An Economic Analysis of Air Pollution: A Case Study of Lucknow, India

ABSTRACT

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BABASAHEB BHIMRAO AMBEDKAR UNIVERSITY
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PROF. SANATAN NAYAK

Submitted by

VANDANA AHIRWAR

DEPARTMENT OF ECONOMICS
SCHOOL OF ECONOMICS AND COMMERCE
BABASAHEB BHIMRAO AMBEDKAR UNIVERSITY
(A CENTRAL UNIVERSITY)
VidyaVihar, Raebareli Road Lucknow-226025(U.P.), India

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ABSTRACT

The environment is affected by human and natural causes and creates environmental degradation condition. Natural causes are heavy rain, floods, storms, earthquakes, volcanoes, etc. However, anthropogenic causes are highly responsible for environmental problems in recent decades. Due to human-induced activities such as industrial process, deforestation, heavy transport system, chemical effluents, change land use patterns cause an increase in gases like SO_2, CO_2 consequently pollution level increases at the global level. The relationship between economic development and environmental degradation has been a source of great controversy for quite a long time. Environmental pollution denotes to the contamination of the earth's ecological balance with materials that interfere with human health, quality of life or the natural functioning of the ecosystems. Therefore, environment and pollution relationship have become a subject of intense public debate on sustainable development. Air pollution is a major global public health risk as well as it is one of the highest-ranking environmental health challenges in the world. In India, air pollution has rapidly increased due to amplified use of fossil fuel, industrialization and large use of vehicles. Therefore, the health problems are rising by air pollution especially outdoor air pollution.

The organization of the thesis is given below:

Chapter 1 "**Economic Development and Environmental Degradation: Theoretical and Conceptual Development"** shows the linkage between environmental degradation and economic development. This chapter covers the part of environmental pollution, historical background of the development and environment, climate change, greenhouse gas emissions, and air pollution. This is further described the selection of the study area, objectives and hypothesis of the study.

Chapter 2 "**Air Pollution and Economic Development: Theoretical Linkage**" is related to the review of literature of the study. These review divided into five parts such as reviews of Environmental Kuznets Curve, air pollution of International level, air pollution of National level, health cost reviews and willingness to pay related reviews.

Chapter 3 **"Extent, Dimensions and Negotiation of Carbon Dioxide Emission"** is based on the secondary data and ten countries are taken for the analysis. This is shows the empirical results of the GDP and carbon dioxide emissions related to the environmental Kuznets curve.

Chapter 4 is "**Air Pollution in India: Acts, Institutions, Mechanisms & Budgeting"** related to the air pollution situation of India. This is included scenario of air pollution acts, regulation, air pollution control boards, air quality index, and budget allocation for environment.

Chapter 5 "**health cost measurement of the surveyed area**" is find out the perception of pollution level in the study area and analysis the health cost (include direct cost and indirect cost) with the help of statistical model.

Chapter 6 "**Willingness to Pay for Reduction of Health Cost in Surveyed Area"** is used reduction of health cost and air pollution. To estimate the environmental health field, contingent is a common method for asses quantifies a person's willingness to pay for better environmental services. The data has been analysed with the socioeconomic characteristics such as employment, income, education, caste etc.

To enable economic activities, the environment provides other services like sequestering carbon, filtering air and water pollution, protecting against flood risk, and soil formation (Everett Tim et.al, 2010, p.12). Therefore, ecological economics is related to the limits of natural capital to handle human impact and the potential for human systems to maintain human well-being. Well-being is a multi-dimensional phenomenon and it is based on the many key dimensions such as material living standards (income, consumption), health, education, personal activities including work, political voice and governance, social connections and relationships, environment (present and future condition) and uncertainty (economic and physical nature). People are more able to respond to difficult circumstances with the other people with a higher level of well-being. Thus, the well-being of a society can be explained as an advantage for all people in the society which is suggesting the achievement of economic development (Ivkovic, A.F., et.al., 2014, p. 2). The environment provides the raw material for economic development in terms of natural resources. The natural resource consists of water, land and plants. Basically, natural

resources are divided into two categories, renewable and non-renewable natural resources. Renewable resources have properties that are easily available for reuse. However, non-renewable resources are not easily available for reuse. Moreover, the use of non-renewable resources cause many types of environmental related problems viz., erratic pattern of rainfall, shifting in climatic pattern, warmer days in cold areas and more cold days in warmer areas. This further leads to several kinds of economic obstacles as well as health-related problems (IPCC, 2007; UNEP, 2009).

