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Kala S. Sridhar and Surender Kumar

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India's Urban Environment: Air and Water Pollution and Pollution Abatement

**Kala Seetharam Sridhar
Public Affairs Centre
15, KIADB Industrial Area
Bommasandra-Jigani Link Road
Hennagara Post, Anekal Taluk
Bangalore 562 106
INDIA**

**Surender Kumar
Department of Business Economics
University of Delhi, South Campus,
Benito Juarez Road
New Delhi 110 021
INDIA**

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Abstract

This paper focuses on air and water pollution in India's cities, provides empirical evidence to demonstrate the seriousness of the challenges, discusses the relevant policies of national and local government that are used to address the challenges, discusses relevant political economy issues related to introducing pollution taxes or other policies which are aimed at "green" cities.

Key words: Urbanisation, Environment, Air pollution, Water pollution, Fiscal instruments

Air and Water Pollution in Urban India

Growing urbanization is posing serious environmental concerns in India in terms of changing land use pattern, increasing carbon emissions, solid waste generation and disposal, air and water pollution, and poor sanitation amenities.. In this article, we focus on air and water pollution and pollution abatement policy.

Carbon emissions have been increasing in India in recent years and they are higher in urban areas. We find that the average per capita carbon emissions are higher in the metropolitan cities of India (being 1.19 tons per capita as compared to only 0.90 tons per capita in the non-metropolitan cities), and the national average is 0.93 tons per capita (Table 1). This is because larger cities have more polluting activity such as emissions from public and private transport. However, note that the corporation level emissions as a percentage of city-level emissions are much higher in the non-metropolitan areas than in the metropolitan areas. Corporation level emissions include those emanating from street lighting, water supply and sewage systems, transportation, building and other facilities. This is plausible because smaller city corporations lack the adequate technology to minimize their carbon emissions in the provision of various public services such as water supply, sewerage, street lighting and transportation.

The concerns related to local air pollution are serious. Table 2 reveals the increasing level of average air and water pollution level in India beginning 1990. Of a total of 127 cities/towns monitored under the National Air Quality Monitoring Programme, 101 cities report at least one pollutant exceeding the annual average air quality standard (CPCB 2009).

Household borne effluents contribute a substantial proportion of water pollution in India. A 2007 study finds that discharge of untreated sewage is the single most important cause for pollution of surface and ground water in India. Nearly 12.47 million (18.5%) households do not have access to a drainage network, while 26.83 million (39.8%) households are connected to open drains. In respect of underground sewerage, the availability is 30 percent and 15 percent in notified and non-notified slums respectively.

A majority of the government-owned sewage treatment plants remain closed most of the time due to improper design or poor maintenance or lack of reliable electricity supply to operate the plants, together with absentee employees and poor management. The wastewater generated in these areas normally percolates in the soil or evaporates. The uncollected wastes accumulate in the urban areas, cause unhygienic conditions and release pollutants that leach to surface and groundwater (CPCB (2008)). Inadequate discharge of untreated domestic/municipal wastewater has resulted in contamination of 75 percent of all surface water across India.

City corporations, municipalities and panchayats having the responsibility of water supply and sanitation are supposed to treat the effluents as per the national water pollution standards or MINAS standards. However, a major portion of effluents, about 70 percent, goes untreated. Table 3 provides the summary statistics of wastewater generation and treatment in India in 2008. Note that Delhi and Mumbai account for about 69 percent of the treatment capacity of the metropolitan cities.

Municipal authorities need to recognize the problem of pollution of water bodies and pay attention to their liability to set up sewage treatment plants in cities and towns to prevent this pollution. Conditioning the intergovernmental fiscal transfers from state governments to local bodies on the basis of wastewater treated could be an effective instrument for strengthening the financial position of municipalities (Kumar and Managi 2010; Murty and Kumar 2011). It will not only strengthen the financial position of local governments but also helps in addressing the problem of domestic water pollution.

