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Water Pollution and Groundwater Depletion Multi-Stakeholders' Dialogue as a key for finding Ways Forward

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Extended Abstract

Deterioration of environment and destruction of ecology have become potential sources of threat for basic human sustenance in India. In recent times, the use of natural resources such as land, water and forests have become utterly unsustainable. This has triggered-off many conflicts, resentments and hatred among different sections of population. Urbanization and industrial expansion are the often-accredited reasons for such degeneration. High degree of urbanization and fast industrial expansion are not detrimental as such from an overall perspective of development. But in India, as may be the case in most of the underdeveloped world, the capacity and the technology of wastewater treatment plants are abysmally poor compared to vast volume of industrial effluent municipal and hospital sewage generated. The discharge of such untreated and under-treated effluent contributes to severe ecological degradation in general and water contamination in particular. As a consequence, even the available water stock – both surface and sub-surface – gets shrunk due to pollution. On the one hand there is growing competing demand for water across different users and uses and on the other, there has been a secular lowering of water table resulting in depletion. The set of questions, which confront the civil society today, are: Is there a need for arresting further urbanization process and close down all the industries which contribute to environmental pollution? Is there a need for more laws pertaining to water and environment? Is there a need for a dialogue on feckless and corrupt governance? What is the role of judiciary and to what extent the intervention of judiciary could resolve these issues? What is the role of civil society in all these? The present paper besides documenting evidences on the subject relating to groundwater use and abuse, discusses the most critical issue of conflicting interests in the use of water and their implications for economy, society and environment. And further, multi-stakeholders' dialogue (MSD) is discussed as a possible tool for resolving the crisis situation; in this context, the author presents his experience of initiating MSD process in a river basin called Palar in Tamilnadu, South India, which is one of the most polluted river basins in the country.

The Palar river basin, which covers an area of about 18,300 sq.km, has an annual rainfall of 800 mm to 1200 mm, with evapo-transpiration rate of as high as 2000 mm per year. This is a water deficit basin. Tanks have historically been the most important traditional surface irrigation source in the basin. There are no storage reservoirs in this basin but one finds a series of diversion weirs, which used to fill a large number of irrigation tanks. Most of these diversion weirs and tanks are in disuse at present except during high rainfall years. Net irrigated area by wells in the

basin works out to about 75%. Groundwater utilization is as high as 92 percent in this basin. Groundwater has also been a major source for drinking and industrial water needs. As high as 200 mld of water is pumped everyday from the Palar riverbed aquifer to meet the drinking water needs of many towns, villages ad industries located along the river. Quality, however, varies a great deal across the basin. This is indeed the vital issue of the basin because of long history of tanning industry, which has contributed quite significantly to the groundwater and surface water contamination.

Though agricultural sector is still the single largest user of groundwater, there have been growing demands for this resource from other sectors, the process which got accelerated due to rapid urbanization, fast industrial expansion and increasing demographic pressure. This is more acute in a State such as Tamilnadu, where, almost all the available surface water sources have been utilized. Of the 1261 TMC (thousand million cubic feet) of surface water annually available, about 1155 TMC or 92% has been utilized for irrigation, municipal and industrial purposes. As a consequence, there has been an increase of conflicting interests among various user groups. In the particular context of groundwater resource, conflicts take place due to one critical factor, namely, scarcity, caused due to excessive unregulated pumping (resulting in secular lowering of water table) and two, due to groundwater pollution caused as a result of discharge of industrial effluent, the use of chemical inputs in agriculture and due to domestic and municipal sewage. The major polluting industry in the basin has been leather tanneries, which consumes about 50 to 60 MLD of water and discharges almost comparable quantity as effluent. On an average, 35 to 45 liters of wastewater is discharged per kilogram of raw skin / hide processed. According to a study carried out by Stanley Associates sponsored by the Asian Development Bank and executed by the Tamilnadu Pollution Control Board, pollution loads in the Palar river is extremely threatening: (all parameters are in kilograms per day) TSS: 29,938, TDS: 400,302; Chloride: 101,434, Sulphide: 3818; BOD: 23,496; COD: 70,990: Total Chromium: 474; Cyanide: 22. Local people and a few activist organizations have been demanding for the closure of these industries. But the closure seemingly is quite difficult for, these industries contribute to about Rs.50 Billion (US$ 1052 million) by way of foreign exchange earning annually, besides providing employment to over 100,000 people directly and indirectly.

To sum up, traditional irrigation sources such as tanks and spring channels are on the decay; There has been competing demand for groundwater among agricultural, industrial and domestic sectors; Groundwater table has been progressively falling; Agricultural activity has been on the decline; there has been decline in income and employment; There is flourishing rural-urban water market; The riverbed aquifer has been contaminated, which was the most important source of drinking and irrigation for 100s of villages and towns in this basin; There is acute drinking water crisis resulting in the emergence of market for drinking water in the urban, semi-urban and rural areas; Groundwater quality has deteriorated; The number of abandoned wells has been on the increase; increasing indebtedness among farmers due to futile investment on wells; Declining life expectancy of tannery workers as well as people in the basin area; And there is a fear of impotency due to the consumption of contaminated water.

This is an extremely stressed regime, which may explode anytime. Such an explosive situation could have been contained had there been some thoughtful policy measures. But unfortunately, all hitherto policy measures have failed to address these important issues of conflicts in the use of water, competing demand for water, relationship between over-use of groundwater and pollution on the one hand and rural-urban migration, deteriorating health due to water contamination and poverty on the other. All the hitherto mitigation measures have comprehensively failed. Common Effluent Treatment Plants were installed in the basin at the direction of the Supreme Court of India but due to lack of effective monitoring and law enforcement mechanism, pollution menace continue to threaten human and animal population in the basin.

Therefore, when everything has failed, including interventions from the highest judicial authority of the country, one wonders whether there is a way out or one confronts a deadlock condition. This is precisely the state of affairs in which multi-stakeholders' dialogue was initiated in the Palar basin, which was actually preceded by a detailed research in 51 villages of the basin.

After several hurdles and initial stakeholder analysis, key stakeholder groups were identified: The first step was to organize a meeting of multi-stakeholders with participants drawn mostly from the Palar river basin. The preparatory research and stakeholder analysis carried out in the basin was found immensely useful to organize this meeting. Although, there were difficulties in involving tannery owners in the meeting, we successfully involved them in the stakeholders' meeting; Other stakeholders who participated in the meeting were the basin farmers, NGOs, local doctors, residents of local towns, micro-biologists, lawyers, media persons, academics and interested general public. Thus the, 'Multi-stakeholders' Meeting of Water Users of the Palar River Basin' was held during 28th and 29th January 2002 at Chennai, with 120 participants. Objectives of the meeting were, (a) To take stock of use and abuse of water in the basin in the overall context of urban and industrial expansion and in the context of poverty, food security and hunger, (b) To assess and examine defaulters of law, their positive and negative contributions to society and economy, (c) To bring together various stakeholders for a fruitful dialogue with a view to hear, debate, document and make public their voices, (d) To find ways for preventing further degradation of natural resource in question and to work towards sustainable development with a common agenda within a framework acceptable to all stakeholders, (e) Most important of all is to find ways to turn situations of conflict and distrust into opportunities for mutual aid and cooperation. Before beginning the dialogue on the first day, there were panelists' presentation on various aspects of water use and abuse with particular reference to the basin. Altogether 12 presentations were made by various stakeholders covering wide variety of issues.