many case studies linked to air pollution and the environment. In India, outdoor air pollution is mainly to urban areas due to large scale automobiles with a concentration of industries and thermal power plants in major industries and some other areas. Industries (toxic gases), thermal power plants (fly ash and sulphur dioxide), and motor vehicles (carbon monoxide, particulate matter, hydrocarbons and oxides of nitrogen) are the major sources of air pollution in India. Air pollution and health status studies with World Health Organisation estimation report and Global Burden Diseases reports. It shows the health effect due to the particular pollutants and number of death separately. Major concerns for human health by exposure with PM10 include effects on breathing and respiratory system, loss of lung tissue, cancer and premature death. Economic cost of air pollution. Economics of air pollution is directed to measure the cost for individuals and society on a large extent. Economic activity generates air pollution, which imposed its biophysical effects (morbidity and mortality) on economic cost. The purpose of health economics is to determine the cost of any disease, which is different from the mortality rates of people associated with morbidity. Thanafter air pollution and willingness to pay described the non-market valuation method. Where contingent valuation method is created a hypothetical market. Because CVM is a useful tool to deal with this type of issue because it can obtain a monetary value for an intangible good that does not have market value. Individual's willingness to pay (WTP) for a specific reduction in air pollution is strongly related to general health risks and the impact of the current level of air pollution on the environment. This also concluded the many studies of air pollution and willingness to pay in different countries.

The concept of sustainable development does indicate the limits, but not an absolute limit to the use of resources. Therefore, our common future emphasized an approach

to development that meets basic needs but is limited by the environment's ability to meet present and future needs. Thus, our common future identified some planned interventions for sustainable development like reviving economic growth, improving the quality of growth while ensuring environmental and social soundness, conserving and enhancing the natural resource base, stabilizing population levels etc. (Katerere Mohamed, 2007, p.8

Global level analysis of economic development and environmental degradation. First, the concentration of atmospheric carbon dioxide rises from 288 parts per million (ppm) approximately 200 years ago (before the Industrial Revolution began) to 391 ppm in 2010. World CO_2 emission is rising mostly by the use of fossil fuel in the energy sector and from some part of land use change. The key sectors of the economy use energy are industry, residential, commercial buildings, and transportation.

Second, shows the empirical analysis of the Environmental Kuznets Curve based on secondary data of GDP and carbon dioxide emission (1990 to 2014) in five developed and developing countries. This shows the trend of CO_2 emissions, panel data analysis of EKC based on fixed effect model and random effect model, and regression results. The shape of EKC is depended on the sign of the different β parameters related to GDP. Data has proved that developed countries follow the EKC model hypothesis but individual country level data is not significant that means its emission increase due to economic development. Therefore, N-shaped found in the graph. Developing countries highly responsible for carbon emissions in the present time especially BRICS nations. The analysis also found a positive relationship between carbon emissions and economic development.

Third, covers the theoretical framework of climate change and sustainable development. Where, three issues are related to climate change, scientific approach of climate change, economic approach to understand climate change and international treaties on global climate change. International treaties on global climate change cover the scenario and negotiations of climate change from 1979 to 2018. This also shows the flexible mechanism for controlling climate change.

Forth, it is found that climate change is continuously increased while many rule, agenda, and target decided after the Kyoto protocol. Due to CO2 emissions, global

warming increasing day to day that is dangers for human health. Developed and developing countries are committing but no control of GHGs emission especially carbon dioxide emissions. Because in the Bali conference it was recommended that cut in carbon emissions 25 to 40 per cent in the advanced industrial countries by 2020 and total world emission reduction of 50 percent by 2050.

In India, Many enactments are linked to health, pollution and environment in India viz., The Air (Prevention & Control of Pollution) Act, 1981, motor vehicle act, 1988. Second, described the administrative structure for air pollution protection in India. Various institutes are working at centre and state level under the government of India. Where, the Ministry of Environment & Forest was established in 1985 by the government of India for environmental protection for is making planning, promotion, co-ordination and overseeing the implementation of environmental and forestry programs and policies. Central pollution control board and its functions are measured the air quality data and prepared the air quality index.

The pollutant related health index and measures the air quality in terms of cubic meter for 24 hours. Secondary level data analysis is based on the pollutant and finds the average from 2007 to 2017. First is particulate matter, the analysis is found that most of the cities that cross in the trend line. Delhi pollution is level highest as well most of the cities of Uttar Pradesh are pollution such as Agra, Kanpur and Lucknow. Second sulphur dioxide, due to this pollutant, Pune is the highest polluted and Ahmadabad is second. Third, nitrogen oxide that is highest in Delhi, Kolkata and Pune due to the vehicular cities. Urbanization is the main cause to increase of this pollutant in these cities. The mean of pollutants are high in these cities duribg 2007 to 2017. While the budget allocation shows increasing growth rate in the same time period. However, the rising budget allocation on environment is based on market price but not the constant price. Further, the allocation of budget reflects that substantial proportion, i.e, nearly 97 percent is spent on the category of revenue expenditure and 2.5 percent is spent of capital account. Therefore, the growth in terms of institutional development is poor and insufficient.

