Sources of government failure and the environmental externality: analysis of groundwater pollution in Tamil Nadu, India

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Abstract

Groundwater pollution and its associated social costs were traditionally considered as the outcome of “market failure”. However, in recent years it has been argued that pollution-related issues can be attributed to the failure of government as well. The literature on “externality” has identified different sources of government failure. In this paper, we have identified certain specific sources of government failure that are potentially affecting the groundwater quality in the state of Tamil Nadu, India. The major sources that we have identified are: the inappropriate approach used by the government agencies to assess the quantity and quality of water resources potential in the state; the inability of the government sector to account for the resulting environmental damage and the lack of coordination between different agencies/institutions involved in managing the water resources in the state. Some remedial measures are also suggested.

Keywords: Groundwater pollution; Government failure; Institutions; Damage assessment; Tamil Nadu

Introduction

Negative externalities such as water pollution cause divergence between the private marginal cost and social marginal cost of polluting activity (Pigou, 1932). In a market system where negative externality exists, the market price of the polluting commodity reflects only the private marginal cost, leaving the social marginal cost to be borne by the third parties. This is the basic principle of the “theory of market failure” (see for example, Verhoef, 1999), which dominates the academic discourse of the theory of pollution control. However, it has been argued that the negative externality cannot be entirely attributed to market failure but it can also arise from “government failure”1 (see, Panayotou, 1993; Dasgupta,

1 Also called policy failure.

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Government failure can be traced to many different biases such as: (a) government intervention in otherwise efficiently functioning markets through taxation or subsidy; (b) government regulation that results in more than an optimal level of intervention in private activities or non-intervention of government in areas where such an intervention is very much required; (c) the “rent-seeking behaviour” of government organisations especially in areas of natural resource management; and (d) governments’ failure to respond adequately to the increased need for adopting changes in the macroeconomic and sectoral policies (see Maler & Munasinghe, 1996; Panayotou, 1993). These biases ultimately lead to inefficient allocation of environmental resources at the micro level. The net result is increased levels of social costs in the economy, which is normally unaccounted for anywhere in the system. It should be noted that if the negative externality is not properly internalised at the micro level, then the cumulative effects of the accumulated social costs in the economy will make the development “unsustainable” (see Ahmed et al., 1989).

One of the important aspects noted in the literature that deals with government or policy failure is that the analysis of market failure focuses mainly on how government intervention or non-intervention in macroeconomic or sectoral policies led to distortion of the market prices. In other words, many studies on this subject place importance on the biases cited above and neglect the following two biases, which make substantial distortions in the efficiency of the institutions in countries like India. These biases are: (a) inadequate approaches and methodologies used by the government agencies, which improperly estimate the demand and supply of the resources as well as future projections in these areas; and (b) lower level or absence of proper interaction between various government agencies dealing with resource policies. This paper tries to highlight how the governments’ failure to adopt a holistic approach to assessing pollution-related issues and lack of coordination between different policy-making bodies within the government sector led to increased level of social cost. The paper highlights specific sources of government failure with reference to groundwater pollution in Tamil Nadu, India.

Nature and sources of government failure in Tamil Nadu, India

The groundwater sector in Tamil Nadu at present experiences two major forms of negative externality, namely “depletion” and “degradation”. While the depletion of groundwater is caused mainly by overexploitation, the degradation issue arises from the reduction in the quality of groundwater caused by pollution from industries, sewage from urban areas and seawater intrusion. Until recently, the focus of the policy makers and the researchers concerned with groundwater sector in the state has been mainly on how to address the issue of depletion of groundwater in the state. For instance, the policy makers concerned with the water sector have taken serious note of the problems arising from depletion and taken action to regulate and control groundwater exploitation.2 Empirical studies on the groundwater sector have highlighted how the depletion of groundwater resources in the past has resulted in a “conflict” or “trade-off” between different users in the state (see Janakarajan, 1999). The trade-off would

