TRAFFIC CONTRIBUTION TO AIR POLLUTION:
A Case Study on Dhaka

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Abstract
Air pollution is causing a serious threat to public health in most of the urban centers in the developing countries. Dhaka is one of the most polluted cities in the world. The environment of Dhaka has been deteriorating rapidly during the last couple of years. The road users frequently complain about headache, eye and skin irritation and breathing problem. The situation is expected to be worsening further with the increase of population, economic development and high influx of people from rural areas. Motor vehicle, which is increasing at a rate of about 5 percent per year in Dhaka, is the most significant source of air pollution.

In this article, we have analyzed the vehicle population structure and trends in Dhaka from 1990 to 2000. The paper also investigates the role of different types of motor vehicles in the trends of air pollution of Dhaka city.

The analysis results of motor vehicle structure show that in 1992 the highest proportion, 45 percent was occupied by 2-wheeler, the second highest proportion which was 22 percent belong to car and taxi, and 3-wheeler vehicle was 12 percent, while those were 38 percent, 26 percent and 16 percent respectively in 2000..It is observed from the result that total NO_X emission in 2000 was 31903 tones and among them 3-wheeler vehicles, diesel trucks and cars and taxis respectively contributed 44, 33 and 11 percent , while the total SO_X emission was 19386 tones and the main contributor diesel truck emitted 58 percent ,the next highest contributor Car and taxi occupied 17 percent. The study also recommends several strategies for vehicular emission control with the aim of improving existing air quality in Dhaka.

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INTRODUCTION

Atmospheric pollution in urban area is a major issue of the developing countries all over the world. Transportation is vital to a nation's economy. Motor vehicle is the most important facility for transportation. In Dhaka, this transportation facility is not only providing movement of goods and human all over the city but also the source of air pollution. The most concerning pollutant species producing from transportation facility are NO_X and SO_X. The rate of increase of pollutant concentration in the city goes very fast due to high influx of people from different parts of the country. Rapid increase of population requiring transportation demand is the most significant cause of NO_X and SO_X emission from vehicles. Emission from traffic vehicles are about 55 percent responsible for severe NO_X and SO_X pollution in Dhaka (Azad and Kitada, 1998). This situation gradually deteriorates the air quality of Dhaka, which directly effects on human health. Only a very few studies have been conducted (Azad and Kitada, 1998a; Kitada and Azad, 1998b; Karim et al., 1997), and those studies were limited to a particular episode or season. In this study, a detail analysis has been performed on the patterns and trends of vehicle population as well as their contributions in the air pollution in Dhaka city from 1990 to 2000.

MATERIALS AND METHODS

Structure of Traffic Vehicle in Dhaka

Dhaka is being more urbanized to mitigate the excess demand of the coming people from the different parts of the country. This excess people force to build up infrastructure for their basic need as well as the number of automobiles for transportation demand. Running motor vehicles in Dhaka are classified in the 6 main categories, (i). Car and taxi,(ii) Jeep, station wagon and microbus ,(iii) diesel bus ,(iv) diesel truck, (v)3-wheeler vehicle and (vi) 2-wheeler vehicle (DUTP,1996).

The trends and patterns of vehicle population of Dhaka city from the year 1990 to 2000 are shown in Figure 1. This figure shows the regular rising of vehicles in the city due to high influx of migrate population from different parts of the country to mitigate their transportation demands. The total number of vehicles rapidly changed within these 10 years from 142414 in 1990 to 233781 in 2000. The rate of increase of Car and Taxi, 3-wheeler, and 2-wheeler were significant in the last 10 years. The reasons for increase of these types of vehicle are economic development, influx of people coming from different parts of the country, and opportunity for less educated people as all economic development, improvement of the country are centralized in Dhaka. Thus, due to high rate of population growth in Dhaka, transportation demand gradually increases, and

those enhance the vehicle population growth and change the distribution of their population as shown in Figure 2 for 1992 and Figure 3 for 2000.

