



South Asian Network for Development
and Environmental Economics

POLICY

Brief

Number 43 - 10, May 2010

Counting the Costs of Vehicular Pollution in Dhaka, Bangladesh

Dhaka, like so many other cities in South Asia, is struggling to cope with traffic congestion and air pollution. This policy brief examines the economic costs associated with illness caused by traffic pollution in the city. The study is the work of Tanzir Chowdhury and Mohammad Imran. It finds that cleaning up the city's air would provide the people of Dhaka with annual savings worth Taka 2.39 billion or USD 34.09 million.

This assessment shows that pollution clean-up projects will have significant health and economic benefits for Dhaka society as a whole. Indeed, the study finds that the savings generated by converting diesel-powered trucks to a cleaner fuel would be worth Taka 1.25 billion or USD 17.86 million per annum. The researchers hope that their study will help to create more awareness among policy makers of the need to design and properly implement air pollution reduction initiatives in Dhaka and other cities in Bangladesh.

THE AIR POLLUTION PROBLEM

Air pollution in Dhaka is a significant and growing problem. For example, monthly average PM_{10} concentrations in Dhaka have been increasing since 2003 and pollution levels are currently well above healthy levels. PM_{10} pollution is an indicator of the amount of suspended particulate matter in the air. This pollution remains in the atmosphere for a long period of time and is the cause of most respiratory illnesses.

As there are few polluting factories within the city, most of Dhaka's air pollution comes from vehicles. A recent emissions study for the city by the United Nations Environment Program (UNEP) showed that motor vehicles emit over 1,500 tons of PM_{10} annually. More than 85 percent of this is contributed by diesel-powered buses, minibuses and trucks, even though these make up less than 15 percent of the vehicles in the city. Unless significant steps are taken vehicle pollution will get worse in Dhaka as the number of registered vehicles in the city is growing – there were 140,000 vehicles in Dhaka before 1995 and 422,000 in 2007. (For more information on Vehicular Pollution and its study in Bangladesh see the side bar).

HOW MUCH DOES AIR POLLUTION COST?

This study uses the Cost-of-Illness (COI) approach to estimate the economic impact of air pollution in Dhaka and to assess the benefits that would result from cleaning up the city's air. The COI is made up of two parts: firstly, missed earnings caused by illness due to lost or restricted work days; and, secondly, the cost of dealing with illness. This second cost involves things such as medicine and other medical expenditures.

The study uses a variety of statistical methods to work out the impact of air pollution on people's health, taking into account a whole range of other factors (such as individual characteristics and climatic conditions) that affect peoples' wellbeing. To do this assessment and to estimate the benefits that would be achieved following a reduction in air pollution, the researchers needed detailed data on pollution levels and on the health of individuals.

This policy brief is based on SANDEE working paper No. 47-10, 'Morbidity Costs Of Vehicular Air Pollution: Examining Dhaka City In Bangladesh' by Tanzir Chowdhury from the University of Warwick, UK and BRAC University, Bangladesh and Mohammad Imran from the United International University, Bangladesh. The full report is available at www.sandeeonline.org

GETTING THE RIGHT INFORMATION

Air pollution data was obtained from the Department of Environment (DOE) of the Government of Bangladesh. Primary health data was collected using a household survey. This gathered information on health and sickness along with a wide range of relevant socio-economic information about households and their individual members. The households that took part in the survey were randomly selected from four different areas of Dhaka that were close to where air pollution monitoring units are located. The number of households selected from around each monitoring station was roughly equal. Overall, information was collected from a total of 239 households or 1,150 individuals.

Other secondary data was also collected. This included meteorological data on humidity, temperature, rainfall and wind from the Department of Meteorology. Relevant census information was also obtained from the Bangladesh Bureau of Statistics (BBS) website, while information on the city's vehicular fleet size and composition came from the Bangladesh Road and Transport Authority (BRTA).

