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Case Study

Study on source inventory and assessment of air pollution load of Patna, Bihar, India – A case study

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Abstract

Air pollution in urban India has become a great concern now-a-days. Most of the Indian cities and metropolis are situated on the edge of health risk because of atmospheric contamination. Patna – the capital of Bihar – is notorious for air pollution. The main culprit of air pollution of this city is vehicular emission. The present study has been carried out to assess the air pollution load of Patna city that resulted mainly due to vehicular emission and to propose some remedial options to the planners and decision makers to solve this issue. It is a survey based study that has been carried out at different sampling locations of Patna city and necessary primary data were collected. The study revealed that the atmospheric condition of Patna city is deteriorating day by day due to vehicular emission and if this situation persists for long the inhabitants of the region will fall in great distress. Hence immediate and fruitful steps should be taken to remediate this situation.

Keywords: Air pollutant, emission factor, pollution load, source inventory, sustainable development.

Introduction

Recently air pollution has become a global issue especially in urban region and India (where it is increasing day by day) is not an exception to it. Dwellers of many Indian cities (including the suburban regions) are suffering from different adverse health effects due to air pollution. Patna is the capital of Bihar state and is well known for atmospheric pollution. It is presumed that vehicular emission is the major reason of air quality deterioration of Patna. Various toxic pollutants that are generated from point as well as non point sources are polluting our ecosystem constantly. Different developmental activities like urbanisation, construction of roads, industrialisation, mining, transportation etc., are creating air pollution[1-17]. Practically no development is devoid of pollution source. Increasing rates of population are exerting more pressure on environment[9]. Different types of vehicles like motor cycle (MC), car, Sports Utility Vehicle (SUV), auto rickshaw, tempo, bus, truck, scooty etc., are the main sources of pollutant emission in the cities like Patna. Various types of pollutants like SO_X (Oxides of Sulphur), NO_X (Oxides of Nitrogen), O_3, PM_{10}, $PM_{2.5}$, PM_1 (Particulate Matter), CO (Carbon mono oxide) etc., are generated from vehicles. The extent of pollution load is depended on a variety of factors such as types of fuel (like diesel, petrol, LPG i.e., Liquid Petroleum Gas, CNG i.e., Clean and Natural Gas etc.,) used, combustion of fuel (complete or incomplete), number of vehicles, types of vehicles, number of passengers per vehicle, distance covered per vehicle per unit time, speed of vehicle, engine efficiency, condition of weather and condition of roads. Assessment of air pollution inventory is very much necessary to measure the pollution load of any urban area. Very few and scanty study was carried out regarding the air pollution source inventorisation of small Indian cities like Patna. To fill this gap the present study has been conducted. The current study is performed to know the condition of different types of vehicles, to measure the load of air pollution of Patna city, to create a baseline data on source inventory for the planners and decision makers and to suggest some remedial options so that the pollution load can be declined.

Materials and methods

The study was performed during the month of July-August of the year 2018. The survey has been carried out at different sampling locations (Dack Bunlow, Boring Road, Gandhi Maidan, Kankarbag, Bypass, R-Block, Ashok Rajpath, Gaya Line Gaumati, NH-30 and Baily Road) of Patna city. The geographical location of the study area is found in between latitude $25^0$35' to $25^0$37' N and longitude $85^0$6' to $85^0$8' E. Drivers and passengers of different vehicles have been asked some simple and basic questions during the interview. Random samplings have been carried out until a definite size is obtained. Total pollution load in terms of total emission (ton/year) and emission factor (EF) has been calculated using standard formula[1,18].

Results and discussion

The results of the survey report are represented statistically in Table–1. It is very clear that the quality of atmosphere of Patna