the socio-economic condition, there are 230 households, 51.94 percent found from the Hindu community and 47.70 percent from Muslim community and rest 0.36 percent from the Christian group. Caste wise analysis is 43.55 percent of General

category, OBC 42.74 percent and SC 13.71 percent. Gender wise classification is 51.85 percent males and 48.15 females analysed. Other part related to perception about the air quality in the study area. Where, air quality awareness, 97.83 percent people are aware of environmental pollution and 2.17 percent are not aware. Approximately 93.48 percent agree for air pollution is a serious problem and 6.52 percent disagree as well as 91.3 percent people are facing outdoor air pollution and 8.7 percent are not facing in both the study area. The condition of air quality shows that the percentage share of the critical condition is 46.10 percent, which is representing the high rank and 27.66 percent population agree for very serious and only 2.13 percent person agrees only for not important. Therefore, it is found that the study area is highly affected by air pollution and people are suffering from many problems. There are four categories of the nature of air pollution such as smoke, smog, dust and other problems. There are 26.62 and 25.37 percent of respondents suffering from smoke and smog-induced air pollution problems respectively. Dust is also a common problem and 39.83 percent people are facing this problem. Season-wise nearly 57 percent people agree for all year round which is very highest and 20 percent person is suggesting for the winter season and 6 percent of the rainy season. There are five sources responsible for air pollution which are vehicles running on the road, smoke from combustion of coal/wood, windblown dust, burning of garbage and grass, and other. The percentage share of windblown dust is highest which is 27.03 and 26.86 percent of the vehicles entrained which is also high it is mostly found in a commercial area (Sarai Mali Khan) and other sources are very low which is only 3.18 percent.

Cost of illness is also high in the study area. The direct cost of the study area is Rs. 406.44 per month, as well as the indirect cost, is 90.26 Rs. Therefore, the total cost of the study area is Rs. 496.70 per month. All models are significant and logit analysis is also significant. it is found that there is no government regulations implemented for industries. They have not provided the medical facilities at the industrial level for the occupational induced disease. They also take more working hours and because of the arbitrariness of the contractors, they are forced to work at low wages. Therefore, workers economic condition is substantially poor and facing many health problems caused by their occupation. Due to availability of air borne pollutants cause to high

health cost. The prevalence of high health cost is due to more working hours, low wage rate and poor health protection by the employment.

willingness to pay method is using to reduce the probability of death. This refers to an individual's own risk. To estimate the environmental health field, contingent is a common method for asses quantifies a person's willingness to pay for better environmental services. In the study area, the results show that most of the respondent is willing to pay to reduce the health problem which they are facing. Where Approximately 93.04 percent person agrees to give monthly the willingness to pay to save their life and 6.96 percent people are disagree for willingness to pay in the study area. As well as the percentage of yearly willingness to pay is 87.83 percent for agreeing and 12.17 percent people disagree for reducing health cost and air pollution.

Second is socio-economic condition wise willingness to pay. Where, the average WTP of the lower income group is Rs. 180.46 per month. The highest mean WTP found in the upper-income group which is Rs. 304.412 per month. It is also analyses that income has a direct relationship with WTP. Therefore, income is an important determinant of WTP for a reduction of health cost.

Education of the respondents also influences for WTP. Where, monthly and yearly WTP is Rs. 176.19 and Rs. 769.85 for the illiterate category. Due to awareness, the highest WTP is found for postgraduate and other categories people. Education wise monthly average WTP is Rs. 237.62 and as well as yearly WTP is Rs. 954. Therefore, it is suggested that WTP is continuously increased with rising literacy and people want to pay the maximum amount for reducing air pollution.

Category wise, the average of WTP general category is Rs. 222.16 per month and same is for the SC category which is Rs. 222.23 per month. The WTO for the OBC category is Rs. 255.56 per month, which is the highest. The same condition shows for the yearly WTP, where OBC category wants to pay the highest amount. Therefore, it is found that caste wise willingness to pay does not a direct relationship.

Occupation wise the mean WTP for the public and private sector is observed an employee in the industrial sector is Rs. 325 & Rs.219 respondent. The same situation is true for yearly WTP in the study area, where government employees want to pay

more amounts and due to lack of income, private sector worker want to pay less amount. It observed that public sector employees earn more income than private sector employees. Therefore, their WTP is high. This also shows the direct relationship between employment and WTP.

It is observed that there is a direct relationship between willingness to pay and socio-economic characteristics in terms of income, education, occupation. Income is the main indicator of observing WTP. When income rises, along with better education and employment, the WTP rises. Various models is used to check the probability of willingness to pay and it is found that educational qualification, employment patter as well as income are important indicators for increase WTP and reduction of health cost. The workers in private and public working regularly on temporary willingness to pay. While the WTP is highest found by the government employees because they are earn more income. Therefore, it is conclude that the willingness to pay increases where the high educational qualification, better occupation and high income is involved. For the cleanliness of air and good health of the area, government should impose the taxes for clean air and provide some facilities such as plantation, public park, and subsidiary tools like mask for good health.