There was quite a good deal of heated arguments and the discussion was lively. At one stage, the discussion was quite intense and many strong words were used. In fact, one of the tanners stood up with an outburst 'we (tanners) are treated like Afghan refugees; what sin have we committed except involving ourselves in this dirty business'. But the heat started melting down in the afternoon which got reflected through the tone of another tanner: 'So far, we (farmers and tanners) were meeting only in the Courts; for the first time we are meeting in a same platform

with a view to sharing the concern'. Farmers at this stage were also yielding and recognized the need for a solution, which is other than 'closure'. Towards the end of the meeting there was a big sign of relief. At that time it was widely acknowledged that MSD is a process and not a one-off meeting. Therefore, there was a general agreement to form a Committee from among those who were present so that the dialogue process could be carried further. The result was the birth of a Committee with 24 members represented by different stakeholders. The objectives of what is called Multi-stakeholders' Committee of Water Users of the Palar River Basin are the following: (a) A comprehensive attempt will be made with an inter-disciplinary focus to document information pertaining to water and environment in the Palar basin; (b) To monitor pollution levels in the surface and groundwater at different strategic points within the basin; (c) To measure the quantum of water consumed by different sectors such as agriculture, industrial and domestic users; to measure also, the quantum of water that goes into tanneries, the quantum of water that goes out of tanneries after use, the quantum of water that goes into the CETPs for treatment and the quantum of water that is released out of CETPs after treatment. To measure also the quality of water at various inlet and outlet points; (d) To measure the actual quantum of water that goes out of the basin for non-agricultural uses such as for domestic and industrial purposes, amusement parks etc.; and (e) Reversal of ecology.

This Committee has already met six times in the last one year and many positive decisions have been taken. (a) It has been unanimously agreed that the closure of tanneries is not the solution; (b) Different stakeholders have agreed to share information among themselves so that more useful and concrete decisions can be made; in particular, tanners who hitherto were denying any access to information, have agreed to share with all the details pertaining to tanneries and CETPs and also have agreed to open access to tanneries and CETPs with a view to enabling the Committee members to visit their sites at any time. This is considered one of the best positive outcomes of the Committee in a short span of time. (c) it was felt that the prevention of any further pollution in the basin is the first step required towards reversal of ecology. (d) Thus, the Committee considered the possibility of hiring a water treatment company so that the tanners could pay to the company for treating the effluent generated by them on volumetric basis. But this idea was given up due to high costs involved; (e) finally, the Committee is contemplating to use cold storage system in all slaughterhouses for preserving and transporting raw hides and skins so that the use of salts could be eliminated completely. At the moment the Committee has undertaken the study of costs involved in the use of cold storage system and is trying to work out it in close collaboration with some experts in the field. The Committee is looking forward for an amicable solution for the century old pollution problem of the basin.

Integrated development & management of local resources and exogenous water

K.R. Datye

Abstract

Post independence water resource developement was characterized by the neglect of community based organizations. All powers were transferred to the state with water being regarded (notionally) as a public property. Subsequently, even after 73rd & 74th amendments to the constitution, the control is with the bureaucracy and influential politicians in the society. It was believed that the traditional low input agriculture would not generate the marketable surplus of food needed for public distribution. There was a bias in favour of water & chemical intensive agriculture.

Presently, a large section of the population suffers from malnutrition while food stocks accumulate. Extension of the area under high yielding varieties would require large investments on irrigation and it will increase the burden of subsidies.

We have to take note of the break down of traditional systems of management resulting from intervention of the state and the market. There are other problems e.g. relatively high seepage and evaporation losses in small reservoirs, social and environmental costs due to submergence in large reservoirs.

These problems can be addressed by utilising the carbohydrate storage in plant organs, productive use of stored soil moisture and ground water recharge. A shift is needed from wheat and rice (relatively inefficient crops with regard to water and input use) to coarse cereals in rotation with pulses and oil seeds. A low cost option emerges by use of labour and local material and adoption of the limited water use norms in existing as well as new projects. Outcome will be dispersal of irrigation and use of significant proportion of external water for ground water recharge.

The problem of increased cost of conveyance and pumping energy resulting from dispersal can be addressed by allocating part of the land and water to irrigated forestry and targeting employment assistance to develop irrigated forestry. Liability of capital cost recovery would be minimised by mobilizing low interest finance, justified by ecological and social considerations.

User should be given the option of cost recovery of energy and capital in kind in the form of biomass produced on the wasteland & farm forestry areas. Further, benefits of advances in renewable energy and material technology should be availed of generate income from value added processing.

Thus it is socially and ecologically beneficial as well as cost effective to ‘integrate development of local resources and exogenous water’.

A consolidated tariff for water and energy and efficiency oriented differentials can motivate users to avoid waste and participate in comanagement of energy, surface and ground water.

For effective decentralization It is necessary to build knowledge base and to promote user group initiatives to augment local resources by using employment assistance and local materials. A performance orientation needs to be given in the disbursement. This can be achieved through two-part payment, the first part being food for work directly made available to the groups. Self help groups of women from resource poor households can be motivated to achieve bankability in the land and water resource development by entitlement to intensive cultivation plots and produce from trees.

Multipurpose Utilization of Godavari River and the Relevancy of Interlinking of Rivers

T. Hanumantha Rao

Abstract

The study proposes a strategy, which aims at solving the eradication of poverty/mitigation of drought in the state as well as in the country through development and proper utilization of Godavari river waters and the comprehensive plan of interlinking of Nation's rivers. Multipurpose utilization of Godavari River gives not only irrigation facilities, but also other benefits such as hydropower, navigation, industries and mineral exploitation to achieve a high level of economic growth. The lift irrigation projects of huge magnitude on Godavari River should not be taken up for execution, unless the same are tied up with hydroelectric power projects. The present lift irrigation schemes will not be able to utilize the flood flows fully. The study proposed to construct the three reservoirs and four barrages across the Godavari River in certain locations to tap the floodwaters of balance 760 TMC, presently being wasted to the sea. In a broader perspective, to mitigate the future drought conditions in India, inter basin transfer of water and constructions of major storage projects are essential. The process of inter linking of river basins involves time-over runs and huge amount of investment. Hence, the study focuses on exploiting the 760 TMC of Godavari water in the state, which is readily available. Eventually, the study proposes full development and utilization of water resources in each state and river basins in the first instance by obtaining project clearance before starting the project in all aspects. A perspective plan of action has to be prepared for interlinking of all the rivers in India, namely the Himalayan River, the West flowing River and the Peninsular Rivers.