Pollution Taxation and Green Cities

Indian government's approach towards prevention and control of pollution has been mostly in the nature of legislation-based command and control measures while natural resource management has been largely carried out through programs supported by allocations from the central (e.g., programs of Ministry of Environment and Forests (MoEF), Ministry of Non-conventional Energy Sources, Ministry of Agriculture) and state budgets. The use of fiscal instruments (other than expenditure policy) in environmental policy has been rather limited, even though the need to employ economic and fiscal policy instruments for the control of pollution and management of natural resources has gained steady recognition during the 1990s (Murty and Kumar, 2004; Kumar and Managi 2009).

For greening cities in India, the Supreme Court has played a catalytic role. The Supreme Court identified critically polluted cities and suggested an action plan to reduce the level of pollution in these cities. In 1996, Delhi was the first city to order to develop an action plan, while the most recent action plans were mandated in 2003. To date, 17 cities have been given orders to develop action plans. In light of the Supreme Court's reputation as a driver of environmental reform in India, as well as the overwhelming approval of Delhi's CNG bus program as part of its action plan, many believe that these policies have made significant gains in improving air quality. Second the Court mandated the use of catalytic converters in vehicles. The use of catalytic converters is a common means of reducing vehicular pollution across the world, due to the low cost of its end-of-the-pipe technology. In 1995, the Supreme Court required that all new petrol-fuelled cars in the four major metros (Delhi, Mumbai, Kolkata, Chennai) were to be fitted with converters. In 1998, the policy was extended to 45 other cities. It is plausible that this regulation could reduce the air pollution level in cities.

The combustion of oil products, which mainly occurs in the transport sector, is responsible for about 13 percent of CO₂ emissions in the country. Efficiency enhancing measures in the transport sector are leading to dual benefits of both local air pollution abatement and reduction in GHG emissions. Emission standards have been prescribed for vehicles. The implantation of vehicle emissions standards results in significant costs savings in terms of health benefits (Table 4). India has taken substantial initiatives to make the transport sector less emission intensive (Economic Survey 2012). The commercial manufacture of battery-operated vehicles has begun in India with a view to promoting low/ no carbon emitting vehicles.

Further to reduce urban local air pollution in Delhi, the Delhi metro rail has provided a major boost to public transport, especially in the most congested sections of the Delhi. In a short span of 5 to 10 years a city-wide network is expected to provide a major mass transport alternative. Similarly, in other cities the mass transit systems are in the process of being implemented, e.g., the Metrobus project in Bangalore. Some large Indian cities (e.g., Bangalore, Chennai) have started to introduce exclusive lane for buses; Delhi is

experimenting with high capacity bus corridors. Several other Indian cities are also planning similar initiatives. Maharashtra has announced to impose congestion tax to discourage the use of private cars where the state government has created sufficient public transport facilities (Government of India, 2008). Srinivasan (2005) reports that in India CO₂ emissions from transportation per passenger kilometer are 16 against the 118 and 193 grams in EU-15 and USA, respectively.

In the Policy Statement for the Abatement of Pollution, released in 1992, the MoEF noted the need for a mix of policy instruments in the form of regulations, legislation, agreements, financial incentives, to address environmental concerns. Task forces were constituted by the MoEF in 1995 and 2001 to evaluate the scope for market based instruments (MBIs) for industrial pollution abatement. The task forces recommended explicit incorporation of MBIs in pollution control laws, greater reliance on economic penalties in the short and medium term, and completely replacing criminal penalties by MBIs in the long run.

In order to encourage the shift of polluting industries from congested urban areas, capital gains made in moving from urban to other areas are exempt from taxes if these are used for acquiring land and building production facilities in non-urban areas. Excise and custom duty exemptions or reductions are given for the use of environmentally friendly raw materials.