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2 A recently proposed Tamil Nadu Groundwater (Development and Management) Bill has provision for establishing a Groundwater Authority to: (i) notify areas for development, control and regulation of groundwater; (ii) grant a certificate of registration; (iii) prohibit sinking wells in notified areas without permission; (iv) register new wells; (v) grant permission to transport groundwater from the notified areas; (vi) curb the Tamil Nadu State Electricity Board (TNEB) from providing electricity to unauthorised wells (IDA, 2003).
result in a non-Pareto optimal situation in which a considerable number of economic agents would become worse off and this would widen the gap, not only between different agents within the sector (such as small versus large farmers in the agricultural sector; small units versus large units in the industrial sector; and so on), but also between those in different sectors (farmers versus industrialists). Depletion leading to irreversibility would affect the “sustainability” of the economy in general and the agriculture sector in particular, thereby increasing the social cost manifold.

In recent years, the degradation of the quality of groundwater caused mainly by industrial pollution and urban sewage has become a serious issue in the state (Government of Tamil Nadu, 2000a). Pollution and its impact on the groundwater quality in the state became the subject of major concern even during the early part of the 1980s (see, Narayana Murty, 1987). Highly polluting industrial units such as leather tanning, bleaching and dying, and so on, in the state have caused and are causing irreversible damage to water and land resources, which may be attributed mainly to the non-compliance of existing polluting units. Moreover, assuming that the percentage of defaulters would continue at the same rate accompanied by an increase in the form of an additional number of polluting units owing to industrial growth in the future, the pollution menace has a lot of implications for groundwater quality in the coming years.

Apart from industrial pollution, the sewage from urban and municipal areas is another major problem that causes degradation of groundwater resources. As much as 85% of the water used in the household sector comes as wastewater and pollutes the surface and groundwater sources directly. Moreover, rapid urbanisation process in the state would result in increased level of sewage and solid waste, which would accelerate the rate of deterioration of water quality in the future.

Degradation severely affects the trade-off between different users of the groundwater resource, which would increase the “social cost” phenomenally. The social cost resulting from degradation takes many different forms such as cost of increased mortality and morbidity among human beings and animals, cost of increased time spent collecting water from distant sources and cost of purchasing water from the private water markets. It should be noted that, as far as the Tamil Nadu economy is concerned, the social cost imposed by degradation of groundwater is not properly accounted for either at the micro or macro level. Many of the development and environmental projects are cleared only on the basis of arbitrary benefit–cost analyses that largely neglect the social costs and benefits. At the macro level, these costs and benefits do not find any place in the estimation of state GDP. This is because most social costs are “non-market” costs in nature and the traditional “market based approach” to estimate the GDP neglects these non-market social costs. Hence, the state income is “overstated” and therefore, the GDP or its proxies (such as, NDP) do not fully reflect whether the income is sustainable or not.

At the policy level, both the central government as well as the state government have initiated several measures to contain the ever-increasing pollution in the state. This is evident from policy initiatives such as establishment of the Tamil Nadu Pollution Control Board, establishment of the Department of Environment and Forests, creating environmental cells in the Water Resources Organisation (WRO) in the Public Works Department (PWD), enactment of water pollution prevention acts, and so on. However, pollution continues to be a dominant issue in the state, despite these initiatives by government agencies. This may be attributed mainly to “inadequate approaches” adopted by the government sectors with regard to pollution prevention. In other words, the causes and effects of groundwater pollution in  

3 See Janakarajan (1999) for a very good description of the pollution scenario in some of the important river basins in the state.
the state could be well addressed through setting relevant institutions for water resource management in the state and by taking appropriate policy measures targeting specifically the issues of groundwater degradation.

This paper, in its first part, analyses government failure from two different aspects, namely (i) the lacuna in the existing approach adopted by the government to assess the groundwater potential; and (ii) government’s neglect of the economic impact of the externality problem caused by deterioration of groundwater quality in the state. The final part of this paper provides some remedial measures such as institutional strengthening and prescriptions for appropriate policy to mitigate the negative impact of degradation of groundwater.

Problem with the current approach in assessing the groundwater potential

The water balance study conducted by the Institute for Water Studies (IWS), Chennai, indicated a total water potential available from all the sources to be 28,361 MCM (million cubic metres) for the entire state, while the demand from all the uses was estimated to be 31,821 MCM in year 1994 (see Table 1).

