



# POLICY Brief

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## THE BENEFITS OF CLEAN AIR – A CASE STUDY FROM INDIA

**In cities across South Asia, air pollution is fast becoming a critical problem. As vehicle congestion gets worse, industrialization expands, and energy use soars, air quality in urban centres is reaching potentially hazardous levels. This is producing a wide range of social and environmental problems, particularly with regard to people's health. This, in turn, is placing a significant economic burden on individuals and society in general, in terms of health costs and loss of economic productivity. Improving air quality calls for a wide-range of responses, many of which can be costly and therefore difficult to politically administer. To ensure that air clean-up policies are cost-effective and have the necessary political backing, it is vital that accurate information is available on the potential economic benefits of pollution.**

A new SANDEE study from India provides crucial evidence on the benefits of clean air. Using an innovative "health diary" approach to data collection, the study estimates the economic costs of air pollution in Kanpur, one of India's most polluted cities. The study finds that the potential annual benefit of bringing air pollution down to a safe level would be about Rs 213 million suggesting significant economic savings and incentive from this clean up.

### AIR POLLUTION IN KANPUR

Kanpur is the largest and most populous industrial city in the state of Uttar Pradesh. However, in recent years, Kanpur has acquired unwanted notoriety as the most polluted city in India in terms of residential air pollution. It is also the second most polluted city in India when it comes to industrial air contamination. Air pollution in the city has been linked to a high incidence of chronic illnesses such as asthma, tuberculosis and heart disease. This burgeoning health crisis has created widespread public concern. A number of policies and projects have been proposed to deal with this problem, but there is a pressing need for more information to

### WHY IS THIS EVALUATION NECESSARY?

Air pollution in the core areas of Kanpur is five to six times higher than prescribed standards. Specifically the level of RSPM (PM10) in residential and industrial areas of the city exceeds the National Ambient Air Quality Standards by 275%. Industrial activity and the city's fleet of mixed vehicles are the two main contributors to air pollution. The Central Pollution Control Board (CPCB) has developed an Environmental Management Plan (EMP) for Kanpur with a strong focus on air pollution reduction. The plan recommends an improvement in the city's road network by constructing more road corridors, and better regulation of traffic to decongest its residential and market areas. It also proposes the realignment of the city's Meter-Gauge (MG) Rail Track. The cost of the proposed measures underscores the need for Gupta's evaluation. Armed with information about the benefits of pollution clean up, policy makers will be able to assess the net gains from the EMP's recommendations.

This policy brief is based on SANDEE working paper No. 17-06, 'Valuation of Urban Air Pollution: A Case Study of Kanpur City in India', by Usha Gupta from Bhim Rao Ambedkar College, University of Delhi, Delhi, India. The full report is available at <http://www.sandeeonline.org>



help policy makers justify the necessary expenditures (see side bar).

This study, carried out by Usha Gupta of Delhi University, estimates the environmental benefits of reducing urban air pollution using a variant of the household health production function model (HHPF). The overall impact of air pollution on health is estimated as a sum of losses incurred due to lost work days and health expenses attributable to air pollution. The first item constitutes loss of income and productivity due to sicknesses caused by air pollution while second item constitutes the expenditures that people undertake to deal with ill health caused by air pollution. Such mitigation costs include expenditure on medicines, hospitalization, pathological tests and doctors' consultations.

Well-known air pollutants are total suspended particles (TSP), nitrogen oxides ( $\text{NO}_x$ ), sulphur dioxide ( $\text{SO}_2$ ) and respirable suspended particulate matter (RSPM). RSPM is particulate matter with a diameter of 10µm or less, also known as PM<sub>10</sub>. This study focuses, in particular, on RSPM, considered the most hazardous pollutant as it can penetrate deep into the respiratory tract and cause a wide range of respiratory and other illnesses. Many studies have found that RSPM pollution causes people to miss work and schooling. It is also linked to an increase in the number of visits people make to the doctor and to emergency rooms.

### COLLECTING HEALTH AND POLLUTION DATA

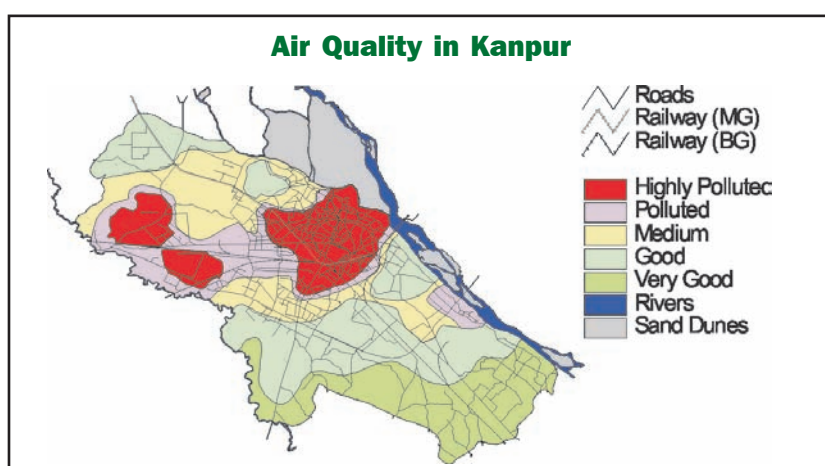
Comprehensive data on ambient air quality (particularly RSPM) and the weather conditions that affect pollution levels (like temperature and humidity) was collected from various pollution control bodies and the Meteorology Department to establish the link between pollution levels and health problems. The RSPM data was collected over a period of 18 weeks spread over three seasons (Summer, Winter and the Monsoon).

