AUTHORS:
Cheledi Tshehla[1,2]
Caradee Y. Wright[1,3]

AFFILIATIONS:
[1]Department of Geography, Geoinformatics and Meteorology, University of Pretoria, Pretoria, South Africa
[2]South African Weather Service, Pretoria, South Africa
[3]Environment and Health Research Unit, South African Medical Research Council, Pretoria, South Africa

CORRESPONDENCE TO:
Cheledi Tshehla

EMAIL:
Cheledi.Tshehla@weathersa.co.za

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15 Years after the *National Environmental Management Air Quality Act*: Is legislation failing to reduce air pollution in South Africa?

Air pollution is characterised by the presence of chemicals or compounds in the air which are usually not present or are present at levels higher than those considered to be safe for human health.[1] Air pollution is the main cause of environmental effects such as acid rain (formed primarily by nitrogen oxides and sulfur oxides in the atmosphere) which can acidify soil and water bodies leading to a threat on food security; and ground-level ozone which is responsible for destruction of agricultural crops and commercial forests.[2] Air pollution can cause detrimental changes to the quality of life. According to the World Health Organization, air pollution is one of the greatest environmental threats to human health that can lead to increased mortality and morbidity. Pollutants mostly associated with health effects are particulate matter, ozone, sulfur dioxide and nitrogen dioxide.[3]

Efforts have been made locally through the transition in legislation from the *Atmospheric Pollution Prevention Act (APPA) Number 45 of 1965* (focused on air pollution emitters) to the *National Environmental Management Air Quality Act (NEMAQA) No. 39 of 2004* to not only reduce emissions of air pollutants but also to monitor effects of air pollution on the environment. National Ambient Air Quality Standards for pollutants such as particulate matter (PM_{10}), lead (Pb), sulfur dioxide (SO_2), nitrogen dioxide (NO_2), carbon monoxide (CO), ozone (O_3), and benzene (C_6H_6) were gazetted in 2009[4], with $PM_{2.5}$ gazetted in June 2012[5]. However, the problems associated with air pollution are far from being solved, particularly with the observed levels of particulate matter and ozone in areas declared as hotspots (Priority Areas) in South Africa. The main sources of particulate matter in these areas have been identified as industry, mining, motor vehicles, and biomass and domestic burning.[6-8] Ground-level ozone is formed as a result of photochemical reactions in the atmosphere in the presence of sunlight.[9] The current approach to implementation of air quality legislation to reduce air pollution may be inadequate considering evidence of negative impacts and risks.[10,11]

Effective management of air quality in South Africa will require sound policy implementation, air quality monitoring and the enforcement of legislation and standards. Cooperation between government departments, economic sectors, research institutions and the public is of great importance in the battle against air pollution. The political buy-in of all spheres of government (municipal, provincial and national) is needed to ensure that environmental issues are at the top of the agenda in every sitting of the legislator to ensure that environmental programmes are allocated enough attention and appropriate resources. A published study has shown that a direct positive effect of democratic institutions on environment quality is higher in developed countries than in developing countries.[12]

The aim of this Commentary is threefold: (1) to provide an overview of the current NEMAQA legislative instruments for air pollution prevention; (2) to consider the current state of NEMAQA implementation approaches; and (3) to reflect on future approaches for effective implementation of NEMAQA and ultimate reduction of air pollution in South Africa.

Air pollution and its management

Air pollutants are solid particles, gases and liquid droplets in the air that can adversely affect ecosystems and human health.[13] Major ambient air pollutants include toxic metals, volatile organic compounds, PM_{10}, $PM_{2.5}$, NOx, SO_2, O_3 and CO[3]. Air pollutants are classified according to the source of emission into two main groups: primary and secondary pollutants. Primary air pollutants are emitted directly into the air from sources. They can have effects both directly and as precursors of secondary air pollutants (such as O_3, NO_3^-, SO_4^{2-}, H_2SO_4) which are formed by chemical reactions in the atmosphere.[14] Air pollutants can be emitted by natural sources such as wildfires, volcanic activities and crustal materials as well as anthropogenic activities such as power plants, smelters, mines, vehicles and domestic wood and coal burning.[15] The distribution of these pollutants is dependent on meteorological conditions.[16]

