Sustainable Water Use in India: A Way Forward[1]

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"Of all the social and national crisis we face today, the water crisis is the one that lies at the heart of our survival, and that of our planet earth".

Stated by the United Nations Report presented to the international community at the third World Water Forum, held in Kyoto, Japan, in March 2003.

1. Introduction

Water is fundamental to the development of India's development. The ambitions set out in the India Vision- 2020 by the Planning Commission (GoI, 2003) are closely linked to the efficient utilization of available water resources. India is moving towards "water scarce" country. With the increase in population, and the economic growth will only demand for greater stress on the water sector. The water challenges for the country and particularly for its states[4], are manifold: a) improving and safeguarding the existing drinking water supplies, b) managing the water demand across the competing sectors, and c) determining environmental requirements and prevention of pollution. These challenges are true for any state in India, as it is clearly stated e.g, in case of Andhra Pradesh (GoAP, 2003). This paper illustrates the availability of water resources, its historical development, growing constraints, reforms attempted in recent years. Towards the end, the paper argues for required policy modifications and effective implementation arrangements to achieve the millennium development goals.

2. Water Resources Availability

Over the years, there have been many estimates of the water resources available to India. The most recent are those given in the Report of the high-level National Commission for Integrated Water Resources Development Plan (hereafter NCIWRDP) set up by the Government of India, Ministry of Water Resources. In that Report (September 1999) the following figures are given (in km^3) [5]:

(Figures in cubic km)

Precipitation over the Indian landmass	4000
Available surface water resources	1953
Available groundwater resources	432
Usable surface water resources	690
Usable groundwater resources	396
Total usable water resources	1086
Present quantum of use	around 600

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[3] *This report was prepared by consultants for the Asian Development Bank. The views expressed in this report are the views of the authors and do not necessarily reflect the views or policies of the Asian Development Bank (ADB), or its Board of Governors, or the governments they represent. ADB does not guarantee the accuracy of the data included in this paper and accepts no responsibility for any consequence of their use.*

[4] Since development of water resources for any purpose and its allocation and utilisation is a state subject in India.

[5] Cubic Kilometers. Also referred to as Billion Cubic Meters or BCM. 1 BCM = 1 km^3.

There are some definitional and conceptual points here[6], but the crucial fact to note is that the above are national annual figures. There are wide variations, both temporal and spatial, in the availability of water in the country. Much of the rainfall occurs within a period of a few months during the year, and even during that period the intensity is concentrated within a few weeks. Spatially, there is a wide range in precipitation – from less than 200 mm (or even 100 mm) in parts of Rajasthan to 11000 mm in Cherapunji in the north-east of the country. This has (or is felt to have) implications for water-resource policy and planning and leads to certain responses. We shall revert to this in the last section of this paper.

As against the above figures of availability, there are projections of water demand for various uses. Many variables and assumptions enter into these estimations, and multiple projections may have to be made with reference to different assumptions and estimations in regard to some of the factors involved. In addition, there can be different expectations (`scenarios') as to the likely course of future developments. Some of the studies on the subject try to project water needs under three scenarios: (a) things go on as before and no significant changes are made in policies and practices (the `Business As Usual' or BAU scenario): (b) some incremental improvements are attempted in policies, procedures, patterns of use and technologies (`Improved Management' scenario); and (c) significant and radical changes are brought about with a view to ensuring economy in water–use, resource-conservation and long-term environmental `sustainability' (`sustainable water world' scenario). Some others adopt BAU, High Growth (HG) and Sustainable (SS) scenarios. Based on their respective assumptions and scenarios, different studies give their projections of future water requirements (for all uses):

(i) The Working Group (WG)[7] of the NCIWRDP and NCIWRDP itself: 973 to 1180 BCM in 2050.

(ii) India Water Vision (IWV) of India Water Partnership: 1027 BCM in 2025.

(iii) Study by Kanchan Chopra and Biswanath Goldar of the Institute of Economic Growth (KC/BG): 920.92 BAU, 1004.72 HG, and 964.9 SS in 2020.

WG and NCIWRDP assume that certain steps to ensure economy, efficiency and conservation will be taken, and predict a fragile balance between supply and demand on that basis. IWV and KC / BG also seem to adopt a similar position of a cautious but not an alarmist view of the future. Is such a position warranted? There are two divergent views on this question. One is that this is a complacent view and that a crisis is imminent. The other view, questioning the prediction of a crisis, is that of the Centre for Science and Environment (CSE): they argue that if there is proper water management, and if local, community-based water-harvesting is undertaken extensively all over the country (wherever it is feasible), there will be no crisis[8]. (We shall revert to this in the final section.)

Be that as it may, there is no disagreement on the need for economy in water-use in all sectors. On the one hand, the agricultural use of water has to come down to some extent from the present level of around 80% of usable water resources releasing more water for industrial, municipal and domestic uses. On the other hand, economy, efficiency and conservation in those

[6] `Precipitation' includes rainfall and snowfall; `available surface water resources' are measured in terms of annual flows at sites close to the terminal points of the river systems; `available groundwater resources' means `dynamic' groundwater or `groundwater potential', i.e., the quantity that can be extracted annually, having regard to the rate of annual replenishment (`recharge') and economic considerations; `usable water resources' means that part of the notionally `available' water resources which is actually available for use through impoundment or other means. (There is a view that the quantum of available surface water resources of 1953 BCM includes the groundwater availability of 432 BCM, as much of `dynamic' groundwater eventually joins surface water flows into the sea and the quantum of groundwater that independently flows into the sea is not significant; but this view is not accepted by all.) Water is also available in the form of atmospheric and soil moisture, and as stored in wetlands; there are also possibilities of local augmentation of availability through rainwater-harvesting or additional runoff-capture. However, these availabilities are not generally taken note of (at any rate not adequately) in the conventional estimations of water engineers; similarly, `usable' water resources can also have a wider meaning than the conventional engineering sense.

[7] For these three studies see References.

