Report on good practices for the reduction of air pollution in South Asia

South Asia Co-operative Environment Programme (SACEP)

Chapter -1-

Introduction

Air pollution is a major problem that has been recognized throughout the world for hundreds of years. It is a major environmental health problem affecting everyone in both developed and developing countries in the world.

Air pollution, particularly in cities, is certainly not a new problem. The problems of poor urban air quality are well documented even as early as in the end of the 16thcentury.In the late 18th century, the Industrial Revolution, beginning in the UK, led to escalation in pollutant emissions based around the use of coal by both homes and industry. Pollutant emissions continued to grow through the 19th and early 20th centuries, and the dramatic smog episodes known as pea-soupers became common place in many of Britain's inner cities, leading to poor air quality. After the infamous London Smog of 1952, pollution from industries and homes was dramatically reduced in an attempt to protect health.

However, during the 1980s the number of motor vehicles in urban areas steadily increased and air quality problems associated with motor vehicles became more prevalent. In the early 1980s, the main interest was the effects of lead pollution on human health, but by the late 1980s and early 1990s, the effects of other motor vehicle pollutants became a major concern. The 1990s have seen the occurrence of wintertime and summertime smogs. These are not caused by smoke and sulphur dioxide pollution but by chemical reactions occurring between motor vehicle pollutants and sunlight known as 'photochemical smogs'.

In more recent times pollution from motor vehicles has become the most recognized air quality issue. The number of cars, in most countries around the world, is now steadily increasing, and a speed up in technological development is required to try and combat the pollution problem. Traffic

has become a major air polluter in the big cities, although most Asian countries have low per capita vehicle ownership in comparison to the world average (World Bank 2000) the motorized fleet (see bar chart) has been growing rapidly; for example, the number of private motor vehicles in Sri Lanka doubled during 1975-92 (Government of Sri Lanka 1994) and in India the number of cars has been doubling every seven years for the past 30 years (ADB 1999). This fact combined with poor roads, fuel quality and vehicle maintenance, and makes vehicular air pollution an alarming issue.

Air pollution is also a major environmental risk to health. According to the WHO air pollution is the sixth most dangerous killer in South Asia. At present, urban air pollution causes 1.3 million estimated deaths per year worldwide, It is also estimated that around 470,000 people die each year because of human-caused increases in ozone.

Therefore by reducing air pollution levels, we can help countries reduce the global burden of disease from respiratory infections, heart disease, and lung cancer. Since exposure to air pollutants is largely beyond the control of individuals it has become an issue which requires action by public authorities at the national, regional and even international levels.

The Key Air Pollutants

Particular Matter (PM)

PM affects more people than any other pollutant. The major components of PM are sulfate, nitrates, ammonia, sodium chloride, carbon, mineral dust and water. It consists of a complex mixture of solid and liquid particles of organic and inorganic substances suspended in the air. The particles are identified according to their aerodynamic diameter, as either PM_{10} or $PM_{2.5}$. The latter are more dangerous since, when inhaled, they may reach the peripheral regions of the bronchioles, and interfere with gas exchange inside the lungs.

In South Asia, road transport, production processes and residential combustion plants are the most important sources of primary PM_{10} - each typically contributing between 15-20% to total emission.

Ozone

Ozone at ground level is one of the major constituents of photochemical smog. It is formed by the reaction with sunlight (photochemical reaction) of pollutants such as nitrogen oxides (NO_x) from vehicle and industry emissions and volatile organic compounds (VOCs) emitted by vehicles, solvents and industry. The highest levels of ozone pollution occur during periods of sunny weather.

Excessive ozone in the air can have a marked effect on human health. It can cause breathing problems, trigger asthma, reduce lung function and cause lung diseases. In Europe it is currently one of the air pollutants of most concern.

Nitrogen Oxide

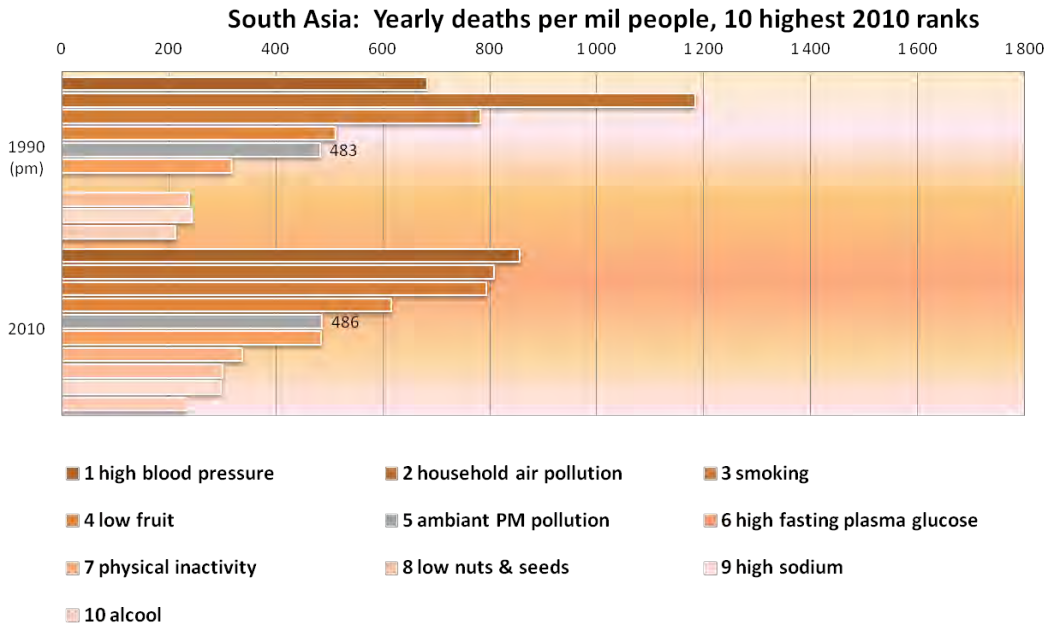
The major sources of anthropogenic emissions of NO_2 are combustion processes (heating, power generation, and engines in vehicles and ships). Epidemiological studies have shown that symptoms of bronchitis in asthmatic children increase in association with long-term exposure to NO_2.

