

Full Length Research Paper

An Assessment of the Capabilities and Gaps in Urban Air Quality Management in Uganda.

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ABSTRACT

Large cities across the globe are today facing a pervasive problem of air pollution. Also according to the 2014 World Health Organisation Report, in 2012 about 3.7million premature deaths occurred across the globe due to exposure to particulate matter of 10 microns or less in diameter (PM10). The purpose of this study is to assess the capabilities and gaps in urban air quality management in Uganda as well as propose strategies for curbing air pollution in various local towns and cities. To achieve its objectives, the study applied face to face interviews targeting key informants such as the environmental experts, urbanisation researchers as well as officials from the lead agencies such as the National Environment Management Authority (NEMA). Existing literature on urban air pollution was also reviewed. Results show that rapid motorisation, continued dependence on fossil fuels, open waste burning, biomass burning for domestic use, industrialisation, bush fires and urbanisation are the key causes of air pollution in Uganda. Among the key gaps identified are: incomplete and fragmented legislation on air quality management, lack of emission inventory, lack of restrictions on the age of imported vehicles, lack of stations for air quality monitoring, lack of air quality strategic plans for both local and central governments, lack of a specific legislation on clean air programme as well as lack of a clear strategy to promote cleaner fuels. Recognised also is that the existing environmental laws have not been adequately enforced due to institutional fragility. Various stakeholders such as the mass media are also rarely involved in local air quality management programmes. To reduce air pollution and improve urban air quality in Uganda, it is critical that a more feasible strategy is adopted to promote mass transit and non-motorised transport, increase access to electricity among households, introduce bye laws to regulate open waste burning, establish fully equipped laboratories to test and analyse samples, strengthen local research and training capacity on air pollution, promote regional and international collaboration on air pollution, introduce more fuel efficient vehicles, introduce regular and periodic vehicle inspection as well as carry out campaigns to raise public awareness about air pollution. Recommended also is the introduction of cleaner fuels such as liquefied petroleum gas, compressed natural gas, unleaded gasoline and ethanol. It is further critical that the institutional capacity required to monitor air quality is established and strengthened through training and providing necessary equipment.

Key words: Urban, Air, Management, environmental laws.

BACKGROUND

Large cities across the globe are today facing a pervasive and insuperable problem of air pollution. Also according to the 2014 World Health Organisation Report, in 2012 about 3.7million premature deaths occurred across the globe due to exposure to

particulate matter of 10 microns or less in diameter (PM10). Besides, the recent increase in cases of upper respiratory tract infections (URTI) is due in part to the deteriorating air quality in most large towns and cities.

Studies also show that urban outdoor air pollution is responsible for an estimated 75,500 premature deaths each year in Africa and 49,100 in the Sub Saharan Africa (SSA) (World Health Organisation, 2007). According to Haq and Schwela (2012) there is evidence linking aircraft noise to high blood pressure.

Domestically, about 2,500 people with asthma were admitted in 2009/10 at Mulago National Referral Hospital. The prevalence of Asthma among children aged 8-13 years in Uganda is estimated at 26 percent. By contrast, it is just 10 percent among children of the same age in South Africa. Also, according to the 2010 NEMA Report, in Uganda, lower and upper respiratory tract infections account for more than 37 percent of the national disease burden.

Highlighted in the 2010 NEMA Report also is the continued emission of dioxins particularly from scrap metal processing factories that are located in big towns such as Kampala. Scrap metal processing is normally undertaken at very high temperatures, leading to the release of the above persistent organic compounds (POPs). Open waste burning in the major towns is also a key source of dioxins in Uganda.

Previous studies on urban growth and development in Uganda have also tended to ignore air pollution as a key issue that need to be investigated and explored with the aim of establishing a more optimal solution and improving air quality in various local towns and cities.

This paper aims to assess and understand the capabilities and gaps in urban air quality management in Uganda. The paper is divided into various sections including the background, specific objectives, applied research method as well as key findings and discussion. Following the above sections is the discussion on existing gaps and capabilities as well as strategies for improving air quality management in Uganda. Last but not least is the conclusion.

Specific Objectives of the study

The overall objective of the study is to assess the existing capabilities and gaps in managing urban air quality in Uganda. Specifically the study aimed to achieve the following objectives:

- Evaluate the capabilities and gaps in urban air quality management in Uganda; and
- Explore ways for local, regional and international cooperation in addressing urban air pollution
- Propose strategies for improved air quality management and curbing air pollution.

RESEARCH METHODOLOGY

To achieve its intended goals and objectives, the study was undertaken using several research methods. Among them is the face –to- face interviews targeting key informants such as the NEMA officials, urbanisation researchers, municipal officials as well as local environmental specialists.

Existing literature in form official documents and reports, journal articles and text books was also reviewed to establish and expose the existing gaps and capabilities in the management of urban air pollution.

FINDINGS AND DISCUSSION

Drivers of urban air pollution: Among the main drivers of air pollution in Uganda are transport, open waste burning, biomass energy for domestic use (cooking and lighting), bush fires, mining, industrialisation as well as rapid urbanisation. According to the National Environment Management Authority (NEMA), 75% of air pollution in Uganda is due to transport-related activities.