Of the total amount of available water the groundwater constitutes 15,346 MCM, or approximately 54% of the total amount. Since the surface water use, especially for irrigation purposes, which constitutes around 85% of the total water demand, is declining over a period of time a greater dependence on the groundwater sources is expected in the state in coming years. The existing situation with the groundwater potential in the state is also not encouraging. For example, the Groundwater Resources Estimation Committee (1995) constituted by the Government of India estimated that of all the 384 blocks in Tamil Nadu, 85 blocks (or 22%) were classified as “over-exploited and critical blocks”, 83 blocks (or 21.6%) as “semi-critical category” and 215 blocks (or 55.9%) as “safe blocks”. On the whole, the situation regarding the groundwater potential in the state poses serious consequences for future development.

Though a deficit of 3460 MCM was arrived at in quantity terms, it is argued that this level of deficit was not considered to pose a serious threat on the use sectors (see Janakarajan, 1999). In the estimates

Table 1. Estimation of water demands by different users in the state (in MCM).

<table>
<thead>
<tr>
<th>Users</th>
<th>1994</th>
<th>1999</th>
<th>2004</th>
<th>2025</th>
<th>2050</th>
</tr>
</thead>
<tbody>
<tr>
<td>Household</td>
<td>916 (2.88)</td>
<td>1002 (3.11)</td>
<td>1090 (3.35)</td>
<td>1452 (4.26)</td>
<td>1898 (5.32)</td>
</tr>
<tr>
<td>Agriculture</td>
<td>29,981 (94.22)</td>
<td>30,026 (93.23)</td>
<td>30,025 (92.30)</td>
<td>30,234 (88.72)</td>
<td>30,236 (84.73)</td>
</tr>
<tr>
<td>Industry</td>
<td>461 (1.45)</td>
<td>692 (2.15)</td>
<td>924 (2.84)</td>
<td>1891 (5.55)</td>
<td>3044 (8.53)</td>
</tr>
<tr>
<td>Livestock</td>
<td>388 (1.22)</td>
<td>386 (1.20)</td>
<td>387 (1.19)</td>
<td>388 (1.14)</td>
<td>385 (1.08)</td>
</tr>
<tr>
<td>Hydropower</td>
<td>35 (0.11)</td>
<td>61 (0.19)</td>
<td>65 (0.20)</td>
<td>72 (0.21)</td>
<td>79 (0.22)</td>
</tr>
<tr>
<td>Environment</td>
<td>40 (0.12)</td>
<td>39 (0.12)</td>
<td>39 (0.12)</td>
<td>41 (0.12)</td>
<td>39 (0.11)</td>
</tr>
<tr>
<td>Total (in MCM)</td>
<td>31,821 (100)</td>
<td>32,206 (100)</td>
<td>32,530 (100)</td>
<td>34,078 (100)</td>
<td>35,682 (100)</td>
</tr>
</tbody>
</table>

Source: IWS, Chennai. Figure in the parentheses refer to the percentage.

4 This figure excludes the water resources in the Cauvery basin where a legal dispute is going on between the Tamil Nadu and Karnataka states over the allocation water in the basin.

5 Overexploited – groundwater development is greater than 100% of annual recharge; semi-critical block – development greater than 70% and less than 100%; and safe block – development less than 70%.
made by the government agencies, it is assumed that even the projected deficit for major water users for the years 1999, 2004, 2019 and 2044 which stand at 2729 MCM, 2995 MCM, 2481 MCM and 2926 MCM, respectively could be met by water augmentation measures such as prevention of run-off into the sea and rainwater harvesting. The basic assumption is that even if there exists scarcity of water at the macro level, this scarcity problem would be resolved by way of incurring “additional expenditure” on water augmenting measures by taking structural measures such as constructing percolation ponds, check dams and rainwater harvesting structures that would recharge groundwater. On the demand side, it is assumed that there is a lot of scope for improving upon the water use efficiency by water conserving technology in the agriculture and industrial sectors, and so on. From the above discussion, it is evident that the government agencies are of the strong opinion that the problem of water scarcity in the state in future will be a “non-issue”, because additional expenditure in the water sector would resolve the scarcity problem. However, trying to project a non-issue scenario at the macro level will be problematic. Analysing the quantification issue at the disaggregated level, especially at the river basin as well as at the user level, will however reveal the true picture of the problem.