[8] Paper circulated at the World Water Forum, The Hague, March 2000.

uses will be imperative for restraining the growth of water demand. In the present paper we are primarily concerned with irrigation as the largest user of water. Before proceeding to a diagnosis of problems and deficiencies and giving an account of the reforms needed and / or undertaken in this sector, a broad overview of irrigation development in India may be useful.

3. Irrigation Development in India

Historical Background

Through most of its history, India has been an agricultural society. The earliest evidence of irrigation in India is provided by the Indus Valley civilization. Medieval India saw the creation of diverse and locally appropriate water management regimes. The diversity of agro-climatic zones, soils and topography resulted in the emergence of a number of traditional institutions of different kinds for collectively managing water, many of which are still extant though not fully active. Apart from the small village-centred irrigation works, some large irrigation structures were also constructed in medieval times. The colonial era marked the beginning of an accelerated development of irrigation works throughout India. In the nineteenth century, a number of canal systems were renovated and modified, and some new canals were also constructed. It must be noted that with the advent of the colonial era control over natural resources including water and the management of the irrigation structures tended to pass from the community to the state. The emergence of large state-built irrigation works gathered pace and became the norm after Independence. The brief synoptic picture given above is filled out to some extent in the ensuing paragraphs.

Tank Irrigation

Surface structures or formations collecting and storing rainwater, runoff and seepage from the surrounding areas are known as tanks or ponds. Over the centuries, locally built water storage systems (e.g, tanks in South India, Johads in Rajasthan), have acted as insulation against droughts, helped in recharging groundwater, provided crucial irrigation for crop production, functioned as a source of multiple uses for the village community (drinking water, washing, bathing, water for livestock and wildlife, fishing, water for cultural and ritual purposes), and played a role in the maintenance of a good natural environment. Because of these benefits, the Indian kings, Jagirdars, religious bodies and philanthropists built large numbers of tanks all over their domains. These rainwater-harvesting structures in various forms were known by different names in different parts of the country, e.g., kere in Karnataka, cheruvu in Andhra Pradesh, erie in Tamil Nadu, johad and bund in Rajasthan, ahar and pyne in Bihar.

Tanks were meant not only for agriculture, but also served as a resource-base for many other activities such as the collection of fodder, fuel, the making of bricks, pots, baskets, etc, with women offering their assistance in these processes. Tanks were also part of the socio-religious and economic system in villages. The location of the tank and its physical conditions were a matter of much significance to the people, particularly women, in carrying out their economic activities. The tank and its surroundings used to be the common property of the village and its people. The reverence for water as a life-sustaining element and the tradition of respect for water-sources ensured the proper maintenance of tanks for use by all, mitigating to some extent the prevalent caste-discrimination in work and access to and control over tank-based resources. The maintenance of natural resources through a continuous process of use and conservation meant not merely the assurance of livelihoods to the people of the village, but also the preservation of the ecological balance. While the given social framework might have restricted women's participation in community matters, their role in the conservation and maintenance of natural resources was implicitly acknowledged.

The integral role of the tank in the livelihood of a village community is also clear from the fact that in the past the village functionaries received land grants (inam) in the tank's command area, in return for their services. While grants of land were considered to be prestigious, their receipt also facilitated a greater sense of ownership among the village functionaries. Recipients

of land grants in this manner included the village headman (Patel or Patil), village accountant (Shanubhog, Karnik, or Kulkarni), priest, blacksmith, barber and so on.

The years after Independence witnessed the abolition of Inamdari landholding patterns and hereditary village offices, and there were also changes in the land-use patterns affecting the catchments of the tanks. These processes, whatever their other merits, had negative effects on tanks. In the post-Independence era there was a decline in the tank-irrigated area and the emphasis shifted to major and medium irrigation projects. The share of net irrigated area under tanks declined in the country from 17.3 per cent in 1950-51 and to 6.8 per cent in 1990-91 (GoI 1994). The decline of tank-irrigated area is common throughout the country. The reasons for this will be gone into later.

Major and Medium Irrigation[9]

Reference was made earlier to the shift from the community to the state and to the emergence of large state-built irrigation works. In pursuance of the recommendations of the first Irrigation Commission, a number of projects on a truly large scale began to be constructed. Table 1 shows the trend of area irrigated in undivided India. In the early 20th century, the aim was to provide protective rather than productive irrigation works (Reddy, 1998).

Table 1 Area irrigated in undivided India (in Million hectares)

Year	Public Sector (Govt-controlled)	Private Sector (Zamindar-controlled)	Total
1900	7.6	5.7	13.3
1920-21	10.4	8.9	19.3
1945	13.5	10.0	23.5

Source: Reddy, 1998.

After Independence, the Government of India launched an ambitious programme to improve agricultural production through the extensive development of the irrigation infrastructure. Development works in irrigation were taken up in all five-year and annual plans. Aside from China, the irrigation system in no other country is as extensive as in India.

Table 2 gives the numbers of major & medium projects introduced in each Plan. Passing over the earlier Plans and confining ourselves to the recent ones, the position is that from the Sixth five-year Plan onwards, emphasis has been laid on the completion of on-going projects and consolidation of gains, rather than on `new starts'. However, new projects continued to be undertaken. As shown in Table 2, the Seventh five-year Plan (1985–90) envisaged 12 major and 33 medium projects. This impetus for new construction was continued in the next two Annual Plans (1990–92). The Eighth Plan (1992–97) emphasized the completion of on-going projects rather than undertaking new ones (Planning Commission, 2001b). The ongoing Ninth Plan (1997–2002) has a comprehensive strategy regarding irrigation development and management. The strategy stresses the promotion of programmes for Participatory Irrigation Management, rational pricing of irrigation water, conjunctive use of surface water and

Table 2 Number of Major and Medium projects introduced in each Plan.

