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Review article: air quality and characteristics of sources

Abstract

Atmospheric pollution is a major problem facing all nations of the world. Air quality management leads to prevent or decrease harm impacts, by applying environmental policies, legislation, and manage ambient air quality monitoring. Air quality assessments help air quality management to understanding of how pollutant sources, characteristics, topography, and meteorological conditions contribute to local air quality. This review article is concerned with the reports concerning air quality around the world, which published by different national and international environmental affair organizations. The air quality monitoring data collected in Egypt by national network stations (EEAA) and (EMC) and published in reports of Central Agency for Public Mobilization and Statistics (CAPMAS).

Keywords: ambient air quality (AAQ), indoor air quality (IAQ), national ambient air quality standards (NAAQS), Egypt

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Introduction

Air pollution (Poor air quality) is considered one of the major challenges facing Egypt.

What is meant by air quality?

Air quality is referring to the concentration of harmful substances (pollutants) present in the atmosphere. It is determined by monitoring a variety of pollution indicators. Good air quality is necessary for preserving the balance of life on earth for humans, plants, animals and natural resources. Poor air quality can affect human health and/or the environment.[1]

Ambient air quality (AAQ)

Ambient air quality monitoring: Monitoring air quality indicators in ambient air provides data regarding the status of present air quality. It helps decision makers to put and evaluate environmental policies. Establishment of air quality monitoring network is based on the air quality indicators.[2] The usual air quality indicators monitored include dust deposition, particulate matter (PM_{10} and $PM_{2.5}$), nitrogen dioxide (NO_2), sulfur dioxide (SO_2), carbon monoxide (CO), ground level ozone (O_3) and lead (Pb). Ambient monitoring is often necessary as a condition of Industrial Emissions Licensing, permit, planning condition,[1]

Air quality management: Air quality management leads to prevent or decrease harm impacts, by applying environmental policies, legislation, and manage ambient air quality monitoring. Air quality assessments help air quality management to understanding of how pollutant sources, characteristics, topography, and meteorological conditions contribute to local air quality. The air quality assessment tools are: (1) land use, (2) mobile monitoring, (3) emission inventories, (4) dispersion modeling, and (5) source apportionment.[3]

National Ambient air quality standards (NAAQS)

The nature and concentration of air pollution varies from city to city. Where, the first requirement to air quality management is the creation of local air quality monitoring network to collect data used to develop an air quality policy.[4] Second step is National Ambient Air Quality Standard (limitation or guidelines). NAAQS are standard concentrations of criteria pollutants in the air, and typically refer to ambient air. The NAAQS is established by the national environmental agency. The regulations for different countries around the world are listed in Table 1.[5–10] Primary standards are designed to protect human health. Secondary standards are designed to protect crops, vegetation, soils, Statues, animals, wildlife, weather, and climate. As well as, to prevent damage of property and transportation hazards. The National Ambient Air Quality Standards (NAAQS) have been set for six principal pollutants known as air quality indicators (criteria pollutants). These are particulate matter, sulfur oxides, nitrogen dioxide, carbon monoxide, lead, and ground-level ozone.[11]

Indoor air quality (IAQ)

It refers to the air quality within and around buildings and structures. Poor IAQ is affect on health, comfort, and well-being of residents of the building. Poor indoor air quality cause sick of building syndrome, impaired learning in schools, and reduced productivity. IAQ indicators are PM_{10}, $PM_{2.5}$, CO, radon, and volatile organic compounds (VOCs). The most effective ways to improve IAQ are to limit the sources of pollutants and to ventilate with clean ambient air.[12]

Characteristics of sources

Many pollutants contribute degradation of air quality; the pollutants of greatest concern include the “criteria pollutants”. These pollutants are particulate matter (PM), nitrogen dioxide (NO_2), sulfur dioxide (SO_2), carbon monoxide (CO), ground level ozone (O_3) and lead (Pb).[4,13] There are many sources of atmospheric pollution.[4] The sources of air pollution are classified into:-

Ambient air pollutants: Air pollutants are gases or particles in the atmosphere which have been linked to harmful human health or environmental effects. Pollutants can be categorized according to these: formation, sources, and chemical composition and characteristics:[4,13,14]

Formation

Primary pollutants (directly emitted to the atmosphere), such as PM, SO_x, NO_x, CO, volatile organic compounds (VOCs), polycyclic aromatic hydrocarbons (PAH) and methane (CH_4).[4]

Secondary pollutants (formed in the atmosphere from reaction between primary pollutants), such as ground O_3 and secondary PM.[14]