is degrading day by day due to ever increasing vehicular emission. It will surely hamper the health status of drivers, passengers and city dwellers. The results show that too many two wheelers and auto rickshaws are available at Patna which creates air pollution. Older vehicles are generating more pollution load than newer ones. High Income Group (HIG) people are very often using their vehicles as a symbol of elite status. There is a growing tendency of using two-wheelers unnecessarily among the youths. Women, young ladies and elderly persons are using scooty which again increases pollution load on air. Totos (containing electrical battery) are available but only for very short distance (1–3km) and its travelling cost is also very high as compared to auto rickshaws. Very few Government (public) busses are available here. Although some private busses (very small in size) are operated in Patna but these are very insufficient in number. Traffic jam is very common phenomenon in Patna especially during the working hours which creates panic among the passengers irrespective of age and sex. Every day passengers have to wait for long time to cover even a very short distance. The condition of roads (within the city) is very dangerous and alarming that becomes really intolerable during monsoon. But the conditions of highways are very good as compared to their counterparts that are reflected in cases of vehicular emission and speed. Very often drivers are found to take tobacco and related products while they are driving. Tendency of taking alcohol and consumption of mobile is very common among the drivers which might result severe road accident at anytime and anywhere. The drivers and passengers of cars and SUVs are found without seat belt. The two wheeler riders (drivers and passengers) are also found to travel without helmet. These kinds of malpractices are surely undesirable from safety as well as legal point of view. Some remedial measures are suggested to obviate these problems. Older vehicles should be banned or restricted as much as possible. Complete ban on very older (> 20 years) vehicles should be strictly applied by the Government authorities. Odd and even system (as already applied in Delhi) could be applied for personal vehicles. Proper maintenance as well as checking of pollution emission of each vehicle should be carried out regularly as a mandatory matter. Road traffic police should aware and warn the drivers and passengers about the ill-effects of smoking, drinking of alcohol or using mobile during driving or journey and should punish them in extreme cases. They also should take initiatives in encouraging and enforcing people to use seat belts in cars as well as to consume helmet in case of two wheelers. Regular awareness campaign regarding the ill-effects of vehicular pollution and causes of road accidents should be carried out by Government authorities as well as by the NGOs (Non Governmental Organisations) through different media such as print and electronic media. Switch to improved technology (in engines) or alternative fuel (CNG, fossil fuel mixed with bio fuel) is the demand of modern cities to access optimum engine efficiency and to arrest pollutant emission in atmosphere. People are encouraged to consume public vehicles as much as possible instead of any type of private vehicle to decrease the pollution load in surrounding air.

Table- 1: Statistical representation of the survey report.

Type of vehicles	Age of vehicles (in year)	Number of vehicles	Percentage share of vehicles	Daily VKT (km/day)	EF (gm/km)	Annual VKT (km/year)	Annual VKT Percentage	TE (gm/year)	Annual TE Percentage
Car	(0 - 5)	200	9.52 %	40	1.0	12000	5.19 %	2400000	5.424 %
	(6 - 10)	150	7.14 %	30	1.5	9000	3.89 %	2025000	4.578 %
	(11 - 15)	72	3.43 %	25	2.0	7500	3.24 %	1080000	2.441 %
	(16 - 20)	62	2.95 %	20	2.5	6000	2.59 %	930000	2.102 %
	(> 20)	16	0.76 %	15	4.0	4500	1.95 %	288000	0.651 %
SUV	(0 - 5)	20	0.95 %	40	1.0	12000	5.19 %	240000	0.542 %
	(6 - 10)	30	1.43 %	35	1.5	10500	4.54 %	472500	1.068 %
	(11 - 15)	25	1.19 %	30	2.0	9000	3.89 %	450000	1.017 %
	(16 - 20)	20	0.95 %	25	2.5	7500	3.24 %	375000	0.848 %
	(> 20)	05	0.24 %	10	4.0	3000	1.30 %	60000	0.136 %
Auto	(0 - 5)	100	4.80 %	100	1.0	30000	12.97 %	3000000	6.780 %
	(6 - 10)	200	9.52 %	80	1.5	60000	25.94 %	18000000	40.681 %
	(11 - 15)	150	2.38 %	60	2.0	18000	7.78 %	5400000	12.204 %
	(16 - 20)	30	1.43 %	40	2.5	12000	5.19 %	900000	2.034 %
	(> 20)	20	0.95 %	20	4.0	6000	2.59 %	480000	1.085 %
Motor cycle	(0 - 5)	250	11.90 %	20	1.0	6000	2.59 %	1500000	3.390 %
	(6 - 10)	500	23.81 %	18	1.5	5400	2.33 %	4050000	9.153 %
	(11 - 15)	150	7.14 %	16	2.0	4800	2.07 %	1440000	3.255 %
	(16 - 20)	90	4.28 %	15	2.5	4500	1.95 %	1012500	2.288 %
	(> 20)	10	0.48 %	12	4.0	3600	1.56 %	144000	0.326 %
Total		2100				2,31,300		4,42,47000	

Introduction of advance pollution control devices (such as catalytic converters) at the source point of vehicular emission should be made. Common people should be encouraged to cover short to very short distances (like 1 – 5km) either by cycles or by walking as a part of their regular habit. Medicated air masks should be consumed by every driver and all other passengers as a preventive measure against any kind of air bourne diseases.

Conclusion

Like any other urban area Patna city is also facing the problems related to air pollution. Increasing population and vehicular emission is showing synergistic effect on pollution load. The State as well as the Central Government should take instantaneous and prolific actions as early as possible to remove or neutralise this issue. Government agencies, policy makers, researchers, NGOs and above all the common people should work jointly to declare war against air pollution.

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