Key pollutants: Among pollutants of the greatest concern in Uganda are: sulphur dioxide (SO₂), carbon monoxide (CO), lead (Pb), nitrogen oxides (NO_x), volatile organic compounds, persistent organic compounds (POPs) and suspended particulate matter (SPM). Secondary pollutants formed from these include smog, ground level ozone and peroxyacetyl nitrate. The major effects of secondary pollutants include poor visibility, soil and soil water acidification and soils and streams, and acid rain.

KEY CAUSES OF URBAN AIR POLLUTION

About 75% of air pollution in Uganda is due to transport-related activities. Due to rapid economic growth as well as rising incomes, many Ugandans have been able to buy and use private vehicles. Also according to Uganda Bureau of Statistics (UBOs), in 2008 there was a 30 % increase in motor vehicle registration.

Uganda's current motor vehicle fleet is also estimated at 800,000 and over 70% of these vehicles are registered in Kampala. Between 1992 and 2004, the number of registered motor vehicles in Uganda increased from 53,000 to 247,000 (Mukwaya, 2007; Bateebe, 2011). Motor vehicles in Uganda are widely regarded as status symbols as well as a sign of individual wealth and success (Mukwaya, 2007). Private cars have also become more popular than public transport in part because they offer a door to door service and provide privacy. Cars are also a reliable mode of transport.

Daily vehicle dependence according Mukwaya (2007) increased from 67% in 2001 to 84% in 2004. Most of the vehicles used in Uganda are second hand vehicles imported from mainly Asia and Europe.

Presently, there are no regulations with regard to the age of motor vehicles and the majority of imported vehicles in the country are not fitted with catalytic converters that reduce carbon emissions (Bateebe, 2011). Increased dependence on fossil fuels such as petrol and diesel is also another key cause of air pollution in Uganda. Over the past decade the amount of fuel consumed by transport has increased substantially. Between 1991 and 2002, motor vehicle fuel sales increased from 202,184 cubic metres to 398, 899 cubic metre (Mukwaya, 2007; Mukwaya, 2011; Bateebe, 2011).

According to Bateebe (2011) diesel and petrol are among the most consumed fuel products in Uganda. Besides, all the petrol and 80% of the diesel are used in the transport sector, which is responsible for over 75% of carbon emissions in the country. In 2009, diesel accounted for 60% of all the fuel sales in Uganda while petrol which is solely consumed by vehicles accounted for 26%. As earlier noted, most Ugandans depend on biomass energy for cooking and lighting. This is largely due to poor connectivity to the electricity grid as well as the ever increasing cost of power. Available statistics show that over 92% of the households in Uganda do not have access to electricity and often use fire wood and charcoal for cooking (NEMA, 2010). It is widely recognised that the use of fire wood and charcoal for cooking is the main cause and source of hazardous pollutants including suspended particulate matter, carbon monoxide, nitrogen dioxide and other harmful gases.

There are also cases where uncollected garbage in the major urban centres is burnt openly by the urban residents in breach of the existing environmental laws as well as city planning ordinances. This is also a prevalent where the enforcement of the urban laws is poor and lacking.

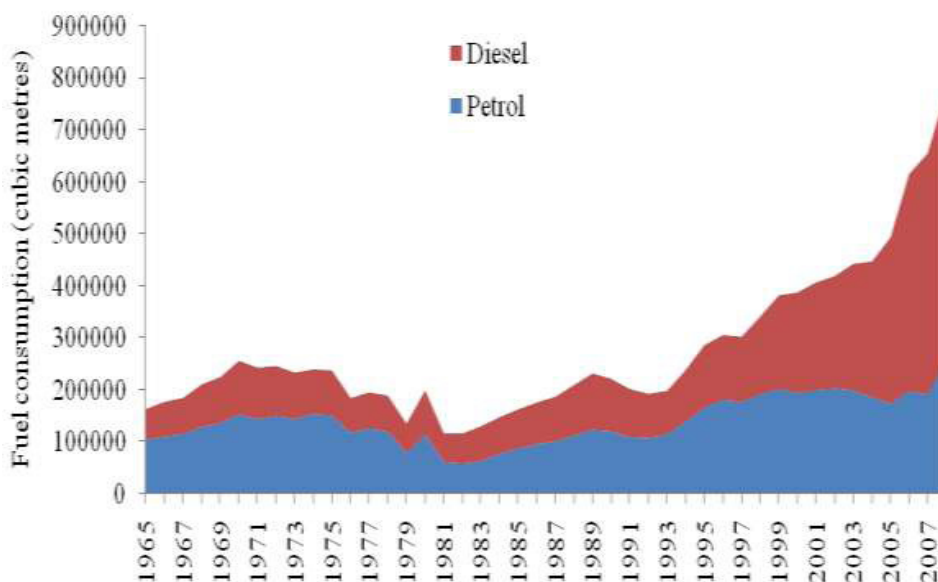


Figure 1: Fuel consumption in Uganda, 1965 – 2007 (Source: Mukwaya , 2011)