Though the macro level picture depicts a deficit, the issues at the river basin level are different for different river basins in the state. More precisely, of the 16 basins in the state (except Cauvery basin), 11 basins are treated as deficit basins whereas five basins are considered to be “surplus” basins. However, there are two problems with the methodologies used to arrive at the water balance at the basin level. First, these methodologies depend heavily on the assumptions of many different parameters such as the amount of groundwater used, percolated, recharged, and so on (see Government of Tamil Nadu, 2000b). On the demand side, estimation of the quantity of water used in various sectors is based on assumptions. For instance, the demand projections for various sectors are made on the basis of prescribed norms for each sector but not on the basis of actual use. This makes the estimates less realistic. Secondly, the methodologies do not incorporate the quality aspects. For instance, the Palar river basin is treated as a “surplus basin” since excess potential was estimated to the tune of 1622 MCM during 1994. The projected scenario also reveals that there will be excess potential in the basin in the future. For example, the projected potentials for the years 1999, 2004, 2019 and 2044 are estimated to be 1594 MCM, 1571 MCM, 1403 MCM and 1389 MCM, respectively. However, the assessment of potential in Palar basin takes into account only the quantity and water quality parameters are completely neglected. The problem of tannery pollution in this basin is well known and a larger area has already been polluted to such an extent that groundwater could not be used for any purpose (Narayana Murthy, 1987; Government of Tamil Nadu, 2000b). Moreover, the government agencies are developing proposals to transfer water from other basins such as Cauvery to some of the important urban areas in the Palar basin and this clearly indicates that the opportunity cost of pollution in the basin is going to increase. Hence, the concept of surplus does not make any sense as long as the pollution menace continues.

Another serious issue is that even in those basins that are considered to be surplus basins, the “sub-basins” experience relative scarcity of water that may be aggravated by the pollution problem. For instance, while the Vaippar basin as a whole is a surplus basin, its sub-basins such as Kaligalar and Deviyar are treated as deficit basins whose scarcity may be intensified by increased level of pollution. Apart from surplus basins, the deficit basins like Vaigai and Tambiabarani are already experiencing severe ground water pollution (Government of Tamil Nadu, 2000a). Further micro level analysis at the “use” level reveals an interesting scenario. It is revealed from water demand analysis of specific river basins that while some of the uses face “unmet” demand in terms of quantity, some other uses face no
such problem (Government of Tamil Nadu, 2000b). The overall deficiency of water in the Kodaiyar basin, for example, is estimated to be 117 MCM and it is claimed that there is no deficiency for the domestic and industrial sectors in the basin while irrigation and livestock demand may face the deficiency. However, the “deficiency” would have been evident if the analysis had taken into account the water quality aspects as well. This means that even a small reduction in the water used for drinking purposes would make the entire amount of water unfit. To highlight this point further, let us discuss the groundwater quality situation in Tamil Nadu in detail.

The groundwater quality in the state is being monitored by various organisations such as the Tamil Nadu Water Supply and Drainage Board (TWAD Board), the Water Resources Organisation (WRO) and the Tamil Nadu Pollution Control Board (TNPCB). Systematically analysed and “easily accessible” groundwater quality data is available from the TWAD Board. The TWAD Board has 1286 observation wells all over the state, which are regularly monitored for physical, chemical and bacteriological parameters such as turbidity, electric conductivity (EC), total dissolved solids (TDS), pH, chlorides, fluoride, faecal coliform, and so on. The latest data available on water quality for the entire state, for the year 2000-2001, reveals that of 22,833 samples from hand pumps screened, 6168 samples (or 27%) were found to be non-potable. A district level analysis of water samples indicates that more than 20% of the hand-pump sources were found to be non-potable in 20 of 29 districts. In the case of samples from the power pumps, the story is same. It has been observed that of all water quality parameters, fluoride, hardness, iron, TDS and nitrate are the five major pollutants that make a considerable number of sources unfit – either individually or in combination with other parameters. The single pollutant that makes a larger percentage of sources unfit is fluoride, which affects around 32% of the sample wells in the state. A subsequent survey which covered 14,325 samples from municipalities and town panchayats in different parts of the state found that 35% of the samples in rural areas, 51% in urban areas and 67.9% in municipal areas were found to be unfit for drinking purposes.