Sources of air pollutants are classified into:

Anthropogenic Sources

I. **Stationary sources** are factories, smoke stacks of fossil fuel power stations, and waste incinerators. Stationary sources are classified into**:**

II. **Point source** is a single, fixed point, from which air pollutants can be emitted into ambient air (e.g., a smokestack, Factories, power plant, refineries, turbine engines and incinerators). Characteristics of the source are its inside diameter and the height above ground. Characteristics of the emissions are the pollutants type, exit temperature, velocity, and rate of emissions exit from the source.[13]

III. **Area source** is a specific area emitted pollutants to ambient air (e.g. dry cleaners, service stations, painting operations, landfills, light industry, wood-burning furnace, gasoline storage, gas stations, metal working, and agricultural burning).[4,13]

IV. **Volume sources** is like area source, but with minimum and maximum height above ground level. Air pollutants are emitted uniformly from the volume of the source. Examples of volume sources are parking garages with open sides and a bank of exhaust fans from an industrial building.[4,13]

V. **Mobile sources** are sources that emitted air pollutants during movement. Mobile sources are classified into:4,13

VI. **Line source:** is mobile source of regular emission rate.

1) **On-road** source such as trucks and automobiles.

2) **Off-road** source such as construction equipment, and agricultural equipment, ships, trains, and airplanes.

Natural sources include desert dust, sea spray, Volcanoes, and wildfires.[4,13]

Chemical composition and characteristics

Ambient air quality indicators are six PM, SO_2, NO_2, CO, O_3 and Pb. Table 2 shows characteristics of sources of air pollutants and its contribution.[4,11,13,14]

Indoor air pollutants (IAP)

In developing countries, a major source of IAQ is the burning of biomass (e.g. wood, charcoal, dung, or crop residue) which used for heating and cooking. In many poor African countries, biomass is the main fuel for rural homes. Biomass and coal smoke emit many pollutants, including $PM_{2.5}$, PM_{10}, SO_x, NO_x, CO, VOCs, formaldehyde (HCHO), and benzene. Sources of indoor air pollution include:[12,13,15]

A. $PM_{2.5}$ and PM_{10} which emitted from degenerated lead paint.

B. Formaldehyde (HCHO) which emitted from building materials (carpeting and plywood).

C. Volatile organic compounds (VOCs) which emitted from solvents and Paints, cleaning supplies, pesticides, building materials and furnishings, office equipment such as copiers and printers, correction fluids and carbonless copy paper, graphics and craft materials including glues and adhesives, permanent markers, and photographic solutions.

D. Smoke particulates which emitted from wood fires in stoves.

E. CO which emitted from the burning of charcoal indoors.

F. Hydrogen sulfide (H_2S) which emitted from domestic plumbing.

G. Radon enters buildings from building materials or through drinking water.

Site environment types

Descriptions of the environment type classifications used for classifying air quality monitoring sites are shown below:[16]

a) **Urban area (U);** it is defined as locations such as residential and commercial areas of cities, parks (away from the trees), big streets or squares with very little or no traffic, open areas characteristic of educational, sports or recreation facilities. Urban sites should measure air quality which is representative of a few km^2.

b) **Suburban area (S);** It is defined as outlying part of a city, which is always associated to an urban area.

c) **Rural area (R);** sampling points shall be cited more than 20km away from built-up areas, industrial installations or motorways or major roads.

d) **Traffic station (T);** it is located nearby traffic (roads, motorways, highways). Air sampled at traffic sites must be representative of air quality for a street segment no less than 100m length.

e) **Industrial station (I);** it is located nearby single industrial sources or industrial areas with many sources. Air sampled at industrial sites must be representative of air quality for an area of at least 250m×250m.

f) **Background station (B);** it is located at areas should not be influenced by agglomerations or industrial sites in its vicinity, i.e. sites closer than 5 km.

Case studies of ambient air quality (AAQ)