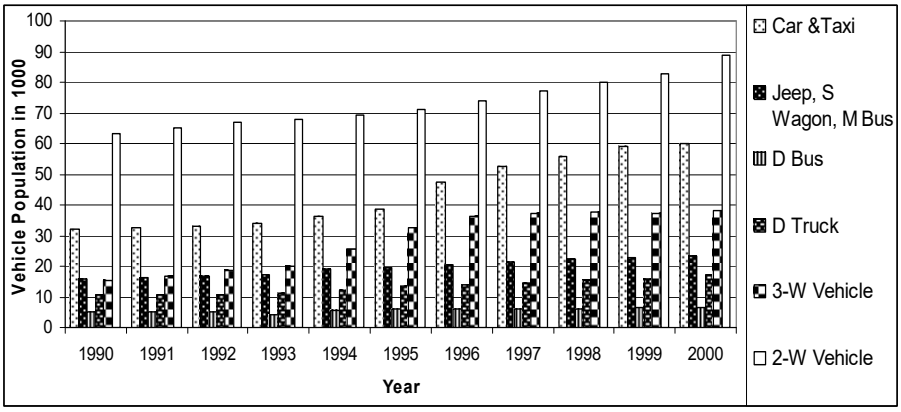

Figure1: Traffic vehicle population in Dhaka city (1990-2000) (source: Bangladesh Road and Transport Authority, 2001)

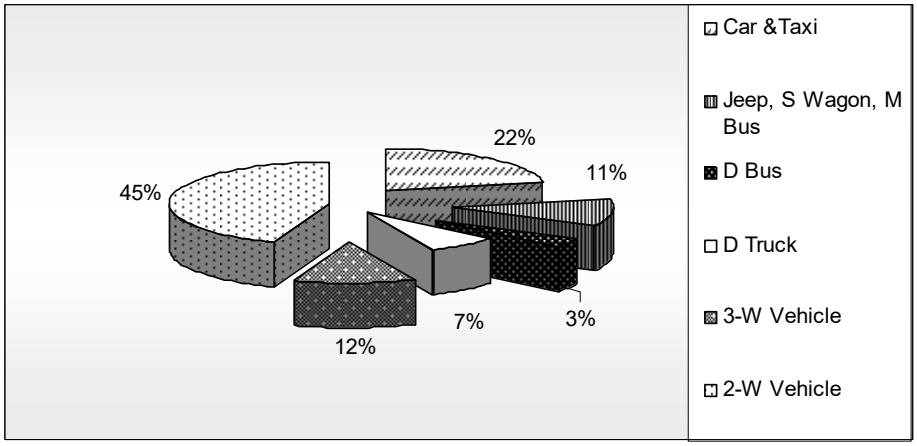

Figure2: Composition of Traffic Vehicles Population in percentage in the Year 1992

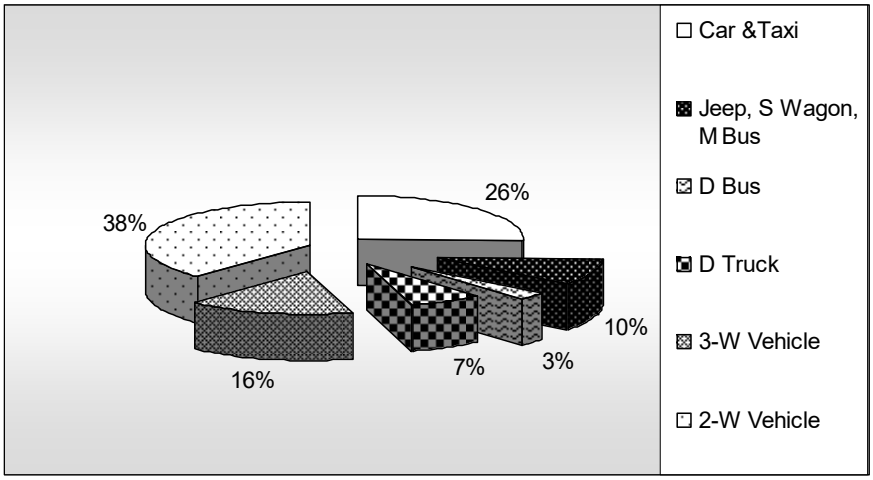

Figure3: Composition of Traffic Vehicles Population in Percentage in the Year 2000

POLLUTANT EMISSION FROM TRAFFIC VEHICLE

Estimating Fuel Consumption by Traffic vehicle

Fuel consumption by traffic vehicles is calculated by using annual distance covered by each vehicle, fuel economy and vehicle population.

Total annual fuel consumption is calculated by dividing the annual distance covered by each vehicle (km) by fuel economy (km/l) and multiplying with total vehicle number of each category. Fuel economy and annual distance traveled data are taken from DUTP (1996).