The above analysis reveals that in general the groundwater sector in the state is in a condition of disrepair. Another important aspect to be noted is that assessment of quantity and quality aspects related to the groundwater sector in the state is dealt with separately. While the assessment of quantity is carried out by one organisation, quality is being assessed by a different organisation. The assessment of quality is done to meet a specific objective of the organisation, while assessment of water quality for other purposes is not high in the state. For instance, the water quality analysis carried out by the TWAD Board has a specific objective namely, whether the water quality norms meet the standard prescribed norms for human consumption. Some of the organisations dealing with assessing both quantity and quality of groundwater resources do not design any scientific methodology to integrate the two aspects. There exists a need to adopt an integrated approach in assessing the groundwater potential that takes into account the quality related issues as well. Even though some attempt is being made to “deduct” the polluted areas from the “potential” areas, it is strongly felt that this may not be adequate to address the real issues arising from the degradation of water.

An important question one may ask is: What would be the consequences if the pollution issues are not properly addressed? The next section of this paper tries to answer this question.

Accounting for environmental damage cost

In should be noted that if the degradation issue of water quality is not seriously dealt with, then the net result is increased social cost that will hinder sustainable development of the state. Not making any
effort to estimate and account for the damage cost in the income accounting system is another area where government failure is glaring. As we have already seen, the social cost emerges in the form of reduction in agricultural and industrial output, loss of welfare owing to mortality and morbidity, increased time spent in collecting water, and so on. In the agricultural sector, there are different kinds of indicators that would either directly or indirectly reflect the economic impact of pollution. For instance, change in the land use pattern, crop failures, reduction in crop yield, decline in land prices and increased cost of production are some of the major economic indicators of pollution-related issues. Even though some of these indicators at the macro level may be “healthy”, the pollution-related issues and their impact on the agricultural sector have some serious implications at the micro level. In other words, even if the development is sustainable at the macro level, it might have been achieved at the cost of agricultural development at the micro level and therefore, micro level issues need to be looked at more seriously.

In the household sector, consumption of poor quality groundwater results in either mortality or morbidity which results in increased social cost in terms of expected earnings forgone, increased defensive expenditure and social welfare forgone owing to reduction in the availability of goods and services (see Gleick, 1998: 46). Another serious issue is that at the household level, water quality deterioration at the local sources places considerable burden on women and children. In poor societies, degradation of resources that are essential for survival results in a demand for a greater number of hands at the household. Collecting fuel wood, carrying out agricultural activities, fetching water, and so on, require many hands. Children are often diverted to these kinds of activities. This affects the education of the children, which in turn results in reduction in social capital (see Dasgupta & Maler, 1991). This problem is aggravated by contamination of local drinking water sources. The poor quality groundwater used for livestock affects the health status of the livestock, which in turn affects milk production, loss of workdays, and so on. This can have a devastating effect on the living standard of poorer sections of the society.

In the case of industry, using polluted water for production process reduces output, reduces the life span of the machines, and so on. Altogether, use of poor quality water in various sectors results in increased social cost. In most cases, the social cost is not being properly estimated to sensitize policy makers on the economic reasons for the control pollution. The major problem in estimating the economic impact of the water quality deterioration at present, as we have already seen, is non-availability of adequate information on the impact of water quality deterioration. Despite this problem, very few attempts have been made to study the economic impact of water pollution both at the macro and micro levels.