In Egypt; air pollution was studied in urban, suburban and rural districts of Greater Cairo area. Atmosphere in the urban area is more humid throughout the year if compared to the suburban area and during the months from October to January in addition to May if compared to the rural area. Urban atmosphere is always warmer than its surroundings throughout the year, except in November when there is a cool island.[17] The major sources of air pollution are residential activities, vehicles and industrial centers (factories of Textile, steel, cement, chemical, fertilizer, petroleum, construction, brick and car industries and power plants),[18] Kanakidou et al.[19] showed that rural and suburban parts of the city have higher ventilation due to higher wind speeds than urban parts, which may lead to higher pollutant levels in the urban regions of Greater Cairo area. Hot desert cyclones associated with strong hot and dry winds often carrying dust and sand that increase particulate matter (PM) levels. Dust and sand storms frequently occur in spring and autumn. During winter the climate is generally cold, humid and rainy; while during the summer season the predominant weather is hot and dry. Residential combustion, on-road traffic and industrial activities are the major sources of air pollution in urban area of SO_2 (71%), CO (35%) and NO_x (50%) whereas VOC (37%) emissions are mostly from solvents use seconded by road transport. Anthropogenic $PM_{2.5}$ in Greater Cairo area originates mainly (54%) from residential combustion and open burnings.[19] The maximum concentrations of $PM_{2.5}$, PM_{10} and Pb in Greater Cairo environments were (120, 200

and 1.1μg/m^3, respectively) in background, (110, 210 and 1.5μg/m^3, respectively) in residential, (130, 230 and 1.1μg/m^3, respectively) in urban, (130, 250 and 11μg/m^3, respectively) in industrial.[19] The maximum concentrations of SO_2, NO_2, ground level O_3 and CO in urban areas of Greater Cairo were 125μg/m^3, 200ppbv and 91ppbv, 10 mg/m^3 respectively.[19]

In Kenya; air quality was studied at two sites (urban site and suburban site) in Nairobi. $PM_{2.5}$ concentration was 21μg/m^3 at urban site and 13μg/m^3 at the suburban site. Highest $PM_{2.5}$ concentration was recorded during the cold and dry season (25μg/m^3) and lowest during the short rains season (8.9μg/m^3). $PM_{2.5}$ sources in Nairobi include traffic, mineral dust, industry, combustion, biomass burning and sea salt (, 2014).

In Burkina Faso; carbon monoxide (CO) were examined in urban, roadside and in-traffic environment of Ouagadougou. Carbon monoxide was generated by incomplete combustion of fuels. CO concentrations in-traffic values (16 ppm) were 2–3 times higher than roadside values (6.5 ppm) and 10–12 times higher than urban values (1.5ppm).[20]

In Italy; the Concentrations of PCBs and PAHs were (20 - 200pg/m^3 and 5 - 48ng/m^3, respectively) in urban and (21-72pg/m^3 and 0.52 - 15 ng/m^3, respectively) in sub–urban sites. Urban areas are characterized by intense emissions from vehicles, incomplete combustion, and industrial activities. Higher air concentrations of PCBs were detected during the warmer periods (summer and spring), and higher concentrations for PAHs during the colder periods (autumn and winter), and attributed to different types of sources for PCBs vs PAHs.[21]

In Poland; aerosol particles were collected in different environments in Legnica (urban site) and Krako´w (rural site).[22] Analysis of airborne particles from urban and rural environments revealed differences in partial concentration of 20 selected elements. Konarski et al.[22] found more; Pb, Cr-20 times, As, Sr-10 times, Co-7 times, V, Y-3 times, Ti, Mn, Cu, Se-2 times and Fe, Ni, Zn, Br, Zr, Mo-2 times in urban than in the rural environment. In urban area contamination is due to road traffic, combustion and industrial emission, while in rural area contamination is due to pollen, animal and microbial allergens.

In Malaysia; PM_{10} concentration were monitored in urban, sub-urban and industrial areas. Result indicated that the highest concentration of PM_{10} was detected in urban areas, followed by industrial and sub-urban areas. The highest concentration of PM_{10} was recorded in the urban areas (116μg/m^3) followed by industrial (101μg/m^3), while the lowest concentration was recorded at sub-urban areas (94μg/m^3). High concentrations of PM_{10} in urban areas might be due to many anthropogenic activities include vehicles emission, power plants, incinerators, cement and quarry industries, road dust, and open burning. In addition, In addition, haze phenomena from neighboring countries were also contributed to high amount of air pollutants in Malaysia.[23]

In India; ambient air concentration of PM_{10} and concentration of heavy metals was assessed at sub-urban and rural areas. PM_{10} concentrations are (37–959μg/m^3) at the rural sites and (151–422μg/m^3) at sub-urban sites. Conversely, lowest PM_{10} concentration recorded during February as result of removal of particles by heavy rain. Highest concentrations of heavy metals; Cr, Fe, Mn, Zn, and Al were 2.04, 30, 0.80, 7.13, and 15.6 ng/m^3, respectively, at rural sites compared with 0.28, 0.37, and 0.02 ng/m^3 for Ni, Cu, and Cd, respectively, at sub-urban site. Main sources of PM_{10} and heavy metals at sub-urban sites were road dust, traffic exhaust, tire abrasion, industrial emissions, and oil lubricants use. Heavy metals and PM_{10} at the rural sites originate from coal and wood burning, sugar mill and brick furnace emissions, fertilizers use, agricultural activity, road construction, and resuspended dust (Tyagi et al., 2011).