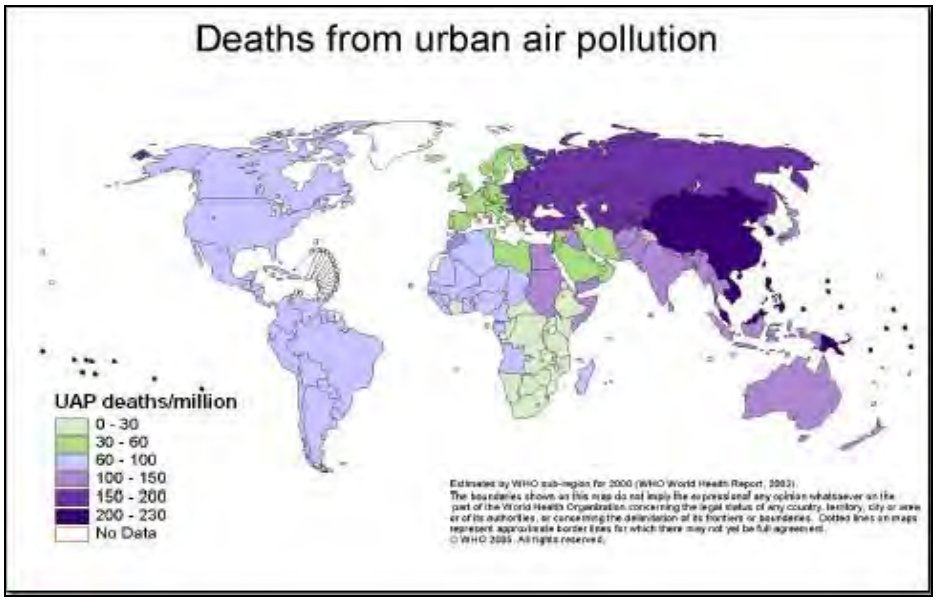
Sulpher Dioxide

SO_2 is a colorless gas with a sharp odor. It is produced from the burning of fossil fuels (coal and oil) and the smelting of mineral ores that contain sulfur. The main anthropogenic source of SO_2 is the burning of sulfur-containing fossil fuels for domestic heating, power generation and motor vehicles.

SO_2 can affect the respiratory system and the functions of the lungs, and causes irritation of the eyes. Inflammation of the respiratory tract causes coughing, mucus secretion, aggravation of asthma and

chronic bronchitis and makes people more prone to infections of the respiratory tract. Hospital admissions for cardiac disease and mortality increase on days with higher SO_2 levels. When SO_2 combines with water, it forms sulfuric acid; this is the main component of acid rain.





Transboundery Air Pollution

Air pollution caused by human activities, including industrial and energy production, the burning of fossil fuels and increased use of certain types of transport, causes serious health problems throughout the world every year. Environmental damage such as acidification, eutrophication, tropospheric (ground-level) ozone and reduced air quality, especially in urban areas, can be a local as well as a transboundary problem as air pollutants are transported in the atmosphere and harm human health and the environment elsewhere.

Transboundery Air Pollution is a particular problem for pollutants that are not easily destroyed or react in the atmosphere to form secondary pollutant. These are cross boundary pollutants that can be generated in one country and felt in others; these require international actions and collaboration to control their formation and effects. Transboundary air pollutants can survive for periods of days or even years and can be transported 100s or thousands of miles before they affect the air we breathe, soils, rivers, lakes and/or our food. Transboundary air pollutants cause a number of different problems: e.g formation of particles, ground level ozone which are hazardous to health, the formation of acid rain which can damage buildings and sensitive ecosystems and some that are toxic to human health and the environment.

Regional Initiatives to reduce Atmospheric Pollution

There are a number of successful on-going initiatives around the world working to reduce regional atmospheric pollution. Some of these groups include:

Asia

1.) **Acid Deposition Monitoring Network in East Asia (EANET)**: a regional cooperative initiative to develop a common understanding of the state of acid deposition problems in East Asia, and to contribute to cooperation among participating nations to prevent or reduce the effects on the environment caused by acid depostion.
2.) **Association of Southeast Asian Nations (ASEAN) Agreement on Transboundary Haze Pollution (ASEAN Haze Agreement):** an agreement between all ASEAN nations to bring haze under control in Southeast Asia.
3.) **Clean Air Initiative – Asia (CAI-Asia):** a multi-stakeholder network of institutions and individuals committed to improving air quality management in Asia. Its mission is to promote and demonstrate innovative ways to improve the air quality of Asian cities by sharing experiences and building partnerships.

4.) **Malé Declaration for Control and Prevention of Air Pollution and Its Likely Transboundary Effects for South Asia (Malé Declaration):** an agreement between eight south Asian nations under the umbrella of the United Nations Environment Programme (UNEP), to monitor and reduce air pollution problems and share information and data towards better management of transboundary air pollution issues.
5.) **Project Atmospheric Brown Cloud (ABC):** an effort initiated by the United Nations Environment Programme (UNEP) to bring together national and international science teams to integrate science with impact assessment in order to provide a scientific base for informed decision making and regional capacity building to address problems associated with Atmospheric Brown Clouds.

Africa

1.) **Air Pollution Information Network for Africa (APINA):** a network of policy makers, scientists, non-governmental organisations, industry and other stakeholders working to ensure that existing impacts of air pollution in southern Africa are tackled and emerging risks are prevented.
2.) **Clean Air Initiative – Sub-Saharan Africa (CAI-SSA):** designed in the context of the World Bank's overall strategy, to bring together representatives from governments and other organisations to raise awareness on air pollution issues, strengthen local expertise, and design, monitor and implement programs to reduce air pollution in cities in Sub-Saharan Africa.