IRRIGATION SUBSIDIES IN KARNATAKA
A GROWING CONSTRAINT FOR REFORMS

K V Raju[*] and H K Amar Nath[**]

Abstract

Over the last three decades Karnataka has focused more on creating irrigation potential. Financially this has resulted in spending more on creating capacities without a proportionate increase in revenue generation, leading to significant cost and time overruns. This paper has estimated budgetary support at macro level and recovery levels of water charges, by reviewing the unrecovered costs and growing liabilities of the irrigation sector. It has also looked at implications and possible options for bailing out.

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IRRIGATION & POVERTY AMONG FARMERS - A MICRO PERSPECTIVE

Y. V. Malla Reddy
Accion Fraterna

Abstract

The broad objectives of this micro-study are: a) to establish what is the MLS in financial terms for a family of 5 members; b) to arrive at the viable unit of irrigated land required for a family's Minimum Level of Subsistence (MLS) and c) application of MLS criteria in 4 villages and assess the situation of irrigated farmers.

The study concludes that in drought-prone areas like Anantapur, in order to be able to cope with drought and be able to live at MLS it is necessary to have assured irrigation facilities. In a situation, where irrigation water is available for 3 crops in a year, minimum of 2 acres of own land is necessary to live at MLS for a family of 5 members. Owning 2 to 3 acres would be desirable to be able to be self-reliant in the long-run. In a situation, where irrigation water is available for only 2 crops in a year, it is necessary to have a minimum of 3 acres. Having 4 acres would likely improve the family's economic self-reliance only in a long-term. The Minimum Level of Subsistence required for a family of 5 is Rs.35,000/-. Anything less than Rs.35,000/- of net income would lead to indebtedness that is hard to overcome.

WATER RESOURCES DEVELOPMENT IN AN UNDERDEVELOPED TRIBAL STATE: ISSUES AND POLICY IN CHHATTISGARH[1]

Smita Gupta[2]

There are several institutional, financial and technical issues that concern policy formulation for water resources development, esp. in a backward tribal state like Chhattisgarh. This paper critically examines the macroeconomic foundations of changing policy approaches to water resources development. In fact, if anything, the changing policy will only worsen the already dismal water resources profile of the state.

The first part of the paper examines the vital role of water in equitable and balanced intra-regional growth, food security, self-sufficiency, poverty alleviation, agricultural growth, etc. The problem of drought for most parts of the state has more to do with poor agricultural growth, land use planning and water resources development rather than chronic deficiencies per se. Productivity is low, due to soil moisture stress, an outcome of poor water management; inadequate protective irrigation and tribal cultivator's inability to invest due to paucity of resources. Land use intensity is very low too, on account of mono-cropping and a high proportion of fallows.

The relationship between production, equity and ecology translates into diverse situations that require different policy interventions. The government prepared a Draft State Water Policy that despite shortcomings successfully addressed the twin issues of unevenness and underdevelopment. There are several aspects to be considered by the State Water Policy: backwardness of vast parts of the state and the low and uneven irrigation facility, drought vulnerability, the high variability of agro-ecological and other features or extreme location specificity; the low purchasing power and ability to invest of cultivators caught in a vicious cycle of poverty and low productivity; pendency of projects due to non-clearance by MoEF and inadequacy of funds; the underutilization of potential because of poor upkeep and maintenance; the skewed and inadequate rural electrification network; poor development of the command area in terms of land leveling, water distribution, etc.

The Price Waterhouse Coopers advise to the state government, offers the following three policy instruments as solutions. The first is a participatory irrigation management Act, to extract higher irrigation tariffs and water charges; the second modality is a water policy that builds an enabling framework for raising tariffs, privatization and reducing state regulation and public investment. The third is the setting up of an independent regulatory body for tariff collection and manage-

1. I am indebted to Prof Jayati Ghosh, Center for Economic Studies and Planning, JNU for valuable comments and suggestions that markedly improved the original draft.

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ment signaling an end to government discretion and regulation. This strategy will not help overcome unevenness and underdevelopment in the water resources sector. Worst, higher charges and reduced public investment strike a severe blow to agricultural growth and food security. This of course will happen where irrigation exists in the first place. Where it does not, it is not very clear how the market or private sector is expected to deliver since private corporate investment demands state financing and state regulated monopoly pricing and compliance.

Unfortunately the state government chose to go along with the PWC strategy in its Vision document. The biggest casualty has been the abandoning of all four principles vital to overcome poverty, backwardness and imbalanced intra-regional development: public investment; location specificity; decentralization; and multipurpose water resources development. The state is well-endowed in water resources, and appropriate water resources management holds the key to development that enables people have work, food and livelihood security. The Price Waterhouse Coopers strategy will not work.

SUSTAINABLE WATER PRICING
An Optimal Approach

MSV. PRASAD

Abstract

The role of ***water pricing*** for managing ***water resources*** is widely recognized in many areas of the world because of the increasing scarcity of ***water resources***, a high competition between ***water*** uses and environmental degradation. Based on the analysis of cost of ***water***, this paper explores an optimal approach to pricing the scare resource water enhance the ***sustainability*** of ***water resources***. Sustainable water pricing is proposed as a means to achieve the ***sustainability*** of ***water resources***. In a number of studies in India, low ***water*** price is analyzed as one reason for unsustainable ***water*** consumption. Thus ***water pricing*** justified is necessary and pressing. It is proposed to justify ***water*** price in phased manner and eventually ***towards*** sustainable p***ricing***. The assessment of impacts on ***water resources*** by raising ***water*** price shows ***water pricing*** could alleviate the conflict between ***water*** supply and demand. This paper concludes that ***water pricing*** can play an effective role in enhancing the ***sustainability*** of ***water resources*** in developing countries.

THE GUIDING VISIBLE HAND OF PARTICIPATORY APPROACHES TO IRRIGATION MANAGEMENT

R. Parthasarathy and Jharna Pathak

ABSTRACT

This paper is based on the Process Documentation carried out on the PIM programme in Gujarat and a comparative research on the Water Users Associations in Andhra Pradesh and Gujarat. The paper focuses on participation of the stakeholders in large-scale canal irrigation systems including the socio-economic aspects in the process of setting up PIM. Participation is believed to impact not only the efficiency and sustainability of water use but also the financial performance of the systems. The paper argues that the difference in the mode of programme implementation between Andhra Pradesh and Gujarat exert an influence on the functions and performance of the local institutions created as well as on the levels of peoples' participation in irrigation management. In this context, the dwindling faith in PIM programme is highlighted with the help of the review of studies.

The irrigation sector reform process began with aspirations of extending the democratic management by users so that the costs of delivery of service could be minimized while the efficiency improves. Empirical evidence suggests that there are positive impacts of PIM on distribution of benefits while costs are uncertain especially for the poor farmers. In most cases, the limited benefits of just management changes are found to restrict the magnitude of benefits. In the sphere of economic and social activity, which the irrigation sector reform tends to correct through involving the users and other stakeholders including the government, action taken by individuals seems to be inadequate to bring about an efficient change process. The process and forms of new institution influenced by political and historical context in which the reforms are situated is emphasized. Though a legal solution toward voluntary action is considered an inferior option to collective action, yet, it appears to be a necessary enebling device to manage collective resources. Evidently then, participatory irrigation management programme appears to rely on the guided, and not so invisible hand, and assumes that individual behaviour is privately oriented yet, by binding the individuals by rules, desired publicly oriented results could be produced. Thus, a legal definition of cooperation may hold partnerships together, perhaps at different levels of efficiency and institutional performance.