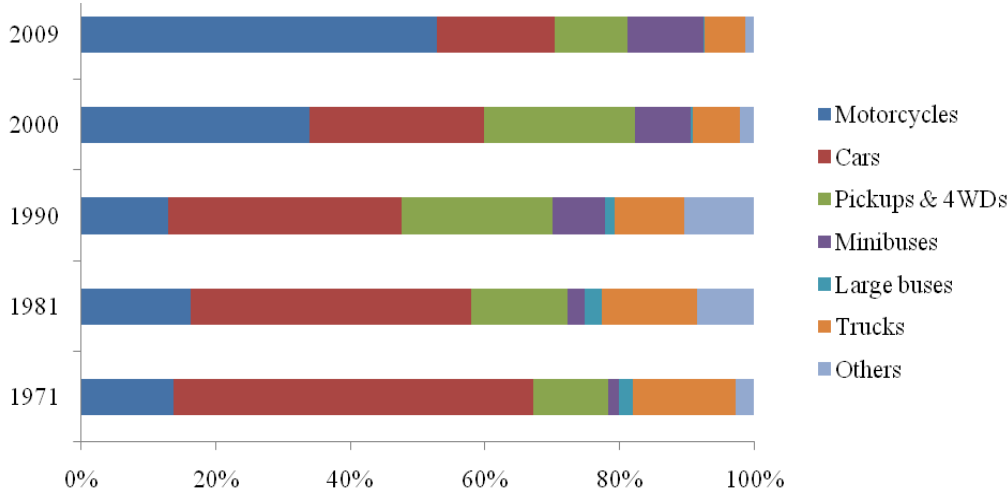


Figure 2: Vehicle composition by percentage 1971-2008. (Source: Uganda Bureau of Statistics (UBos) and Mukwaya (2011))

Leaded fuels are also still being used in Uganda by motorists, contrary to the 2001 Dakar declaration and the 1995 World Health Organisation (WHO) recommendation that the use of additives in motor vehicles be phased out by 2005. Current standards by the Uganda National Bureau of Standards on leaded fuels are that lead petrol levels should not be more than 0.05 – 0.4g/l. There are however, signs that more fuel stations especially in the major towns are beginning to embrace the idea of selling unleaded fuels, which is a good policy in managing air quality and reducing air pollution.

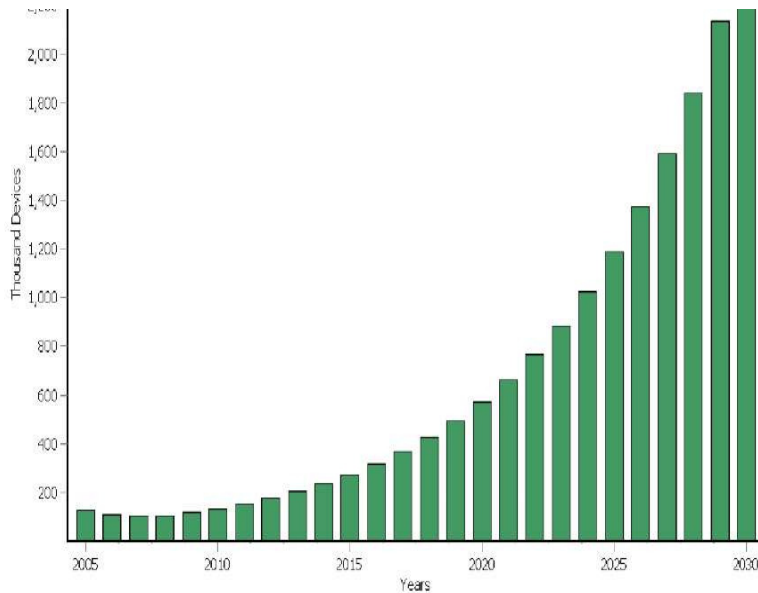


Figure 3: Automobile projections in Uganda from 2005 to 2030



Figure 4: Dependence on old and low capacity minibus taxis is a key cause of traffic jam as well as air pollution in Kampala city

Air Quality Legislation and Control

Introduced in 1994, the National Environment Policy was the first environmental legislation to be made in Uganda. Among the key objectives of this policy is to collect, analyse, store and disseminate reliable information relating to environmental management issues in the country.

Following the National Environment Policy was the National Environmental Act Cap 153, which was introduced in 1995. Under this Act several institutions and governance structures such as the National Environment Management Authority (NEMA) and district environmental committees were established with a clear mandate of protecting the environment. NEMA is also required to make emission standards for various sources and make guidelines for air pollution control for both mobile and stationary sources. NEMA is also mandated under Section 28 of the Act to make standards for the control of noise and vibration pollution.

The above two environmental legislations are further reinforced by Articles 39 and 41 of the Constitution of Uganda. Article 39 provides for the right to a clean and healthy environment, while Article 41 provides for the right of access to information.

Due to the growing public concern about the urban air pollution, a draft of the air quality standards and regulations was developed and released in 2005 by the National Environment Management Authority (NEMA). Emission standards for vehicles under the proposed NEMA air quality standards and regulations are as stated in Table 1 below. In addition, the standards for Uganda were developed for heavy duty diesel powered vehicles, diesel passenger cars, petrol passenger cars and petrol gasoline light trucks.

