

TRANSPORT SECTOR TECHNICAL INSPECTION SYSTEM IN NEPAL

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ABSTRACT

Air pollution is increasing in urban areas of Nepal, and the major source of this problem is transport sector. Number of vehicles increases at the rate of over 10 percent per year. Nepal distributes unleaded petroleum all over the country but there are records of adulterated fuel supply by dealers thus making the condition worst. Nepal has set vehicular emission standards of CO, HC and smoke. In general 23% vehicles emitted more than the standard fixed. Maintenance of vehicles and monitoring systems are relatively unsatisfactory, asking to aware people about traffic norms, maintenance of vehicles and quality of fuel. An inspection on road and air quality monitoring programmes should be launched by the government.

INTRODUCTION

The Himalayan kingdom, Nepal is known for its exquisite environment, majestic mountains, lusting rivers, and an attractive destination for tourists. Development activities have brought some undesirable changes in the physical environment, particularly air quality in urban areas has degraded. Major root causes of the degradation are: unplanned urbanization, pollution-prone industries, increasing number of uncontrolled polluting vehicles, poor quality of roads, lack of sound environmental policy, etc. His Majesty's Government of Nepal and several non-governmental agencies have taken it seriously in the last few years. The present paper is aimed to highlight programmes, achievements and issues of air pollution due to transport sector, and discuss technical inspection and maintenance system of transport sector in Nepal.

Nepal is a developing country in South Asia holding 129th position in the human development index (HDI). Though the development activities started after 1950, development accelerated after a political change in 1990.

TRANSPORT SYSTEM IN NEPAL

There are two major modes of transport in Nepal: (i) road and (ii) aircraft. There is a small sector (51 km) of railways in Nepal and no waterways.

Road construction was given top priority during 1956-1970, and thereafter government is giving high priority to this sector. In 1951, the total length of roads was 276 km, which increased to 15,905 km (4617 blacktop roads, 3959 gravelled roads, 7329 erthen roads) by 2001 (Table 1). Thus, road accessibility increased from 0.47 km to 6.85 km per ten thousand population in Nepal in the last five decades. Being a mountainous country (87 percent of land has mountain topography), road construction is difficult and expensive in mountains. Lowland (Terai) has the highest mileage (54%) of black topped and gravelled (65.85%) roads. The mountain region above 3000 m has only 147 km of black topped, 158 km of gravelled and 145 km of earthen roads.

Three administrative districts (Kathmandu, Lalitpur and Bhaktapur) of Kathmandu valley have 702 km of black topped, 290 km gravelled road and 327 km of earthen roads, totalling 1319 km (8.3% of total roads of Nepal). Nepal has 2974 km of national highways. Over 10546 buses, 2961 mini buses, 21580 trucks/tankers, 23991 tractors, 6934 tempos, 59115 cars/jeeps/vans, 176476 motorcycles, and 3792 other vehicles run on these roads. The main public transport organisation (Sajha Yatayat) for passenger movement was established in 1961 under the Japanese grant. A 13 km Trolley bus service (through Nepal Transport Corporation) was developed in 1975 in Kathmandu valley with the Chinese assistance.

The railway was the first mode of modern transport installed in 1935, but it remains the most neglected sector. A 51 km narrow gauge railway still run between Janakpur-Jayanagar in Terai.

A 42 km rope way was developed in 1964 between Hetauda and Kathmandu for transport of goods. Recently, this ropeway has been closed by the government.

The first aircraft landed in Kathmandu in April 1949, and domestic flights started in 1951. Now, Nepal has one international airport at Kathmandu and 42 domestic airports (total 43 airports).

VEHICLES

The first vehicle was imported in Nepal some eighty years ago. Number of vehicles registered in Nepal reached to 305395 in middle of 2001 (Fig. 1), and 56.21% of these vehicles ply on the roads of Nepal, particularly in Kathmandu valley (Table 1). Out of these 11000 vehicles running on the roads of Nepal are older than twenty years. There are 176476 motorcycles, sharing 57.78% of the total number of vehicles, followed by car/jeeps/vans (19.35%) and tractors (7.85%) (Table 2). The annual growth rate of vehicles in the last 12 years ranged from 10.66% to 16.45% (average 13.43%). In the fiscal year 2000-2001, the highest number of vehicles (40995 vehicles) were registered in Nepal (Figs. 2 and 3). It is to be noted that.