Plan Period	Major	Medium
First Plan (1951-56)	44	169
Second Plan (1956-61)	33	102
Third Plan (1961-66)	32	44
Annual Plan (1966-69)	11	30
Fourth Plan (1969-74)	32	73
Fifth Plan (1974-78)	70	300
Annual Plan (1978-80)	13	52
Sixth Plan (1980-85)	30	91
Seventh Plan (1985-90)	12	33
Annual Plans (1990-92)	1	-
Eighth Plan (1992-97)	14	50
Total	292	944

[9] In India, irrigation schemes and projects are classified as `major', medium and minor in terms of culturable command area covered (major: having more than 10000 hectares of CCA; medium: 2000 to 10000 hectares of CCA; minor: below 2000 hectares of CCA).

groundwater, and strengthening of CADP. It lays particular stress on the improvement of water-use efficiency by progressive reduction in conveyance and application losses (Planning Commission, 2001c). For the forthcoming Tenth Five-Year Plan (2002–2007), the Planning Commission recommends a major revival of public investment in irrigation capacity and water management and suggests the Accelerated Irrigation Benefit Programme as a potential means of providing resources to State Governments to support ongoing projects (Planning Commission, 2001a).

Minor Irrigation

Much of what goes by the name of `minor irrigation'[10] is based on groundwater, though some of it also based on water from other sources. There has been a dramatic increase in groundwater-based irrigation in the last several decades. This is further referred to in the next section.

4. Present Status of Irrigation

The gross irrigated area (GIA) of the country increased from about 23 million hectares (mha) in the triennium ending (TE) 1952–53 to about 72 mha in TE 1996–97, an increase of 2.62 percent per annum. During the same period the net irrigated area (NIA) is seen to have increased from about 21 mha to nearly 54 mha, an increase of 2.16 percent per annum. This is elaborated below in terms of category of irrigation.

Canal irrigation: In absolute terms, the net canal-irrigated area increased from about 8.61 mha in TE 1952–53 to about 17.25 mha in TE 1996–97. This increase was not commensurate with the magnitude of the investments on the `major and medium' irrigation sector in the Plans. The rate of growth of the area under canal irrigation tended to decelerate after the Sixth Plan despite increased investments mainly because of three reasons. First, the relatively easier potential had already been utilized, and further development was more difficult, with the result that there was inevitably a decline in the rate of growth of the area under irrigation. Secondly, the investment costs of the irrigation projects that were taken up from the Seventh Plan onwards were much higher, and a given order of investment could create only a lower order of irrigation potential than was possible in earlier Plan periods. Thirdly, budgetary allocations could not be made in adequate measure for the large number of major and medium irrigation (MMI) projects taken up, and this inevitably resulted in the slower completion of projects and therefore the slower creation of irrigation potential. There is every possibility that the growth of canal-irrigated area may decelerate further in future for these reasons. Further, while the area under canal irrigation did increase in absolute terms in almost all the States, the share of canal-irrigated area in the net irrigated area either declined or did not increase very much between the early sixties and late nineties, because of the significant role played by groundwater irrigation during the last 40 years.

Tank Irrigation: Tank irrigation has gradually declined over the last 50 years both in absolute terms and also in relation to NIA (Figure 1). Among the three major sources of irrigation, the tank is the only source where this phenomenon is observed. Tank-irrigated area started declining continuously from the 1960s, though some improvements have been noticed during the nineties (see Figure 2 below). Interestingly, this reduction in area under tank irrigation happened despite the construction of thousands of new tanks during this period (Vaidyanathan, 1994 and 2001). Tanks are mostly concentrated in areas where other sources of irrigation are limited or absent. The worst affected group because of the continuous decline of tank irrigation is that of poor farmers (small and marginal) for whom an alternative source of irrigation is costly or not available.[11] Studies (Janakarajan, 1993; Narayanamoorthy, 1993; Palanisami et al. 1997;

[10] As explained in the last footnote, the definition of `major', `medium' and `minor' irrigation is by culturable command area. However, the term `minor' has the unintended effect of belittling the importance of this category. This is unfortunate, as minor irrigation accounts for a significant part of the total irrigation potential, as will be seen from Table 4 below.

[11] As per the estimate of All India Report on Agricultural Census of 1990-91, tank irrigated area accounted for nearly 10 percent of the net irrigated area among marginal farmers, whereas it accounted for only 3.6 percent among large farmers.

Sivasubramaniyan, 1997; Dhawan, 2000; Palanisami and Easter, 2000; Vaidyanathan, 2001; Raju et al., 2001) have identified many reasons for the decline of tank irrigation:

a) encroachments in the tank foreshore and along the feeder channels have reduced the supply of water to the tanks;
b) the accumulation of silt in the tank basin/bed has reduced the water-holding capacity of the tanks;
c) the construction of dams/reservoirs in the upper watershed or catchment area has prevented the water supplies from reaching downstream tanks;
d) the rapid development of groundwater irrigation in the tank command areas has reduced the participation of farmers in tank-related works, which ultimately reduced the area under irrigation;
e) the poor design of new tanks has resulted in low levels of performance;
f) there has been a breakdown in village institutions because of caste and other conflicts, while community participation which was part and parcel of tank irrigation development has declined drastically; and finally (but importantly)
g) there has been inadequate attention on the part of the government.

The last factor figures prominently in most of the research studies carried out so far (Vaidyanathan, 1994 and 2001; Sivasubramaniam, 1995; Palanisami, 1990; Palanisami and Easter, 2000, Raju, et al, 2001). Considering its cost and other advantages, adequate attention needs to be given to the improvement of the performance of tanks.