Table 1: Draft Emission Standards for Automobiles in Uganda

| Vehicle Category | Standard Applicable | | | | |
|---------------------------------------|---------------------|-----|------|------|------|
| | NOx | CO | PM | HC | VOCs |
| Heavy duty diesel powered (g/kWh) | 7.0 | 4.5 | 0.15 | 1.23 | |
| Diesel Passenger Cars (g/km) | 1.25 | 4.2 | 0.08 | | |
| Petrol/gasoline passenger cars (g/km) | 0.08 | 1.2 | | 0.10 | |
| Diesel light duty trucks (g/km) | 0.38 | 2.6 | 0.06 | 0.19 | 0.19 |
| Petrol gasoline light trucks (g/km) | 0.6 | 2.1 | | 0.3 | |

Note: a. Heavy vehicles include good vehicles and buses (exceeding 3.5 metric tons) and trains; b. Light duty vehicles include cars and light trucks (less than 3.5 metric tons). Source: National Environmental Management Authority (2007)

Table 2: Proposed Ambient air quality emission standards for Uganda and WHO

| Pollutants | Time of average | Draft Ugandan Ambient Air Quality Standards (ppm) | WHO Ambient Air Quality Standards (ppm) |
|-------------------------------------|-----------------|---|---|
| Sulphur dioxide (SO ₂) | Annual | | |
| | 24 hour | 0.15 | 0.0076 |
| | 1 hour | | |
| | 10 mins | | 0.19 |
| Nitrogen dioxide (NO ₂) | Annual | 0.1 | 0.022 |
| | 1 hour | | 0.111 |
| Particulate Matter (PM10) | Annual | | 20 |
| | 24 hour | 300 | 50 |
| | 1 hour | | 10 |
| Carbon monoxide | 8 hour | 9 | - |
| | 1 hour | | - |
| Hydro carbons | 24 hour | 5 | - |

Source: NEMA (2005) and WHO (2005)

With support from the World Bank, the National Environmental Management Authority Laboratory was established in 2005. Although not fully equipped, the NEMA laboratory is a critical national asset used in protecting the environment in Uganda. Environment inspectors from the NEMA laboratory often use noise meters to monitor noise pollution generated by bars, dancing halls and industries especially in Kampala.

Key sections of the Public Health Act 1964, the National Physical Planning Act 2010 as well as the Mining Act 2003 have also been used to protect the environment and improve air quality. Under the Mining Act 2003 for example, mining companies are required to take necessary steps to 'ensure the prevention and minimisation of pollution of the environment in accordance with the standards and guidelines prescribed under the National Environment Statute 1995, statute No.4 of 1995'. In addition, mining companies are required under the same Act to carry out an environmental impact assessment and annual environmental audits.

Due to the recent surge in the number of imported second hand vehicles, a new scheme code-named pre-shipment vehicle inspection scheme was introduced in the early 2010 by the Ministry of Trade and Industry as a strategy to prevent old vehicles from being imported into the country.

Challenges for Air Quality Management

The management of urban air quality has become difficult because the majority of vehicles imported in the country are old vehicles without emission control. Most vehicles used in Uganda are also poorly maintained. Poor maintenance of motor vehicles as highlighted by Bateebe (2011) and Mukwaya (2011) contributes to the higher emission in all classes of vehicle. Continued use of dirty fuels is another major challenge faced in managing air quality in Uganda. There are cases where major fuel suppliers in Uganda have been apprehended by the Uganda National Bureau of Standards because of selling poor quality fuel. Most of these cases involve suppliers mixing paraffin with petrol.

Recognised also is the lack of a clear strategy to promote biofuels. Under the national energy policy (2002) it is proposed that biofuels such as ethanol be introduced as a strategy to reduce air pollution. The problem however, is that not many start-up plantations of biofuels have been established in the country.

There is fear however, that biofuel production is likely to impact negatively on food production as more arable land will be earmarked for biofuel-related plantations in the country (NEMA, 2010). Poor connectivity to the electricity grid which has resulted into dependence on biomass energy for cooking and lighting among households is also widely recognised as a key challenge faced in improving air quality. Indoor cooking with fire wood and charcoal has led to exposure of particulate matter to women and children.



Figure 5: Sacks of charcoal being displayed for sale in Kampala

There is an apparent lack of integration and mainstreaming of air quality issues in various national development plans. As elsewhere in the developing world, planning in Uganda is still based on a sectoral approach that allows development programmes and projects such as roads, power dams and housing to be implemented separately.

Interviews conducted with key informants from the National Environment Management Authority (NEMA) and Makerere University revealed that contrary to the Dakar declaration of 2001 and 1995 World Health Organisation (WHO) recommendation, motorists in Uganda still use leaded fuels. Also critical is the lack of the required regulatory framework such as approved air quality standards and regulations as well as the failure by NEMA to enforce the existing laws such as the Public Health Act, 1964 as well as the mining act 2003.

In the absence of a fully-fledged air quality management (AQM) system, key environmental issues such as air pollution continue to be addressed in an ad hoc fashion (Mukwaya, 2007; Bateebe, 2011). Also missing in Uganda's air quality management (AQM) system is the required monitoring equipment as well as the lack of stakeholder participation including the mass media.

Unlike South Africa, Uganda lack well established urban air quality monitoring stations as well as local research networks focusing on air pollution. There are also no specific training programmes on air pollution taught at local Universities.

A further issue relates to the failure to involve various stakeholders in urban air quality management programmes. A study carried out by Bateebe (2011) found that 95% of the 40 minibus taxi operators interviewed in Kampala were not aware of the environmental damage caused by their poorly maintained vehicles. The study also revealed that the minibus operators were only

concerned about making money to fend for their families. This obviously points to the lack of stakeholder participation as well as low levels of public awareness about the problem of air pollution in Uganda.