NEMAQA specifies that to reduce and manage air quality there needs to be:

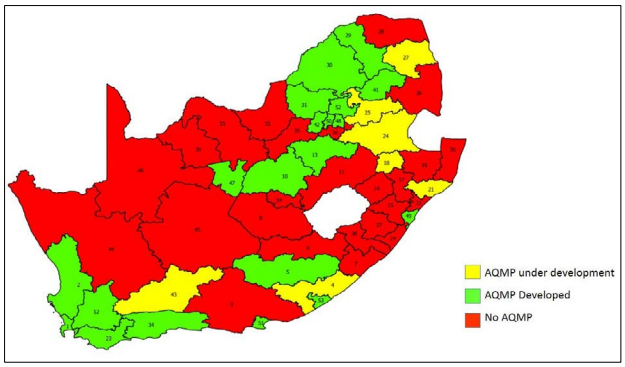
- decentralisation of air quality management among all spheres of government;
- identification and quantification of all sources;
- compliance monitoring and enforcement;
- setting of ambient and emissions standards;
- development of Air Quality Management Plans (AQMPs) by all spheres of government and emissions reductions and management plans by all source emitters;
- access to information and public consultation; and
- norms and standards for air quality monitoring and management.

South Africa's national Department of Environmental Affairs (DEA) is mandated to develop, review and revise systems and procedures for attaining compliance with Air Quality Standards in South Africa. The provincial DEAs must monitor ambient air quality in their provinces as well as the performance of municipalities in implementing the *Air Quality Act*. Local authorities are required, in terms of the *Air Quality Act* (Section 8(a)), to monitor ambient air quality and emissions from point, non-point and mobile sources. Therefore, authorities must study emissions reports from licensed emitters to ensure that they comply with the conditions of their licences. The municipal by-laws should

also be structured in such a way that they address emissions from small industries that are not regulated by atmospheric emission licences.

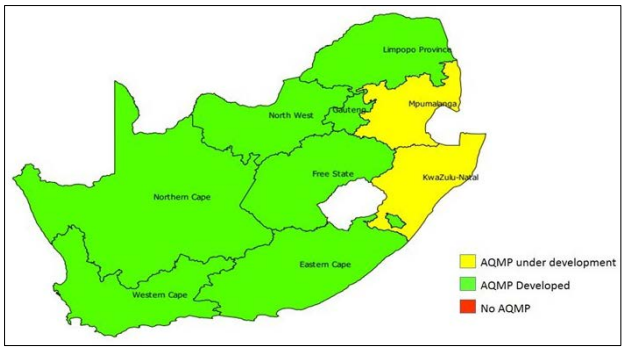
Consideration of progress to date

The evidence collected during the development of the Mpumalanga Provincial AQMP suggests that decentralisation of air quality management in South Africa is not effectively managed, with most local authorities not performing this function due to several constraints (Supplementary tables 1–4). The *Municipal Systems Act No. 32 of 2000* requires local authorities to include their AQMPs in their Integrated Development Plans for resource allocation. However, only a few district municipalities have AQMPs in place, as shown in Figure 1. All provinces have developed their AQMPs with the exception of KwaZulu-Natal and Mpumalanga which are still under development (Figure 2). For the three areas that have been declared Priority Areas (that is, areas where the ambient air quality standards are being, or may be, exceeded, or any other situation which is causing, or may cause, a significant negative impact on air quality in the area) in terms of Section 18(1) of the *Air Quality Act*, processes are underway to implement the Priority Area AQMPs. Given that the status quo has not changed, there could be underlying problems in the implementation of the AQMPs.



Source: South African Air Quality Information System[22]

Figure 1: Current development status of district municipality Air Quality Management Development Plans in South Africa.



Source: South African Air Quality Information System[22]

Figure 2: Current development status of provincial Air Quality Management Development Plans in South Africa.