The Ozar Water User Societies: Impact of Society Formation and Co-management of Surface Water and Groundwater

Suhas Paranjape[*], K. J. Joy[*] and Christopher Scott[#]

Abstract

This is a study of the three Water User Societies in Ozar – the Banganaga Co-operative Water Distribution Society, the Mahatma Phule Co-operative Water Distribution Society, the Jai Yogeshwar Co-operative Water Distribution Society – on Minors 17, 18, 18A and 19 and Distributary 1of Sub-Minor 3 situated at the tail end of the Right Bank Canal of the Waghad Project in Nashik District, Maharashtra State, India. The Ozar Societies were among the first to be formed in Maharashtra and have served as examples for many societies in Maharashtra and elsewhere. They have also developed techniques for the co-management of groundwater and canal water. The societies have recently completed ten years of operation and the study concentrates on the process of society formation, the impact on society formation, and the issues in co-management that have surfaced through their work.

The study is divided into five sections. *The first section* provides the background and methodology of the study. The study is based mainly on secondary sources, supplemented with intensive discussion with the activists of the Samaj Parivartan Kendra, who were the initiators of the effort, and the office bearers of the Societies. The extensive records the Societies have maintained is supplemented by a household survey among the members of the three Societies to study the impact of society formation. *The second section* describes the process of society formation and what they have achieved since their formation. It brings out the novel aspects of the Societies and their formation and also highlights the hitherto not highlighted role of SPK and its nature as an important factor in their success. The building of check dams in the command areas and their judicious use for recharge by letting a portion of the canal water into the check dams, switching over to hourly rates for individual farmers and levying a charge on wells in the command in Mahatma Phule Society are important innovative steps.

The third section evaluates the impact that the societies have made on the lives of the farmers on the basis of the voluminous and meticulously maintained record of the three societies. Incomes have risen many times, more perennial crops like grapes and a larger summer area under crops characterise the change as also a shift from food crops to cash crops. *The fourth section* studies the impact on the basis of a field survey carried out especially for this study of a sample of the households in the three societies. It extends the evaluation of the impact to inter-household comparisons. What it finds it is that the impact and improvement has been secular across land-

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holding patterns as well as location patterns. Labour income has also grown along with farm incomes. The differential has also grown but the lowest sections have managed to almost meet all livelihood needs. *The fifth section* discusses issues that emerge out of the experience of co-management and in relation to replicating it. Difficult questions of mensuration had to be faced and solved in an acceptable, non-technical simple manner. The major achievement is that the methods they have evolved are not necessarily accurate, but follow a logic that is amenable to consensus, and though there may be discrepancies they are sufficient approximations. However, the issue of canal recharge has not been truly addressed and remains one of the challenges. More work and study is needed in this direction. Issues remain but their nature has changed. What were problems flowing from lack of development have now given place to problems that arise from development itself.

Economics of Drip Irrigation in Sugarcane Cultivation: An Empirical Analysis

A. Narayanamoorthy*

Abstract

Considering the fast decline of irrigation water potential and low water use efficiency under flood (conventional) method of irrigation, one of the methods introduced recently in Indian agriculture to increase the water use efficiency is drip method of irrigation. Besides saving substantial amount of water, it also helps to increase the productivity of crops that too with reduced cost of cultivation. Though sugarcane is highly suitable for drip method of irrigation, detailed studies using field level data are not available in the context of sugarcane, which is a water-intensive crop. In this study, therefore, an attempt is made to evaluate the impact of drip method of irrigation on different parameters of sugarcane crop using farm level data collected from Maharashtra. Discounted cash flow technique is used to study the economic viability of drip investment in sugarcane cultivation. It is found that productivity of sugarcane cultivated under drip method of irrigation is 23 percent higher than that of cultivated under flood method of irrigation. While water saving is about 44 percent per hectare due to drip method of irrigation, electricity saving was estimated to be about 1059 kwh/ha. Benefit cost ratios with different discount rates indicate that drip investment in sugarcane cultivation remains economically viable even without subsidy. The study suggests that reduction in capital cost required for drip set, restructuring subsidy programmes and effective (quality) extension network are essential for promoting the cultivation of sugarcane under drip method of irrigation.

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MANAGING THE WATER SECTOR IN THE NETHERLANDS

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Abstract

The Dutch have a long tradition of managing water. Can any lessons be learnt from Dutch experience for the managing and facing the financial challenges faced by the Indian water sector? In order to abstract lessons learnt it is first necessary to broadly examine the water sector in the Netherlands and in particular the main actors. Next we zoom in on the Dutch Water Boards and the Water supply companies. We will analyse the way the water sector is managed and financed in the Netherlands, to be able to eventually answer the question whether there is a Dutch model of managing and financing and whether this is a model that can be used for other countries as well.

The paper will deal separately with management and financing water supply and flood control, water quality management and wastewater collection and treatment. First the origin of the Water Boards and how they finance their activities and then the history of the water companies and their sources of revenue and capital will be described. Separate attention will be given to the Bank for the Water Boards in the Netherlands (NWB), before addressing the question whether there is a Dutch model for financing the water sector.

Subsequently the question relevant for India will be studied: which elements of such a model could eventually be repeated elsewhere?

COMMUNITY MANAGEMENT OF GROUNDWATER RESOURCES IN RURAL INDIA

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Abstract

This paper examines the negative externalities caused by groundwater resource degradation and the role of community in management of groundwater resource in Coimbatore District of Tamil Nadu where the groundwater problem is alarming. It was found that groundwater is extracted unscrupulously in the recent years resulting in drastic annual lowering of water table, at an alarming rate of 6 metres per year. The number of bore wells has increased over a decade and increase was more predominant in large farmers where the number of bore wells per farm increased from 2 to 4 over a period of 10 years. Similarly the average size of HP increased from 5 to 10 and 7.5 to 10 respectively under open and bore wells. Increase in depth of bore wells and open wells coupled with lower discharge rate, the farmers had to operate electric motors relatively longer hours leading to higher consumption energy. Farmers follow various coping mechanisms such as construction of farm surface storage tanks, altering cropping pattern, farm diversification, changes in household economic activities etc. Farmers shifted growing from water consuming crops to rainfed crops particularly sorghum. The diversification took place in the form of inclusion of trees and livestock activities in the farming systems. As the scope for agricultural production declines due to failure of monsoon and consistent depletion of groundwater, the farmers, do investment on non-agricultural activities. The extent of collective action revealed that the rural farm households act collectively in activities such as construction of percolation ponds, desilting of percolation tanks to enrich the groundwater recharges in the local area. To regularize over exploitation of groundwater, the existing NABARD norms such as 150 meters spacing between two wells be strongly enforced. Farmers' Associations (FAs) should be encouraged and effectively utilised to regulate the utilization of groundwater. Given the level of well failure, there is an urgent need to implement artificial recharge programmes in a large scale wherever the well intensity and groundwater problems are acute. The watershed programmes (existing and proposed) be effectively implemented to address the recharge issues given the zone of influence in each region. Most of the farmers had practiced only conventional irrigation methods. Advanced water management technologies and drip irrigation technologies may be followed in non-rice crops. Cultivation of water consuming crops like rice, sugarcane, banana etc., be discouraged particularly under well irrigation. This will help to minimize the pumping hours and over exploitation of groundwater to some extent. Legal measures are needed to minimize the overexploitation and the resulting well failure.