In China; air pollutants in Jinan (urban and suburban areas) are monitored in Jinan during 2013 to 2014, while the suburban area was less polluted than the urban area. The mean daily average concentrations of SO_2, NO_2 and $PM_{2.5}$ were (95.4, 60.0, and 108.0 μg/m^3, respectively) in urban area, (49.9, 38.9, and 70.7μg/m^3, respectively) in suburb area. It was found that all three of the pollutants in urban area were 0.5–2 times higher than that in suburb, indicating that urban population represents a group more exposed to ambient air pollution than suburban population.[24]

In Nepal; the maximum concentrations of NO_2 (270 -310μg/m^3), CO (450 – 520μg/m^3), and $PM_{2.5}$ (226μg/m^3) and PM_{10} (2,928μg/m^3) was recorded during winter and spring seasons in Kathmandu Valley (urban areas). Common sources of air pollution are household combustion devices, forest fires, vehicles, haphazard digging of road, brick kilns, unplanned expansion of roads, and building materials waste on the busy road sides.[25]

Case Studies of indoor air quality (IAQ)

In Egypt; Culturable airborne fungal concentrations were assessed in different seasons. Samples were collected indoors of 43 homes in urban and rural environments. The median indoor total fungal concentrations were 608 CFU/m^3 in the urban environment and 1,932 CFU/m^3 in the rural environment, respectively. The greatest concentrations were found in the autumn and spring season. The concentrations and types of airborne fungi depend on time of day, climatic conditions, geographical location and type of vegetation. Airborne fungal concentrations in homes and schools ranged between 102 and 104 CFU/m^3 in warm climates, and averaged 102 CFU/m^3 in cold subarctic climates.[26]

In Poland; indoor air quality parameters (SO_2, NO_2, $PM_{2.5}$ and PAHs) were characterized in naturally ventilated kindergartens in urban and rural area in Silesia, during spring season. Indoor pollutants in Poland emitted from house heating (coal and wood combustion) in domestic stoves, increased production in heating and power plants. The concentrations of SO_2 (8.6μg/m^3), NO_2 (8.2μg/m^3), $PM_{2.5}$ (28.2μg/m^3) and ∑PAHs (38.8ng/m^3) in urban area, while concentrations of SO_2 (10.1μg/m^3), NO_2 (8.2μg/m^3), $PM_{2.5}$ (31.9μg/m^3) and ∑PAHs (45.3ng/m^3) in rural area.[27] Indoor daily concentrations of SO_2 in Belgian primary schools during winter were (1.9 - 2.9μg/m^3) in urban area and (1.4 - 3.5 μg/m^3) in suburban area. [27] Lower concentrations of indoor SO_2 were found in two Turkish schools 5.6 μg/m^3 and 6.7 μg/m^3. [27]

In Malaysia; indoor air quality was studied in preschool children (urban area) and houses (suburban area), indoor pollutants included $PM_{2.5}$, PM_{10}, VOCs, aldehydes, mold, bacteria and Gram-negative bacteria. Indoor pollutants originated from indoor smoking, cooking activities, paint, wall, air cooling system and even outdoor air toward building residents. The concentration of indoor pollutants were $PM_{2.5}$ (67 μg/m^3), PM_{10} (74 μg/m^3), VOCs (0.005 ppm), mold (402 CFU/m^3), bacteria (550 CFU/m^3) and Gram-negative bacteria (60 CFU/m^3) in urban area. While concentration of indoor air pollutants were $PM_{2.5}$ (119μg/m^3), PM_{10} (131 μg/m^3), VOCs (0.04 ppm), mold (275 CFU/m^3), bacteria (142.5 CFU/m^3) and Gram-negative bacteria (17.5 CFU/m^3) in suburban area.[28]

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Status of air quality

In different countries around the world, the regional and local environmental authorities carry out the monitoring of local air quality, to implement environmental management plans and environmental programs, and regulations to reach good air quality.

