AN EMPIRICAL STUDY ABOUT WATER POLLUTION IN INDIA

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INTRODUCTION

Water pollution is a serious problem in India as almost 70 per cent of its surface water resources and a growing percentage of its groundwater reserves are contaminated by biological, toxic, organic, and inorganic pollutants. In many cases, these sources have been rendered unsafe for human consumption as well as for other activities, such as irrigation and industrial needs. This shows that degraded water quality can contribute to water scarcity as it limits its availability for both human use and for the ecosystem.

In 1995, the Central Pollution Control Board (CPCB) identified severely polluted stretches on 18 major rivers in India. Not surprisingly, a majority of these stretches were found in and around large urban areas. The high incidence of severe contamination near urban areas indicates that the industrial and domes-tic sectors' contribution to water pollution is much higher than their relative importance implied in the Indian economy. Agricultural activities also contribute in terms of overall impact on water quality. Besides a rapidly depleting groundwater table in different parts, the country faces another major problem on the water front—groundwater contamination—a problem which has affected as many as 19 states, including Delhi. Geo-genic contaminants, including salinity, iron, fluoride, and arsenic have affected groundwater in over 200 districts spread across 19 states.

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Extent of Water Pollution in India

The level of water pollution in the country can be gauged by the status of water quality around India. The water quality monitoring results carried out by CPCB particularly with respect to the indicator of oxygen consuming substances (biochemical oxygen demand, BOD) and the indicator of pathogenic bacteria (total coliform and faecal coliform) show that there is gradual degradation in water quality (CPCB 2009). During 1995–2009, the number of observed sample with BOD values less than 3 mg/l were between 57–69 per cent; in 2007 the observed samples were 69 per cent. Similarly, during this period of 15 years between 17–28 per cent of the samples observed BOD value between 3-6 mg/l and the maximum number of samples in this category were observed in 1998. It was observed that the number of observations remained unchanged and followed a static trend in percentage of observations having BOD between 3–6 mg/l. The number of observed BOD value > 6 mg/l was between 13 and 19 per cent during 1995–2009, and the maximum value of 19 per cent was observed in 2001, 2002, and 2009. It was observed that there was a gradual decrease in the BOD levels and in 2009, 17 per cent had BOD value > 6 mg/1. The worrying aspect of this trend is the high percentage (19 per cent) of sampling stations exhibiting unacceptable levels of BOD, which might either mean that the discharge sources are not complying with the standards or even after their compliance their high quantum of discharge contributes to elevated levels of contaminants (Rajaram and Das 2008). However, the status of water quality cannot be adequately assessed through monitoring of basic parameters in the current inadequate number of sampling stations.

Another aspect of water pollution in India is inadequate infrastructure, comprising of monitoring stations and frequency of monitoring for monitoring pollution. Monitoring is conducted by CPCB at 1,700 stations, under a global environment monitoring system (GEMS) and Monitoring of Indian National Aquatic Resources (MINARS) programmes (CPCB 2009). There is an urgent need to increase the number of monitoring stations from their current number, which translate as one station per 1,935 km^2 to levels found in developed nations for effective monitoring. For example, in the state of Arkansas in the US there are monitoring stations per 356

km^2 (Rajaram and Das 2008). CPCB (2009) also reports the frequency of monitoring in the country. It is observed that 32 per cent of the stations have frequency of monitoring on a monthly basis, 28.82 per cent on a half-yearly basis, and 38.64 per cent on a quarterly basis. This indicates the need for not only increasing the number of monitoring stations but also the frequency of monitoring.

The water quality monitoring results obtained by CPCB during 1995 to 2009 indicate that organic and bacterial contamination was critical in the water bodies. The main cause for such contamination is discharge of domestic and industrial wastewater in water bodies mostly in an untreated form from urban centres.

Effects of Water Pollution

Lack of water, sanitation, and hygiene results in the loss of 0.4 million lives while air pollution contributes to the death of 0.52 million people annually in India (WHO 2007). Environmental factors contribute to 60 years of ill-health per 1,000 population in India compared to 54 in Russia, 37 in Brazil, and 34 in China. The socio-economic costs of water pollution are extremely high: 1.5 million children under 5 years die each year due to water related diseases, 200 million person days

Murty and Kumar (2004) estimated the cost of industrial water pollution abatement and found that these costs account for about 2.5 per cent of industrial GDP in India. Parikh (2004) shows that the cost of avoidance is much lower than damage costs. According to one estimate (Parikh 2004), India lost about Rs 366 billions, which account for about 3.95 per cent of the GDP, due to ill effects of water pollution and poor sanitation facilities in 1995. If India had made efforts for mitigating these effects in terms of providing better sanitation facilities and doing abatement of water pollution the required resources had ranged between 1.73 to 2.2 per cent of GDP. It may however, be emphasized that these damage costs do not fully reflect the loss in social welfare. These estimates only suggest that the abatement of pollution is socially desirable and economically justified.