Estimation of Pollutants Emission from Traffic Vehicles

Pollutants emission from traffic vehicle is calculated by using fuel consumption and emission factors for the unit consumption. The emission factors are taken from Azad and Kitaka (1998a), and Kato et al.(1991).

RESULTS AND DISCUSSION

NO_X Emission

Figure 4 shows the contribution to NO_X emission in percentage in the year 2000 from 6 main types of vehicle. The figure also illustrates that 3-wheeler and diesel trucks are mainly responsible for NO_X emission. In the year 2000, among the vehicle population 2-wheeler vehicles, car and taxis and 3-wheeler vehicles occupy respectively the highest rank (Figure1). By comparison the vehicle population with NO_X emission in the year 2000, it is found that 2-wheeler

vehicle has insignificant contributions to NO_X emission although its population occupies the highest rank.

By comparing the NO_X emission in the 1992, 1994, 1996, 1998 and 2000, it could be concluded that the major role played by the vehicles are 3-wheeler, and diesel truck, Car and taxis (Figure5).

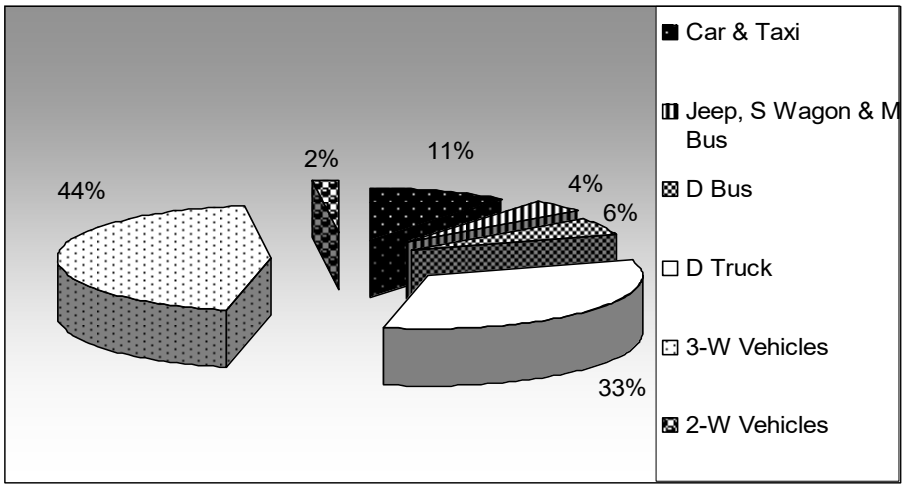

Figure4: Contribution to NO_X emission from various types of vehicle in the year 2000 in percentage

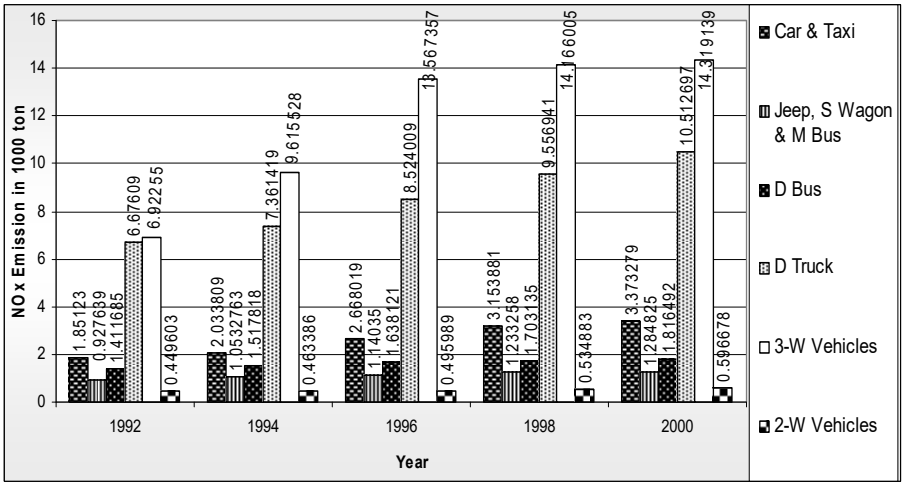

Figure 5: Comparative NO_X emissions from vehicles in the year 1992, 1994, 1996, 1998, and 2000.