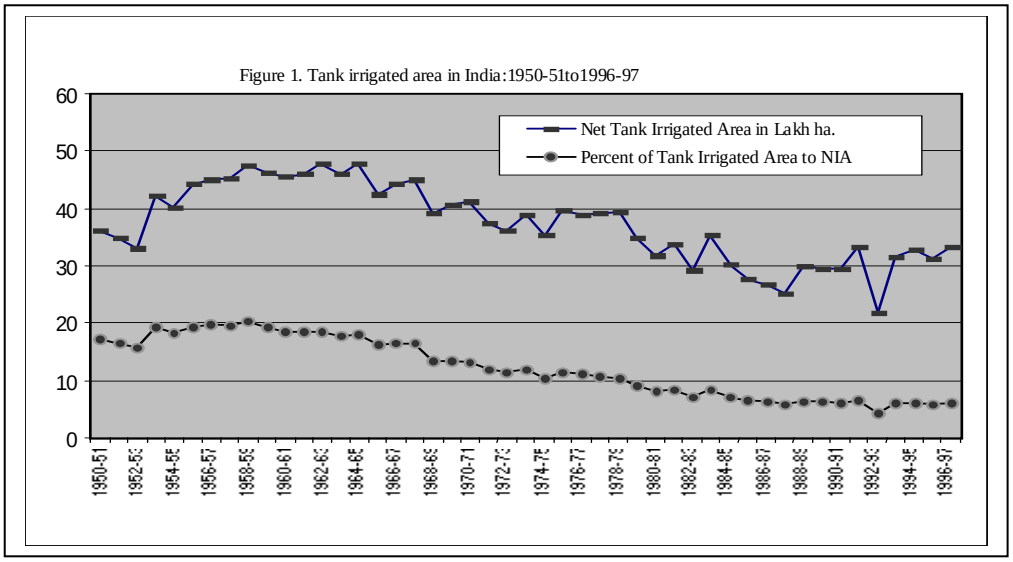


Figure 1. Tank irrigated area in India:1950-51to1996-97

Other factors that have been identified (Raju et al, 2003) include:

- the abolition of zamindari and the tanking over the rights of ownership of zamindari or other private tanks by the government;
- the involvement of multiple governmental agencies and a lack of coordination among them;
- political interference compounded by poor technical capabilities in the location and construction of new tanks and their size, which hampered the water regulation and capacity of centuries-old upstream/downstream tanks in recent decades.;
- a widening conflict of interests between tank-bed cultivators (including unauthorized ones) and command farmers, especially in the absence of institutional mechanisms to safeguard the interests of the resource;
- increased control by the government agencies without accountability;
- the absence of accountability to, or control by, local communities ; and

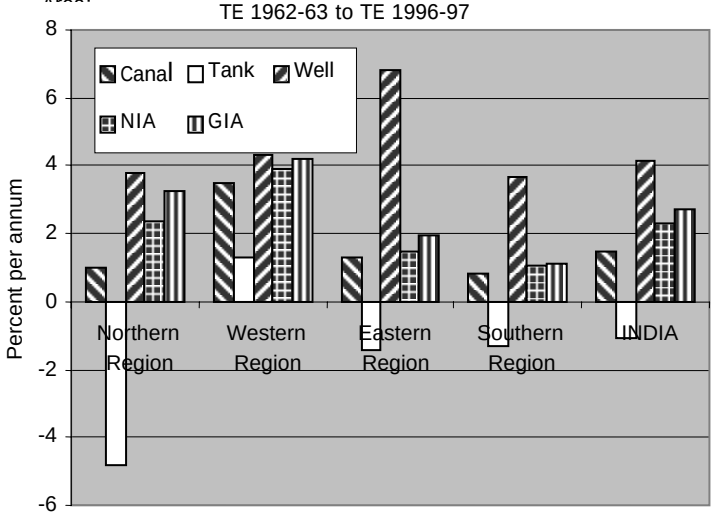
- the lack of governmental policy and programme support for traditional water management institutions.

Groundwater Irrigation: The importance of groundwater in the national life is evident: around 50% of irrigated agriculture is based on groundwater, and 85% of rural drinking water comes from groundwater. Even after all the major and medium irrigation projects (under construction or contemplated) are implemented, a substantial part of irrigation (not far below 50%) will still depend on groundwater.

One of the biggest developments that have taken place in Indian irrigation after Independence is groundwater irrigation. This source is predominantly owned and managed by farmers (Shah, 1993). While groundwater-irrigated area has increased to about 29.81 mha in TE 1996–97 from about 6.39 ha in TE 1952–53, its share in NIA increased from about 30 percent to about 55 percent during this period. Unlike tank and canal irrigation, the area under groundwater irrigation grew at a rate of 3 to 5 percent during different sub-periods from the 1960s onwards. The main factor in the growth of groundwater irrigation is tubewell irrigation, which grew at an impressive rate of 9.90 percent per annum during the period 1960–61 to 1996–97. The area under tubewell irrigation, which accounted for less than one percent of NIA up to 1960, increased to about 33 percent in TE 1996–97. The development of the rural electrification programme and the availability of credit at highly subsidized rates have helped the farmers to increase the area under groundwater irrigation significantly (Shah, 1993; Vaidyanathan, 1994). The rapid development of groundwater irrigation not only helped the well-owning farmers but also the non-well-owning farmers through water markets (Narayanamoorthy, 1994; Saleth, 1996; Shah, 1993; Shah and Raju, 1987). However, there are problems associated with tubewell/borewell irrigation and with water markets, which will be referred to later.

Irrigation by Other Sources: Over the last 40 years, changes have also taken place in areas under other sources of irrigation. While the share of this category in the total net irrigated area declined consistently in the majority of the States between TE 1962–63 and TE 1996–97, the absolute area has increased moderately in many States during this period. During TE 1962–63 and TE 1996–97, Madhya Pradesh registered the highest growth rate of over 9 percent per annum, where its share of NIA also increased impressively from 6.31 percent to 12.95 percent during this period.

Figure 2. Region-wise and Source-wise Growth Rate of Irrigated Area: TE 1962-63 to TE 1996-97



Regional Variations: The development of irrigation is not the same across different States and sources of irrigation from TE 1962–63 to TE 1996–97. Between TE 1962–63 and TE 1996–

97, the highest growth in the area under irrigation, whether from canals or from other sources, was registered in the western region as compared to the other three regions (see Figure 2). This was because of the higher irrigation potential and the higher level of investments on irrigation development made by the States forming part of the western region. The growth rate of irrigation (both NIA and GIA) is found to be very low in the southern region as compared to other regions during the period mentioned above. There are two reasons for this: first, most of the surface irrigation potential had been harnessed before Independence by the southern region and therefore further growth was bound to be low; secondly, tank irrigation, which is an important source in the southern region, declined at a rate of 1.31 percent per annum between the sixties and late nineties, which affected the growth of both NIA and GIA.