Impact of Electricity Prices and Volumetric Water Allocation on Energy and Groundwater Demand Management

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Abstract

In recent years, power tariff policy has been increasingly advocated as a mean to influence groundwater use and withdrawal decisions of farmers in view of the failure of existing direct and indirect regulations on groundwater withdrawal in India. Many researchers argue that pro rata electricity tariff, with built in positive marginal cost of pumping could bring about efficient use of the resource, though some argue that the levels of tariff in which demand becomes elastic to pricing are too high to be viable from political and socio-economic points of view.

The paper presents a theoretical model to analyze farmers' response to changes in power tariff and water allocation regimes vis à vis energy and groundwater use. It validates the model by analyzing water productivity in groundwater irrigation under different electricity pricing structures and water allocation regimes. Water productivity was estimated using primary data of gross crop inputs, cost of all inputs, and volumetric water inputs. The analysis shows that unit pricing of electricity influences groundwater use efficiency and productivity positively. It also shows that the levels of pricing at which demand for electricity and groundwater becomes elastic to tariff are socio-economically viable. Further, water productivity impacts of pricing would be highest when water is volumetrically allocated with rationing. Therefore, an effective power tariff policy followed by enforcement of volumetric water allocation could address the issue of efficiency, sustainability and equity in groundwater use in India.

Key Words: Overall Gross Water productivity, Overall Net Water Productivity, Overall Net Water Productivity Exclusive of Irrigation Cost

ISSUES AND POLICY OPTIONS FOR GROUNDWATER RESOURCES IN GUJARAT

Dr. B. M. Jani

Abstract

Introduction:

As per UNESCO estimates (1992), over half of the World's population depends upon ground water for their survival, whereas, in the case of India, 85% of rural and over 50% of urban water supplies depend upon ground water for meeting drinking & domestic water needs. It is most necessary for the developed state like Gujarat in India to tap potential sources of ground water for sustainable growth.

As per estimates of Central Water commission Report (1999), 90% of country's drinking water supply in India comes from groundwater resources. Drinking water requirements of urban areas where groundwater sources are not utilized are met from the reservoirs of irrigation and multi-purpose projects. Therefore, Geologists and hydraulic engineers pleaded for immediate completion of Narmada Sardar Sarovar project in Gujarat so as to raise the levels of ground water relatively in scarcity affected drought areas. North-Gujarat and Saurashtra regions in Gujarat state of India are scarcity affected drought area in general and districts like Kuchchha, Banaskantha, Mehsana, Jamnagar, Junagadh and Rajkot in particular. Ahmedabad – Vapi Industrial Belt on west coast of India in general and Gujarat in particular is famous for highly industrialized and urbanized geographical areas. Groundwater is used for drinking, agriculture and industrial purposes in the region as it can be developed at low cost. However, advent of green revolution with high yields varieties of crop, demands extraction of ground water in excess of recharge leading to depletion of water table, vis-à-vis degradation of water quality, heavy application of fertilizers, pesticides, relocate of industrial effluent and domestic sewage and its infiltration to aquifers aggravated the problem. Since groundwater quality is deteriorated, it is very expensive to restore, monitor and protect for sustainable period of time.

The present paper is divided into four parts the first one reviews existing body of literature grown in the recent past so as to sort out issues of debate in area of ground water resource management in India Vis-à-vis Gujarat. The second one shows present scenario of ground water resources and their quality in Indian and Gujarat. The third one analyses district wise nature of ground water resources in Gujarat, whereas, the fourth one expresses policy options to be followed for better ground water resources management in Gujarat.

ACCESS TO DRINKING WATER IN URBAN INDIA: AN ANALYSIS OF EMERGING SPATIAL PATTERN IN THE CONTEXT OF NEW SYSTEM OF GOVERNANCE

Amitabh Kundu
Sandeep Thakur

An Abstract

The paper analyses the availability of potable water at the national level, across states and size class of urban settlements and within a few large cities. This has been done by building comparable indicators for the early eighties, nineties and thereafter. Further, it identifies the socio-economic factors that explain the spatial variation. Intra-urban inequality has been assessed by focussing on access of drinking water to poor and slum dwellers within the cities. It briefly overviews the implications of changing policy perspective in the nineties and its impact on the quality and quantity of drinking water in select large cities. Finally, it analyses the problems in a fast growing metropolis by taking Delhi as a case study.

The analysis reveals significant disparity in the availability of drinking water across states and size class of urban centres. Developed states generally report a high percentage of households having access to this facility. Similarly, class I towns, particularly the metropolises, enjoy a distinctly higher level of this amenity, compared to other urban centres.

Disparity in the level of earning of the local bodies (as also the facilities provided by them) across size categories is high, the smaller towns reporting a figure which is one third that of class I cities. The resource crunch is acute in case of the backward states where the per capita grant given by the state governments to local bodies is low. It may further be noted that the small and medium towns in these states have experienced rapid growth in population until the nineties that puts tremendous pressure on their water supply system.

Limited survey data available for a few large cities indicate that inter locality variation in the level and quality of water is high and increasing over time. Understandably, the well-to-do have much larger capacity to organise themselves and better access to institutions at state levels, providing these facilities. Even the local bodies have a vested interest in serving the groups that are politically and economically powerful. Non-governmental and community based organisations have entered the water supply sector during recent years largely in the slum areas where the provisioning by the state is low. Involvement of private sector and voluntary agencies has thus tended to institutionalise the inequality in provisioning of water within the cities. Furthermore, the 74th Constitutional Amendment has a clause that the committees at the ward level could decide about the mix of water sources, viz. piped water, ground water, other open water bodies etc, based on the capability and willingness of the residents to pay. This is likely to accentuate further intra-urban inequality.

An analysis of the data from NSS, pertaining to the access of people in different consumption fractiles, suggests that substantial benefits from the formal system provided by the pubic agencies are cornered by middle and upper income households. Per capita water consumption for these people works out as extremely low and so is the amount of subsidy, even when water is given free to them. The rich, on the other hand, get much higher subsidies. Moreover, many among the poor do not get water through PSPs and have to depend on private or public tube wells and hand pumps. Besides paying higher costs, they end up consuming water with dubious quality, often causing water borne diseases and, sometimes, epidemics. The slum pockets in the heart of the large cities or their peripheries mostly have serious deficiency in terms of the quality of water, causing health hazard for the entire city population.

The national capital Delhi has serious water crisis as the gap between and demand and supply is increasing over the years and the city going in for exploitation of ground resources in a big way, leading to fall in water tables in several areas. Delhi Jal Board (DJB) seems to be in a vicious circle with annual deficit of 150 million rupees, which comes in the way of its installing meters and making investments to stall leakages and pilferage. That, in turn, comes in the way of improving the revenue earnings and reducing the deficits. Consequently, it is not in a position to do much with regard to the uncovered population, which is as high as 25 per cent.