Regulation of Water Pollution

Environmental policies are designed to alter the behavior of economic agents, either individuals or group of individuals, in such a manner that the environmental externalities generated during the course of individual actions are internalized. As shown in Figure 19.3 policy responses can be classified into two categories: formal and informal. A legislative response requires policy responses mandated by the state.

Informal Regulation and People's Participation

Economic instruments and command and controls are instruments of formal regulation. The designing and implementation of these instruments involves a top-down or a centralized approach. The success of these instruments in controlling pollution depends upon the quality of governance and its ability to incur high trans-action costs. A bottom-up or decentralized regulation involving civic society and local communities and with a very limited role of the government could save trans-action costs and get rid of political and bureaucratic

The management of environmental resources can no longer be taken as the responsibility of a single institution like a market or the government (Murty 2008). The now well-known limitations of either the market or the government in managing the environment have paved the way for a mixture of institutions. Market agents, consumers, producers, and stockholders have incentives for controlling pollution. Consumers regulate the market for pollution intensive commodities by expressing preferences for green products or commodities produced using cleaner technologies. Investors also have incentives to invest in industries using cleaner technologies.

Higher level of observed pollution in a firm is an indication to the investors that the firm uses inefficient technology resulting in the loss of profits. Profit losses may occur because of reduced demand for its products by green consumers, increased costs due to higher penalties imposed by the government for non-compliance with pollution standards, and the settlement of compensation to victims. In this case there may be a downward revaluation of the firm's stocks in the capital market. On the other hand, a good environmental performance by a firm may result in an upward evaluation of its stocks (Murty 2008).

Informal regulation by local communities is resulting in factories complying with standards as explained by the examples given earlier. The amount of influence that the local communities exert on factories to undertake pollution depends, among other factors, upon their affluence, the degree of political organization, education, and environmental awareness. Pargal and Wheeler (1996) found a negative relationship between BOD load in a factory effluent and per capita income and educational levels of local communities in a sample of 243 factories in Indonesia. Similarly, Murty and Prasad (1999) found a negative relationship between the BOD effluent -influent ratio and a relative index of development of local community, and the political activity of the local community measured in terms of percentage of votes polled in the recent elections to the Indian Parliament.

Collective action constitutes costs to factories, the government, and affected parties. Factories incur the cost of abatement to meet standards. The effected people incur the cost of public litigation cases and the cost of organizing themselves as a society. The government incurs the cost of financial incentives provided to the factories. We now discuss a method of estimating cost to factories is given with a case study.

Economic Instruments and Institutions

The discussion so far indicates that choices for policy responses will involve some mix of regulatory and market-based instruments, but this policy analysis must be done with respect to specific problems that need to be solved. Based on an analysis of the application of incentive based policies in other countries, Table 19.4 provides an inventory of economic instruments available and the targets that they are supposed to address.

The first three policy options are suited for municipalities' to reduce water pollution and the remaining policy options are better suited for reducing industrial water affluent. To address the problem of urban waste-water treatment for better handling of organic wastes coupled with chronic revenue shortages for such investments, introduction of wastewater user fees could be a strong consideration. Similarly, as a potential corollary to enhanced revenues from higher service fees (and possible partial privatization), considering increased government subsidies for wastewater treatment system development—common in many countries—is also deemed to merit a careful analysis. Groundwater contamination has been observed from leaking septic fields and the dumping of waste from cesspits into canals.

Policy Implications

Measuring water pollution, estimating benefits from reduced pollution, and designing regulatory instruments for environmental improvements require inter-disciplinary approaches. Detailed studies are needed to establish relationships between pollution at sources and ambient pollution of surface water bodies and ground-water resources. Some useful work on river quality modelling has been already going on in India but many more studies are needed for identifying the changes in water quality due to anthropogenic activities. Data of physical accounts of environmental changes are needed for the valuation of environmental services and the design of environmental policy instruments. Environmental valuation is central for natural re-source management. It is required for designing an environmental policy and environmental accounting for estimating a green GDP. Environmental value could be measured either as cost of abatement of environmental changes or the value that the households place on these changes. There are already a few studies about benefits and costs of water pollution abatement in India but many more detailed studies are needed.

There is an urgent need of increasing the number of monitoring stations in India to levels found in developed nations for effective monitoring. Moreover, presently the scope of monitoring is limited to conventional compounds (such as BOD, total suspended solids, faecal coli form, and oil and grease), which needs to be expanded to non-conventional pollutants, such as ammonia, chlorine, and iron also which have hazardous health impacts. Effective regulation requires that the monitoring responsibilities should be devolved to the states and further down to local bodies.

Note also that though India has defined wastewater discharge standards for the domestic and industrial sectors, there are no discharge standards for the pollution emanating from agriculture. Agriculture is the source of non-point water pollution and agricultural water pollution is linked, among other things, to the use of fertilizers and pesticides. Therefore, corrections in fertilizer and pesticide and electricity pricing policies could be an instrument for addressing the non-point water pollution in India.

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