Highlighted also by the respondents is the lack of emission inventories for all sources. Hag and Schwela (2012) argue that without these inventories, it is practically impossible to apply dispersion modelling.

Existing Policies and Laws for Air Quality Management in SSA Countries

Governments across the globe have a responsibility to formulate policies and introduce required legislations for controlling air pollution. However, rarely have developing country governments especially in Sub Saharan Africa (SSA) introduced all the necessary laws to control both air and noise pollution.

A closer look at the existing legal regime in selected SSA countries show that all countries have to some extent formulated policies and made laws to control urban air pollution. Among the selected SSA countries however, only South Africa has approved air quality standards as well as sound pressure standards. The rest (Tanzania, Uganda, Zambia, Zimbabwe and Mozambique) lack the required standards for controlling air pollution. SSA countries outside South Africa also lack noise management plans.

Without approved air quality standards it is difficult to determine compliance as well as to punish those breaching the law. It is further difficult to prevent a continuous increase in air pollution. According to Haq and Schwela (2012) 'noise regulatory standards can set the reference point for emission control and abatement policies at the national, regional or municipal levels, and therefore can strongly influence the implementation of noise control policies'.

Table 3: Legislation, policies, strategies and programmes on air pollution in selected SSA countries

| Country | Environmental Protection Legislation | Year | Major Responsible Authorities | Policies/ Strategies/ Programme | Emission Standards | Sound Pressure Standards | Noise Impact Assessment | Noise Management Plan |
|--------------|--|------|--|---|--------------------------------------|--------------------------|-------------------------|-----------------------|
| Uganda | National Environment Act Cap 153 | 1995 | National Environment Management Authority | National Environment Management Policy (1994); the national environment action plan for Uganda (1995) | Being Developed (Draft is available) | No | No | No |
| Tanzania | Constitution | 1998 | Office of the Vice President | National Environmental Policy | No | No | No | No |
| Zambia | Environmental Protection and Pollution Control Act | 1990 | Environmental Council of Zambia | National Conservation Strategy | Being Developed | Being Developed | No | No |
| Zimbabwe | Environment Management Act | 2002 | Environmental Management Agency | Draft National Environmental Policy | No | No | No | No |
| South Africa | Constitution | 1996 | Department of Environmental Affairs and Tourism (DEAT) | Environmental Management Policy | Yes | Yes | Yes | Yes |
| Mozambique | Constitution | 2004 | Ministerio para a Coordenacao da Accao Ambiental (MICOA) | No | NO | NO | NO | NO |

Source: Haq and Schwela (2012) and Mukwaya (2007)

KEY GAPS AND CAPABILITIES IN URBAN AIR QUALITY MANAGEMENT

Legislation

Several legislative gaps exist in the management of air quality in Uganda. Among them is the lack of a specific legislation focusing on controlling air pollution and promoting clean air programmes. Most of the existing environmental laws are general laws introduced to assist in managing the environment as a whole.

It is also worth noting that the existing legal regime for managing urban air quality in Uganda is fragmented and scattered in various legislations such as the Mining Act 2003, the National Environment Act 1995, the National Physical Planning Act 2010 as well as the Public Health Act 1964.

A further issue relates to the lack of approved air quality standards and regulations. Without these standards it is virtually impossible to determine compliance and punish those breaching the law.

A pre-shipment inspection scheme for imported vehicles introduced by the Ministry of Trade and Industry in the early 2010 to prevent very old vehicles from entering Uganda also failed to achieve its intended goal in part because of strong opposition from the car lobby.

Local car importers argued that the scheme contributed to delay transactions, increased the cost of doing business and created avenues for corruption. Due to the fear to lose tax revenue government was forced to suspend the scheme in September 2010.

Recognised also is that there are no specific regulations for controlling dust as well as indoor air pollution in Uganda. Most crucially, the proposed emission standards and regulations for Uganda were developed basing on the standards of developed countries. While the introduction of developed country standards may not be a bad idea, the institutional capacity required to enforce them is largely lacking in Uganda.

Training programmes

There is currently no known University in Uganda offering specific training programmes on air quality management. Most of the training programmes offered are general programmes focusing on environmental management.

Even the short courses that were recently introduced at Makerere University on climate change mitigation are largely theoretical and do not provide the learners and trainees practical skills in sampling for gaseous and particulate pollutants as well as air quality monitoring.

Some local human resource capacity comprising of mainly environmental experts trained from abroad however, exists. Most of these experts work in private engineering consultancy firms such as Water Air Earth.

Research capacity

The local capacity to carry out research on air pollution is somewhat inadequate and lacking. There are also no permanent monitoring sites/stations and studies on air quality are undertaken in ad hoc fashion. Existing laboratories are not fully equipped to enable researchers to carry out meaningful scientific research on air pollution in the country.

Research on air pollution has also been affected by the absence of well-established networks for collaborative research at both national and regional levels.

Uganda also lacks an emission inventory as well as continuous air pollution monitoring and control system. Besides, there are no comprehensive studies that have been carried out to establish the exact impact of air pollution on the economy as well as health of the people.