It is indeed true that the metropolis does not have problems of non-availability of ground water in east and north Delhi where water table is quite high. The quality, however, is poor here due to mixing of various pollutants.The surface water taken out of Yamuna, too, has serious problems due to contamination. A ten year clean up effort was launched up 1983 but unfortunately left no impact on the quality of river water. Biochemical Oxygen Demand levels hovers between 15 to 30 micrograms per liter which is fifteen times the permissible level. The same is the case of coli form bacteria. All these increase the risk of water borne diseases. The discharge of 2,700 million liters a day from households and 300 MLD from industries are the major factors responsible for pollution. Only half of the domestic sewerage is treated, that too inadequately, by the 17 mini plants, set up in the first phase of the Yamuna Action Plan. The sewage treatment plants can not take care of the problem of coli form bacteria which has reached alarmingly high level in the nineties. Besides, sanitary landfills and discharge of untreated sewage into river is polluting the aquifers which are resulting in contamination even at deeper levels. Unless strong measures are taken up and implemented in a well coordinated manner by the agencies at different level, Delhi seems to be sitting on a dangerous ground which can any time jeopardise the current development processes in the city and the region.

Drinking Water and Well-being in India: Data Envelopment Analysis

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Abstract

The study examines the use of Data Envelopment Analysis (DEA) for the estimation of the well being from drinking water using 'commodities and capabilities' approach. DEA uses the general-purpose linear programme version of the *input oriented multi-input multi-output model* for the estimation taking state as the decision-making unit. The transformation efficiency of the water characteristics into achieved capabilities (free from morbidity rates of water borne diseases) shows that Punjab has the least efficiency while Kerala and Orissa as the Pareto-efficient Peer states. The major reason for the input use efficiency in Kerala may be due to the cultural practice of boiling drinking water before consumption. In the case of Orissa, it can be attributed to better hygienic water handling practices. One such indicator, taking water from the storage containers using vessels with handles, is very high among the households in Orissa.

An integrated approach to improve and protect rural water supplies in semi-arid India

A. J. James

Abstract

Widespread domestic water-supply problems have been a major feature of the ongoing and recent droughts in rural areas of southern Andhra Pradesh and north-eastern Karnataka. Watershed development projects do not target soil and water conservation activities at improving and protecting village water supplies, neither do they do much to engender collective responsibility for the protection and management of aquifers that are important sources of domestic water supply. Also, institutions at the village level do not usually have sufficient information, either about the problem and the options that exist, or about the way in which to approach the problem.

During the last 3 years, the WHIRL project has developed practical district and village-level planning tools for: 1) Assessing the status of village water supplies as perceived by the users; 2) Assessing the scope for concentrating runoff and groundwater recharge near to the sources of village water supply; and, 3) Estimating water potential and hence whether or not additional infrastructure can be supported by the existing stock of water. Drawing on the South African experience, the project is also assessing approaches that seek to provide a constitutional provision of a minimum quantity of water 365 days per year even during drought years. Providing PRIs and district-level bureaucracy with simple to use planning and decision-making tools are vital if village water supplies are to be conserved and improved to meet the contingencies of acute summer shortage and drought.

This paper argues that water management is the need of the hour, and that simple practical tools at all levels, starting from the community upwards, is vital to provide water sustainably in future. Using results of the WHIRL project and water audits carried out by the KAWAD and APRLP projects, this paper makes recommendations for improving the new Hariyali guidelines, especially from the institutional and planning perspectives, so that the main objectives are realised.

WATER SUPPLY AND SANITATION IN KARNATAKA STATUS, ISSUES AND POLICY

R. Maria Saleth and G. S. Sastry

Abstract

Although the water supply and sanitation sector of the state of Karnataka in India has made significant progress in terms of area coverage and, to some extent, meeting consumption targets, the two tasks, i.e., fulfilling the unmet backlog demand and meeting the water needs of future population, continue to remain as its major challenges. Based on an analysis of the data and information pertaining to the sector during 1999-01, this paper aims to assess the financial capacity and reform commitment of the state to successfully meet these sectoral challenges. Towards this end, this paper (a) describes the current status and recent performance of the sector; (b) reviews the financial health of the sector including an estimation of the magnitude of budgetary subsidy; (b) discusses the causes for and consequences of subsidy growth; (c) identifies the issues and strategies for sectoral reforms including an evaluation of some recent reform initiatives; and (e) concludes by highlighting the major implications for sectoral policy in the state in particular and India in general.

Household Water Services in Incomplete Markets Managing Water Stress for the Urban Poor

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Abstract

Where imperfections exist in the markets for water services, market prices do not reflect the true value of the services from water for either consumers or producers. Bringing social costs of supplying water into the picture, further complicates matters of pricing. This paper attempts to put together available empirical evidence relevant for urban Delhi on the appropriate valuation of water. While methodologies for valuation of water cannot by themselves provide pricing rules and nor can estimates of these provide investment criteria in a pure efficiency context, they do provide insights for policy-making. The paper also focuses on the institutional aspects for water supply. In the face of increasing strain on the capacity of the existing public sector institutions entrusted with the task of managing water resources, alternative formal and informal institutions have emerged in the provision of drinking water. In as much as the supply curve for water depends on factors other than technology, such as commitments on the quality of water supplied, the nature of contracts that govern water markets becomes critical in determining outcomes in managing water stress, particularly for the poor.

URBAN WATER PROBLEM

P. C. Bansil

Abstract

Rapid urbanization accompanied by faster population growth has already created enormous stresses on the natural environment throughout the world including the Indian subcontinent. These stresses extent far beyond the land that urban areas actually occupy to affect the land that provides the resources to sustain urban life. Urban areas claim the ecological output and life-support functions of both nearby areas and distant regions. For example, nearly 60 per cent of the water withdrawn for human use goes to the urban areas- about half of that to irrigate food crops for urban residents, roughly one-third for use by industry, and the remainder for drinking and sanitation (10). While the links between population and freshwater resources are complex, there is no doubt that population growth increases the demand for freshwater, more particularly in the towns and cities. While new approaches to managing urban water supply and demand can help in the short term, reducing population growth in urban centers, particularly through migration from rural areas is essential to avoid imminent catastrophe in many metropolis, cities and towns.

Closely related to population growth is the changes in the transformation of demographic patterns. The most vital of these demographic characteristics, particularly in terms of projecting future water and food needs in a fast-growing economy like India, is the rate of urbanization. Urbanization accelerates changes in diet away from basic staples like sorghum, millet, maize and root crops, to cereals requiring less preparation (such as wheat), fruits, livestock products, and processed foods. More urbanization influences the rate of growth in domestic and industrial water demand, as well as agricultural water demand through changes in the food demand. Rural to urban migration - and its attendant significant effect on demand structures – increased quite rapidly over the past- few decades in the country and will continue to grow further in future.