The actual use of fiscal incentives in the country has, however, been rather limited. These take the form of tax concessions for the adoption of pollution control equipment and a somewhat more structured policy for the promotion of renewable energy technologies. Tax incentives are usually specified for identified abatement technologies and activities, not providing dynamic incentives for technological innovation and diffusion. Also, since most of these are end-of-the-pipe treatment technologies, these incentives do not promote more efficient use of resources. There are some provisions for the use of levies, cess, fines, and penalties for polluters, though their implementation and effectiveness could do with improvement.

In the last few years, the government of India has expressed the desire to use markets for control of pollution in the country. India has levied a cess on coal at the rate of Rs. 50 (~US\$ 1) per ton, which is applicable to both domestically produced and imported coal. This money goes into a National Clean Energy Fund that is used for funding research, innovative projects in clean energy technologies, and environmental remedial programmes. To control the industrial pollution of NO_x and particulate matters, the government is going to start the emission permit markets as pilot projects in three states namely, Gujarat, Maharashtra and Tamil Nadu.

Similarly, to increase the energy efficiency in the energy intensive industries in a cost effective manner, the Bureau of Energy Efficiency has launched the trading in energy efficiency certificate known as PAT programme. The Electricity Act 2003 together with the National Electricity Policy 2005 (NEP) and the Tariff Policy (TP) mandates promotion of electricity generation from renewable sources and encourage use of markets. The initiatives of the Central Electricity Regulatory Commission (CERC) range from determination of preferential tariff for renewable energy and creating a facilitative framework of grid connectivity through the Indian Electricity Grid Code to developing market-based instruments like Renewable Energy Certificate (REC). The REC mechanism is seen as a major initiative towards promoting renewable energy and encouraging competition in this segment. It addresses the twin objectives of harnessing renewable energy sources in areas with high potential and compliance with Renewable Purchase Obligation (RPO) by resource-deficit states. This

important framework was formally launched in November 2010, heralding a new era in the development of green energy in India (Economic Survey 2011-12, 2012).

Moreover, the Government of India has recently launched the National Mission on Sustainable Habitat (NMSH) under the National Action Plan on Climate Change (NAPCC). The NMSH would also help in greening the Indian cities. The mission promotes energy efficiency in residential and commercial sectors by bridging the knowledge gap on designing green infrastructure, by ensuring better implementation of government schemes, and by offering appropriate financial incentives. It also asks for developing a comprehensive approach to managing water, solid waste and wastewater that takes into account potential for recycling, reuse and energy creation. Moreover, the refurbishing of urban transportation to increase usage and energy efficiency through a combination of promotional, regulatory and fiscal measures, including mandatory fuel efficiency standards to be notified shortly would be a step in greening the Indian cities.

Results also show that the emissions intensity of India's GDP declined by more than 30% during the period 1994-2007 due to the efforts and policies that India has proactively put in place.

In India, at the sub-national level, several city corporations have taken the lead in reducing carbon emissions. Some cities such as Gorakhpur, Surat, and Indore have taken up pilot projects for adaptation and mitigation of the impact of climate change in their cities. Indore, which has been affected by climate change in the form of rising temperatures and increasing incidence of non-monsoon drought, has identified potential pilot activities such as underground water storage and a volunteer-based water supply availability tracking system. Various carbon emission-reducing processes are gaining carbon credits in the Ahmedabad Municipal Corporation (AMC). Technologies involved in cutting electricity consumption in street lights, use of LED (light emitting diodes) lighting source, the BRTS mass transit system, green technologies and e-governance are part of this process. AMC has agreements with several companies with a profit-sharing arrangement for carbon credit trade.

Summary and conclusions

India's carbon emissions are currently are not alarming, given the low share of manufacturing in its GDP, but are likely to increase with the increasing role of manufacturing, urbanization, rising incomes and the use of personal vehicles. The government of India has resorted to a market based approach to containing pollution. In addition, at the sub-national level, cities are also doing their bit to reduce carbon emissions, and increasing green urbanization by making their buildings more energy efficient.