TRAFFIC SYSTEM

The first traffic concept emerged in Nepal in 1944 for Kathmandu valley. With the increase in vehicles and traffic pressure, Nepal formed the Transport Act in 1963. In 1992, the old act was replaced by the Vehicle and Transport Management Act covering major issues related to traffic. Besides managing traffic, the Traffic Police runs several programmes including awareness campaign, paid parking system, documentation, etc. In Kathmandu, parking fee system has been introduced on 17 sectors since April 1995. In Kathmandu, traffic management system includes automatic signalling at several crossroads, one way traffic, prohibition of movement of trucks and tractors during peak traffic time on congested roads, mobile traffic patrolling, inspection of driving license and vehicle condition, etc. Traffic density has increased remarkably in different zones of Nepal during 1995-2001 (Table 3).

AIR POLLUTION

Air quality in urban areas of Nepal has deteriorated in the last one decade, particularly quantity of particulate matter has been found very high generally ranging between 500 to 1000 $\mu\text{g}/\text{m}^3$ at heavy traffic sites. SO_2 , NO_x , O_3 and Pb concentrations have been recorded at different sites in Kathmandu (Table 4). SO_2 , NO_x and O_3 have been found to cross the WHO standard at heavy traffic sites. Karmacharya and Shrestha (1993) reported SO_2 , NO_x and Pb concentration higher than WHO standard in central part of Kathmandu. Silwal et al 2001 reported gaseous concentration of NO_x , SO_2 and O_3 upto 60 ppb in general, but NO_x and O_3 reached upto 180 and 155 ppb in January and April at heavy traffic sites in Kathmandu valley. Leaders Nepal (1999) analysed Pb concentration in air of Kathmandu, Nepalgunj and Biratnagar, and recorded Pb range between 0.31 to 0.69 $\mu\text{g}/\text{m}^3$.

ENVIRONMENTAL POLICY

For the first time, a national level policy on environment management was incorporated in the seventh five year plan (1985-90). The eighth five year plan (1992-97) emphasized on Environment Impact Assessment. The Environment Protection Council was formed by the HMG Nepal under the Chairmanship of Prime Minister, in 1992, and Nepal Environmental Policies and Action Plans (NEPAP) was endorsed by the HMG Nepal in 1993. Political parties also included environmental issues in their election manifesto. Nepal enacted Environment Protection Act (EPA) in 1996, Environment Protection Rules (EPR) in 1997, and first amendment of EPR in 1999. The EPA covers pollution control, formation of environment protection council, provision of environmental inspectors to inspect and report on the implementation status of desired environmental condition. The ninth five year plan (1997-2002) gives continuity to pollution control programme and implementation of environmental standards and involvement of NGOs in environmental education. However, there is no comprehensive national policy on environment in Nepal. The Ministry of Population and Environment is working on a national policy on environment expected to be complete by the year 2002, and other tools would be tuned according this policy.

TRANSPORT POLICY

There is no national policy on transport, but the Department of Transport Management of HMG Nepal has been working on this important document. At present, transportation sector is guided by the Vehicle and Transport Management Act 1992. This act talks to prevent pollution of noise and smoke emitted from a vehicle, empowers to prescribe standards for the examination of vehicles, empowers to refuse to register vehicles, prohibits smoking in public vehicles, and empowered authority to punish those who violate traffic and transport rules. There is no speed limit of vehicles fixed by the government. The HMG Nepal has prohibited registration or transfer of ownership of 20 year old vehicles in Nepal since February 19, 2000, and has banned the import of reconditioned and second hand vehicles. Government has given economic incentives to three wheeler owners who intends to import 10 to 14 seated microbus which has less polluting alternative energy, such as compressed natural gas or liquefied natural gas, are provided with 99% tax exemption and full VAT exemption

VEHICULAR POLLUTION CONTROL PROGRAMME

His Majesty's Government of Nepal has taken the following steps to control vehicular pollution:

- The first time in 1993, vehicles were tested to determine polluting emissions under the Kathmandu Valley Vehicle Emission Project, funded by UNDP, Nepal.
- Conversion of diesel operated three wheeler vehicles into electrical charge battery system was introduced in 1994. At present, there are over 800 electric battery or LPG operated vehicles in Kathmandu valley.
- Since 1996, vehicles in Kathmandu valley have been tested for emissions. All vehicles (three and four wheelers) which ply in Kathmandu valley must have the compliance certificate.
- Lead free gasoline was introduced in Kathmandu valley in July 1997, and since December 26, 1999 only unleaded gasoline is distributed in Nepal.
- The government has banned diesel operated three wheelers in Kathmandu valley, Pokhara and Lumbini, since September 1999. (Later on from July 2001 government resolved to ban movement of these vehicles in other municipalities in Nepal but could not implement the decision).
- The government has banned the registration of new two stroke engine vehicles in Kathmandu.
- The government resolved on November 10, 1999 to ban movement of vehicles older than twenty years and all three wheelers and two stroke engines from valley beginning middle of November 2001. (This decision is also not implemented by the government as there was protest by the vehicle owners).

- Nepal has introduced Nepal Vehicle Mass Emission Standards Act since December 23, 1999. These standards are similar to EURO 1, and comprise levels of nitrogen with provision for type approval and conformity of production of the vehicles.
- Since February 19, 2000, the government has prohibited movement of government, corporation and the diplomatic mission owned vehicles in eight sectors in Kathmandu valley, which do not comply with the standards prescribed by the government.

FUEL CONSUMPTION AND PROPERTY

Energy consumption in Nepal is very less compared to developed countries. Per capita commercial and total energy consumption in Nepal was 1 and 14 GJ, respectively in 1995, while the global average was 60 and 65, and USA's per capita commercial and total energy consumption was 331 and 346 GJ, respectively (Mishra 1998). Of the total energy used 88 percent is met from traditional sources and remaining 12 percent (8.53% petroleum fuel, 2.37% coal and 1.11% electricity) from commercial sources (Jha et al 2001).

It has been recorded that the proportion of consumption of commercial energy has been increasing 3 to 4 percent every year and there is a decline in consumption of traditional energy. The sectoral distribution of energy consumption pattern in Nepal shows that 90% of the total energy is used in the residential sector or for domestic use, 4.2% in industrial sector, 2.9% in transport sector, 1.2% in commercial sector, and 0.2% in agricultural sector. The transport, commercial and industrial sectors are mostly dependent on imported commercial fossil fuels (Jha et al 2001).

Although the imported fossil fuels represent only a small fraction of total energy sources, the country spent a total of US \$ 110 and 154 million for import of fossil fuel in the year 1996/97 and 1997/98, respectively (HMG 1998). Nepal spent 40 percent of total merchandise export as a cost of petroleum products. Nepal sold 295389 kilolitre of fossil fuel (gasoline) in 1990-91 which increased to 784919 kl in 1999-2000 (Fig. 4). Out of the total consumption in Nepal, 79% of gasoline and 27% of diesel is consumed in Kathmandu valley.

Nepal supplies unleaded gasoline with Octane number 88 and sulphur content 0.1% on weight basis. Cetene number of diesel oil is 48 and sulphur content is 0.25% on weight basis.

There is a general complain that petrol and diesel supplied to consumer by dealers is adulterated (Himal 1999, Nepal Times 2001). The authority of Nepal Oil Corporation says that they maintain the quality, but due to great price difference in kerosene, diesel and petrol, dealers (1600 dealers in Nepal) adulterate diesel and petrol with kerosene (price of kerosene, diesel and petrol in Nepali Rupees: 17 Rs. (0.22 US\$), 26.50 Rs. (0.39 US\$) and 46 Rs. (0.60 US\$) per litre.

EMISSION STANDARD AND INSPECTION SYSTEM

In January 1998, HMG Nepal specified standards for CO and smoke emissions from petrol and diesel vehicles, respectively. In October 2000, HMG Nepal set the standard for emission of hydrocarbon for petrol and gas operated vehicles (Table 5). Hydrocarbon testing of vehicle emission has started from March 2001.