Latin America

1.) **Clean Air Initiative – Latin America (CAI-LA):** improve air quality in Latin American cities to protect the health of its inhabitants and to mitigate global pollution by bringing together the efforts of the appropriate authorities of each city represented, from the private and social sectors, non-governmental organizations, international organisations, and governmental international aid agencies.
2.) **The Inter-American Network for Atmospheric/Biospheric Studies (IANABIS):** a scientific network created to report on the adequacy of existing measurements and plans for the future to study the changing chemical composition of the atmosphere, with a Latin-American focus.

Europe and North America

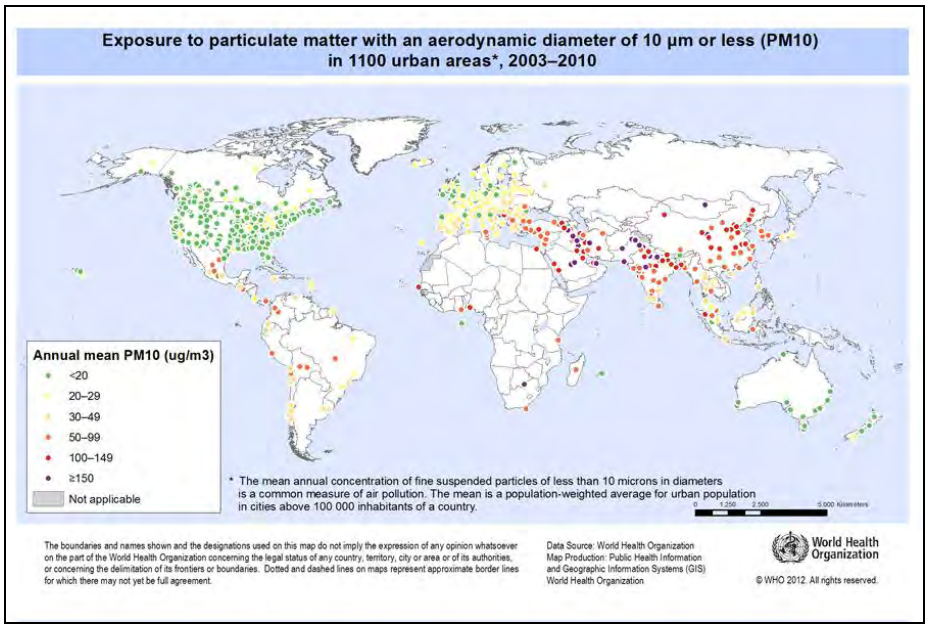
1.) **The United Nations Economic Commission for Europe Convention on Long-range Transboundary Air Pollution (UNECE LRTAP):** nations in Europe and North America that

have developed protocols to limit and gradually reduce and prevent air pollution, including long-range transboundary air pollution.

Chapter -2

Air Pollution in South Asia

South Asia, is composed of eight countries, namely Afghanistan, Bangladesh, Bhutan, India, Maldives, Nepal, Pakistan and Sri Lanka. It has nearly 1.6 billion inhabitants (United Nations, 2007a), representing nearly 24% of the world's total population spread over less than 4% of the world's surface. The population of these countries is growing at a variable pace and as a consequence Environmental degradation remains a challenge in countries of South Asia. With the projected increase in industrial activity, exponential growth in number of vehicles and population it is expected that the contribution of each South Asian country to the regional air pollution will increase over time (Sri Lanka Economic Update, 2010).



BANGLADESH

Environmental problems in all major cities of Bangladesh occur due to the lack of environmental facilities, such as infrastructure, coupled with the rapid rise in transportation demand. It is also caused by huge number of non-motorized vehicles on roads, lack of application of adequate and proper traffic management schemes, improper land use planning, industrial growth, construction activities, re suspension of dusts, and open burning. Ever increasing traffic congestion in the streets, use of low leaded gasoline without catalytic converters, increasing number of two stroke engine vehicles and high content of sulfur in diesel enhance sufferings of the inhabitants of Dhaka from vehicle emissions. Air pollution in the Bangladesh capital annually kills thousands of urban poor and millions more suffer from respiratory diseases.

The exposure of the public to air pollution in Dhaka is estimated to cause 15,000 premature deaths and several million cases of sickness every year. It is also recorded that Dhaka is the 31st most polluted city out of 132 cities across the world. However the air pollution in other cities and small

towns is not as acute as in Dhaka. The poor are particularly vulnerable to air pollution, impoverished children suffer from additional effects of air pollution due to malnutrition.

The Department of Environment (DoE) has estimated the density of airborne particulate matter is around 250 micrograms per cubic meter in Dhaka, which is five times the acceptable level. The air consists of common pollutants, sulphur dioxide (SO2), carbon monoxide (CO), nitrogen oxides (NOx), ground-level ozone (O3), volatile organic compounds, hydrogen sulphide (H2S), sulphates and nitrates. The authorities in Bangladesh assume if air pollution in its overcrowded capital could be reduced by only 20 to 80 percent, an estimated 1,200 to 3,500 lives annually could be saved. The Ministry of Environment and Forests (MoEF) claims that another 80 to 230 million cases of respiratory diseases could be averted each year. The studies further reveals that if the air pollution is reduced, it would also save $170 to 500 million in healthcare costs and simultaneously increase the productivity of city dwellers. .

Some of the main concerns regarding air quality in Bangladesh are:

(i) High sulfur diesel used by buses and trucks

(ii) Poor road infrastructure in Dhaka city accompanied by poor traffic management leading to huge traffic jams. Only recently some electronic traffic signal system have been installed.

(iii) Too many brick kilns around Dhaka city to feed the current construction boom of apartments and shopping malls. These brick kilns use cheap high sulfur imported coal, firewood, old tires, etc.

(iv) Lack of coordination among the concerned Ministries:

Key Initiatives on Air Pollution Reduction

(i) Banning 2-stroke 3-wheelers (baby taxies)

(ii) Introduction of lead free gasoline (petrol) throughout the whole country

(iii) Introduction of compressed natural gas (CNG) as an alternate cleaner fuel with 58 refueling stations in Dhaka city . Most of the taxis in Dhaka are now on CNG. Private cars and microbuses are gradually being converted to CNG as the gasoline prices are gong up.