Air quality in Egypt

Air pollution is considered one of the major challenges facing Egyptian society. The Ministry of State for Environmental Affairs (EEAA) put air quality on the top of its priorities, and gives extraordinary attention to execute the strategies that face air pollution. Relatively with economic growth, industrial activities and other development processes. Air quality has been partially monitored in Egypt since 1970. Local air quality monitoring network has been updated continuously. It reaches a total of 92 stations covering different geographic locations in Egypt. Recent air quality states of the environment in Egypt published in reports of Central Agency for Public Mobilization and Statistics (CAPMAS), depending on air quality monitoring data collected by the national network stations of the ministry of environment (EEAA) and the ministry of health and population (EMC) compared with the ambient air quality standards for urban (Egyptian limits) are illustrated in Figure.[9,29] In recent years, EEAA has developed the national network for monitoring ambient air pollutants to increase the efficiency of monitoring stations and supplying the stations with devices for weather factors monitoring.[9] The national air monitoring network is considered as a basic reference for air quality indicators: I) SO_2 which is emitted from power plants, various factories, and vehicles; II) NO_2 which is produced from processes of the burning of fuels; III) CO which is emitted from incomplete combustion of fossil fuels, various industries, and vehicles; IV) Ground O_3 which is higher during summer months than in winter as a result of the increase in sunshine hours; V) PM is emitted mainly from natural sources. The geographical nature, location of Egypt in the desert of North Africa, and the scarcity of rainfall lead to increase effect of natural sources on rates of suspended particulate matters. PM is considered the main indicator of air quality in Egypt; VI). Foundries are considered the most important source of industrial emissions of lead (pb). In Egypt, The contribution of mobile sources in air quality of Greater Cairo with PM is shown in Figure 2.[9]

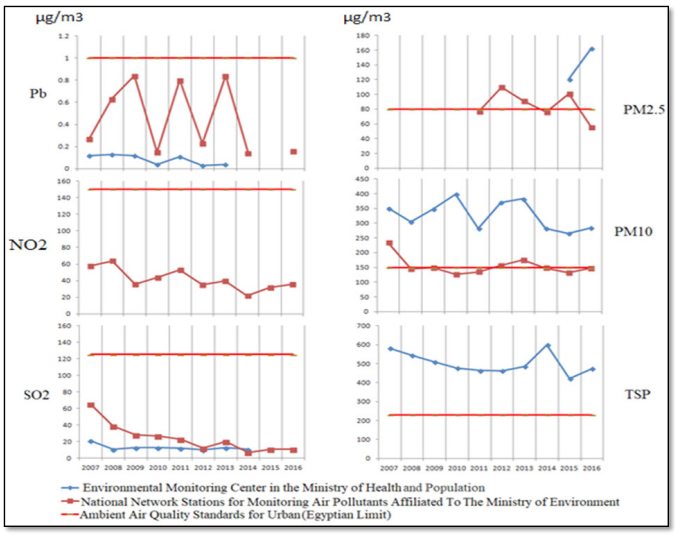

Figure 1 Air quality in Egypt.[29c]

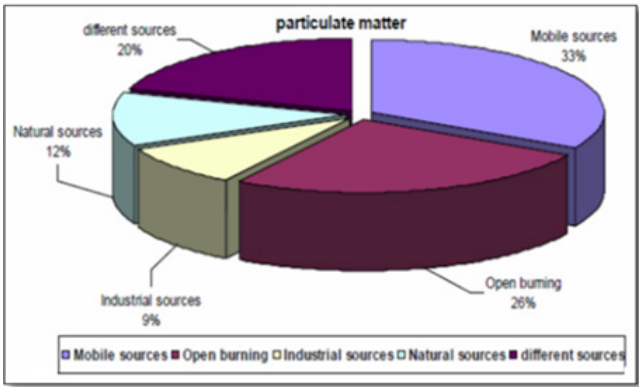

Figure 2 The contribution of mobile sources in air quality of Greater Cairo with PM.

Air quality in gulf countries

In United Arab Emirates (UAE); the main sources of air pollution are natural sources and industrial sources (such as fuel combustion, power generation, desalination, vehicles, ships, generators and oil and gas processing.[10] In most areas, SO_2, CO, NO_2 and O_3 concentrations are within the limits values in UAE. While the natural levels of suspended particles in the Emirate of Abu Dhabi are significantly higher due to the dry nature of the region, indicating the high natural levels due to the natural sources of these particles (Figure 3). In Kuwait; Sources of air pollution in Kuwait are vehicles, petroleum refineries, power plants, oil fields, construction, and industries.[30] In Qatar; Air pollution sources in Qatar include vehicles, power plants, petroleum refineries, oil and gas processing, construction, and industries.[31] In Kingdom Saudi Arabia (KSA); the sources include desert storms, oil refinery, power generation, plant a desalinization plant, industries, and vehicle fuels.[32] Figure 4 show comparison of air quality in Kuwait, Qatar and Kingdom of Saudi Arabia.

