

Air Pollution in Kathmandu Valley

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General Introduction of Kathmandu Metropolitan City

Kathmandu, the Capital City of the Kingdom of Nepal, is the only metropolis in the Country. The city is situated in a valley at an altitude of 1,350 meters. Kathmandu experiences all four seasons with the maximum temperature of 32°C in summer and minimum temperature of 0°C in winter. Average rainfall is 1,307mm per year with 90% of the precipitation occurring during the four months of June to September. The City is spread over an area of 50,67sq. Km and can be broadly divided into three sectors; historic city core, the city centre, and the city outer ring. Administratively, the City has been divided into 35 wards.

Population

Due to economic opportunities, facilities and urban glamour, Kathmandu is the centre of attraction for people from all over the country as well as neighbouring country India. At present the population of Kathmandu Metropolitan city is estimated to be about 701,962 according to Census 2001.

City key indicators

Country	-	Nepal
Capital	-	Kathmandu
Longitude	-	85°20'East
Latitude	-	27°42'North
Elevation	-	1350m
City area	-	5067 ha (50,67 sq km)
Household	-	1716912
Average household size	-	5,2 (persons)
Main Rivers	-	Bagmati, Bishnumati
City road network	-	219.5 km
National Highway	-	17 km
District road	-	9.7 km
Urban road	-	273 km
Major industry	-	Tourism, Handicrafts, garments & cottage industries

Administration Structure of Kathmandu Metropolitan city office

There are 58 Municipalities in Nepal. KMC is the only Metropolitan City in Nepal. The Mayor who is directly elected by the people for a period of five years, heads the KMC, and Deputy Mayor, a ward Chairperson, four ward members and a woman member from each ward are also elected directly.

KMC has the following departments to run the institution and deliver urban service to the people in the city.

- **Environment Department** responsible for improving urban environment through solid waste management, pollution control and greenery promotion.
- **Enforcement Department** responsible for regulating and implementing activities in conformity with provision of the acts.
- **Administration Department** responsible for administrative affairs of KMC office.
- **Finance Department** responsible for financial management.
- **Heritage Department** responsible for heritage conservation and promotion of tourism.
- **Law and Litigation Department** responsible for matters relating to law and litigation.
- **Revenue Department** responsible for resource mobilization.
- **Public Work Department** responsible for the development and maintenance of urban infrastructures.
- **Urban Development Department** responsible for planning aspects of urban areas and building permission.
- **Social Welfare Department** responsible for community development.
- **Public Health Department** responsible for delivering primary health services to the people and educating them on different aspect of health and hygiene the citizens.
- **Information and Communication Department** responsible for disseminating information related to urban management and people's concern.
- **Protocol & Liaison Secretariat** responsible for dealing with international affairs of KMC and public relations.
- **City Planning Commission (CPC) responsible** for providing advisory supports in determining implementation process as well as formulating long-term and short-term plans necessary for providing urban services and facilities.

Financial Structure

Year	Total Exp.	Environment Department	Income (Gov.)	Income Others (Int. Donors)	Income (SWM services)
2000	App. US\$ 6,500,000	App. US\$ 2,000,000	App. US\$ 3,100,000	App. US\$ 3,400,000	App. US\$ 72,000
2001	App. US\$ 5,200,000	App. US\$ 2,000,000	App. US\$ 3,100,000	App. US\$ 2,100,000	App. US\$ 72,000

Air Pollution in Kathmandu Valley

Air pollution inside Kathmandu valley is a burning problem and its history is not so long. The history of air pollution can be identified with the development of road networks and different types of automobile. The air pollution in Kathmandu's is the high concentration of particulate matter. Total Suspended Particulate (TSP) is the main cause of air pollution in the valley. In the winter reason effect of pollution is more serious, because during the night cooling of atmosphere cause the formation of the inversion layer which act as lid to trap pollution.

Number of brick kilns (2000 currently) in the valley increase by 200 percent between 1980 and 1990. 96 percent of the kilns are Bull's trench kilns, which are energy inefficient and produce significant amount of pollutants. Main cause is that these industries burn low quality coal and tires.