(iv) Setting up of a Continuous Air Monitoring Station (CAMS) in Dhaka city

(v) Introduction of Ambient Air Quality Standards and Vehicle Emission Standard

(vi) some nongovernmental organizations (NGOs) are involved in raising awareness and urging government agencies to take appropriate steps for reduction of air pollution

Ongoing activities of Pubic Awareness on AQM in Bangladesh

(i) Radio and TV programs on air quality including interviews/panel discussions, etc.

(ii)Programs by environmental NGOs led by national NGOs—Bangladesh Paribesh Andolon: Bangladesh Movement for Environment (BAPA), Bangladesh Environmental Lawyers' Association (BELA) Federation of Environmental Journalists of Bangladesh (FEBJ) and Bangladesh Centre for Advanced Studies (BCAS).

(iii) BAPA organizes protest meetings and marches with banners and festoons to sensitize people about the importance of air quality in their lives. This group also lobbies the Government for taking necessary steps to ensure better air quality. BELA has mobilized resources through High Court interventions on environmental issues. Members of the FEJB write informative articles in local newspapers on environment issues including air quality. FEJB also publishes Report on the State of Environment, Bangladesh each year. This effort is supported by the United Nations Development Program (UNDP) and MOEF. BCAS is involved with climate change issues among other environmental subjects.

(iv) Short courses/workshops on Environmental Management (including AQM)

(v) Newspaper articles about AQM and problems.

(vi) Undergraduate and graduate courses on Air Pollution and Control at public/private universities

(vii) DOE programs (e.g. poster competition, essay writing competition, seminars, exhibitions, etc.) on World Environment Day

BHUTAN

Thimphu, the capital city, accounts for 75 percent of all urban population, which is over seven times higher than the second largest town Phuentsholing with 10.5 percent of urban population. Vehicular emission is a growing problem in Thimphu caused by rapidly increasing number of vehicles. The city is suffering from air pollution due to rapidly increasing vehicle numbers, poor fuel quality, burning of wood in bukharis and open fires. However the primary sources of air pollution emission in Bhutan are exhaust emissions from diesel and petrol vehicles, and particulate matter from brake and tire wear and resuspended road dust, industrial emissions, smoke from wood stove (Bhukaris), windblown dusts from construction sites, smoke from forest fires, and burning forests for agricultural purposes and many more.

The foremost air pollutant of concern in Bhutan is particulate matter. There are indications from existing measurements and observations that particulate matter levels in Thimphu can approach and exceed the WHO guideline levels, and the potential human health impacts are of concern.

It is suspected that similar levels of particulate matter may be found in Phuentsholing and at some industrial estates. According to the survey, about 96% of houses burn a total of more than 10,000 cubic feet of fi redwood in Thimphu each day during the winter months, substantially affecting the total amount

of emission during this period. Heating of bitumen during road construction, dust from unpaved roads and open spaces, and burning of kitchen garden waste and farm waste during the dry season.

The various studies have recommended that the Government initiate programs (introduction of smokeless stoves for heating, tax incentives for importing electric heaters, and development of vehicle emission standards) to improve and monitor air quality in the valley

Although the Bhutanese government has implemented many strategies to control vehicle emissions, the strategies appear is found to be inadequate and there is still a need to explore alternative strategies for alleviating the problem.

So far NEC, has initiated the following activities:

(i) 1996, the Ministry of Finance banned the importation of second-hand vehicles and new two-stroke, two-wheelers after the recommendations made by NEC. Prior to the ban, Bhutan imported more than 950 second-hand vehicles within 12 months (DRC 1997).

(ii) 1999, The Government also established type approval standards for Bhutan for the import of new vehicles. The standards suggest that all new vehicles should be Euro 1 type approval.

(iii) 2001, Bhutan began to import unleaded petrol.

(iv) 2003, Bhutan began to import Ultra Low Sulphur Diesel (0.025% sulfur-content diesel)

(v) Reduction of import tax on vehicle spare parts particularly related to vehicle emission, such as air, oil, and fuel filters.

(vi) In 2003, established the vehicle emission standards for in-use vehicle.

(vi) In 1999, Government developed the Road Safety and Transport Regulations, which highlights that all vehicles registered in Bhutan should comply with the vehicle emission standards. However, the government still does not have enough testing equipment and staff to make the activity meaningful.

A Transport Management and Policy is still in the draft stage, and the implementation of the vehicle emission standards is currently limited to emission testing only.

MALDIVES

Maldives is located south-south west of the Indian main land. It is an Island chain of atolls with white sandy beaches. As of 2012, population in Maldives was estimated to be around 328,536 with roughly one third living in urban centers. The most populated city, Male is also the capital. Air pollution is an emerging issue in Maldives largely due to pollution from vehicle emissions and is exacerbated by a very congested population of around 100,000. Maldives has no conventional energy resource that can be utilized to meet its energy requirement and depends on import of its energy needs. Increases in vehicle numbers, imported fuel and building numbers all contributes to the decline in air quality in Male. Inhabitants of Male are using more and more motorcycles and cars replacing bicycles used few years ago. Public road passenger transport was only trough taxis till 20011 and in 2011 a trial bus service was introduced in to the island. Other pollution sources identified in Male are diesel combustion emissions and dust emissions from construction related activities.