There are three stations to test vehicular emissions, two stations under the control of traffic police test old vehicles, and one under Department of Transport Management tests new vehicles prior to registration. In the beginning emission test was free, but for the last one year a nominal fee (Rs. 20 for motorcycles and Rs. 35 for three and four wheelers) has been charged from the vehicle owners. New vehicles generally meet the standard fixed. Vehicle emission tests of 202529 old vehicles between June 1996 to June 2001 revealed that 23 percent vehicles did not comply the standard (Tables 6 and 7). There was gradual increase in quantity of pollutants till 1995, but a little decrease was estimated in 1996 (Fig. 5). It was estimated by ICIMOD (2001) that transport sector contributed about 20.6% in the year 1996 (Fig. 6). Eighty five percent of diesel tempo (three wheeler) failed, followed by 77% vans, 61% trucks, 53% mini

trucks and 32.5% buses. The efficiency of vehicle emission testing instruments has also been questioned now as 240% more vehicles are failing after testing with new instrument (Boch, France) has started. Vehicular emission inspection is not generally done on roads (occasionally testing on roads done). Environmentalists are asking for inspection on roads, as several vehicle owners temporarily adjust their engine to pass the test. The vehicles are required to get a green sticker from the traffic police and renew it at an interval of six months.

The Ministry of Population and Environment has programme to establish a "Valley Air Quality Measuring Centre" by 2002. The proposed centre would measure air quality (TSP, PM₁₀, CO, NO_x, SO₂) at eight stations and publish daily air pollution index.

MAINTENANCE SYSTEM

Maintenance system of vehicle is not very sound in Nepal. There are 744 workshops and driving institute registered in Nepal, and several times more workshops and driving institutes are operating without registration. Most of these workshops are run mostly by persons who do not have proper education and training. There are hardly two dozen authorized workshops in Nepal. As a result, vehicles remain in poor condition. Poor quality roads, less qualified technicians, and adulterated gasoline worsen the condition of vehicles and result in accidents and air pollution. There were 2055 cases of vehicle accidents and 124 people died in 2000-2001. There are courses on automobiles offered by the Institute of Engineering, Tribhuvan University, but these diploma (3 year course) or degree (4 year course after higher secondary) holders prefer white collar jobs.

NECESSARY POLICIES AND ACTIONS

Vehicles contribute about 60% air pollutant to the environment of Kathmandu. To minimize and prevent air pollution by vehicles, government should: develop soon transport policy. The policy should include inspection of vehicles, maintenance, inspection of vehicles on roads, vehicle speed, monitoring, energy saving policy, etc.

- Inspection of vehicles on roads for emission level is required, as several vehicles entering Kathmandu valley violate the emission standards.
- An urgency of air quality measuring centre is realised. Because of bowl shape topography of Kathmandu valley, pollution scenario becomes alarming.
- Nepal has set standard for three pollutants (CO, HC and smoke). There are other pollutants that also need to be measured and their standard should be set. In this concern, immediate initiative should be taken to set standard for PM₁₀, Pb, SO₂ and NO₂.
- Fuel used in vehicles are adulterated by the dealers, thus emitting more pollutants and deteriorates condition of vehicles. One of the measures that can discourage adulteration is fuel pricing. There is remarkable difference in price of kerosene, diesel and petrol. If price of kerosene is brought near to diesel, adulteration rate would go down (kerosene is subsidized by the government).
- A comprehensive environment action plan would help in over all management.

CONCLUSION

Air quality in urban areas has deteriorated in the last one decade. Government has taken some important steps to prevent vehicular emissions, and some success has also been recorded. The government has plans to minimise air pollution. To implement these plans, Nepal should strengthen the institutions, show firm commitment and develop human resources. International support is also required to establish monitoring stations and strengthening institutes.

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Table 1. Number of vehicles in different zones in Nepal upto July 15, 2001.

Zones	Roads		Vehicles	
	Length (Km)	Percentage	Numbers	Percentage
Bagmati	2503	15.73	171678	56.21
Narayani	2022	12.71	52856	17.30
Lumbini	1526	9.59	19716	6.45
Koshi	1442	9.06	19674	6.44
Gandaki	1094	6.87	13987	4.58
Janakpur	1818	11.43	6782	2.22
Bheri	1144	7.19	6997	2.29
Mechi	1157	7.27	3767	1.23
Sagarmatha	811	5.09	2971	0.97
Seti	702	4.41	4154	1.36
Mahakali	635	3.99	1434	0.47
Rapti	962	6.05	1379	0.45
Dhaulagiri	89	0.56	-	-
Total	15905	100	305395	100

Table 2. Number of vehicles (by type) registered in Nepal upto July 15, 2001.