Cause of Air Pollution

The main cause of air pollution inside the valley is anthropogenic sources more than by the natural sources. Most of the pollution is related with human activities as fuel burning, stone grinding factories, brick factories, and unmentioned roads. Among them, automobiles are the main source of air pollution inside the Kathmandu valley, which emits the carbon monoxide hydrocarbons, and nitrogen oxide. The automobile exhaust such as lead gas and black dust is very dangerous for human health. In 2001, total annual PM10 and total suspended particles (TSP) load in Kathmandu valley is app. 7500 and app. 2000 tons respectively, which inventory were conducted by Environment Sector Programme Support (ESPS). It is higher than a previous inventory, which was done by World Bank in 1997. At that time an annual load was estimated to be 4712 and 16575 tons for PM10 and TSP respectively. According to an inventory conducted of the PM10, but the recent inventory indicates that 67 percent of the PM10 is contributes by the vehicle emission in Kathmandu valley.

Vehicles

Air pollution from automobiles are the complex function of fuel characteristics, extent of combustion, reactions with other gases and atmospheric condition. The rapidly increasing vehicular traffic in the valley is a major contributor to air pollution in Kathmandu valley. It is mainly because of the large number of vehicles on congested streets, poor quality fuel and weakness in the emission controlling system. According to 2002, Department of Transport Management (DOTM) estimated that around 198667 vehicles were registered in Bagmati Zone. Most vehicles in Kathmandu have old engines, (more than 15 years old); are not well maintained. In 1992, there were only 325 kilometres of motor-able road in the Kathmandu valley, of which 150 kilometres were considered to be in poor condition. It is causing serious problem of traffic congestion and air pollution.

Table 1
Total number of vehicles registered in Bagmati zone over last six years.

Vehicle type	1996/97	1997/1998	1998/1999	1999/00	2000/01	2001/02
Tractor	1672	1672	1672	1672	1673	1673
2-wheeler	58029	64142	71612	94217	112000	134852
3- wheeler	3844	3925	4262	4778	4949	5073
Car/Jeep/Van	27153	28915	30919	35993	40674	43409
Tanker/Truck	4483	4759	4811	5295	5484	6274
Mini bus	1468	1500	1527	1610	1804	2172
Bus	1163	1298	1403	1632	1744	1858
Other	3020	3278	3311	3338	3350	3356
Total	100831	109489	117836	148535	171678	198667

According to: Department of Transport and management (2002)

Table 1 shows the total number of vehicles registered in Bagmati Zone, which are mainly running within Kathmandu valley over the last six years.

Industries

There are several industries in the valley, in particular Himal Cement factory uses old cement production technology is now closed. Ever since it was established it was considered to be a major contributor to the amount of suspended particulates in the valley. In 1998, about 150 brick kilns were estimated to be in operation in the Kathmandu valley. Smoke emission from these kilns are strongly high during the major brick production season from November to May. In the driest months the effects of air pollution are very high. There is no special exhaust system in these kilns. Therefore smoke, ash particles and brick dust are directly released into the atmosphere. As the brick manufacturing process in bull's trench and clamp kiln is very poor and inefficient, the amount of smoke spewing from these kilns is very high.

Households and other Factors

The majority of households in Kathmandu still use biomass. Specially, firewood for cooking and heating, but some households have started cook with LPG gas. However, these kinds of gas are only use by high income families. In addition, the solid waste in the valley is regularly burned in an attempt to destroy waste at source. Lack of dust control mechanisms during the construction of buildings and small industrial also contribute to air pollution. The releases from all these sources have created a high level of air pollution in the Kathmandu valley.

Effect of Air Pollution

Directly and indirectly people of Kathmandu valley are facing the various problems caused by the air pollution. The main effects are as follows.

- a. Reduction of solar radiation.
- b. Fog.
- c. Human Health
- d. Acid rain.
- e. Ozone layer depletion.
- f. Effect of plants and animals.
- g. Reduction of visibility.