Agro-Climatic Zones: From an agro-climatic perspective, India is divided into 15 zones (see Figure 3). Water-resource availability and the circumstances of water-utilization vary considerably in the different agro-climatic zones. The area of irrigated land varies from 64% of the net sown area in the Trans-Gangetic Plain zone (States of Punjab and Haryana) to 6.3% in the Western Dry Region. Broadly, the level of irrigation (and consequently the use of water) is high in the Gangetic Plain region and in the Eastern Coastal plain zone.

Some reflections: Irrigation development has followed varying trajectories in different zones. As has been established, some regions (Gangetic Plains and Eastern Coast) have achieved a relatively enhanced stage of irrigation development. Other zones have performed poorly in this regard. In some developed areas, the results of over-irrigation are becoming evident. Many areas in Punjab and Haryana suffer from deteriorating groundwater quality because of salinity. Incidence of `dark' blocks (i.e., blocks marked by over-exploitation of groundwater) is on the increase in areas in the north and west of the country.

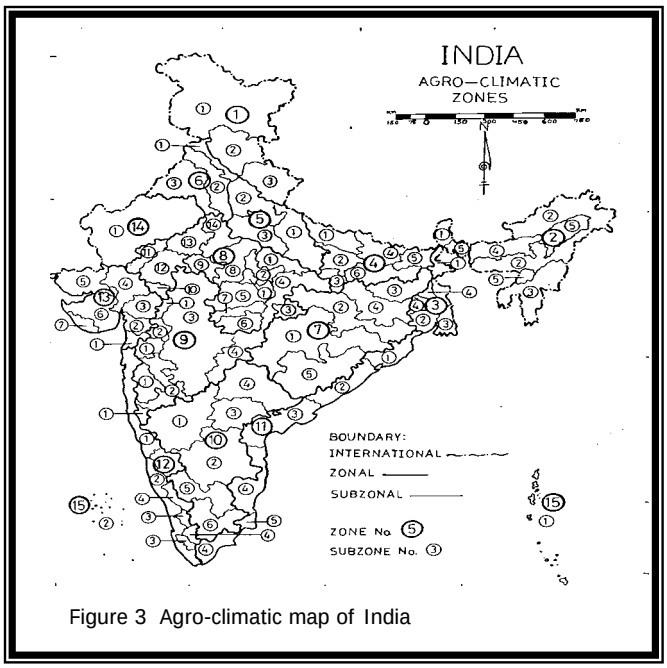


Figure 3 Agro-climatic map of India

A related point is the unquestioning reliance on canal/groundwater-based irrigation for all areas and regions and the tendency to assume that in the absence of this no `development' is possible. Many areas in the country practise types of irrigation (usually classified in statistical tables under the category `Other Sources') that are suited to the local terrain and conditions. It would be myopic to dismiss these systems as anachronistic. They have their place. Modern knowledge and technology can be utilized for improving and modifying the traditional systems so as to make them more relevant to present conditions (Sengupta, 1985). Institutional means of

reviving those systems by synthesizing traditional technology with modern knowledge could rejuvenate the development of irrigation in these areas.

Finally, there are regions with modest or limited irrigation development. These are classified as `rainfed'[12] areas. Rainfed agriculture is usually associated with images of deprivation and underdevelopment. However, recent research conducted on the divide between irrigated and rainfed agriculture has provided some unexpected results. Fan and Hazell have conducted an analysis on the productivity of irrigated and rainfed districts in the country from 1970 to 1995 (Fan and Hazell, 2000). They utilized Indian Council of Agricultural Research classification of 20 agro-ecological zones for their analysis. They categorized the districts (the ultimate unit in this method) into irrigated and rainfed areas with reference to the level of irrigation in the districts. Districts with irrigation levels greater than 25% were denoted as irrigated and those with levels less were rainfed (Fan and Hazell, 2000). Districts with poor irrigation development (hence `rainfed' according to this nomenclature) were further defined as having poor or high potential depending on whether the zones within which these districts lie, have poor or rich soils, low or high rainfall and short or long growing seasons. Their analysis by considering a number of factors such as public and private irrigation, high-yielding varieties of crops, fertilizer application, literacy rates as well as rural markets, reach the conclusion that investment in rainfed areas including many low-productivity regions is at least as productive as in irrigated areas, and also has a much larger positive impact on poverty (Fan and Hazell, 2000).

5. Irrigation: Problems and Deficiencies

Irrigation development in India has undoubtedly brought many benefits, but it has also been characterized by many problems, weaknesses and failures. Canal irrigation, groundwater irrigation, tank irrigation and rainfed agriculture: there are problems in relation to all of these. A synoptic account of these will be given in this section. (Some of these issues have been referred to in passing in the foregoing overview. Some will be discussed in greater detail in the section on reforms.)

Canal irrigation

(i) Canal-irrigation efficiency in India (around 35 to 40%[13]) is very low. It is true that what is lost from canals through seepage is partly recovered as groundwater recharge and as `return flows' further down, but that is not a reason for inefficient conveyance. (In any case, it is the actual application of water on the ground in irrigation that contributes more to recharge and return flows than seepage from canals. That again is not a justification for the excessive use of water in irrigation.)