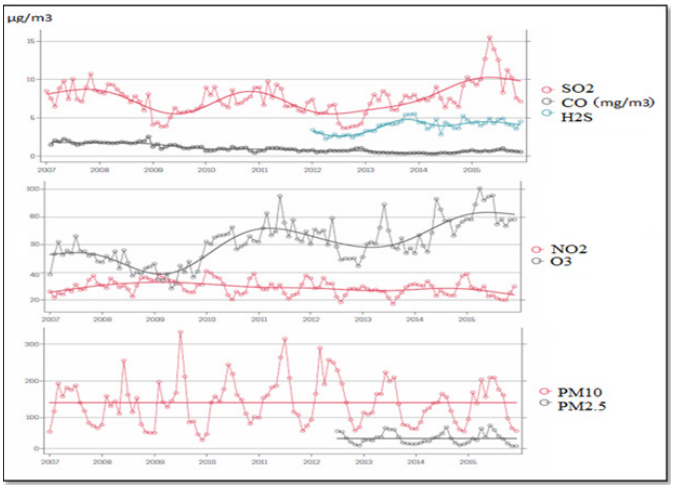

Figure 3 Air quality in UAE.

Air quality in African countries

In South Africa sources of ambient air pollutants are natural sources (volcanoes, Wildfires domestic animals, and pine trees) and anthropogenic sources (vehicle emissions, fossil fuel burning, electricity generation, aircraft emissions, domestic fuel burning, biomass burning, and waste incineration). Indicator pollutants are PM,

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SO_x, NO_x, CO, VOCs, and CH_4.[33] In Rwanda; The main sources of anthropogenic air pollution are from industry, domestic fuel burning and road traffic.[34] Key pollutants of concern in Rwanda are: NO_x, NO_2, SO_2, PM_{10}, $PM_{2.5}$, O_3, and CO.

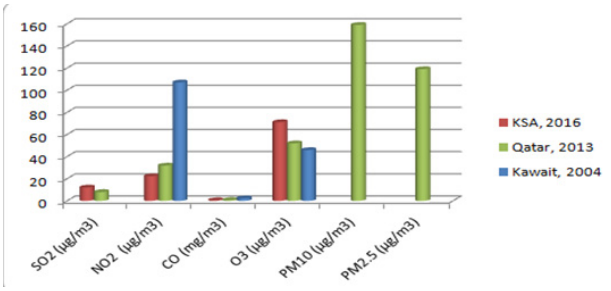

Figure 4 Comparison of air quality in Kuwait, Qatar and KSA.

Air quality in Asian countries

In recent years, poor air quality in different Asian cities was monitored. According to the WHO, air quality has worsened in Asian cities and presents a threat to human health.[5,35,36] Figure 5 shows most polluted capital cities in Asia. In Singapore; air pollution sources include vehicular traffic, industrial activity, cargo ships, natural emissions and wildfires. In Bangladesh: The commercial sources include the combustion of fuels for power generation in industrial processes, powering motor vehicle, different construction, brick kilns, paper and pulp industries, oil refineries and burning of agricultural residues. In Bhutan; air pollutants are emitted during the combustion of biomass fuels and responsible for both indoor and outdoor air pollution.[37] In India; the combustion of fuels in the domestic, industrial, transport sector, petroleum refineries, textiles, paper and industrial chemicals, vehicles and transport fertilizer manufacturing are the major sources of air pollutants. In Maldives; the main sources include the land and sea transport, power generation, construction activities, vehicles and domestic combustions. In Nepal; the major sources are vehicles, industrial (cement, brick, tile and textile factories) and incomplete combustion of fossil fuels. In Pakistan; the main sources are vehicles, refuse burning, open dumps burning, vehicular automobiles and aircrafts. In Sri Lanka; the emissions are from industrial activities, especially thermal power plants. In China; sources of pollution are including industrial facilities, biomass burning, automobiles, electric power plants, and fossil fuels.