Information about peoples' socio-economic and demographic features, their health, and their mitigation efforts was collected from a representative sample of households lying within 1 km radius of the city's four functional air pollution monitoring stations. The survey, which lasted 18 weeks collected information from 815 working people.

### Source Distribution of PM<sub>10</sub> (RSPM) in Various Areas of Kanpur

Sources	Percentage of PM <sub>10</sub> (RSPM) contributed in various areas			
	Industrial	Commercial	Residential	Kerb side
Auto exhaust	-	-	-	16
Auto exhaust and diesel generation	32	22	39	-
Re-suspended dust	24	30	20	31
Secondary aerosol formation	12	8	-	10
Earth crust	-	-	6	14
Small scale industries	8	16	12	-
Other sources	24	24	23	29

Source: Auto Fuel Policy Report (2002)



To obtain an economic value, the average wage of a working person per day (Rs 207) was multiplied to the number of days lost due to pollution, which would give an annual gain of about Rs 130.39 per person per year. Kanpur, with a working population of about 0.84 million (out of a total population of 3 million), would gain Rs 109.53 million annually in terms of increased incomes.

### HIGH POLLUTION LEVELS – HIGH CLEAN-UP BENEFITS

Air pollution levels were found to be higher than the National Ambient Air Quality Standards even though there were wide variations in the recorded levels in the study area due to meteorological and weather conditions (see side bar for more details). The number of patients experiencing chronic illnesses such as asthma, tuberculosis, blood pressure and heart ailments was also found to be high. Crucially, these people are more susceptible to rising levels of air pollution.

Gupta calculates the impact of changes in air pollution concentrations on the health of a “representative person” by analyzing a number of variables, including weather and temperature, age, employment and health status. Since data was collected over a period of time, the panel data model, with time dependent and individual characteristics variables, has been used to estimate the coefficients.

Gupta first calculates how much lost work time per week a person would gain if RSPM levels fell by one  $\text{mg}/\text{m}^3$ . She then estimates the level of pollution reduction necessary to bring RSPM to the safe level of  $60 \text{ mg}/\text{m}^3$ . By combining these two results she finds that a representative person would gain 0.0121 days per week or 0.6292 days per year if pollution levels reduced to safe levels.

Gupta using a similar method calculates the reduction in health related expenditures that would occur if RSPM pollution is brought to safe level (i.e. the cost of mitigating activities). The per annum reduction in medical expenditure is expected to be Rs 34.43 for a representative person. Extrapolating this gain to the entire population in Kanpur, the citywide annual saving would be Rs 103.29 million.

### JUSTIFYING POLLUTION CLEAN UP

A reduction in air pollution to safe levels would therefore lead to higher incomes on the one hand and lower wealth expenses on the other. The sum of these gains annually for the city would



## SANDEE

The South Asian Network for Development and Environmental Economics (SANDEE) is a regional network that seeks to bring together analysts from the different countries in South Asia to address their development-environment problems. Its mission is to strengthen the capacity of individuals and institutions in South Asia to undertake research on the inter-linkages among economic development, poverty, and environmental change, and, to disseminate practical information that can be applied to development policies. SANDEE's activities cover Bangladesh, Bhutan, Nepal, India, Pakistan and Sri Lanka.

SANDEE's Policy Brief Series seek to inform a wide and general audience about research and policy findings from SANDEE studies.

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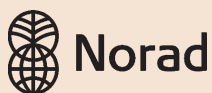
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be around Rs 212.82 million. This value is in line with earlier studies but is a conservative estimate of aggregate possible gains. It does not include various other gains from pollution reduction such as less time spent on travelling and waiting at the medical clinic. It also does not include economic gains from reduced discomfort caused by illness, improved recreation opportunities and reductions in pollution damage to buildings.

Gupta's study presents conclusive evidence of the considerable economic gains that would be achieved by a reduction in air pollution. Individuals would benefit significantly from reduced air pollution, due to reduction in the number of work days lost as well as medical expenses. Society as a whole would also benefit from increased economic productivity and from the fact that people would be able to play a fuller role in all aspects of society. Kanpur is a city that needs to act now to reduce air pollution. However, there are significant costs involved in any attempt to improve air quality. The estimates of benefits or welfare gains from air pollution reduction obtained in this paper should help justify these costs.

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