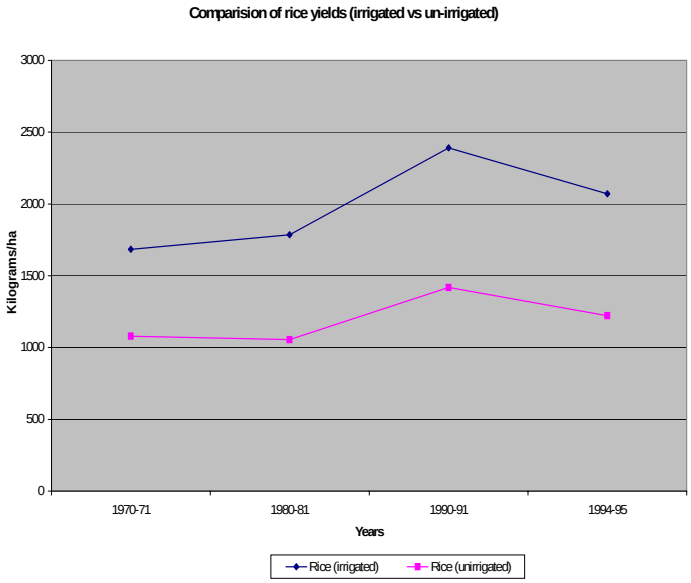
(ii) Injudicious canal-irrigation without regard to soil conditions, over-application of water, failure to take the groundwater table into account, and inadequate attention to drainage, have led to the emergence of conditions of water-logging and salinity in many areas, resulting in valuable agricultural land going out of use. The reclamation of such lost lands is not always possible, and where feasible, it often requires large investments. A 1991 Report of a Working Group of the Ministry of Water Resources estimated the extent of waterlogged land in the country at 2.46 million hectares (mha), and that of salt-affected land at 3.30 mha.

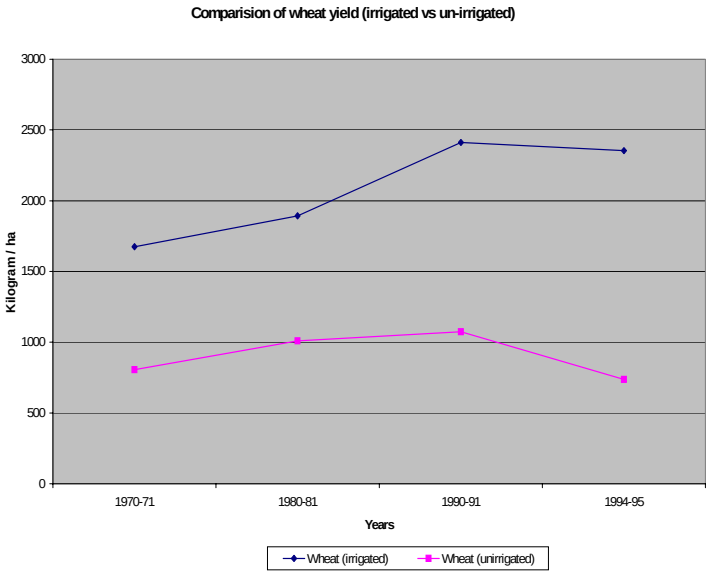
(iii) The yields in irrigated and unirrigated agriculture are given in Figure 3 below.

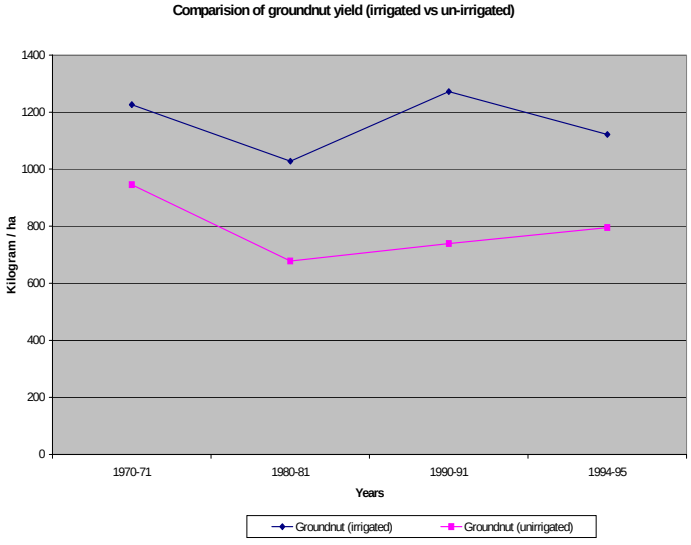
[12] The distinction between `irrigated' and `rainfed' agriculture is not as sharp as may be imagined. If by `irrigation' we mean the artificial application of water as distinguished from natural rainfall, then rainwater-harvesting and watershed development, mostly undertaken in `rainfed' areas, convert those areas into partially irrigated areas, even if the irrigation is limited. However, such areas continue to be classified as rainfed; the term `irrigated' is confined laregely to canal-irrigated and groundwater-irrigated areas.

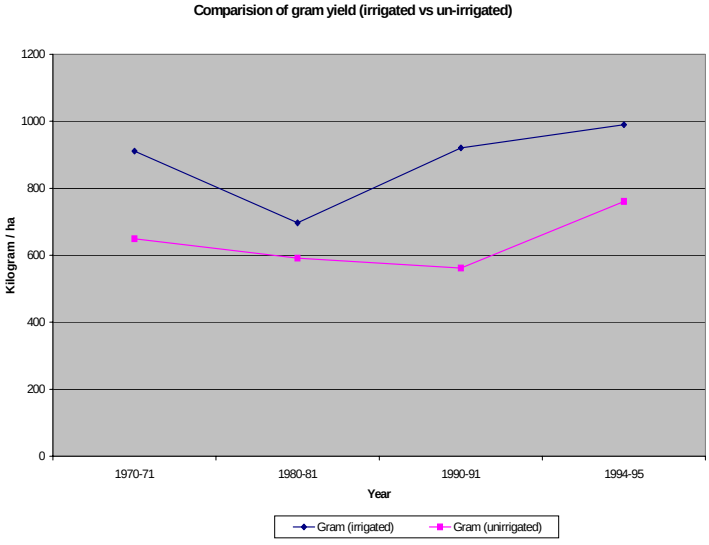
[13] Source: National Commission on Integrated Water Resource Development Plan.