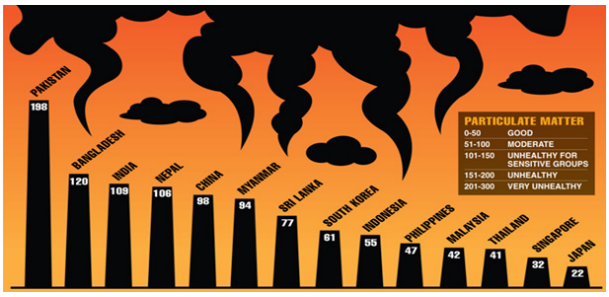

Figure 5 Most polluted capital cities in Asia.[16]

Air quality in european countries

In UK; the main pollutants are NO_x, SO_x, VOC, NH_3, CO, $PM_{2.5}$, PM_{10}, and heavy metals (HMs). Sources of pollutants are nature sources, agriculture, extraction and distribution of fuels, combustion plants, solvent use, electricity generation, and transport.[16,38] In Scotland; the main sources of air pollutants are transport (diesel combustion), power stations and domestic combustion, agriculture (fertilizers and manure), road dust, brake, sea salt, construction, fuel combustion household products (aerosols, paints and disinfectants), domestic and industrial combustion, incomplete combustion of fossil fuels, solvents.[39] In New Zealand; the major source of air pollution is combustion, whether it is from the burning of coal and wood to generate heat, or the burning of petrol and diesel in vehicles (SPIC, 2016).[39] Combustion creates particles (PM_{10} and $PM_{2.5}$) and gases (NO_x, SO_x, and, CO) that affect human health. Figure 6 & Figure 7 show air quality in Europe.

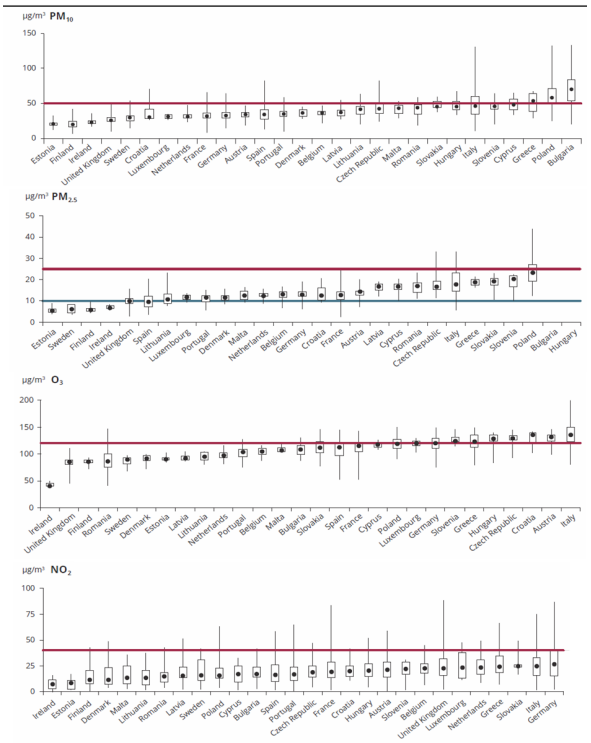

Figure 6 Air Quality in Europe during 2015.[14]

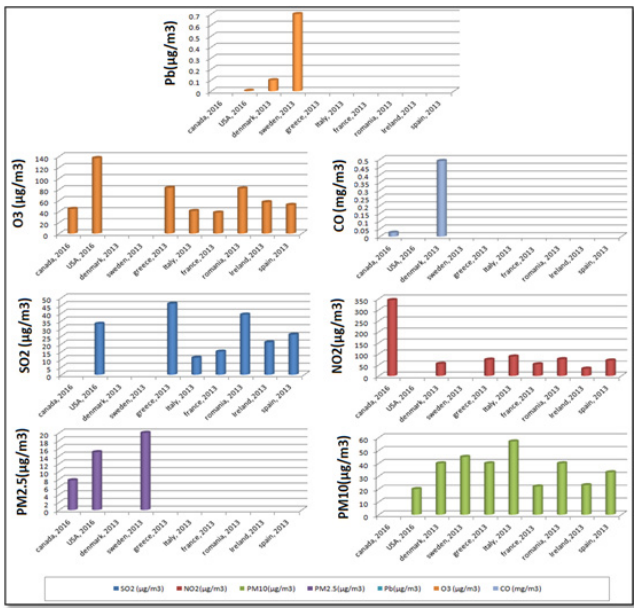

Figure 7 Air Quality in Europe during 2013-2016.[14]

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Air quality in USA and Canada

In United States of America (USA); diesel engines, ports, vehicles, transportation sector, fuel combustion, incomplete combustion of fossil fuels and industrial processes are main sources of air pollution.[40] In Canada; sources including mining process, Agriculture activities, construction, dust from paved and unpaved roads, industrial activity, smelting, home firewood burning, transportation, oil and gas industry and fuel for electricity and heating.[14] Figure 8 show air quality in USA during 1990-2015 and Canada during 2002-2016.