The available indicators of air pollution in Male include:

(i) An increase in vehicle numbers;

(ii) The rising quantity of imported fuel;

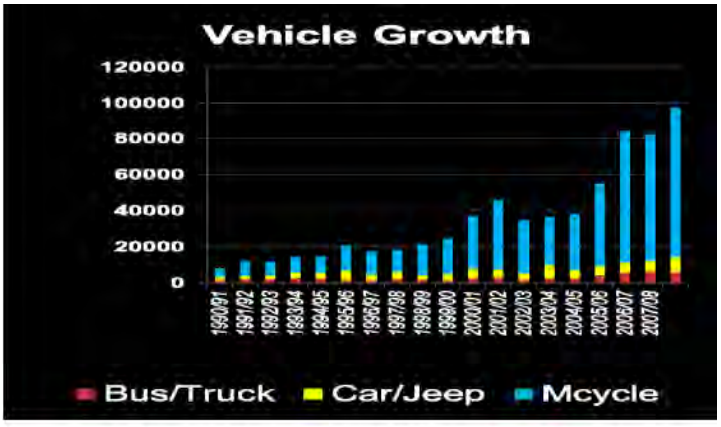
(iii) A positive trend in recorded respiratory disease; and

(iv) Number of buildings constructed over the years.

In 2001, the Government adopted, Addressing **Air Pollution – National Strategy for Action** with the aim to establish the necessary framework for addressing air pollution to protect the environment of the Maldives. The action plan calls for regular monitoring of air pollution and to assess the impacts of air pollution on human health and assets, introduction of preventive and management measures for air pollution at the source level, development of suitable coordinating mechanisms for the successful implementation of the air pollution action plan and for building adequate capacity to address the issues of air pollution.

As a means of reducing the traffic problems and improving the air quality in Malé, the Government banned import of reconditioned motorcycles which have and engine capacity of less than 150 cubic meters into the country in December 2000. Further the Ministry of Transport, Government of Maldives started to register the taxi canters since 1997 and by year 2000 taxi services was totally regulated.

NEPAL



Nepal, a relatively small country with 147, 181 sq km area inhabited by 22 million people, is known for exquisite environment. However, the real scenario is quite different because urban areas are environmentally degrading due to rapid unplanned urbanization and industrialization.

Kathmandu, the capital of Nepal, has a land area of 395 km2 , a rapidly increasing population of 1.08 million, and a vehicle usage rate that is growing by approximately 10 percent per year (CBS, 2005; Faiz et al., 2006). The valley is especially vulnerable to air pollution due to the exploding population inflow, rapid urbanization, valley centric industrialization and significant increase of vehicular transport in narrow streets. Furthermore, the bowl like topography of the valley restricts wind movement and retains the pollutants in the atmosphere. This is especially bad during winter season when thermal inversion persists. Cold air flowing down from the mountains is trapped under a layer of warmer air and acts as a lid. As a result, the pollutants are kept within the valley.

The main problem in Kathmandu's air quality is the high concentration of particulate matter. Among the major air pollutants released to the atmosphere, suspended particulate is considered as one of the major health impact and therefore numerous studies have been undertaken especially in developing countries in the last decade. In recent years, particulate matter has been recognized as the most dangerous and widely spreaded air pollutant. Vehicle emission is a major source of air

pollution in Kathmandu. This is mainly because of the large number of vehicles on congested streets, poor quality vehicles, poor quality fuels and weaknesses in the emission inspection system. Due to unmanaged urban development, infrastructure, a growing number of vehicles, polluting industries and population growth,

Kathmandu's air is getting dirtier day by day. The concentration of particulate matter in the ambient air is already several times higher than WHO guidelines and increasing. This growing air pollution is having an adverse impact on human health and the economy of the Valley. About NRs. 3, 00, 00000 (30 million) of hospital costs every year could be saved by reducing Kathmandu's PM10 level to meet World Health Organization (WHO) guideline values. (The Clean Energy Nepal/Environment and Public Health organization, 2003)

Due to the fact that the air pollution has become a major environmental issue in Kathmandu, there have been some efforts for the air quality management.

- In 2002, Ministry of Population and Environment established six permanent air quality monitoring stations in Kathmandu Valley. It is the only air quality monitoring system in Nepal. These stations monitor daily PM10 concentrations; & other key parameters such as sulphur dioxide (SO2), oxides of nitrogen (NOX), benzene, lead, polycyclic aromatic hydrocarbons (PAH) are monitored through passive samplers and such monitoring is not carried out on a regular basis.
- Introduced Nepal Vehicle Mass Emission Standard,
- Ban on import of second-hand and reconditioned vehicles, two-stroke engine
- vehicles
- Phase out of three-wheeler diesel tempos (1999), three wheeler two-stroke
- engine vehicles, and 20 years old taxis from Kathmandu valley (2004)
- Introduction of electric and LPG three-wheelers

- Introduction of Vehicle Emission Standards for in-use vehicles. Green stickers for vehicles meeting emission standards. In-use emission standards further improved after 1998 to include HC- and gas-operated vehicles such as LPG in 2000
- On-road tailpipe emission monitoring of polluting vehicles (2003)
- Ban on trucks and other heavy goods carrying vehicles during night (1999/2000)
- Ban on new registration of Bull's Trench Kiln brick manufacturing industries in the valley. Others changed to cleaner technology (2004)
- Emission standards for brick kilns of 900 mg/m³ by Industrial Promotion Board in 2004
- National Indoor Air Quality Standard and Implementation Guidelines 2009
- Implemented Polluter Pay Principle in Kathmandu valley by placing Rs. 0.5 per liter petrol and diesel to reduce air pollution Kathmandu valley

Future Plan

- Government is planning to upgrade Nepal Vehicular Mass Emission Standard similar to Euro-3.
- Vehicles test through ultra-modern equipments from Vehicle Fitness Test Centre (VFTC).
- Formulating new National Transportation (Vehicle) Policy which will encourage to import and manufacture environment friendly and low pollutant vehicles in Nepal.

India


Industries, thermal power plants and motor vehicles are among the major contributors to air pollution in India. In metropolitan cities such as Delhi and Mumbai , as much as 50 to 60 per cent of the air pollution is due to motor vehiclis. Use of coal and fuelwood for cooking also contributes significantly to air pollution on India. According to air quality surveys, the levels of sulphur dioxide and oxides of nitrogen in Indian ciities are well within prescribed limits, but the levels of particulate matter are on the higher side this is partly due to natural dusty conditions prevailing in India and partly due to high flyash emissions from power plants

The quantum of vehicular pollutants emitted is highest in Delhi followed by Mumbai, Bangalore, Kolcutta . Apart from the concentration of vehicles in urban areas, other reasons for increasing vehicular pollution are the types of engines used, age of vehicles, congested traffic, poor road conditions, and outdated automotive technologies and traffic management systems.