The NO_X emission increase rate is approximately 13.87 percent per year in the last 10 years. If this increase rate continues without adopting any mitigation measures, the estimated future of NO_X emission trends would be as shown in the Figure 6.

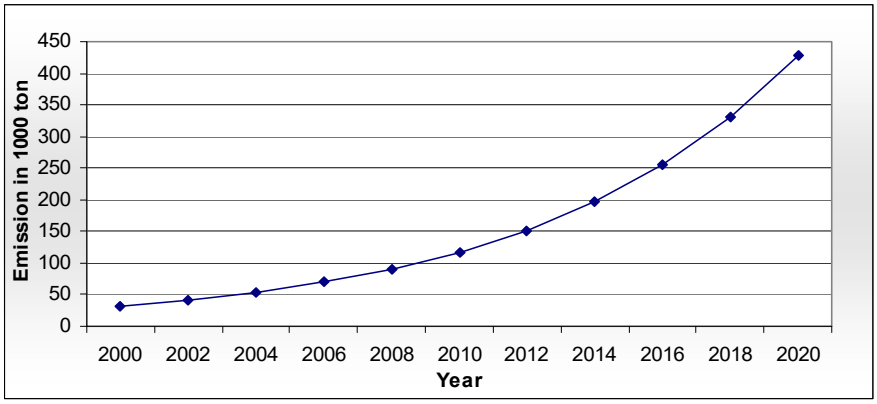

Figure 6: Future Trends of NOx Emission in the next 20 years (2000-2020)

There exists positive relationship(r=0.97) between traffic vehicle population and NO_X emission. Figure7 shows the relationship between traffic population and NO_X emission. The first point of the figure shows that the total number of vehicle population and total amount of NO_X emission in the year 1992 and second point for those in 1994 and so on . It could be concluded that the rapid increase of vehicle population enforces the increase of NO_X emission with duration of time.

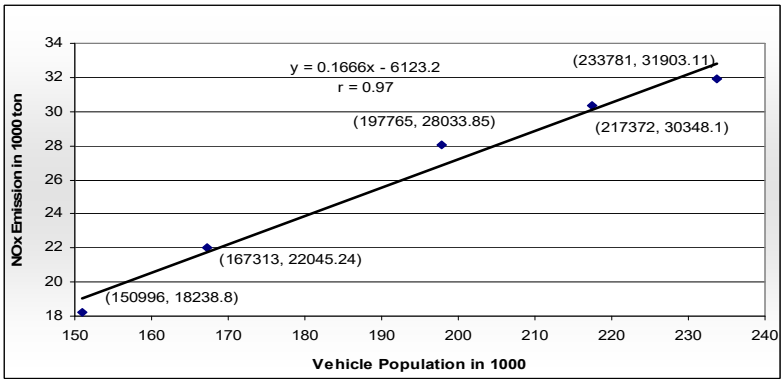

Figure 7: Relationship between vehicle population and NOx emission (year 1992- 2000).

SO_X emission

Figure 8 shows the contribution to SO_X emission in percentage from main types of vehicle in the year 2000. The major role-played for SO_X emission in Dhaka city is diesel truck, which occupies the first rank although it is small in population in comparison to other vehicles. The main reason is that diesel truck carry heavy load that results high fuel consumption rate and its emission factor is high too. Except diesel truck, contribution of SO_X emission from other types of vehicle varies to their yearly basis population change (Fig 9).

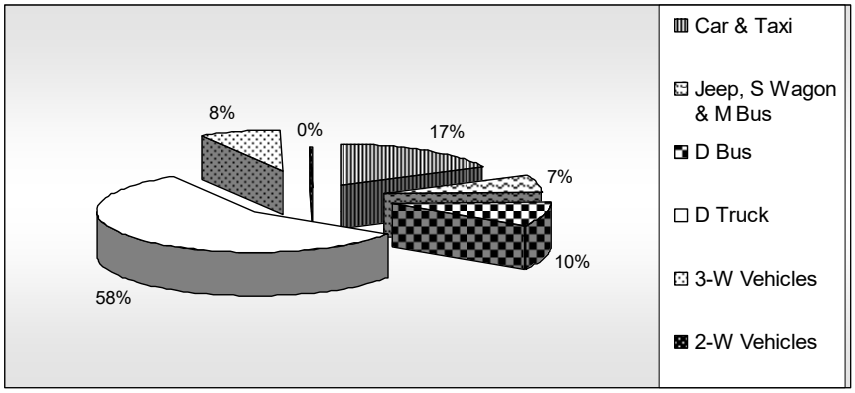

Figure 8: Contribution to SO_X emission from various types of vehicles in the year 2000 in percentage