Institutional capacity

Most institutions and agencies mandated to regulate and manage air quality in Uganda are relatively new. For example, the National Environment Management Authority (NEMA) was established after the introduction of the National Environment Act in 1995. The capacity of these institutions to regulate air pollution and enforce the existing laws is largely lacking. This is because of inadequate funding as well as the failure to recruit enough skilled manpower. The lead agencies such as NEMA also lack fully equipped laboratories to test and analysis samples. Above all, there are no air quality strategic plans as well as established stations for regular air quality monitoring for both the central as well as municipal governments.

Table 4: Key Gaps and Capabilities in Air Quality Management in Uganda

| No. | Identified Gaps | Comments | General Progress |
|-----|--|--|---|
| 1. | Lack of approved emission standards and regulations | There are no gazetted emission standards and regulations and it is difficult to determine compliance and punish those violating the law. Also some provisions of the NEMA Act 1995, Public Health Act 1964, the Mining Act 2003 and the National Physical Planning Act 2010 are used by NEMA to protect the environment. Uganda is also a signatory to the Stockholm Convention on Persistent Organic Pollutants and the Minamata Convention on Mercury. | A draft of emission standards and regulations has been developed by the National Environment Management Authority (NEMA). Legislation on air quality is incomplete. There is no specific air quality policy or Act |
| 2. | Emissions from biomass burning not regulated | Over 90% of households in Uganda use biomass energy for cooking and lighting. Access to electricity is still limited, that is, (8%) of all households in the country. Most people are not aware of the problem of the emissions generated by biomass burning. Indoor cooking with fire wood and charcoal has led to high exposure of particulate matter to women and children in Uganda | Better cooking stoves have been introduced. In general however very little has been done to regulate indoor air pollution. |
| 3. | Existing legal regime is fragmented and scattered in various national legislations | Existing legal regime for managing air quality is fragmented and scattered in various legislations such as the NEMA Act 1995, Mining Act 2003, National Physical Planning Act 2010 as well as the Public Health Act 1964 | The laws to protect the environment in general are available but there is no specific clean air Act |
| 4. | Lack of specific dust control regulations | Given that most roads in Uganda are not tarred or tarmacked, it is important that mechanisms are put in place to regulate dust | Lack of approved standards and regulations for air quality monitoring including dust |
| 5. | Lack of a feasible strategy to address the issue of open waste burning | Open waste burning is common in large towns where the urban authority lack both the institutional and financial capacity to collect and dispose of solid waste. The uncontrolled burning of solid waste creates smoke. Open waste burning is also a major source of dioxin in Uganda. | Inadequate response from the municipal authority to the problem. There is need to provide more financial resources to the urban authorities for managing waste, introduce bye laws and encourage the urban residents to participate in addressing the challenge |
| 6. | Lack of specific training programmes on air pollution | There are various training programmes offered at various local Universities focusing on environmental management in general and climate change in particular. Most of these training programmes are theoretical and do not provide the trainees practical skills in air quality sampling and analysis. | Training programmes offered by local Universities are generally focusing on environmental management and climate change. There is need for specific training programmes on air pollution with the aim to create a critical mass of air pollution experts |
| 7. | Land use and transport planning programmes rarely consider the issue of air pollution | Physical planning regulations only focus on the environmental impact assessment and do not address the issue of environmental audits | There is need to integrate air quality management in land use and transport planning |

Table 4: Key Gaps and Capabilities in Air Quality Management in Uganda (cont.)

| | | | |
|-----|--|--|---|
| 8. | Lack of routine and periodic vehicle inspection and maintenance | Most of the vehicles used in Uganda are second hand vehicles imported from Asia and Europe. Most vehicles are poorly maintained and not subjected to routine and periodic inspection. Old and poorly maintained vehicles pollutes more than those that are new and maintained periodically. | There is a proposal by government to privatise vehicle inspection. There was also a plan to introduce pre-shipment inspection for all imported vehicles but failed due to opposition from the car lobby. There are no restrictions on the age of vehicles to be used. |
| 9. | Continued dependence on fossil fuels | Most motorists use petrol and diesel. There are also cases where the fuel suppliers adulterate fuel by mixing petrol with paraffin. Cleaner fuels such as LPG are also on the market in Uganda | Fossil fuels are still most popular among motorists. However, cleaner fuels such as liquefied petroleum gas (LPG), compressed natural gas (CNG) and ethanol are also being sold and used at small scale |
| 10. | Continued use of leaded fuels | Contrary to the 1995 World Health Organisation (WHO) recommendation, leaded fuels are still being used by motorists in Uganda. In fact, the current local fuel standards used by the National Bureau of Standards also allow lead petrol levels of not more than 0.05 – 0.4g/l. | There are signs that fuel suppliers are changing from leaded fuels to unleaded fuels. |
| 11. | Lack of a coherent strategy to introduce cleaner fuels | Under the National Energy Policy 2002, it is proposed that cleaner fuels such as biofuels be introduced. However there is no specific policy on biofuels in Uganda. There is also fear that biofuel production would negatively affect food production in the country and lead to food insecurity. | The National Energy policy highlights the importance of biofuels. |
| 12. | Lack of emission inventory | Information on air pollution is scanty. No air quality monitoring system in place. No equipment. Air quality management is undertaken on ad hoc basis. Baseline air quality data does not exist. | NEMA has established the National Environment Management Authority Laboratory but there is no air quality monitoring system. There are also no approved emission standards |
| 13. | Limited involvement of various stakeholders in air pollution control | Various stakeholders such as the media, the public and researchers are rarely involved in air quality management. There are not so many NGOs working on the environmental and air pollution issues | NEMA and a few government departments are involved. A few Universities and NGOs are also involved. |
| 14. | Lack of credible information about the exact impact of air pollution on human health and economic performance | No known comprehensive studies have been carried out on the two areas | A few surveys and studies by researchers at Makerere University and NEMA have been carried out such as Bateete (2011), Mukwaya (2012), NEMA (2008) |