At the macro level, a study by the World Bank (Brandon & Homman, 1995) has highlighted the fact that economic damage caused by water pollution amounted to Rupees (Rs) 42,000 millions in 1992 prices, for India as a whole. The study revealed that water pollution damage constituted the largest percentage of the total economic damage caused by all forms of pollution. It should be noted that the scope of the damage assessment made by the World Bank was very limited because only a very few areas _ such as health damage and land degradation _ were covered in their study. The authors have pointed out that if a complete damage function covering all the areas experiencing damage could be established for assessment, then the economic value of the damage caused by water pollution could have been much larger in the country (see Brandon & Homman, 1995). The practical problem is that the secondary data available on the level of waterborne diseases is not reliable and therefore, any meaningful analysis on the economic impact of waterborne diseases is not possible at present. Despite
this difficulty, some attempts have been made at the micro level to highlight the seriousness of the issue in the state. For example, a damage assessment study at the local level by Loss of Ecology Authority (LEA) constituted by the Government of India found the economic value of the damage caused by groundwater pollution to the agricultural sector in the Palar basin in Tamil Nadu to be Rs 28.62 million.\(^6\) But another study by TAHAL consultancy found that in terms of net present value, the total damage cost in the same basin would be Rs 351 million (Government of Tamil Nadu, 2000b). However, these studies concentrated only on the damage to agricultural sector and not the health damage caused to human beings, animals, and so on. Similarly, a study by Appasamy & Nelliyat (2000) also highlights the economic impact of the industrial pollution on the agriculture and household sectors in the Noyyal basin. However, the results of these micro level studies are subject to criticism because of the methodologies used to assess the damage.

Despite the criticisms, the results of the empirical studies, in general, highlight the importance of estimating the cost of pollution so that one can understand whether the present trend in the economic development could be sustained over a period of time and what kind of the remedial measures need to be undertaken to contain the groundwater pollution.

This requires the following macro as well as micro level intervention: (i) since the present level of state income is considered to be overstated by that amount of social cost, there exists a need for estimating the economic value of the damage at the state level and this value needs to be netted out from the net domestic product (NDP) of the state so that a true sustainable income of the state can be arrived at; and (ii) the water pollution damage at the micro level (especially at the river basin level) will have to be estimated in economic terms so that action plans at the micro level can be initiated to contain the pollution problem. However, it should be noted that the state government has not initiated any measures to estimate the level of environmental damage and incorporate them into the estimation of the state income so as to monitor the “sustainable development” of the state.

**Lack of coordination between government agencies**

Some of the studies in developing countries have shown strong evidence that institutional factors play a pivotal role in addressing many of the issues related to the water sector (see Gyawali & Dixit, 1999; Saleth, 1996). It is necessary to examine whether the existing institutional set-up in the state is conducive to better management of water resources in general and quality issues in particular. We start with the assumption that lack of coordination between different government sectors dealing with the water resources as such is an institutional failure, which we will highlight in this section.

As far as Tamil Nadu State is concerned, there are different kinds of organisations that are concerned with water resources. Some of them are water-augmenting agencies, some of them are water-using organisations and some of them belong to both categories. Table 2 summarises major activities of some of the important departments dealing with the water-related activities. Apart from these departments, there are committees/working groups to look into the question of water resource management at the state level.

Even though different departments/committees are concerned about the quantity and quality of water resource sector in the state, a close look at their activities reveals that all of them operate independently. It should also be noted that some of the water quality-related activities of a particular department are just

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\(^6\) Reported in the *Hindu*, November 16, 2000.
repetition of what other departments are doing in the state. Even though there is a possibility that the water quality-related issues could be dealt with by a single agency, lack of coordination between different departments potentially increases the “transaction cost” in the government sector. Apart from the increased level of transaction cost, water quality data collected by some of these agencies show that the level of pollution is moving up in the state. Therefore, there exists an urgent need for integrating the activities of various departments so that not only the transaction cost would be reduced but also the pollution could be brought under control.