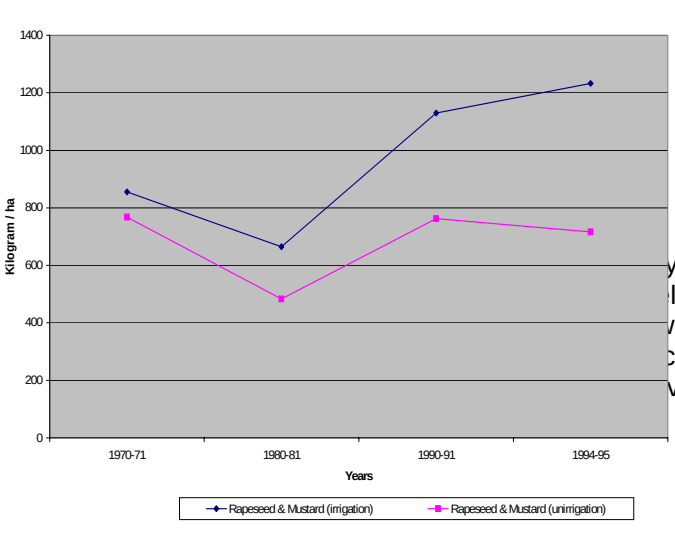
Figure 3. Comparison of crop yields (irrigated vs un-irrigated) at the national level











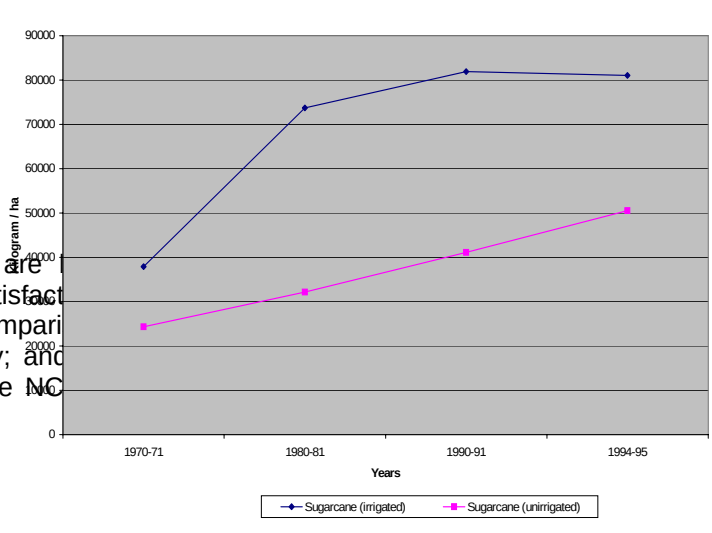


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Table 3 NCIWRDP's projections of yields (tonnes per ha)

Average Yield (projected)	Year 2010	Year 2050
Irrigated Foodcrop	3	4
Unirrigated	1.1	1.5

Higher yields, which ought to be achievable, will mean a reduction in the demand for water.

(iv) The source of canal irrigation is generally a major project, and the cost of creating irrigation potential through such projects has been steadily increasing: from Rs. 1200/ha in the first Plan (1951-56) to Rs. 66570/ha in 1990-92 in current prices; and from Rs. 8620/ha to Rs. 29587/ha in constant 1980-81 prices[14]. The figures today must be much higher. (Rough figures of Rs. 80000/ha to 100000/ha (in current prices) have been mentioned.)

(v) Further, there is a persistent gap between the irrigation potential[15] created at such cost and the extent of its utilization (Table 4). This problem, which was earlier presumed to occur only in the case of major and medium projects, was later found to be present in the context of minor irrigation also.

Table 4 Gap between irrigation potential created and utilized (end of 1995-96) (in mha)[16]

Category	Ultimate	Created	Utilized	Gap	Actually irrigated (land-use statistics)
Major/medium	58.46	32.20	27.45	4.75	
Minor (surface)	17.38	12.10	10.72	1.38	
Minor (groundwater)	64.05	44.42	40.83	3.59	
Total	139.89	88.72	79.00	9.72	70.64

The Command Area Development programme which was formulated as the answer to this problem is considered in the ensuing section on reforms.

(vi) Resource constraints, an unsound Plan/Non-Plan distinction, and an in-built preference for new construction over the efficient running of what has been built, have together resulted in the under-provisioning and neglect of maintenance. Systems built at great cost fall into disrepair, and there is a failure to provide the planned service. Canal irrigation is thus dependent on an inefficient and unreliable supply.

(vii) Canal irrigation in India has been marked by a number of inequities. As waters begin to rise in the reservoir, and canal systems for taking them to the tail-end are not yet ready, the head-reach farmers have plenty of water available and tend to plant water-intensive crops. This establishes a pattern of water-use that cannot easily be changed at a later stage: by the time the full canal system is ready, much of the water stands pre-empted in the head-reach areas and there is little left for conveyance to the tail-end. This is a familiar problem in most project commands. Further, with the increasing affluence of the large farmers, their money power begins to transform itself into political power with a potential for influencing policy formulation and the planning, designing and location of major projects, as also their operation.

(viii) Irrigation water from canals is supplied to farmers at very low prices in most States. This leads to the wasteful use of water and is not conducive to the promotion of resource-conservation. Even at the prevailing low rates, the collection of irrigation charges is poor in most States. The result is that the revenues accruing to the government from the provision of irrigation do not even cover the operation and maintenance costs of the systems, and there is no contribution towards capital-related

[14] Source: Ninth Plan Working Group on Major/ Medium Irrigation Sector.
[15] `Irrigation potential' is a problematic concept inasmuch as it involves the translation of the water storage created by a project into the area of land that can be irrigated, on the basis of assumptions in regard to cropping patterns and watering needs and practices; nevertheless, the `gap' between created and utilized potential cannot be dismissed as unreal.
[16] Source: National Commission on Integrated Water Resource Development Plan.

charges, much less any generation of resources for further investments. This subject is dealt with further in the section on reforms.

(ix) Finally, most of the inter-State river water disputes arise in the context of canal irrigation (existing or desired) from major projects. Examples, among others, are the Ravi-Beas, Telugu Ganga, Alamatti and Cauvery disputes.

Groundwater irrigation

(i) There has been over-extraction (mining) of groundwater leading to depletion in some areas, and salinity ingress in coastal zones (e.g., in Gujarat). On the other hand, there is a situation of rising water tables and the emergence of water-logging and salinity in other areas (e.g., in the Sharda Sahayak command in Uttar Pradesh).