Table 4: Key Gaps and Capabilities in Air Quality Management in Uganda (cont.)

| | | | |
|------|--|--|--|
| 15. | Lack of regular air quality monitoring | No air pollution monitoring equipment and stations. There is shortage of expertise. Incomplete legislation on air quality management | Little progress |
| 16. | Rapid motorisation and the decline of public transport as well as Non-motorised transport (walking and cycling) | Many Ugandans are beginning to own and use cars. The majority of these cars are second hand vehicles imported from Asia and Europe. Rapid motorisation has caused traffic jam especially in big towns like Kampala. It has also contributed to urban air pollution. However, due to traffic jam, government has initiated projects to promote sustainable modes of transport such as public transport, walking and cycling. A Bus Rapid Transit project and a Non-Motorised Transport project are being implemented in Kampala.. The age range of the Uganda vehicle fleet lies between 6 and 15 years, which presents old vehicles. | There is an increase in motorisation. However, a Bus Rapid Transit (BRT) project and Non-Motorised Transport project are being implemented in Kampala. The BRT project is being funded by the World Bank while the NMT project is funded by the UN-Habitat. It is hoped that private transport will become less popular as commuters begin to embrace public transport |
| 17. | Inadequate capacity and capability for air quality monitoring and measuring | Institutions that are responsible for regulating air quality such as NEMA and municipal governments do not have equipment. The capacity to monitor air quality on regular basis is also lacking. There are no permanent air quality monitoring stations in the country. | The NEMA laboratory was established in 2005 under a World Bank funded project but air pollution measurement is done on ad hoc basis. |
| 18. | Public awareness of air pollution as a key urban problem in Uganda is still poor | In a study that was carried out by Bateete (2011) found that 95% of the minibus taxi operators are not aware of the environmental damage caused by their poorly maintained vehicles. The main focus of the minibus operators was money. Very few NGOs working on air pollution as a problem | Low public awareness levels and very few NGOs working on air pollution |
| 19.. | Inadequate funding for air quality management | Air quality management has not been prioritised by the government. Financial capabilities are inadequate | Funding is not adequate |

OPPORTUNITIES FOR COOPERATION IN AIR QUALITY MANAGEMENT

Several opportunities for cooperation at national, regional and global levels in air quality management exist. Globally, Uganda and other EAC (East African Community) countries are parties to various multilateral environmental agreements including the United Nations Framework convention on Climate Change.

In addition the 2001 Dakar Declaration on phasing out leaded gasoline in Sub Saharan Africa countries constitutes a big opportunity for cooperation at international level. Under this Declaration, 25 Sub Saharan Africa (SSA) countries including Uganda agreed to phase out leaded gasoline in all SSA countries by 2005 at the least.

Uganda and other African countries are also a party to the Vienna Convention on trans-boundary air pollution. Through the Minamata Convention implementation plan, Uganda could participate in the development of a mercury emissions inventory and the assessment of mercury emissions. Also important is the existence of several international protocols such as Kyoto and Montreal protocols.

Several international research networks such as the Test Network and APINA could be used to further cooperation and collaboration on air pollution control and regulation especially at national and regional levels.

International funding programmes such as GEF (Global Environment Facility) could also be used to finance air quality management projects at both national and regional levels.

STRATEGIES FOR IMPROVING AIR QUALITY MANAGEMENT

Based on the findings of the study as well as the gaps and capabilities highlighted above, it is recommended that

Emission standards and regulations should be gazetted: For the lead agencies such as the National Environment Management Authority (NEMA) to be able to control air pollution and determine compliance it is critical that the air quality standards and regulations in Uganda are gazetted. It is further critical that the capacity of NEMA to enforce these standards is strengthened through the purchase of required equipment as well as the recruitment of enough skilled manpower.

Provide access to mass transport: Mass transport (trains, light rails, buses and trams) should provide direct and fast connections to key destinations such as urban centres, major employment centres as well as leisure zones. It is also critical that transit systems offer a reliable, affordable, frequent and accessible service. Bateebe (2011) asserts that a passenger standard vehicle (private cars) has CO emission rates ten times higher than those of an urban bus. So efforts must be made to improve transit efficiency, operations and competitiveness especially in the major local towns and cities.

Strengthening of local research and training capacity on air pollution: Strengthening of the local research and training capacity on air pollution is a critical component of an effective air quality management system. This can be achieved through increasing staffing levels of the lead agencies such as NEMA, training of staff for enhanced air quality control as well as establishing fully equipped laboratories. It is also important that the air quality monitoring stations are established to allow regular monitoring and research on air pollution. Besides, efforts must be made to introduce specific training programmes on air pollution in various local Universities and other research institutions.