The country has fought hard to get breathing space and various strategies for control of air pollution in non-attainment cities and problem areas have been adopted by the Government of India

Industrial Pollution Control

(i) Identification of problem areas: Compliance with respective air standards has been continuously ascertained in 17 categories of highly polluting medium- and large-scale industries as their emissions are regularly monitored. Actions against defaulters are contemplated from time to time.

(ii) Emission standards evolved and notified under Environment (Protection) Act, 1986: Emission standards have been notified for a large number of industries while several others are under finalization.

(iii) Minimal National Standards: These standards have been prepared for highly polluting industries under The Air (Prevention and Control of pollution) Act, 1981 and Environmental (Protection) Act, 1986. 24

(iv) National Ambient Air Quality Standards: CPCB had first adopted NAAQS on 11 November 1982. They were revised on 1 April 1994

(v) Environmental auditing: The process of environment auditing has been initiated in highly polluting industries. The methodology has been standardized and finalized for espective industries.

(vi) Fuel quality specification: Recommendation of improvement of fuel quality and beneficiation of coal at pitheads has been notified and implemented.

(vii) Development of pollution prevention technologies: Industries are encouraged to use cleaner technologies and low waste or zero waste technologies to reduce waste generation and emissions of pollutants.

Vehicular Emission Norms:

(i) During 1990-91 India for the first time notified mass emission norms for vehicles at the manufacturing stage as well as for in-use vehicles.

(ii) Emission norms introduced in 1996 have been important in controlling vehicular pollution because of the stringency of emission norms along with fuel quality in 1996.

(iii) From April 1995 passenger cars were allowed to register only if they are fitted with a catalytic converter in four metros (Delhi, Mumbai, Kolkata and Chennai).

(v) More stringent norms were introduced for the year 2000. These norms were notified under the Motor Vehicle Rules during 1997.

(vi)In 2000 only private vehicles conforming to Euro-II equivalent, i.e., Bharat Stage-II norms were registered.

In Mumbai Euro-II norms for private vehicles (4-wheelers) were applicable from 2001. In Kolkata, India-2000 norms (Euro-I) have been made applicable from November 1999.

(vii) From 1 October 1999, emission norms for agricultural tractors were introduced throughout the country.

(viii) Bharat Stage-II norms for new 4-wheeler private noncommercial vehicles were introduced in Mumbai from January 2001, Kolkata and Chennai from July 2001 to 24 October 2001.

Fuel Quality Specifications

For the first time diesel and gasoline fuel quality with respect to environment related parameters has been notified under the EPA during April 1996.

Lubricants Quality

(i) Specifications of 2T oil for 2-stroke engine with respect to smoke have been notified under EPA during September 1998 for implementation from 1 April 1999 throughout the country.

(ii) Pre-mix 2T oil dispenser has been installed at all petrol filling stations in Delhi so that excessive oil is not being used by the vehicle owners. Sale of loose 2T oil has been banned from December 1998 in Delhi.

Alternative Fuels

(i) All government vehicles were required to compulsorily fit compressed natural gas (CNG) kit or catalytic converter by December 1996.

(ii) Emission norms for CNG/liquefied petroleum gas (LPG) vehicles notified.

(iii) Emission norms for diesel vehicles fitted with LPG engine notified and made effective from 1 May 2003.

(iv) So far more than 122 CNG filling stations for CNG driven vehicles have been installed in Delhi and about 22 CNG stations in Mumbai.

(v) More than 85,000 CNG vehicles (including autos, taxies and buses) are plying in Delhi. Only CNG buses are plying in Delhi from November 2002.

(vi) Customs duty on CNG kit has been exempted for promotion of CNG vehicles.

(vii) Emission norms for CNG vehicles have been notified under Motor Vehicles Rules

(viii) LPG is being used as alternate fuel for motor vehicles after making amendments in CMVR.

(ix) Battery-driven vehicles have been introduced in a few corridors in Delhi.

(x) Gasoline with 5 % ethanol to be supplied in sugar producing states of Maharashtra, Andhra Pradesh, Goa, Gujarat, Haryana, Karnataka, Tamil Nadu, Uttar Pradesh and Union Territories of Daman and Diu, Dadar and Nagar Haweli, Chandigarh, and Pondicherry from January 2003.

(xi) Bio-diesel specifications have been finalized. Some trial runs on bio-diesel have been completed.

Restriction of Grossly Polluting Vehicles

(i) Registration of new auto rickshaws with a conventional engine has been banned from May 1996 and Defense Service and government-auctioned vehicles from April 1998 in Delhi.

(ii) 20-year old commercial vehicles were phased out from October 1998, 17-year old commercial vehicles from November 1998 and 5- year old commercial vehicles from December 1998 in Delhi.

(iii) Registration of altered vehicles (by replacing petrol engine) with diesel has been banned from 1 April 1998 in Delhi.

Traffic Management

(i) Restriction has been imposed on goods vehicles during daytime from August 1999 in Delhi.

(ii) Left lane has been made exclusive to buses and other heavy motor vehicles in Delhi.

(iii) Time clocks have been installed in important red lights to enable drivers to switch off their vehicles depending on the time left in the time clocks.

(iv) Construction of more flyovers and subways and closing of T-junctions for better traffic flow.

Public Transport System

(i) Number of buses has been increased to discourage the use of individual vehicles to allow vehicles from the private sector vehicles to operate.

