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The Economy and Environment Program for Southeast Asia (EEPSEA) was established in May 1993 to support training and research in environmental and resource economics across its 10 member countries: Cambodia, China, Indonesia, Laos, Malaysia, Papua New Guinea, the Philippines, Sri Lanka, Thailand, and Viet Nam. Its goal is to strengthen local capacity for the economic analysis of environmental problems so that researchers can provide sound advice to policymakers.

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Don't Choke on the Cost: The Health Benefits of Reducing Diesel Pollution in Colombo, Sri Lanka

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As anyone who has coughed their way through a traffic jam in a Southeast Asian city will tell you, urban traffic congestion is one of the region's major challenges. A new study from Sri Lanka has focused on one key aspect of this problem – the health impacts of diesel vehicles in the country's capital, Colombo. Assessments were made of the make-up of the city's traffic and the ➔

A summary of EEPSEA Research Report 2006-RR2, *Health Impacts Of Diesel Vehicle Emissions: The Case Of Colombo* by Dr. Sunil Chandrasiri, Senior Lecturer, Department of Economics, University of Colombo, Colombo – 3, Sri Lanka. E-mail: sunilch@sltnet.lk

"Several pollution control options would ...

➔ potential health impacts of various diesel emission sources. It was found that particulate pollution (much of it coming from diesel vehicles) is linked to health problems that may be costing the city up to LKR 22 billion per year.

The study identified several pollution control options that would bring net benefits to the city. In other words, the cost of setting them up would be less than the health-related benefits they would deliver. In light of these findings, the study recommends that an effective vehicle inspection and maintenance program and an increase in road user charges be considered priority projects for implementation.

Diesel Vehicle Growth At The Root Of The Problem

The study was undertaken by Sunil Chandrasiri from the Department of

Economics at the University of Colombo, Sri Lanka. It was carried out against a background of massive growth in the number of vehicles on Colombo's roads and, in particular, a precipitous rise in the number of petrol-powered motor cycles and diesel-powered dual-purpose vehicles. The relative share of diesel-powered vehicles in the total traffic 'mix' has increased from 8% in 1960 to 26% in 2004. This growth has been matched by a rapid rise in the consumption of auto-diesel and in diesel pollution. A number of surveys and reports have now identified diesel-powered vehicles as the main source of local air emissions in Colombo. In turn, diesel emissions have been linked to a rise in a number of illnesses. For example, there was a 2.5-fold increase in asthma admissions to state hospitals between 1985 and 2001.

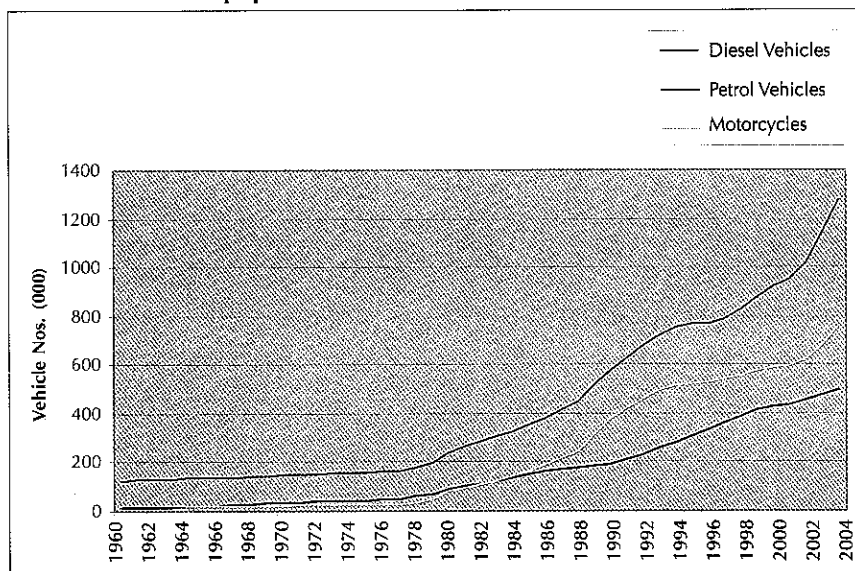
The study took in the whole of Colombo – a city with an area of 37 sq km and a population of about 650,000. The main pollutants assessed were PM10 and PM 2.5 – particulate matter of 10 and 2.5 microns in size respectively. This fine, respirable particulate matter is a major cause of many respiratory illnesses and is a key emission from diesel engines. In the past few years, both PM10 and PM2.5 levels in the city have exceeded the recommended international health safety standards.

The Health Impact Of Particulate Pollution

Given the diverse nature of the city of Colombo, it was difficult to accurately gauge who is affected by particulate pollutants from diesel engines. The impact of auto-diesel emissions was therefore assessed based on three scenarios: high, middle and low. The high case scenario assumed that the total population in Colombo is exposed to high pollution concentrations. The low case scenario was limited to 'direct exposure' groups (eg. people at traffic intersections) and encompassed only 35 of Colombo's 47 wards. The scope of the middle case scenario was part way between these two extremes and covered 43 wards.