Institutional strengthening

It should be noted that although a variety of institutional arrangements exist in the state to deal with the water quality issues, there is no integrated approach among the institutions to address the problem of degradation of the groundwater quality in the state. The major institutions that are responsible for
addressing quality issues are TNPCB, WRO, the Department of Environment and the TWAD Board. However, the pollution control authority lies with the TNPCB, which is responsible for controlling pollution only at the industries level. Controlling industrial pollution is not effective because of various economic, political and administrative problems. As a result, the pollution level in the river basins is increasing. The PWD does not have any clear authority to deal with pollution control. Its role has been restricted to “monitoring water quality” at the river basin level. The existing problem is aggravated by non-point sources such as urban and municipal sewage, agricultural run-off, and so on. However, the TWAD board, which is responsible for dealing with the urban sewage is not doing anything concrete. Controlling urban sewage is a difficult task and needs considerable coordinated effort between the existing government institutions. Agricultural run-off causing damage to water resources is another serious issue for the Department of Agriculture.

The solution for the existing water quality problem lies in institutional strengthening by integrating the activities of various departments. In the case of industrial pollution, the TNPCB and the PWD could coordinate with each other by exchanging information on level of pollution, damage caused to agriculture and other sectors, and technical know-how in pollution control. In the case of sewage and open-air defecation, coordination between PWD and the Department of Rural Development and municipalities is essential. Collection of sewage, solid waste, and so on could be done by the panchayats and municipalities at the local level and the treatment could be carried out by PWD. In the case of open-air defecation, provision of sanitation facilities is an essential task. For agricultural run-off, there is scope for cooperation between the PWD and Department of Agriculture.

Environmental action plan

As part of institutional strengthening, an environmental action plan needs to be implemented to contain the problem of groundwater pollution. The environmental action plan includes the following steps:

- Pollution control policy
- Controlling non-point source pollution
- Economic valuation of damages
- Water pricing.

Pollution control policy

Industrial pollution is the major source of groundwater degradation. Although stringent pollution control laws exist in the state, the industrial pollution is not controlled adequately. This may be attributed to the fractured nature of the institutions, increase in the pollution control cost at the industrial level, etc. Moreover, there exists no clear-cut pollution control policy that is capable of guiding policy makers as well as the polluters to adopt suitable methods of pollution control that could achieve pollution control at least cost. The “command and control method” has been adopted in the area of pollution control, but has not resulted in fully achieving the objectives. The failure of the command and control method occurs because it gives no freedom to the polluters to choose cost effective pollution control methods. The Tiruppur case is a best example. Under the command and control policy, the
polluting textile units were asked to join either common effluent treatment plants (CETPs) or to control pollution through individual effluent treatment plants (IETPs). These units were asked to reduce pollution up to the prescribed level. However, many of the units found both the options “costlier” and the net result was a continued level of pollution. Now these units find the clean technology to be more cost effective and this may make the huge investment made on CETPs a waste of money. Moreover, the command and control method increased the transaction costs as well. It is accepted that application of market-based approaches (such as introduction of tradable permits, change of product mix, clean technology, etc) would be more effective in tackling point source pollution. There exists a need to introduce market-based instruments, in combination with command and control methods whenever applicable. In this regard, suitable economic instruments need to be devised for different kinds of industries.

Controlling non-point source pollution

Non-point source pollution is a serious problem in the state. While constructive efforts are being taken to control industrial pollution, only limited attention is being paid to control non-point source pollution. There is an immediate need to initiate action to stop discharge of urban sewage without treatment into lands and rivers. This requires proper treatment of the sewage from urban and municipal areas by collecting sewage into one point. Moreover, there is a need to explore the potential for using the treated sewage for agricultural purposes. Several empirical studies have demonstrated that the yield of some crops like sugarcane is not affected by the treated polluted water (e.g. Venkatachalam, 1992).