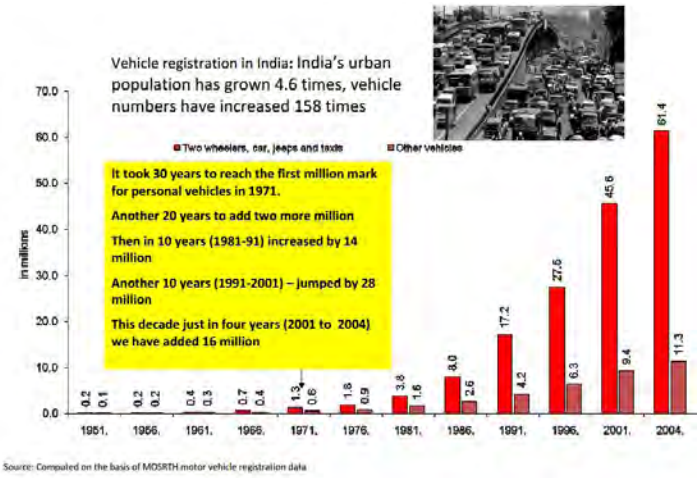
(ii) Metro Rail Project in Delhi has been completed and commissioned from December 2003.

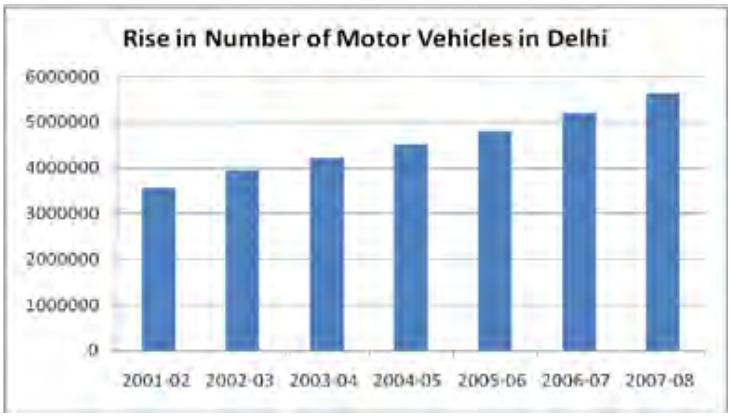
Awareness

(i) Messages/articles related to vehicular emissions are disseminated through newsletters, pamphlets, newspapers, magazines, television, radio, Internet, workshops and summer exhibitions.

(ii) Display of ambient air quality data through display system near ITO, newspapers, daily news and Internet.

(iii) NGOs working on vehicular pollution control are being encouraged for mass awareness campaigns.





Pakistan

Air quality in Urban Centers in Pakistan has degraded to an alarming level over the past two decades due to increased consumption of fuel and poorly controlled missions. The most serious and alarming issue is the presence of highly particulate matters in air. A study conducted by Pakistan EPA with the assistance of JICA in five cities namely Lahore, Faisalabad, Gujranwala, Rawalpindi and Islamabad revealed that the inhalable suspended particulate matter in the ambient air reached to 6-7 times higher than the WHO acceptable limits. The study further revealed that 40% effect of suspended particulate matter was due to vehicular emissions while the rest was due to industry and natural sources. Experts consider that 60-70% cause of urban air quality degradation in Pakistan is due to vehicle exhaust as the vehicle population in major cities has shown sharp increase over the years. In Pakistan 60-70% cause of the urban air quality degradation is due to vehicle exhaust. Vehicles population has shown a sharp increase over the years. Due to this presence of high suspended particulate matter in air, respiratory diseases, throat irrigation, eyesore are very common in many of the cities in Pakistan. Air pollution which leads to formation of haze and dense fog not only affect public health but also has immense impact on national economy too.

Pakistan Environmental Protection Council (PEPC) in February 2011 approved a National Environmental Action Plan(NEAP) for the country which identified clean air as one of the core program.

Under the NEAP five major sources of air pollution that needs to be addressed were identified. They are 1.) Emission from vehicles

2.) Emissions from Industry

3.) Burning of solid waste

4.) Natural dust/transboundery pollution.

Compared to the other economic sectors the Industrial sector in Pakistan is small in size however it is rapidly expanding due to the Government Policies. Majority of Cement, Fertilizer, sugar , Power plants and steel furnaces located in the vicinity of towns cause excessive air pollution. Brick kilns are another source of pollution in many cities.Use of low-grade coal and old tires in these generate dense black smoke and other kind of emissions.

Natural Dust/Transboundery Pollution

During the season of Summer the high temperature causes the fine dust to rise up with the hot air and form “dust clouds” and haze over many cities of Southern Panjab and upper Sindh. Dust storms are also generated from deserts such as Thal,Cholistan and Thar during the summer time.

Major Initiatives

The Ministry of Climate Change, Government of Pakistan in coordination with other Ministries introduced unleaded gasoline in the country, Reduction of Sulpher content from 1% to 0.6% in Diesel oil, Concessionary import duty on anti-pollution and recycling machinery, Conversion of 1.7 million vehicles on CNG .

Future programmes

1. Gradual exclusion of 2- Stroke and diesel run vehicles from the public service transport from urban centers.
2. Establishment of Environmental Squad of Traffic police in all major cities to control visible smoke.
3. Ban import and Local manufacturing of two stroke vehicles.
4. Restriction of conversion of vehicles from gasoline engine to second hand diesel engines.
5. Identify high pollution spots in major cities and introduce better traffic management plans.
6. Regular checking of quality of fuel and lubricating oils sold in the market.
7. Establish vehicle inspection centers with private/public partnerships.
8. Relocation of brick kilns and adoption of alternative technology for brick manufacturing industry.

Sri Lanka

Rapid Urbanization and growth over the last few decades has had a massive impact on the environment in Sri Lanka. Urbanization along with the growth in transport demand together with inadequate public transport and rapid motorization is also common problem in Sri Lanka as same as to most of the developing countries. Over the years there has been a rapid increase in the vehicle fleet over the country mainly due to importation of used vehicles. This together with high emission rates from many other vehicles has been associated with serious air pollution problems in many urban areas.

Main air pollutants in Sri Lanka include ground-level ozone, carbon monoxide, sulfur dioxide, nitrogen dioxide and particle pollution. In order to protect the health of the general public from each of these pollutants, National Ambient Air Quality Standards, regulation have been gazzetted under the National Environmental Act in 1994.