All of the above points are directly or indirectly related with the human health hazards and serious problems due to air polluting. Respiratory disease, blood cancer, eye problem, skin problems, hair problems and nasal problems are increasing day by day. Other problem may also arise due to vehicular exhaust, which cause convulsion. Brain damage and even death. Similarly, the presence of nickel particles in diesel oil, tobacco smoke may cause lung cancer. The pollution is deteriorating the human health by various ways. Air pollution in Kathmandu is also causing damage to many historical building that represent the cultural heritage of the Kathmandu valley. Acid for made as a result of various sulphurous and nitrous oxides reacting with water can damage fine wood carving, marble and metallic exteriors common to many historical building in Kathmandu. Air pollution also has a negative impact on the local environment and ecology, with acid rain resulting from pollution being detrimental to plant and animal life.

Impact on Visibility

The number of good visibility days recorder in 70s is 155 days from Nov. to Feb. Now it has decreased from 155 to 20 days.

Air Pollution Management

The Kathmandu valley is experiencing many environmental problems stemming from unplanned growth. As the country's capital, Kathmandu is suffering from the affects of air pollution. There have been some efforts for the air quality management. Government and different organizations have been involved in these efforts.

His Majesty's Government of Nepal (HMG)

HMG has introduced several policies to control air pollution in the Kathmandu valley. The government has taken steps to mitigate air pollution in the valley. In a cabinet decision in November 1991 the government banned diesel operated three-wheeler, popularly known as Vikram Tempos, from the streets of Kathmandu. These 12 seats three-wheeler are also the main cause of air pollution in Kathmandu. The Department of transport has set the threshold of exhaust for Diesel Vehicles at 65 HSU (Hetridge Smoke Unit) and 3 percent Co for petrol

operated vehicles in Kathmandu. In 1995 HMG established the ministry of population and environment (MOPE). MOPE introduced the Nepal Vehicular Mass Emission – 2056 for new vehicles in December 1999, which is equal to the European Emission Standard -1. Since 1999 HMG has banned the import of new two-stroke vehicles.

MOPE has initiated a program of testing vehicle emission (Table 2).

Table 2
Emission Standard for In-use vehicles in Nepal.

For Gasoline vehicles	Permissible Smoke until (Co in %)
Up to 1980 manufactured fore-wheeler vehicle	4,5
1981 and later manufactured vehicle	3,0
Up to 1991 manufactured three-wheeler vehicle	4,5
For Two-wheeler vehicle	4,5
For diesel Vehicles	Hetridge Smoke Unit (HSU)
Up to 1994 manufacture all types of vehicles	75
1995 and after manufactured vehicles	65

Source: MOPE 1998

Table 3
Vehicle Emission Test Result (Co test for Petrol and HSU for diesel Engine)

Year	Pass	Fail	Total vehicle Tested
1995/96	162	324	486
1996/97	25220	16246	41466
1997/98	24240	8189	31173
1998/99	34255	3778	28018
1999/2000	26669	8571	42826
2000/2001	13823	5154	31823
Total	133530	42262	175792

Source: Kathmandu valley traffic police, 2001

HMG has already announced to stop the registration of Bull's trench kilns in Kathmandu valley.

Kathmandu Metropolitan City (KMC)

KMC realizes the seriousness of air pollution in Kathmandu and is committed to take effective action to improve air quality in Kathmandu. KMC's vision is a city where citizen can breath clean fresh air. KMC has stepped up to lunch an air quality-monitoring program with partnership of local organizations. KMC will monitor vehicular emission together with traffic police, air quality monitoring, and make people aware of seriousness of the problem.

KMC is going to take an active role regarding air quality of the city. It has established an environment Department in 1998, which will be primarily responsible for implementing programs like monitoring, advocacy, water treatment, reduce air pollution and public awareness.