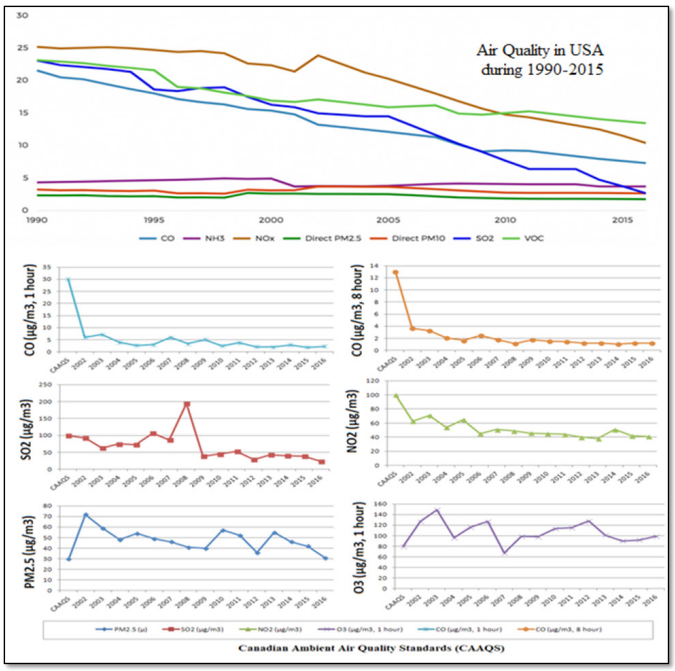

Figure 8 Air Quality in USA during 1990-2015 and Canada during 2002-2016 .[14,40]

Indoor air quality in developing countries

Poor air quality in developing countries is due to urbanization and industrialization.[41] Figure 9 show indoor air quality of particulate matter (PM_{10} and $PM_{2.5}$) in different developing countries during.

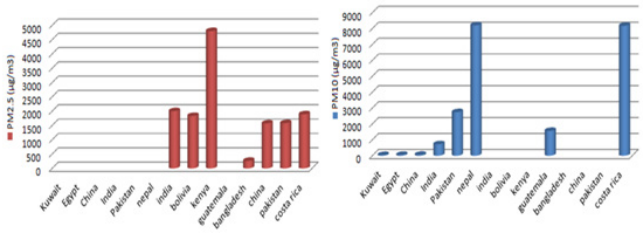

Figure 9 Indoor air quality of PM_{10} and $PM_{2.5}$ in different developing countries.

The relation between air quality and climate change

Air quality has been affected by changes in climate through different mechanisms. Direct effect is ability of black carbon to absorb heat from surroundings, and indirect effect is formation of soot clouds that acts as mirrors and reflects back heat towards earth's surface. Also, increase ambient temperatures due to climate change, leads to increase formation of ground ozone (O_3) from nitrogen oxides. On the other hand, sulfates and nitrates particles have a cooling effect, due to it reflects sunlight.[42] Weather can affect air quality. Where, low temperatures during dry season make ambient air denser, move pollutants to lower altitude (breathing level). High pressure induces inversion layers, where cold air is trapped close to earth surface. This leads to prevents dispersion of pollutants, and lead to formation of smog.[42]

Conclusion

In this paper air quality and characteristics of sources are reviewed around the world and concluded into:

Good air quality is necessary for preserving the balance of life on earth for humans, plants, animals and natural resources.

Monitoring air quality indicators helps decision makers to put and evaluate environmental policies.

Each country monitors pollutants (such as PM_{10}, $PM_{2.5}$, NO_2, SO_2, CO, O_3, VOCs and Pb) as indicators for air quality.

There are requirements for air quality management, first; is creation of local air quality monitoring network. Second is National Air Quality regulations.

Characteristics of air pollutants are varied according to its formation, source, chemical composition and environment site type.

There are relation between weather parameters, climate change and air quality.[43–47]

Recommendation

The air quality monitoring data collected by national network stations (EEAA) and (EMC) should be reviewed by scientific committee to avoid conflict and errors before publishing it in reports of Central Agency for Public Mobilization and Statistics (CAPMAS). Improve data availability in all sectors which impact on ambient air quality with the aim of establishing mass emissions of key pollutants by sector. Also, the data collected should be used in emissions inventory. Encourage awareness activities (communicating with the public during poor air quality episodes), data dissemination, regulatory measures, vehicle inspection and maintenance; transportation planning and industry standards. Encourage use clean energy resources such as renewable energy from sustainable sources like solar and wind.

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Conflicts of interest

The authors declare that there are no conflicts of interest.

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