Type of Vehicles	No. of Vehicles	Percentage
Bus	10546	3.45
Minibus	2961	0.97
Truck/Tanker	21580	7.07
Car/Jeep/Van	59115	19.35
Tempo	6934	2.27
Motorcycle	176476	57.78
Tractor	23991	7.85
Other	3792	1.24
Total	305395	100

Table 3. Traffic density in different zones of Nepal in 1995 and 2001.

Administrative zones	Traffic density per len of road		Change (%)
	1995	2001	
Mechi	2.00	13.25	62.5
Koshi	9.31	13.64	46.50
Sagarmatha	2.86	3.66	27.97
Janakpur	3.75	3.73	-0.53
Bagmati	51.04	68.60	34.40
Narayani	19.15	26.14	36.50
Gandaki	9.07	12.80	41.12
Lumbini	7.20	12.90	79.16
Rapti	1.21	1.43	18.18
Bheri	3.53	6.11	73.08
Seti	2.37	5.91	149.36
Mahakali	1.77	2.25	27.11
Nepal	13.83	19.20	38.82

Increase in Road (%) during 1995-2001 = 48.31%.

Increase in vehicles (%) during 1995-2001 = 105.85%.
 Increase in traffic density (%) during 1995-2001 = 38.82%.

Table 4. Level of air pollutants in Kathmandu.

Pollutant	Range	Reference
TSP/1	800 µg/m ³	URBAIR 1997
	308-401 µg/m ³	ENPHO 1999
PM ₁₀	100-190	ENPHO 1999
CO	6-7 ppm (at heavy traffic)	Upadhyay and Ghimire 1997
NO ₂	14-126 µg/m ³ (NO _x)	KVVECP 1993
	16.0-25.3 µg/m ³ (NO ₂)	ENPHO 1999
	18-140 ppb (NO ₂)	Silwal et al. 2001
SO ₂	100-225 µg/m ³	KVVECP 1993
	5.30 ppb	Silwal 2001
	7.8-104	ENPHO 1999
Pb	0.31-0.69	Leaders Nepal 1999.

Table 5. Emission Standards for vehicles in Nepal.

Fuel	Wheelers type	Manufacturing date	Emissions
Petrol and LPG	4 Wheelers	upto 1980	4.5% CO, 1000 ppm HC
	4 Wheelers	after 1981	3.0% CO, 1000 ppm HC
	3 Wheelers	upto 1991	4.5% CO, 7800 ppm HC
	3 Wheelers	after 1992	3.0% CO, 7800 ppm HC
Diesel	—	upto 1994	75 HSU
		after 1994	65 HSU

CO = Carbon monoxide, HC = Hydrocarbon, HSU = Hertridge Smoke Unit.

Table 6. Number of vehicles tested for emission level between 1996-2001.

Vehicles	Petrol	Diesel	Total	Pass	Fail
Government	4161	6606	10767	7976	2791 (35%)
Corporation	1510	2919	4429	3116	1313 (30%)
Private	58760	33285	92045	71880	20165 (22%)
Diplomatic	2835	5236	8071	6528	1543 (19%)
Rental	65465	14656	80121	60819	19302 (24%)
Tourist	2548	4548	7096	5651	1445 (20%)
Total	135279	67250	202529	155970	46559 (22.98%)

Source: Department of Transport Management, HMG Nepal.

Table 7. Number of vehicles failed to meet emission standards.

Vehicles	Pass	Fail	Total
Car	82815	16016 (16.2%)	98831
Jeep	24547	9652 (28.2%)	34199
Van	1977	6661 (77%)	8638
Petrol Tempo	19307	5733 (23%)	25040
Diesel Tempo	239	1327 (84.7%)	1566
Minibus	6721	3176 (32%)	9897
Mini Truck	1533	1732 (53%)	3265

Bus	2907	1403 (32.5%)	4310
Truck	542	856 (61.2%)	1398
Crane	8	3 (27.3%)	11
Total	155970	46559 (23%)	202529

Source: Department of Transport Management, HMG Nepal.