Introduce bye laws to regulate open waste burning: Open waste burning is a pervasive problem in many local urban centres and it is largely caused by poor waste management practices. To address this challenge, it is important that bye laws are introduced and strictly enforced by the urban authority especially at the peri-urban level. Also the urban residents, the private sector and other key stakeholders should be involved in the management of solid waste.

Introduce a new policy to promote tax rebates: Tax rebates have been introduced in many developed countries such as Singapore as an incentive and a strategy to encourage consumers and investors to use cleaner technologies such as fuel efficient hybrid vehicles and as a means to reduce air pollution. In Uganda, this policy has not yet been introduced. So it is critical that tax rebates are introduced as a strategy to promote cleaner technologies and curb air pollution.

Reduce dependence on biomass energy: Continued dependence on biomass energy (especially fire wood and charcoal) for cooking and lighting among households in Uganda is a major cause of air pollution as well as respiratory diseases among women and children. While new and more efficient cooking stoves have in the recent years been introduced in Uganda, very little has been done to popularise them among the households across the country. It is also critical to increase access to electricity as well as other renewable energy sources such as solar energy. Campaigns should also be carried out to raise public awareness about the dangers associated with the continued dependence on biomass energy as the main source of energy for cooking and lighting in the country.

Promote walking and cycling: Walking and cycling are widely regarded as sustainable modes of transport because they produce zero carbon emissions. Also in developing country towns and cities where walking is still popular among commuters (for example in Kampala, over 50% of the commuters walk each day from home to their work stations and back), it is important that a conducive environment for the use of the two modes of transport is established. This can be achieved through: (a) providing cycling and walking infrastructure such as pedestrian paths and cycling lanes; (b) secure bike storage in cycle stands; (c) improve road safety by providing pedestrian walkways, footbridges and lighting; (d) promote bike sharing schemes; and (e) improve walking and cycling facilities in schools, near shopping centres and neighbourhood areas.

Reduce car dependency: Continued dependence on private vehicles is one of the major causes of air pollution in the developing country cities. Reduced car dependency can be achieved by the introduction of the following transport demand management measures: establishment of car free zones within the city centre, reducing on the supply of car parking spaces, restriction of car access at certain time of the day, providing park and ride facilities, introducing congestion charges as well as increasing both car and fuel taxes. It is further critical that public awareness campaigns are carried the problems caused by rapid motorisation as well as its impact on economic performance.

Introduce fuel efficient hybrid vehicles: The hybrid vehicles are associated with a very low fuel consumption resulting in a great reduction in emissions. A study by John et al. (2010) on energy impacts of hybrid vehicles revealed that the use of Plug-in Hybrid Vehicles (PHEV) could halve gasoline use relative to conventional vehicles.

Reduce dependence on fossil fuels and introduce cleaner fuels: The use of fossil fuels such as petrol and diesel should be reduced. In addition government should adopt a more feasible strategy for promoting cleaner fuels such as liquefied petroleum gas (LPG), unleaded gasoline, ethanol as well as compressed natural gas (CNG). Incentives in form of tax rebates should also be introduced to allow a shift to cleaner fuels.

Introduce periodic and regular motor vehicle inspection: Regular and periodic vehicle inspection is important for controlling air pollution and safeguarding air quality. It is therefore recommended that a comprehensive motor vehicle pollution control program be designed to implement the proposed NEMA vehicle emission standards. The new program should also aim to control the age of motor vehicles as well as making it mandatory for all imported vehicles to be fitted with catalytic converters.

Engage various stakeholders in the air quality management: The participation of various stakeholders is critical because air pollution control requires behaviour change in consumption as well as individual travel. Programmes aimed at promoting cycling, walking and public transport cannot be successful without the involvement of the various stakeholders. The media is also critical in raising public awareness about air pollution and partnerships should be established with various local media organisations with the aim of educating the public.

Introduce a training programme on air quality monitoring in Africa: Through APINA and other regional and international research networks a training programme on air quality monitoring should be introduced in Africa as a way of building local research capabilities and filling the existing training gaps.

CONCLUSION

The main objective of this research was to assess the existing gaps and capabilities in air quality management and make policy recommendations for Uganda. Highlighted in the study is that transport contributes about 75% of air pollution in Uganda. Also the study identified various capacity gaps and capabilities such as: incomplete and fragmented legislation on air quality management, lack of a clear strategy for promoting cleaner fuels, continued dependence on biomass energy for cooking and lighting, prevalence of open waste burning, bush fires, lack of regular and periodic vehicle inspection and maintenance, lack of emission inventory, inadequate research and training capacity, lack of an integrated approach towards land use and investment planning, dependence on fossil fuels such as petrol and diesel, rapid motorisation, lack of control and restrictions on the age of vehicles used in Uganda as well as lack of operational air quality monitoring system. The study also revealed that various stakeholders such as the mass media and local urban residents are rarely involved in the air quality management programmes. To reduce air pollution and improve air quality in Uganda, it is critical that the air quality standards are gazetted and approved by the government, integrate air pollution in the national development plans and existing planning system, introduce bye laws to regulate open waste burning in various towns, increase access to electricity and solar power among households, increase access to public transport among commuters, strengthen regional and international collaboration on air pollution, strengthen local research and training capacity on air pollution, adopt a more feasible strategy to promote fuel efficient vehicles, introduce a policy to control the age of imported vehicles, promote walking and cycling, and adopt an integrated approach towards land use and transportation planning.

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