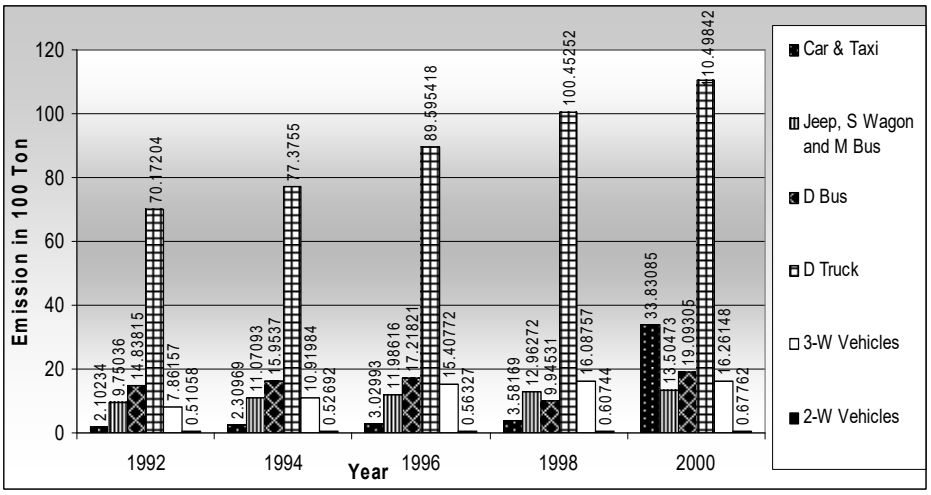

Figure 9: Comparative SO_X emission from vehicles in the 1992, 1994, 1996, 1998, and 2000.

The average SO_X emission increase rate in Dhaka is 10.02 percent per year in the last 10 years. If this rate of SO_X release continues without improving the fuel quality i.e., reduces the sulfur contents in fuel, the estimated future of SO_X emissions scenario would be as shown in the figure10.

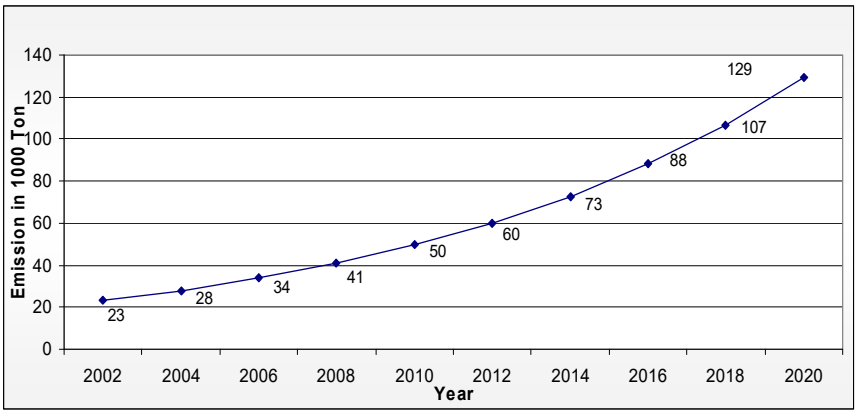

Figure10: Future Trends of SO_X Emission in the next 20 years (2000-2020)

Figure 11 shows the relationship between traffic population and SO_X emission and shows the slightly positive relationship between them from the year 1992 to 2000. The first point of the figure shows the total number of vehicle population and SO_X emission in the year 1992 and other points are for the year 1994, 1996, 1998 and 2000, respectively.