AIR POLLUTION'S IMPACT AND THE BENEFITS OF CLEAN-UP

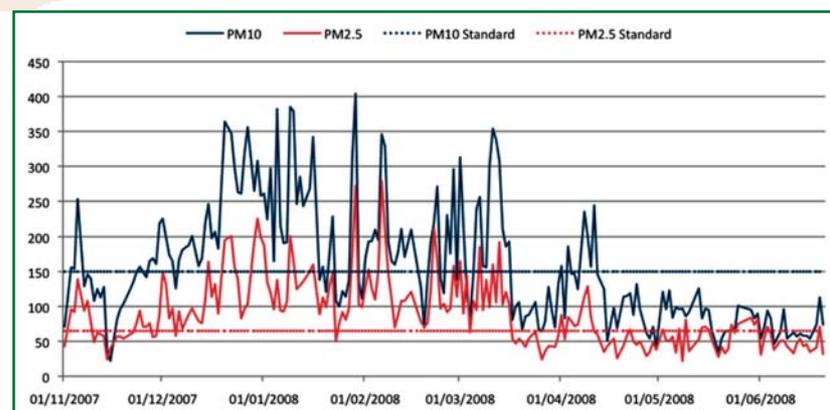
The study finds that the weekly average PM₁₀ concentration in Dhaka is 193.74 $\mu\text{g}/\text{m}^3$ – well above the national standard of 50 $\mu\text{g}/\text{m}^3$ (see Figure). As expected, air pollution does have a negative impact on people's health and an increase in air pollution does result in people taking more sick days off or restricting their working activities. Analysis of the study's findings shows that, for each Dhaka resident, air-pollution-related illnesses cause an average of 0.23 days of restricted activity per week. The average amount of money that people spend to deal with pollution-related illnesses is Taka 3.81 per week.



The study estimates the monetary benefits that would be achieved by reducing air pollution from its current level to the national safe standard - a reduction of 143.74 $\mu\text{g}/\text{m}^3$. The annual gain in workdays from a reduction in PM concentration to the safe level would be 0.53 days per year for each employed person. Given that the average daily wage in the survey area is Taka 250.21, the annual economic gain produced by reducing air pollution to a safe level would be Taka 131.37 for an average working person. This level of pollution clean-up would also save each person Taka 150.49 (USD 2.15), thanks to reductions in the amount of money they would have to pay to mitigate the health impact of pollution.

The estimated population in Dhaka is 12.3 million. Given that the ratio of employed to unemployed in the survey households is 33.13 percent, the estimated working population in Dhaka is 4.075 million. Thus the total monetary gain that would be produced by reducing air pollution in Dhaka to a safe level would total Taka 2.39 billion or USD 34.09 million (using the exchange rate of USD 1 = Taka 70). This is the sum of savings due to a reduction in both lost earnings and mitigation expenditure.

Figure: Daily PM Trend in Dhaka (November 2007 - June 2008)



HOW DOES THIS COMPARE TO OTHER ESTIMATES?

To gauge whether the findings of this study differ from previous estimates, the researchers compare their results with similar estimates from previous studies conducted in other major Asian cities. It is clear that estimates of

health benefits derived in this study are quite low compared to previous studies. For example, the World Bank report in the Bangladesh Country Environmental Analysis assessed the morbidity costs that would be saved by reducing outdoor air pollution to the revised national standard in three major cities of Bangladesh. It found that these savings would total USD 380.1 million. In contrast, when the appropriate conversions are carried out, this study gives an estimate of only USD 121.76 million. This difference may be explained by the fact that the World Bank estimates were not based on local data and were derived using the benefit transfer method. This is an approach where numbers obtained from studies undertaken elsewhere are transferred to a local situation.



There are a number of reasons why this survey's results may be on the conservative side. The current study only estimates the COI from a reduction in air pollution to a safe level and that it does not include two other costs that air pollution can be responsible for: the cost of undertaking averting activities and the cost of disutility incurred due to illness. What is more, the estimate does not include any costs from premature mortality associated with air pollution.

gas (CNG) as an alternative source of vehicle fuel; the second was the replacement of the two-stroke three-wheelers in Dhaka by CNG-powered three-wheelers. According to some sources, roughly 200,000 vehicles have switched to CNG already. To see what economic impact other similar projects might have, the study assesses the health benefit of switching more of Dhaka's vehicles to run on CNG (Table).