India needs a Blue Revolution in water management, just as we need of another Green Revolution in agriculture. Time is of the essence. Dwindling freshwater supplies per capita are threatening the health and living standards of thousands of denizens of the country's cities and towns. Achieving a blue revolution will require coordinated policies and responses to problems at international, national, and local levels. For example, in India, currently there is no coordination among the six ministries, including, water resources, food and environment that manage water. It is necessary to bring the water policy exclusively under one ministry. In fact, many urban areas of the country are growing in population so fast that their economies, services and infrastructures cannot keep up. Further, there is also chronic shortage of resources to solve the growing water problem any time soon.

In most parts of the country the groundwater resources has been over-exploited causing alarming environmental problems. High urban usage of water requires steps to augment supply by ensuring roof water harvesting compulsorily. Further, as urban water supply is heavily subsidized, there is little compulsion of conservation of scanty freshwater. Needless to say, proper pricing of water should be a weapon for conservation. Unless people are made to shell out appropriate rates for the water they use, conservation is sure to fail.

The unfinished tasks in water supply in urban areas, may be summed up as augmentation to attain the prescribed norms, higher degree of reliability, assurance of water quality, a high standard of operational and management efficiency, accountability to customers and in particular special arrangement to meet the needs of urban poor living in slums, constituting nearly 22 per cent of the total urban population, and levy and recovery of user charges to finance the maintenance functions as well as facilitate further investment in the sector.

Last but not the least, a vital part of a long-term solution to urban water supply problem lies on recognition of the links between rapidly growing populations and shrinking freshwater supplies. Recognition, knowledge, and concern can help build the political will to avert a crisis and develop the commitment needed to assure that humanity's apparently unquenchable thirst for freshwater does not exhaust the country's finite water supply.

THE ECONOMICS OF WATER SUPPLY IN IMPHAL CITY AND ITS SUSTAINABILITY

Ksh. Jhaljit Singh

Abstract:

The paper takes a holistic view of the issues relating to water supply in Imphal, the capital city of Manipur. The city spread over an area of 135.29 sp.km has a population of 5.95 lakhs, which is almost one quarter of the state population. The paper looks into various sources of fresh water, which are being or could be tapped by the population. The sources discussed are piped water supply, retail water outlets, roof-water harvesting and ponds or the pukhris. The city water supply schemes are found to be completely dependent on small rivers and streams flowing in and around the city for its raw water. From sustainability point of view, the need for scientific watershed management has been spelt out in the paper. The city water supply system has in general been found to be dismal and worrying. The official population coverage is very low. Even the select few with pipe connection suffer from erratic and inadequate water supply. Population at large are resorting to all kinds of malpractices to grab the maximum possible water for themselves from the water supply. There is complete failure on the revenue front as well. This is very serious as financial sustainability is an essential element for sustainability of any utility providing system. The functioning and health of the water supply system needs to be immediately improved from the equity and social justice point of view as the system failure is causing maximum damage to the economically weaker section of the society. Roof water harvesting as an option to partially meet the water need of the people is found to be a very suitable and viable option for Imphal city on many counts. This option could be made much more effective if an engineering mind along with a water scientist get together to popularize it amongst the people. The pukhris or the ponds, which are the traditional water harvesting structures of the place, have been serving the local population very well since a very long time. These institutions need to be strengthened for its sustainability against the onslaught of increasing population pressure and emerging trend of consumerism. The paper also notes that though the concept of waste water recycling and sewerage treatment plants have not yet arrived in Imphal, it should be taken up immediately and with care before the water-bodies get polluted beyond redemption and also to supplement the availability of water for use. In the end, the author while emphasizing the importance and effectiveness of demand management strategies in solving the water problem of any place, recommends the use of pricing of water to discourage profligate consumption and not to deprive the people of their basic water requirement.

Mainstreaming gender equity in water management: policy and practice

Sara Ahmed[1]

Over the past decade, there have been a plethora of global commitments recognising the need to involve women *and* men in participatory water resource management at all levels of governance. Action plans and recommendations have called for efforts to strengthen women's capacity to implement and manage water projects as well as provide them with equal access to information and decision-making channels. However, despite the recognition that access to water is a prerequisite for good health and sustainable livelihoods, and that gender equality and women's empowerment is essential to poverty eradication, the understanding of gender as a *relational* concept varies considerably, in both water policy and practice. Not surprisingly, for many bureaucrats, donor agencies, NGOs and community workers, gender is often synonymous with 'involving women' or addressing their 'visible' needs (drudgery of water collection) rather than also for example, looking at men's responsibilities in water collection, domestic work and childcare. This myopic perception has supported a *false dichotomy* in the division and perception of gender roles with women being assigned to the household sphere and therefore, domestic water, sanitation, health and hygiene are largely perceived as their responsibility, while men are seen to be more concerned with the productive domain, as farmers, fishermen or small producers, or technically skilled (water masons, hand-pump mechanics).

Beginning with a critical overview of the global discourse on women's /gender roles in water management and the institutional framework underlying water policy in India, the paper moves on to look at the essential 'ingredients' necessary for a sustainable and gender just approach to water management through the experience of a range of NGOs in India working largely, but not exclusively, in the field of drinking water and/or irrigation management. Attempts to mainstream gender raise questions about access to resources such as land, technology and information, facilitate capacity building for neo-literate women, and seek to challenge assumed gender roles. In this context, organizations as 'engendering mechanisms' play an important role in reflecting on the inter-connections between institutionalised processes and practices of power within organizational boundaries and the external environment of social action.

Focusing on women and men as 'actors' provides a new dimension to our understanding of water management *as a process* approach which seeks to *enable* civil environment to move from being mere implementers and users of technical fixes to water problems, to agents of good governance for sustainable water development and conservation. Empowerment in this framework cannot be achieved by separating and isolating women or men from the complex social relations underlying their myriad and diverse relationships with water, the environment and the larger socio-economic, political and cultural context within which a gendered approach to water management is embedded.

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Community initiatives in Water in a Decentralised Governance System of Madhya Pradesh

Abstract

Dr. Yogesh Kumar

Madhya Pradesh has faced severe draught situation over the last three years. Crisis of water has brought the concern for effective water management on the forefront of planning and implementation of programmes. The history of water programmes management clearly reflect that increasing control of the Government on water resources has negatively influence community ownership of water assets. Therefore, there is an apathy and indifference of the local institutions and citizens to strengthen community managed systems of water resources.

Madhya Pradesh is a pioneering state in establishing Panchayati Raj institutions after the 73rd Amendment. The process of decentralization is further deepened by introducing 'Gram Swaraj' where each village is treated as autonomous Gram Sabha. Each village can constitute eight committees around various sectors involving stakeholders for planning and implementation of their programmes. This legislative framework has created favourable conditions for the involvement of democratically elected local institutions to take control of their own resources including water.

Micro planning exercises in selective villages have been undertaken around the issue of water management. The processes and outcomes of micro planning clearly demonstrate abilities of the local institutions and their leaders to identify and implement most appropriate solutions of water resource management. As the processes did not involve Government machinery, there were various hurdles created by them to assert their power and position.