The more immediate problems of India's cities relate to inadequate solid waste management, poor sanitation and sewerage which lead to pollution of the ground water aquifer. While a new National Urban Sanitation Policy has been drafted and innovative methods are being adopted by cities with respect to their solid waste management (e.g., waste segregation), the challenges that remain to be addressed relate to financing of the huge urban infrastructure backlog along with that for future requirements.

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Table 1: Carbon Emissions in India's Cities

City	CO2 emission per capita (tons)	Corporation level emissions as % of city-level emissions
Asansol	0.25	3.63
Thiruvananthapuram	0.25	22.50
Jabalpur	0.30	7.80
Bhopal	0.31	8.83
Madurai	0.31	8.64
Tiruchirapalli	0.33	6.11
Nashik	0.34	8.94
Gwalior	0.37	6.09
Kochi	0.40	7.53
Indore	0.41	2.28
Kanpur	0.45	3.20
Sangli	0.52	3.40
Agra	0.64	10.29
Lucknow	0.64	20.77
Shimla	0.66	12.50
Nagpur	0.67	7.80
Rajkot	0.67	2.80
Dehra Dun	0.71	7.14
Guntur	0.71	1.72
Mysore	0.72	6.80
Udaipur	0.76	6.33
Bengaluru	0.82	4.14
Patna	0.83	7.10
Bhubaneshwar	0.84	1.17
Vijayawada	0.90	1.20
Chennai	0.91	2.68
Surat	0.91	3.48
Haldia	0.95	NA
Bhavnagar	1.11	2.39
Thane	1.15	2.88
Ahmedabad	1.20	2.91
Pune	1.31	2.16
Raipur	1.32	1.85
Coimbatore	1.37	0.67
Faridabad	1.58	2.06
Jaipur	1.63	4.22
Kolkata	1.83	2.15
Ranchi	1.97	0.06
Gurgaon	2.13	0.27
Vishakapatnam	2.25	0.32
Jamshedpur	2.76	NA
Average, all	0.93	5.30
Average, Metros	1.19	10.39
Average, Non-metros	0.90	4.72

Source: ICLEI-South Asia, Energy and Carbon Emissions Profiles of 54 South Asian Cities, 2009 and Sridhar (2010).

Table 2: Air and Water Pollution in India

Year	Air Quality			Water Quality		
	PM	SO ₂	NO ₂	BOD	Ln(Fcoli)	DO
1990	249.1	19.9	24.9	3.9	6.6	7.2
	44	43	43	273	205	275
2000	193.5	16.7	27.8	4	4.9	7.1
	68	71	71	313	270	311
2005	210.6	12.7	26.7	4.1	5.9	7.1
	97	86	93	310	285	308
2006	202.9	12	25	--	--	--
	116	104	115	--	--	--
2007	206.7	12.4	24.9	--	--	--
	125	106	124	--	--	--

Notes: Units are ug/m³ for all air pollutants; mg/l for BOD and DO; Ln(MPN/100 ml) for Fcoli.

Source: Greenstone and Hanna 2011

Table 3: Wastewater treatment capacity in urban areas in India in 2008

Category	No. of Cities	Total Water Supply (in MLD)	Wastewater Generation (in MLD)	Treatment Capacity (in MLD)
Class-I City	498	44,769.05	35,558.12	11,553.68 (32%)
Class-II town	410	3,324.83	2,696.7	233.7 (8%)
Total	908	48,093.88	38254	11787.38 (31%)

Source: CPCB 2008

Table 4: Annual health costs with pre Euro and Euro vehicle emissions standards in Delhi (Rupees in crores at 2000-2001 prices)

	Pre Euro	Euro I	Euro II	<i>Euro III</i>
<i>Annual health costs</i>	228	30	20	15

Source: Auto Fuel Committee of India (cited in Zhang, 2008).