THE BENEFITS OF SWITCHING TO CLEANER FUELS

Given the findings of the report, it is clear that vehicle pollution clean-up projects will have significant health and economic benefits for Dhaka society as a whole. Two major pollution-clean-up projects have already been implemented in the city: the first was the introduction of compressed natural

Table: Emission Estimates with and without CNG Vehicles

Source	Vehicles (2007) ¹	Avg. Usage (Km/day) ⁴	Emission Factor ⁴	PM Emission (Tons/year)	Relative Contribution
With CNG					
Motor Car (Petrol)	16,261	40	0.1	24	0.017
Motor Car (CNG)	146,347 ²	40	0.03	64	0.047
Taxi (CNG)	10,672	130	0.03	15	0.011
Three-wheeler (CNG)	13,521	130	0.03	19	0.014
Bus (CNG)	6,152	130	0.4	117	0.086
Minibuses (CNG)	8,098	60	0.2	35	0.026
Truck (Diesel)	25,193	60	1.6	883	0.648
Motor-cycle (Petrol)	173,637	30	0.1	190	0.140
Others (CNG)	21,816	60	0.03	14	0.011
Total	421,697			1,362	
Without CNG					
Motor Car	162,608	40	0.1	237	0.068
Taxi	10,672	130	0.1	51	0.015
Three-wheeler	40,000 ³	130	0.8	1,518	0.326
Bus	6,152	130	1.6	467	0.134
Minibuses	8,098	60	0.8	142	0.041
Truck	25,193	60	1.6	883	0.253
Motor-cycle	173,637	30	0.1	190	0.054
Others	21,816	60	0.8	382	0.109
Total	438,176			3,870	

Notes:

1. Data on number of vehicles are acquired from BRTA (Bangladesh Road and Transport Authority)
2. According to different newspaper sources, ninety percent of the total private motorcars use CNG
3. This includes the 26,429 Two-stroke Three-wheelers that were removed from Dhaka in 2003
4. Emission coefficients and average vehicle usage estimates are taken from the 'Dhaka City State of Environment 2005' (UNEP, 2005)

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This policy brief is an output of a research project funded by SANDEE. The view's expressed here are not necessarily those of SANDEE's sponsors.



MORE WORK LEFT TO DO TO JUSTIFY FUTURE CLEAN-UP WORK

The estimated annual health benefits of converting the remaining diesel-powered trucks to CNG-powered vehicles is Taka 1.25 billion or USD 17.86 million per annum. This gives some indication of the potential savings that would accrue from getting more CNG-powered vehicles in Dhaka and of introducing cleaner vehicles and fuel in other major cities in Bangladesh with high VAP.

It is clear that such measures would bring significant benefits to society as a whole so long as they are properly implemented. However, before decisions can be made about the feasibility of such projects, any benefits need to be compared with potential costs. Studies must be carried out on the costs of switching to CNG. This is a crucial next step, if Bangladesh is to secure a healthy future for its urban dwellers.

VEHICULAR AIR POLLUTION

Vehicular air pollution (VAP) is regarded as the main contributory cause of outdoor air pollution in many large cities around the world. The problem is even more pronounced in developing countries, where large cities are experiencing rapid growth and there is an explosion in the number of private and commercial vehicles on the streets.

Vehicular emission arises due to the formation of Nitrogen Oxide (NO₂), Carbon Monoxide (CO), Carbon Dioxide (CO₂), Sulfur Dioxide (SO₂), Particulate Matter (PM), Lead (Pb) and other byproducts of combustion such as hydrocarbon (HC) and black smoke. Among the identified short-term effects of these pollutants are increased respiratory syndromes and reduced lung function and irritation, headache, fatigue, asthma and high blood pressure. More importantly, longer-term exposure to particulate matter (PM₁₀ and PM_{2.5}) can lead to heart disease, cancer, and other medical problems.

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