In terms of identification and quantification of sources of air pollutants, no formal study has been undertaken solely by any of the three spheres of government to identify and apportion sources of air pollutants. In 2016, a source apportionment study was commissioned by the DEA for the Vaal Triangle Airshed Priority Area (VTAPA).[17] This study was commissioned after the 2013 mid-term AQMP review revealed that there was no improvement in air quality in the VTAPA.[18] Given the unchanging status quo on air pollution levels in the Priority Areas, the source apportionment studies are necessary for effective implementation of abatement strategies. Air pollution has no boundaries; therefore, air pollution from the Priority Areas could also be transported to other regions in the country. As such, a directive should also have been issued to all provincial DEAs to commission source apportionment studies in their respective provinces for effective air quality management.

The establishment of the Environmental Management Inspectorate to monitor and enforce compliance with the *National Environmental Management Act* was to ensure that all those undertaking activities that may lead to detrimental effects on the environment are held accountable. However, the regulatory authorities either are not scrutinising the compliance reports from industries to look at the root-cause analyses, not following up on non-compliance or not doing trends analyses of the reports to check consistency. In a number of DEA Implementation Task Team meetings, industries have mentioned that they submit reports to regulatory authorities but their reports are not attended to nor do they receive feedback from authorities. The response from authorities was that there are not enough personnel to study the reports. This situation presents a potential loophole that industries may have identified within the regulatory framework and, as such, provides an opportunity for non-compliance with the minimum emissions standards by industries.

According to the South African Government website, there are 278 municipalities in South Africa.[19] Supplementary table 5 shows the 121 government-managed ambient air quality monitoring stations that have been reporting to the South African Air Quality Information System (SAAQIS) since 2009 when the system was launched. If all the municipalities were implementing Section 8(b) of the *Air Quality Act*, there would be 278 ambient air monitoring stations reporting to SAAQIS (i.e. one station per municipality) to ensure widespread spatial coverage necessary for effective compliance monitoring. The DEA and South African Weather Service have embarked on a project to revamp SAAQIS through the development and implementation of SAAQIS phase III. This improvement has led to live reporting of air quality monitoring stations. The DEA is in the process of reviving stranded municipal air quality monitoring stations to increase the number of stations reporting to SAAQIS. Privately owned stations are also targeted to report live on the SAAQIS system. New features on SAAQIS phase III include a mobile app to view live ambient data and the air quality index, and the ability to download data on the public page.

National norms and standards are required to ensure that there is standardised ambient air quality monitoring and management in the country. But to date, there is no document that outlines the national norms and standards for air quality management in South Africa that can be used as a directive to all regulating authorities and the source emitters. With a total of 164 monitoring stations reporting to SAAQIS, only a few are considered to have credible data that can be used for scientific research to inform policy development. As shown in Supplementary tables 2–4, the reason for non-credible data can be attributed to lack of funding and skilled personnel to perform air quality related functions. This situation is a matter of concern given the non-compliance with the National Ambient Air Quality Standards shown in Supplementary tables 6–8.

There has not been a cost–benefit analysis undertaken by the government since the promulgation of the *Air Quality Act* in 2004 to determine the impact of air pollution on the economy of South Africa. Some industries in South Africa have been applying for the postponement of minimum emissions standards for several years. Furthermore, there has not been projected cost–benefit analyses on how much will be saved by the country if air pollution was reduced to acceptable limits by complying with the minimum emissions standards and ambient air quality standards. Eskom undertook a cost–benefit analysis[20] of the offset (defined as an intervention to counterbalance an adverse environmental impact) project in the Highveld Priority Area. However, the focus of this analysis was on reducing pollution from households and compliance with the 2020 NEMAQA minimum emission standards was not considered. A report[21] by the Centre for Environmental Rights and groundWork indicates that the initiatives undertaken by Eskom to reduce household emissions from coal burning in Zamokuhle Township through air quality offset interventions did not bear positive results because of the high cost of electricity. The high cost of liquid petroleum gas in South Africa is also a negative factor in the proposed Eskom retrofit project and will lead to communities reverting to coal use for space heating and cooking.

In terms of mining, the Department of Mineral Resources is responsible for issuing Atmospheric Emission Licences and granting environmental authorisations. Environmental authorisations are a key tool in effective environmental management, including the management of air quality. However, the Department of Mineral Resources officials are not designated as Air Quality Officers and as such air quality related matters may not be fully explored during the authorisation process. This arrangement makes the management of mining-related air pollution very difficult in South Africa.