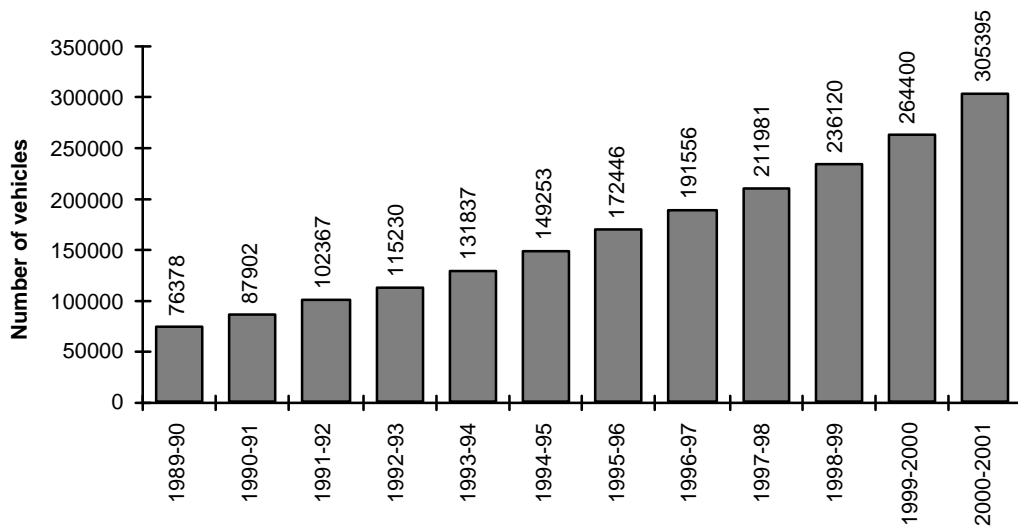


fig. 1. Number of vehicles in 1989-90 to 2000-2001.

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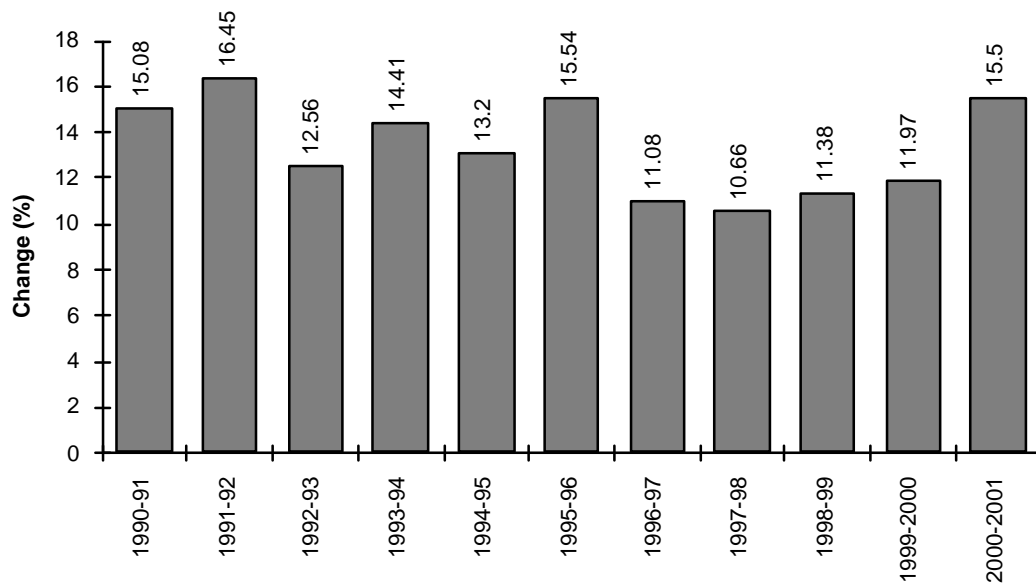


Fig. 2. Annual growth rate of vehicles in Nepal between 1990-91 and 2000-2001.