Annual average pollution concentration data was obtained from the Central Environment Authority's Air Quality Monitoring Station located at Colombo Fort. Information from other reports on

Growth of vehicle population (1960-2002)



bring net benefits to the city."

the relationship between particulate pollution and the incidence of illnesses was used to assess the physical impacts of this pollution. This assessment covered illnesses recognized as being caused or exacerbated by auto-diesel emissions: asthma in adults and children; pneumonia in adults; lower respiratory tract infection in children; and acute respiratory infection (excluding pneumonia) in children and adults. Colombo-specific details on the spread of these illnesses were obtained from the Ministry of Health.

How Much Does This Illness Cost?

In order to translate health impacts into monetary values, a separate study on the costs of illnesses (COI) was carried out. The costs of illnesses include the cost of diagnoses, drug treatments and personnel costs and non-medical costs such as costs incurred by patients for food and accommodation. Information on these costs was obtained through an assessment of operating and drug costs in public and private hospitals and amongst general practitioners. The treatment of over 200 patients was assessed. The monetary cost of mortality due to diesel emissions was assessed using values from other recent studies. These values were adjusted as necessary for inflation and currency exchange rates.

Health damage due to PM₁₀ and PM_{2.5} (2004)

Particulate matter	Unit	High	Middle	Low
PM ₁₀	LKR Millions	10.37	8.37	8.01
PM _{2.5} (includes PM ₁₀)	LKR Billions	21.8	17.6	16.8
Total	LKR Billions	21.8	17.6	16.8

The total impact of particulate matter in monetary terms was about LKR 22, 18 and 17 billion per annum based on the high, middle and low impact scenarios respectively. The health cost per ton of particulate emissions (using the middle-case scenario) was calculated at LKR 2.6 million.

Pollution Control Options

Four pollution control approaches were assessed and their costs compared with the health damages their application would avoid. The options chosen were taken from a set of possible action plans identified by the Sri Lankan Ministry of Natural Resources and Environment.

The first option involved reducing the price differential between petrol and diesel. Sri Lanka has maintained a significant price differential between petrol and diesel over the past few decades. In June 2005, petrol and diesel were priced at LKR 80/litre and LKR 50/litre respectively. The impact of a 44% increase in the price of auto-diesel was assessed (i.e. a reduction of the price differential between petrol and diesel of 11% or LKR 8/litre. The resulting net benefit over a period of 15 years (2006-2020) was about LKR 5.9 billion.

The second option assessed was a road User Charge (UC) – specifically registration fees and annual license fees – on the use of diesel-powered vehicles. The assessment was based on current vehicle projections up to 2020 and the assumption that increases in UC would take place once every five years. It was found that a 10% increase in UC for diesel-powered vehicles would reduce the demand for vehicles and thereby reduce PM₁₀ emissions by over 1,300 tons over a period of 15 years. In terms of health benefits, this would amount to LKR 401 million at a social cost of about LKR 8 million. The estimated net benefit would therefore be about LKR 393 million.

Can Improvements In Maintenance And Diesel Quality Help?

The third option was a vehicle inspection and maintenance (I/M) program. This involves many technical and administrative tasks, including establishing on-the-road emission standards, the introduction of test certificates, the construction of inspection lanes, and the establishment of a central vehicle inspection database. Although difficult to implement, an effective I/M program can reduce vehicular emissions significantly. Based on the findings and recommendations of a

study from the Air Resources Management Center (ARMC) it was calculated that the costs and benefits of an I/M program targeted at diesel-powered vehicles would be in the region of LKR 228 million and LKR 1.4 billion respectively (between 2006 and 2010).

Given the high sulfur content of auto-diesel, improvements in the quality of diesel are a potentially important initiative and this was the fourth option assessed. Diesel fuel reformulation requires both short-term (for example the immediate use of more low sulfur crude oil) and long-term actions (e.g. investment in hydro-cracking technology). These would reduce PM10 emissions by between 10% and 15% (according to the ARMC). Based on these assumptions, the estimated costs and benefits of a short-term fuel quality enhancement program (2006-2010) were LKR 3.4 billion and LKR 2.8 billion respectively. Similarly, the estimated costs and benefits of a long-term fuel quality enhancement program (2011-2020) were in the

region of LKR 14.1 billion and LKR 2.1 billion.

What Should Be Done

Despite the fact that the upward adjustment of auto-diesel prices would potentially deliver the greatest net benefits, this policy option was not recommended by the author. This was because of the heavy tax burden that would have to be borne by low-income earners, unless some form of offsetting compensation was provided. It is clear that, of the other pollution control options, an inspection and maintenance program and an increase in user charges should be considered as priority items for implementation. These options also have the advantage of allowing selected categories of vehicles to be targeted.

Because emissions of smoke and soot from diesel vehicles are believed to be the main sources of particulate matter, vehicle inspection and maintenance programs should be given top priority in an attempt to control vehicular emissions in Colombo. The capital and operating

costs of an I/M program should be recovered through a fee paid by the vehicle owner to the inspection station.

Another important issue worth considering is the use of the revenues that could be generated through road user charges. A 10% increase in user charges could provide an income of LKR 1.2 billion over 15 years. The earmarking of these revenues for alternative pollution reduction strategies such as retrofitting buses and lorries would be an important policy consideration given budgetary constraints at national level.

Overall, considering the potential health damage associated with the burning of low-quality auto diesel, both technical and policy options should be implemented on a complementary basis. In this way the full benefits of pollution control interventions will be achieved.

104 LKR (Sri Lankan Rupees) = 1 USD

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