There is a gap between science and policy

Supplementary tables 6–8 show the 2018 National Ambient Air Quality Standards exceedance tables for the areas which have been declared pollution hotspots in South Africa: VTAPA declared in 2006, Highveld Priority Area declared in 2007 and Waterberg/Bojanala Priority Area declared in 2012. The VTAPA AQMP identified the main sources of air pollution in the area as biomass burning, domestic fuel burning, mining operations, petrochemical sector, power generation, transportation, waste burning, iron and steel and ferroalloy industries, and smaller industries. The Highveld and Waterberg/Bojanala Priority Area AQMPs identified the major sources of air pollution as residential fuel burning, coal mining, power generation, transport, biomass burning and burning coal mines and smouldering coal dumps, landfills, incinerators, waste treatment works, tyre burning, agricultural dust, and biogenic sources.[7,8] The variation in source categories in Priority Areas clearly shows that these sources will be complex to manage and will require multi-stakeholder partnership in implementation of abatement strategies. It is evident from the exceedance data that there is a problem with particulate matter and ozone in all the areas. However, there have not been any studies commissioned by the DEA to comprehensively identify sources of particulate matter and ozone (except in the VTAPA) and there are no known memoranda of understanding between DEA and research institutions to develop and fund programmes aimed at tackling this research gap.

The *Air Quality Act* requires new Atmospheric Emission Licence applicants to undertake an atmospheric emissions modelling study. Many air quality dispersion models rely on surface meteorological parameters to model air pollution dispersion, particularly in complex terrain. Section 4.2.1 of the draft regulations regarding Air Dispersion Modelling (Notice 1035 of 2012) in the *Air Quality Act* requires site-specific meteorological data for modelling purposes in complex terrain. However, there has not been any collaboration between the DEA and the South African Weather Service to ensure that there is a sufficient number of surface meteorological monitoring stations in remote areas with complex terrain. One such place is the Greater Tubatse Municipality which has several industrial facilities and a complex terrain but no meteorological stations. (A Research Article in this issue reports on air pollution in the Greater Tubatse Municipality). Institutional collaborations between government entities and research institutions may narrow the gap between science and strategic policy development and implementation for successful management of air quality. Air pollution reduction could be achieved by strengthening collaboration between government departments such as DEA and Department of Mineral Resources for better management of pollution from the mining sector; and allocating funding for environmental issues at all spheres of government to be centralised at DEA for better management of air quality. It could also entail developing a cost–benefit study for the implementation of the *Air Quality Act*; and making source apportionment a pre-requisite for the development of air quality management plans by authorities and for all industry applications for postponement of complying with the minimum emission standards by April 2020, and for atmospheric emission licence application for new facilities. The source apportionment and source quantification results will ensure that the contribution of major sources, as well as the impact that results from granting postponements and/or new licences, will be known. Establishing expert panels to identify research programmes aimed at addressing air pollution problems would also be beneficial, as it would ensure that resources are channelled to research studies that are relevant to air quality improvement. Lastly, air pollution programmes should be introduced from the foundation phase of basic education to build a nation that is conscious of and educated about air quality issues.

Conclusions

The *Air Quality Act* was passed in South Africa over 15 years ago, but it is evident that several of its strategic objectives have yet to be met. Even though emissions reduction is implemented by some industries, and there also are efforts by local authorities to develop and implement by-laws to reduce household emissions, the introduction of new small industries, and the failure to effectively reduce pollution from domestic burning, waste burning, biomass burning, vehicle emissions and mining activities within the air pollution hotspots makes it impossible to achieve the desired air pollution reduction. Particulate matter and ozone are two pollutants for which there is non-compliance with the National Ambient Air Quality Standards. Therefore a comprehensive study to look at the major precursors of ozone is necessary to develop abatement strategies for ozone. There is a need to relook at the drivers and factors influencing policy implementation such as political buy-in (by educating politicians on air quality matters) particularly in local authorities and reprioritisation of societal needs, especially with respect to housing and economic development in relation to protection of the environment and human health.

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