Major activities initiated by the Ministry of Environment to bring down the air pollution levels

- Use of leaded petrol was banned in 2002
- Reduction of the sulphur content of Auto Diesel from 1.0g/l to 0.5 g/l in 2005
- Drafting interim emission standards for specific industries
- Ratified Vienna Convention for the protection of the Ozone Layer and Montreal Protocol in 1989
- Ratified the UNFCCC in March 1999
- Ratified the Stockholm Convention in 2005
- Kyoto protocol

In response to the increasing air pollution, the Air Quality Management Centre was established in 2002 under the then Ministry of Forestry and Environment to coordinate air pollution mitigation activities. Some of the major activities initiated by this Centre were:

- The development of the National Policy on Air Quality Management, Gazetted Mobile Air Emissions, Fuel Quality and Vehicle Specification Standards for Importation, and the finalization of the "Clean Air 2007 Action Plan".
- To foster Vehicle Emission Reduction a plan for vehicle emission control was developed
- Standards on mobile air emissions were amended with fuel quality and vehicle specification for importation designed.
- Officers of the Traffic Police, CEA and Department of Measurements and Standards, and Technical Officers and Garage Mechanics were trained island wide on "Vehicle Emission Reduction of Motor Vehicles".
- Commencement of a major Awareness Creation programme commenced (newsletters, brochures, leaflets, posters, stickers and newspaper articles for the general public and vehicle owners)
- Establishment a web site (www.airmacsl.org) to disseminate information
- Two one-day international workshops on "Air That We Breath" were held that showcased local research.

IRAN

Iran is a country with a population of around 61.3 million of which 60% live in cities, Two thirds of Iran is either desert or mountains. And according to the World Health Organization's 2011 report on air quality and health, three of Iran's cities are among the world's 10 most polluted cities.

Tehran, the capital city of Iran, is the largest urban area of Iran with a population of 8,700,000. In 2011 The city also is ranked as one of the largest cities in Western Asia and 19th in the whole world. As in other large cities, Tehran is also faced with serious air quality problems. About 2,500 people in Tehran die annually because of health problems caused by pollution. Pollutants such as PM10, SO2, NO2, HC, O3 and CO are the major air pollutants in Tehran, about 80-85% of which is produced by mobile sources of pollution. The city has a capacity for 700,000 registered cars yet 3 million roam its streets on a daily basis. The low quality of gasoline and diesel used by local automobiles is partly responsible for the smog in Tehran, a situation that also occurs in other large Iranian cities including Isfahan, Mashhad and Tabriz. Domestically manufactured cars and their ineffective combustion systems account for as much as 80 percent of Tehran’s air pollution rather than the poor quality of the locally produced fuel, Most cars use leaded gas and lack emissions control equipment.

The World Bank estimates losses inflicted on Iran's economy as a result of deaths caused by air pollution at $640 million, which is equal to 5.1 trillion rials or 0.57 percent of GDP. Diseases resulting from air pollution are inflicting losses estimated at $260 million per year or 2.1 trillion rials or 0.23 percent of the GDP on Iran's economy.

With the location of 35° 41' N - 51° 25' E and altitude of 1000–1800 meters above mean sea level, Tehran is located in valleys and is surrounded on the north, northwest, east and southeast by high to medium high (3800–1000 m) mountain ranges. The mountain range stops the flow of the humid wind to the main capital and prevents the polluted air from being carried away from the city. Thus, during winter, the lack of wind and cold air causes the polluted air to be trapped within the city. Dust storms originating from neighboring Arab countries also increase the air pollution in the capital. The dust storms descend on Iran from the deserts and dried-up ponds of Iraq and Saudi Arabia. Many ponds which were once located in the arid and desert regions stretching from the eastern shores of the Mediterranean Sea to Iran have gone dry over the years. This ongoing desertification process has greatly increased the number of dust storms in the region, and every year heavy dust storms envelope more than half of Iran.

Rising incidence of respiratory illnesses prompted the city governments of Tehran and Arak, southwest of the capital, to institute air pollution control programs. These programs aim to reduce gradually the amount of harmful chemicals released into the atmosphere.

- ***Awareness:***

  The people of Tehran have been made aware of environmental problems in the city and agreed that counter measures are needed.

- ***Policies and measures:***

  Iran made significant progress in improving the quality of air by reducing emissions and traffic. Improving public transport, parking, and green zones

- Tehran Municipality has converted more than 1,500 diesel-fuelled buses to Compressed Natural Gas (CNG).

- Mandatory emission inspection and control programs for motor vehicles permitted to enter the city's Restricted Traffic Zone (RTZ) has been enforced.
- The Restricted Traffic Zone (RTZ) were established in 1983 to reduce traffic in the city Centre.
- Lanes have been specifically designated for buses. As a result, urban bus services, including ridership and average trip time, have increased
- A Park and Ride facility with a capacity of 200 cars has also increased bus ridership.
- Development of Green space to filter air

  The air pollution problem has put the development of green space on the list of priorities for Tehran. Since 1989, the green space per person has increased from 2.5 square meters to 10 square meters in 1993.

Nomenclature

Abbreviations

BC	- black carbon
CLRTAP	- Convention on Long-Range Transboundary Air Pollution
CO	- carbon monoxide
EMEP	- European Monitoring and Evaluation Program
HTAP	- Hemispheric Transport of Air Pollution
LRT	- long-range transport
NH_3	- ammonia
NMVOC	- non methane volatile organic compound
NO_x	- nitrogen oxide
O_3	- ozone
PFC	-policy failure case
PM	- particulate matter
$PM_{2.5}$	-particulate matter 2.5
POP	- persistent organic pollutant
PSC	- policy success case
REAS	-Regional Emission Inventory in Asia
REF	- reference case
S/R	- source–receptor
SO_2	-sulfur dioxide
TF-HTAP	- Task Force on Hemispheric Transport of Air Pollution
VOC	-volatile organic compound