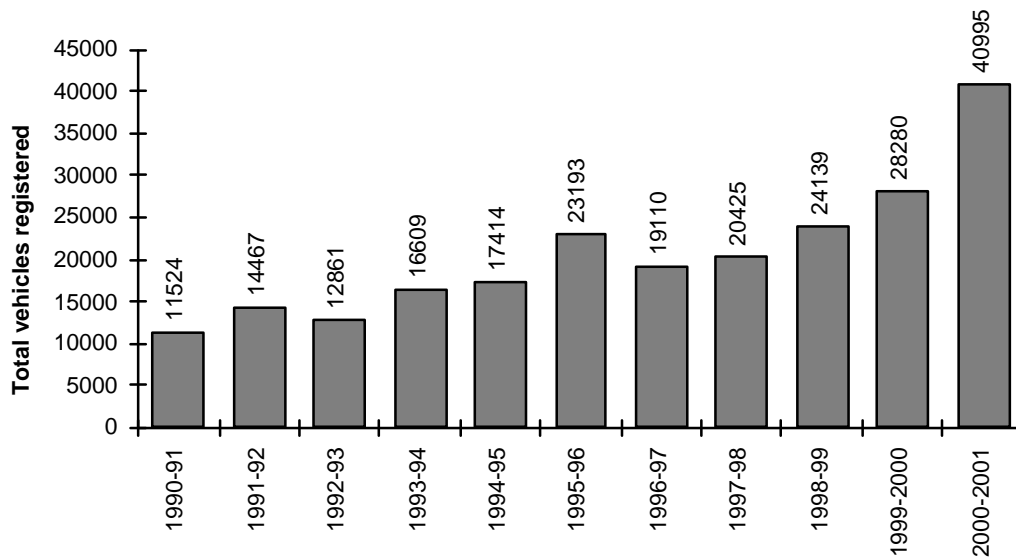


fig. 3. Number of vehicles registered in Nepal between 1990-91 and 2000-2001 (Source of data of Figs. 1-3: Department of Transport Management, HMGN) F

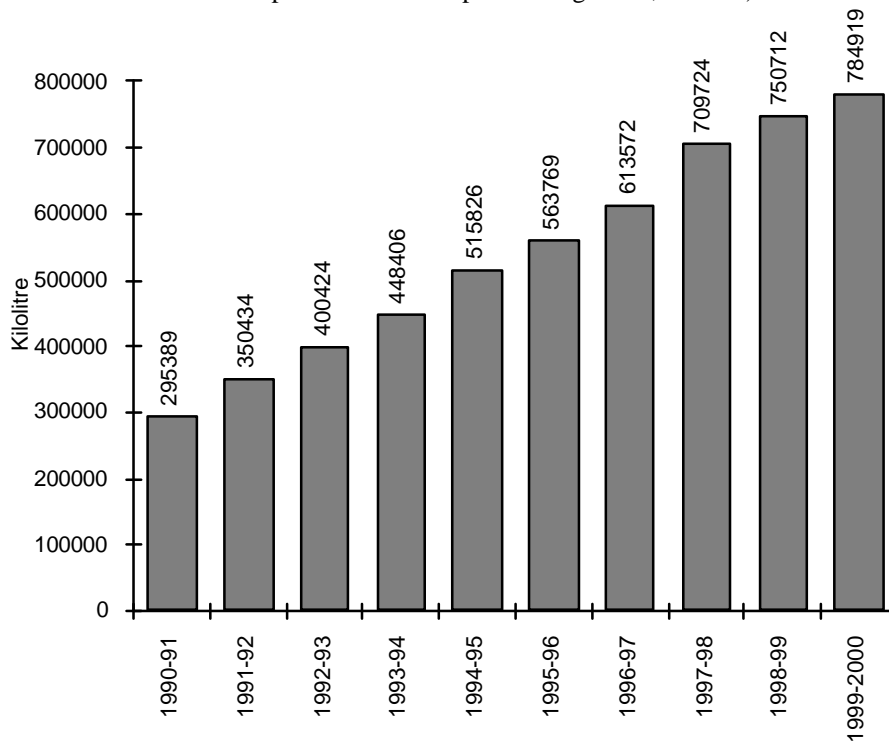


Fig. 4. Sales of fossil fuel (petroleum products) between 1990-91 and 1999-2000 (Source: Nepal Oil Corporation)