The paper also provides details of a large scale campaign of the Government called "Pani Roko Abhiyan' utilizing the strength of local self-governance institutions. The results of the campaign are phenomenon as more than 7 lakhs structures were created investing Rs.415 crore with 24% community contribution in a year. This demonstrates the strength of grassroot Governance to reach out to a large number of area in a short period of time. There were evidences of misuse of Government resources to either meet political or personal vested interests by local leaders or the quality of construction around the water structure was very poor.

The argument of strengthening local bodies of democratic governance is pursued by identifying ways forward. It is pertinent that Panchayats/villages should be provided with more untied funds so that Panchayats can determine their own priroties. There is a need to reduce influence of development administration for enabling local institutions to perform Panchayat representatives/local leaders require capacities in planning and water management. Last but not the least, there is a need to build data base appropriate enough to meet the information requirements of local self governance bodies.

EFFECT OF INDUSTRIAL EFFLUENTS ON GROUNDWATER AND THE CONSEQUENT IMPACT ON ECONOMIC, SOCIAL AND ENVIRONMENTAL GOVERNANCE

Dr.Chellappan Sekar, Associate Professor [Ag. Econ.], Department of Bio-Energy, Agricultural Engineering College and Research Institute, Tamil Nadu Agricultural University, Coimbatore-3.

Ground water has been a reliable source of fresh water for human consumption, irrigation and industrial uses. The total annual replenishable ground water has been estimated to be 43.2 million hectare metre [mhm]. After making a provision of 7.1 mhm for domestic, industrial and other uses, the available groundwater resource for irrigation is 36.1 mhm., of which the utilizable quantity is 32.5 mhm and about 85 per cent of the rural drinking water, 52 per cent of the irrigation water and 50 per cent of the total industrial and urban water in India is provided by the ground water.

In the arid regions of India, particularly in states like Tamil Nadu, dropping water tables, deteriorating water quality and increasing level of water pollution are not uncommon. Out of 4,272 blocks in the country 231 blocks have been categorized as *over-exploited* and 107 blocks are *dark*. In Tamil Nadu, out of 97 dark blocks, about 38 blocks are in western zone. In recent years, most of our water sources are polluted with untreated/partially treated wastes from industry, domestic sewage and fertilizer/pesticide run off from agricultural fields. Indian industry has grown substantially in the last decades, which have also created externality. According to CPCB, out of 8,432 large and medium industries in the country, only 59% have installed appropriate measures and operating effluent treatment plants (ETP) to treat wastewater before discharge.

A study conducted in Muthalipalayam revenue village in Tiruppur Taluk of Coimbatore District, where the pollution of groundwater is high due to industrial effluents, shows that the water resources in the study village have created some external effects on land quality, land value, crop yield, loss of manpower employment etc. The externalities caused by the changes in the qualities of water resources due to mismanagement and misuse included the common health disorders *viz.*, fever, jaundice, dysentery, headache, allergies and to some extent skin rashes etc. Farmers have incurred a total amount of Rs.518/annum/household towards the cost of physician and medicine and loss in time and management. Reductions in animal population, poor health status, reduction in milk yield, pre-mature delivery/abortion were the external effects on animals due to the degradation of ground water. Land selling, diversion of farm lands for non-agricultural activities, labour mobility towards non-farm sectors and poor economic status were the consequences of pollution externalities observed. The productivity of different crops like sorghum, cumbu, ragi, pulses, sugarcane, coconut, banana, etc., is less in spite of the advanced production technologies. It is mainly due to decline in soil fertility and water quality by the effect of industrial effluents. When the inhabitants were enquired about the Willingness to Pay for compensating the loss in agriculture by bringing good quality water from outside and rejuvenating water

resources, the responses received were very much disappointing. Majority of the respondents were not willing to pay much amount. The WTP was Rs.784, Rs.240 and Rs.162, respectively by farmers, non-farmers and agricultural labourers.

It is revealed that 14 per cent of farm households, 28 per cent of non-farm and 32 per cent of agricultural labour households are not interested in conserving land and water resources. The displacement of community-controlled regulation was found to be the chief reason for the non-implementation of strict environmental rules and regulations. There exists a lot of scope for augmenting the existing availability of water through recycling, treatment of wastewater and minimising its wasteful uses. The study comes out with a conclusion that institutional interventions should be strengthened, wherever the improper application and use of water is observed. As a first measure, installation of abatement equipments and operationalization of effluent treatment plants should be made mandatory in all the dyeing factories to reduce externalities and the non-compliers should be dealt with severely to reduce the degradation of surface and sub-surface water resources, which are considered to be the lifeline for agricultural production systems and rural prosperity. The extension of assistance to recoup the existing abandoned irrigation wells should be thought of to revitalize the agricultural activities and a substantial portion of the investment funds required for reusing the un-operated wells can be collected from the industries causing water pollution. This will ensure the participation of polluters in the rehabilitation programmes dealing with water conservation. Vigilant stakeholders with strong and technically equipped institutional support can play a very important role in managing the groundwater resource and the environment.

WATER POLLUTION GENERATION AND ABATEMENT COSTS IN SELECTED INDUSTRIES OF WEST BENGAL

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Abstract

Water is indispensable in our life. The quality of water is of vital concern in both domestic and industrial use. It is rarely possible to find a source that is completely free from pollutants. All sources of water are susceptible to pollution from a variety of sources, e. g., industrial effluent generation, household sewage disposal and agricultural activities. Among these, the industrial effluent generation has the greatest potential for polluting the receiving waters. A significant number of industries in West Bengal has been producing water pollution at much higher rate than the Minimal National Standards (MINAS) approved by the West Bengal Pollution Control Board. These industries continuously discharge their wastewater and thus pose an increasing threat to economic growth and the development prospect of West Bengal Economy. A limited number of these industries have put effort to minimize the water pollution generation by installation of Effluent Treatment Plant (ETP). The present paper attempts to study the pollution generation, abatement cost and other aspects and also to evaluate the viability of the investment in ETP. Five industries in West Bengal from different location have been chosen for our study. These are- (i) Eastern Spinning Mills & India Ltd., (ii) Samson Processing Industries, (iii) Jenson & Nicholson (I) Ltd., (iv) Infar India Pharmaceuticals, (v) East India Pharmaceuticals.

The paper makes a detailed analysis of the waste water quality status, cost and benefit involved with Effluent Treatment Plant.

Results show that due to the installation of ETP the wastewater quality of each industry becomes improved. This means that ETP of each industry is effective in keeping the quality of wastewater within the permissible limit of discharge. It also means environmental profitability. The viability of ETP of the industry has been evaluated through Internal Rate of Return (IRR), PayBack Period (PBP) and Cost-Benefit Ratio (CBR)using Cost Benefit method.

It is reflected from the values of PBP that all the aforesaid industries can recover its full investment in the ETP within the lifetime of ETP. The recovering rate is different for different for different industries. The values of CBR are greater than one except one industry (Infar India Ltd). IRR values are also different for different industries. The value for the five industries is more than the cost of investment (10%).

Thus from the findings of the modest attempt we submit that measures to control water pollutants by setting up ETP in five industries studied by us have been successful. So, the paper recommends setting up ETP in other industrial units, which have not yet implemented these measures.