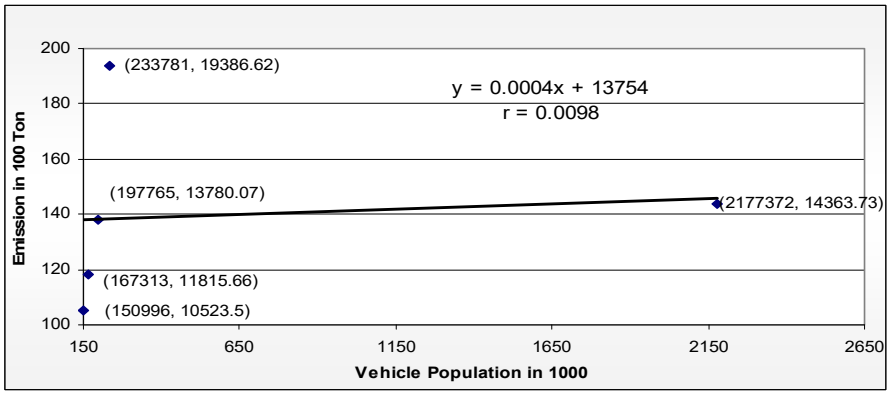

Figure 11: 1Relationship between vehicle population and SOx emission (1992-2000)

COMPARISON WITH OTHER STUDIES:

Table1: comparison of the estimated SO_X and NO_X in this study with those adopted from other studies.

Studies	SO_X emission (t/d)	NO_X emission (t/d)
This study	38	60
Azad and Kitada(1998a)	40	38
Karim et. Al. (1997)	42	42

Limited published data on Dhaka city are available for the comparison of SO_X and NO_X emission. Comparisons to the data adopted from the studies of Azad and Kitada (1998a), and Karim et, al. (1997) are shown in Table 1. The SO_X emission calculated in this study compares very well to those of Azad and Kitada(1998a) and Karim et al (1997). However, the NO_X emission estimated in this study is slightly higher than those of other two studies. Because Azad and KItada assumed all traffic vehicles use diesel oil as fuel, which has lower emission factor for NO_X compare to petrol and octane.

MITIGATION STRATEGY FOR TRAFFIC POLLUTION

Proper traffic management

The pollutants dispersion can be reduced by avoiding stop- go traffic, particularly near the residential and shopping areas. Traffic needs to be regulated to ensure by restricting certain roads for light vehicles, proper maintenance of roads, appropriate location of traffic signals, synchronization of signals located very close to each other, proper planning of traffic islands etc. By ensuring a smooth flow of traffic, there will be greater dispersion and dilution of the pollutants.

Fuel quality improvement/ alternative fuels

(i)Sulfur in diesel

One of the most important processes to remove sulfur from fuel is through hydro desulphurization (HDS). HDS is a process commonly used to reduce sulfur content from fuel by converting sulfur compound into hydrogen sulfide.

(ii)Alternative fuel

Pollutants emission from automobiles can be controlled by replacing leaded petrol and diesel oil. There is a scope for improvement of the pollution from vehicular emission through planning of alternatives fuel use. Alternative fuel includes Compressed Natural Gas (CNG).

(iii) Exhaust gas control

Exhaust gas control is a control of emitted gas through tailpipe, of which exhaust gases are expelled from an internal- combustion engine, for example, in a motor vehicle. NO_X emission from traffic vehicle can be controlled by Exhaust Gas Recirculation (EGR) and Catalytic Converter Package.

(iv) Strictly imposing the emission standards for Traffic vehicles

The most crucial component in the exhaust pollution control strategy is stringent vehicular emission standards. Government should enrich DOE with adequate technical support for extensive monitoring of vehicular emission within the city. Regularity in monitoring will aware the vehicle owners to maintain exhaust gas emission standards by proper maintenance of vehicles.

CONCLUSION

The patterns and trends of traffic vehicle population as well as SO_X and NO_X emissions from the traffic vehicles in Dhaka city have been analyzed in details. The overall study findings can be summarized as follows-

(i) Analysis of vehicle population structure shows that the proportion of 2-wheeler vehicle is the highest, which was 45 percent of total vehicle population in 1992.A significant increasing trend for Car and taxi, and 3- wheeler vehicles were found in the analysis.

(ii) Estimation of pollutants emission in the period 1990-2000 from traffic vehicles found that 3-wheeler vehicle, car and taxi and diesel truck are the major contributor to NO_X emission in the city.

(iii) The analysis of vehicular SO_X emission from 1990 to 2000 indicates that diesel truck is the most significant contributor.

(iv) It is very essential to take effective actions for recovering traffic pollution problems. Government should take appropriate measures to fulfill the future transport demand as well as planning for improvement of existing traffic management encourage the vehicle

owners for using alternative fuels and widely develop monitoring system. These measures will protect the environment from existing deterioration with improvement of transport facility.

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