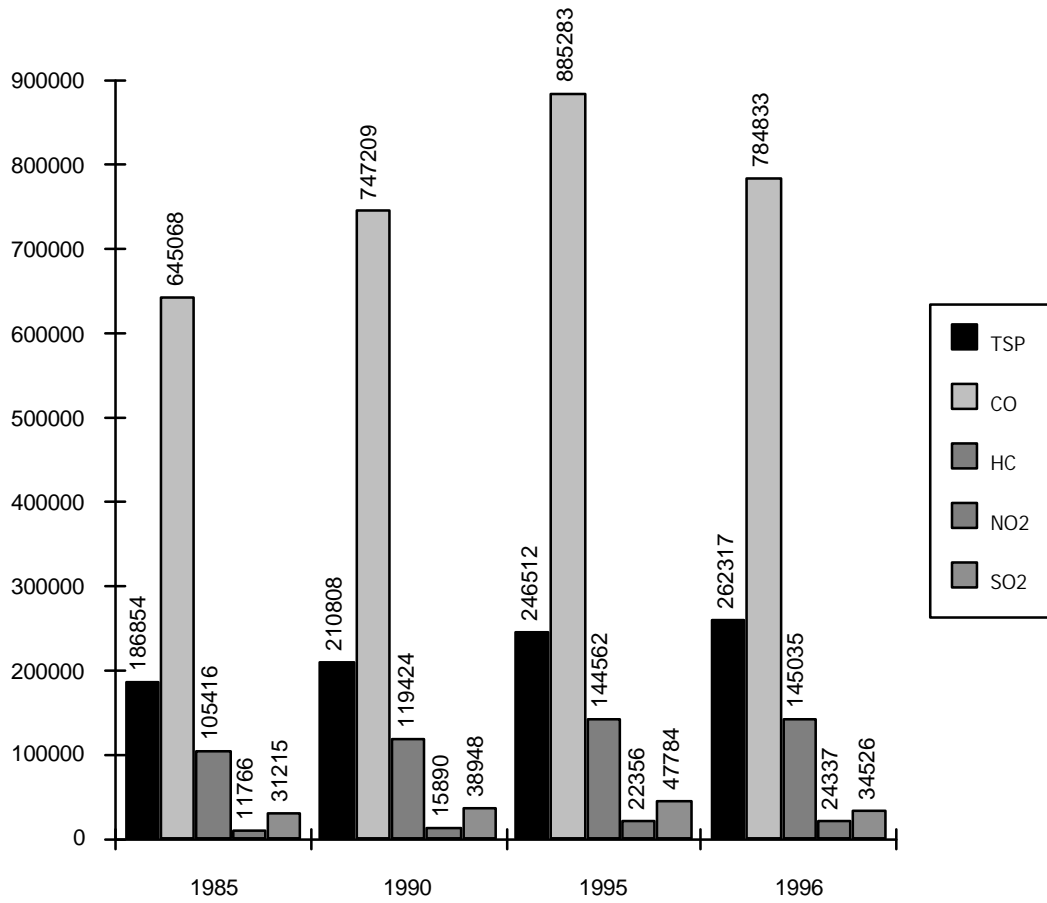


Fig. 5. Emissions of TSP, CO, HC, NO₂ and SO₂ from 1985 to 1996 (adapted from ICIMOD 2001)

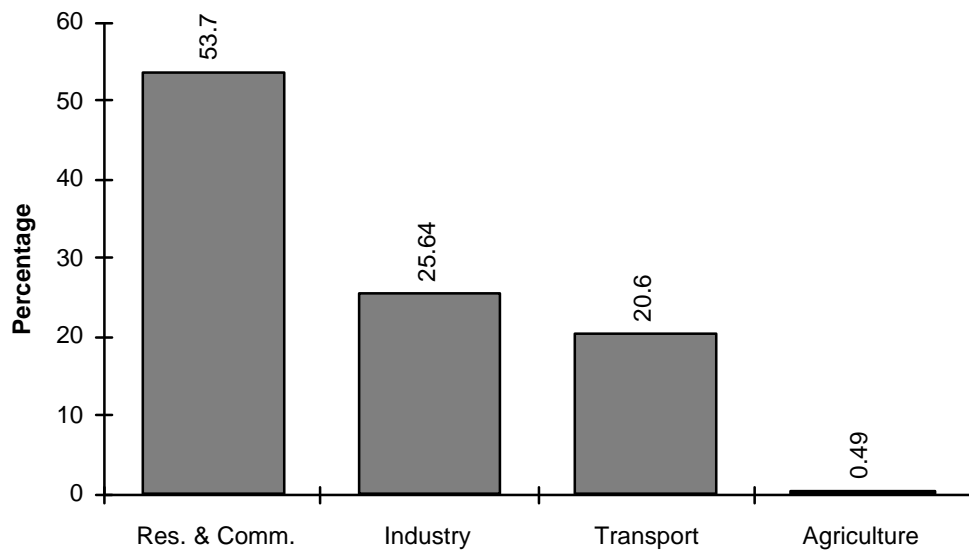


Fig. 6. Emission of pollutants by different sectors in Nepal in 1996 (adapted from ICIMOD 2001)