In the case of agricultural run-off, “pollution control” is a difficult task. Farmers need to be educated about the proper use of fertilisers and pesticides and to stop open-air defecation, provision of proper sanitation facilities to all the rural and semi-urban areas is essential. A problem is to maintain the sanitation establishments owned collectively by the public on a sustainable basis. Though the initial investment has a greater subsidy component either from the government or from the international donors, the cost of maintenance is a problem to be addressed carefully. But studies on infrastructural projects such as water supply, sanitation, and so on have demonstrated that the users are willing to pay for both the initial investment and the maintenance charge, provided the benefits from these goods are reliable (e.g. Venkatachalam, 2000). The local administration, such as town and village panchayats, has a greater role to play in this regard. Though the central and state governments have initiated some action to address the issue of urban sewage (especially through the National River Water Conservation Directorate), action needs to be implemented more rigorously.

Economic valuation of damage

Pollution control activity requires estimation of damage caused by groundwater pollution so that pollution control measures can be justified on economic grounds. The economic benefits restored/damage avoided owing to pollution control measures should be greater than the cost of controlling pollution. The first step in estimating the economic damage is to identify and quantify all the possible benefits generated by the water resource in an unpolluted condition and to assess the reduction of benefits to the users after pollution. The economic damage assessment exercise should basically recognise that pollutants can affect almost all kinds of benefits enjoyed by different users. For instance, the deterioration in the quality of water in Palar basin has affected use of water in the household sector,
agricultural sector and industrial sector. Any damage assessment study should cover the entire spectrum of benefits/uses as well as the reduction in these uses. To do a meaningful exercise, government agencies should strengthen their capacity in the areas of environmental impact assessment and economic valuation by appointing experts in these fields.

Water pricing

One of the economic measures by which not only the degradation issue but also the depletion issue could be properly addressed is water pricing. Proper pricing of water would have two results: (a) efficiency at the user level may be achieved though the price intervention. This would result in optimum use of water resulting ultimately in reduction in the wastewater released from different uses. Moreover, the users may find out other economically cheaper options such as recycling wastewater. This would eventually result in minimising the negative impact on the quality of the groundwater sources; (b) increased revenue to the water supply authorities would enable them to make safe disposal of wastewater from various sources which in turn would address the degradation issue. Hence, there exists a strong case for devising a proper pricing mechanism to address quality-oriented issues.

Appropriate pricing of water depends on many aspects. The economic principles suggest that the pricing of water for each use should be based on the opportunity cost of water use. In other words, the efficient allocation of scarce water between different uses requires that the price of the water in each sector should reflect the value of water in its best use, i.e. the use that would generate maximum amount of benefit for a given amount of water used. Formulating an efficient water pricing policy requires estimation of marginal benefit (i.e. additional benefits generated for one unit of increase in the quantity of water) in each sector. The price of the water should be equal to the highest marginal value appropriated in the best use. However, estimating the marginal benefit in each sector is a difficult task and therefore, pricing of water on the basis of opportunity cost is also a difficult task. In many cases, water pricing is based only on the assumptions made by water supply authorities and the pricing policy does not take into account the preferences of the users. Also, apart from pricing, there are so many other factors – social, economical, historical, institutional, etc – which determine the sustainability of the water supply schemes in the concerned areas. To make the water supply projects more sustainable, pricing policy should reflect the users “willingness to pay” for the water, which is determined by various socio, economic and institutional factors.

Conclusion

In this paper, we have highlighted the issues related to various sources of government failure in relation to groundwater pollution in the state of Tamil Nadu. We have identified three major sources of possible failure of the government sector that increase the damage cost in the state. In the case of assessment of water resources in the state, we have found that the existing approach does not have any mechanism to integrate the quality aspects of the groundwater sector in the state. Because the issues relating to quality have been undermined in the estimation of potential stock, we get an unreliable picture of the potential groundwater in the state. This results in increased social cost in various sectors. We have attributed the causes and effects mainly to “fractured institutional set-up” in the state and we...
have provided some recommendations for institutional strengthening and other policy suggestions to put the issues into the right perspective.

It should be noted that though groundwater quality-related issues assume paramount importance in the state, only a very few research studies focus on the implications of the quality-related aspects in a systematic way (e.g. Janakarajan, 1999). It is suggested that more of these kinds of studies are required to highlight the issues in the groundwater sector in the state so that certain important policy decisions can be initiated in future.

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