Adoption of clean vehicle emission standard will be one of the goals of KMC. To implement this, KMC will encourage people to use electric vehicle and bicycle. KMC is preparing a separate 1,3 km bicycle lane in line with its aim to prepare a large bicycle lane network in Kathmandu to promote this environment friendly technology. KMC has its own FM radio station and TV Programme for the general public to crate awareness on urban environment and other issues of concern. KMC has signed MOU with ESPS/MOPE to establishment and operation of two permanent air quality monitoring station situated in Kathmandu. KMC has already provided necessary space to installed the monitoring equipment and system.

KMC's clean air strategy.

There are various types of work in KMC, but has been working on following areas.

- Awareness among citizen on issues related air quality and pollution control, and changing people behaviours.
- Regular monitoring the vehicular emission and air quality in various areas of the city.
- Promote conservation and management of open spaces and greenery in the city.
- Take an active role in bringing unleaded gasoline in the country.
- Encourage the use of electric vehicles and use of mass transportation.

Private Sector Initiation

There are some private companies are also involved in Kathmandu's air pollution. Kathmandu Electric Vehicles Alliance (KEVA), which has been formed by government, non-government (NGO) and private partners to improve the air quality of Kathmandu. KEVA is supported by USAID/Nepal under Asia and Near East Bureau's clean air Initiative and the Alliance Partners. The Alliance brings new ideas, partners, new technologies. KEVA will work with KMC and National Government, donors and other groups to identify and eliminate constraints to the expansion of the electric- based mass transit and to promote the spread of electric vehicle operation system and technologies. Electric vehicles are very good means for reducing air pollution as they virtually emit Zero pollutants.

KEVA's target is reduction in air pollution through expansion of electric vehicle (EV) use in Kathmandu by:

- Encouraging expansion of Electric tempos and trolleys.
- Improving the EV industry in Nepal.
- Identifying and designing new ways to expand electric- based transportation.

Electric Vehicle Association of Nepal (EVAN) is involved in advocacy, research and public education to promote electric vehicles. Some private companies are also involved in managing urban greenery and building bus stops to manage public transportation.

National / International Organizations

There are some non-governmental organizations (NGO) involved in public awareness, research, advocacy work related to air pollution control. Himalayan light foundation (HLF) is being involved in pilot project and recently developed a four-wheeler electric vehicle. Environment and public health organization Environment and Public Health Organization (ENPHO), has been involved in air quality monitoring and research.

MOPE and DANIDA supported project ESPS are working in air pollution monitoring and research work. ESPS is work for the promotion of electric vehicle in Kathmandu valley. Vehicle Anti – Pollution Programme (VAPP) of ESPS is working on engine maintenance and had established a vehicles engine emission and maintenance-training centre.

Conclusions

It is not to easy control the air pollution directly in Kathmandu valley. Due to un-management urban development, infrastructure, a growing number of vehicles, polluting industries and pollution growth, Kathmandu's air is getting dirtier day by day. The concentration of particulate mater in the ambient air is already several times higher than WHO guidelines and this is increasing. Kathmandu is highly susceptible to air pollution due to the bowling effect and the problem is more sever in winter due to thermal inversion. Kathmandu should treated be treated in a different way keeping the view of its susceptibility to air pollution and human health damage, and more efforts are required to control Kathmandu air pollution.

There have been different policies regarding the control of Kathmandu's air pollution. In the days ahead more work needs to be done in the following areas;

- The quality of gas discharge from industries should be controlled and regular operation and maintenance in essentials.
- The number of vehicles should be reduced and traffic management should be effective.
- Promote the use of electric vehicles.
- Industrial process should be modified and new equipment should be applied.

- Improve the vehicle inspection and maintenance system.
- Improve the road condition in Kathmandu.
- The controlling system should be implemented to fuel pump station with the help of Nepal Oil Corporation and KMC.
- Facilitate the use of non-motorized vehicles.
- Improve in fuel quality.
- Alternative energy sources, which are more efficient, less polluting, and cost effectiveness should be promoted to replace. E.g. use of methane gas from landfill site to brick industries.
- Continuous ambient air quality monitoring and set up standards for local level.

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