(ii) Water markets tend to emerge in the context of groundwater extraction through tubewells and borewells, and they serve some useful purposes, but there are dangers of unsustainable extraction as also of inequitable relationships between sellers and buyers.

(iii) The answer to both (i) and (ii) above may be claimed to lie in regulation, but this has so far not been found feasible because of political factors and the legal problem of easement rights. Under the directions of the Supreme Court, the Central Groundwater Authority has been established, but it is not yet clear how it will evolve and operate, what kind of regulation it will attempt, and with what success.

(iv)There are problems of pollution/ contamination of aquifers (fluoride, arsenic).

Tank irrigation

This has already been dealt with in earlier sections. In brief, the problems in relation to tank irrigation are mainly physical decay and institutional decay arising from the passing of ownership and management into the hands of the Government followed by inadequate attention on its part, the increasing dominance of other forms of irrigation, and a decline in interest on the part of the farmers.

6. Reforms in recent years

Over the years, many reforms have been attempted in answer to the problems and weaknesses identified above. These combined in varying degrees policy changes, institutional reforms, administrative and procedural changes, new laws, and attitudinal changes. The following paragraphs outline some of the major areas where reforms were felt to be needed and have been attempted.

The Utilization Problem

While the creation of `irrigation potential' (a problematic concept as mentioned earlier) is doubtless a good measure by which to judge sectoral progress, the actual utilization of that potential is a better indication of the speed and effectiveness of accessibility of irrigation to farmers (Vaidyanathan, 1999). At the national level, the utilization of the potential is 86% in the case of major/medium irrigation projects, while for minor irrigation as a whole it is 91% (92% for groundwater irrigation and 88% for minor surface irrigation (CWC, 2000). Figure 4 shows the variations in utilization in the different categories of irrigation in different Five-year Plan periods.

Utilization levels vary considerably among the various States. Some states such as Tamil Nadu and Punjab consistently record levels of utilization of nearly 99%, while other States such as Assam, Maharashtra, Madhya Pradesh and Bihar record significantly lower levels.

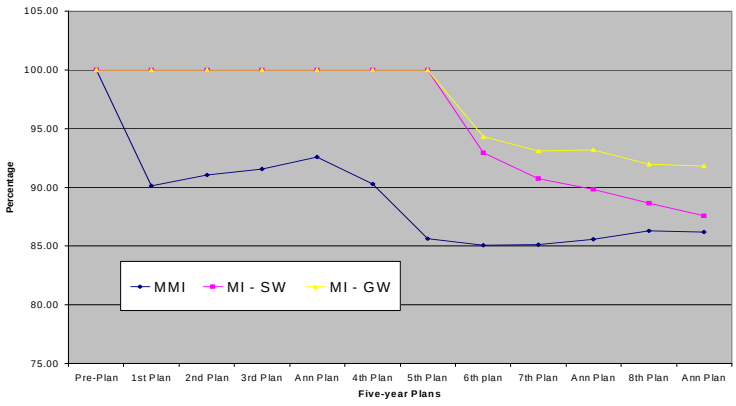

Figure 4 Variation in utilization across Plan periods.

The under-utilization of surface-water irrigation potential has been attributed in large measure to the delay in the construction of field channels and the establishment of water distribution systems (Saleth, 1996). The phenomenon of poor distribution infrastructure in the command area has given rise to two serious problems in Indian irrigation – excessive conveyance losses and tail-end deprivation. Seepage and other conveyance losses are high in some commands with the result that a sizeable portion of the water below the outlet is lost through seepage[17]. The World Bank notes that deterioration in distribution infrastructure has also contributed to reduced utilization and increased seepage (World Bank, 1999a). Increasing incidence of waterlogging and salinity can be attributed to the increased seepage.

Data on irrigation potential developed and utilized contain significant discrepancies. The discrepancies occur both across States (i.e., in data relating to different States) and within the same State (i.e., in data reported by different agencies). Data regarding irrigation area developed and utilized are reported by two distinct agencies at the national level, namely the Ministry of Agriculture (Land Use Statistics) and the Ministry of Water Resources (Sengupta, 1993). The Land Use Statistics data are collected through various sources – village-level officials in some states, Irrigation Department officials in some and sample surveys in others – while data for the Ministry of Water Resources are collected by the State Irrigation Department officials (Sengupta, 1993; Vaidyanathan, 1999). There are substantial differences between the data reported by the two sources. Further, definitions and methodology of collection show variations across States, which further add to the discrepancies. In addition, the conjunctive use of groundwater and surface water is not reported by any of the data- compiling agencies, resulting in double-counting errors in the data.

Discrepancies notwithstanding, the gap between the creation and utilization of irrigation potential is a real problem and has been causing concern. The Command Area Development Programme was conceived essentially as an answer to this problem. This was one of the earliest `reforms' undertaken in the irrigation sector.

Command Area Development

The Command Area Development Programme (CADP) started in 1974, mainly focused on-farm development works in the irrigated command areas, and the utilization of the created

[17] It has been estimated that of the total water let in the outlet, about 45% is lost through seepage by unlined field channels while 15% is lost due to excessive water application (from Rath, 1989) as reported in (Saleth, 1996).

irrigated potential. By 1997, CADP covered 203 projects, with cultural command area of about 21 million ha in 22 states.

The physical progress achieved in respect of construction of field channels has been very high but in case of rotational water distribution, it has been moderate viz, about 60% of the area covered by the field channels. Farm roads, included in the CADP package, are not a part of the Centrally-Sponsored CADP, and the Ministry of Water Resources is therefore not monitoring this activity. This is now being undertaken through the State sector.

The survey of relevant legal provisions in the existing Irrigation Acts in various States shows that most of the States do not have on-farm development works included in their Acts. In the absence of a statutory provision, the CADP is being implemented by obtaining possession of land from the farmers concerned without any payment of compensation. In such a situation, several difficulties arise, such as field channels being undone after sometime without any check, field channels being generally aligned on field boundaries resulting in a zigzag alignment and causing higher costs of implementation and higher conveyance losses. The consolidation of holdings is another activity which needs attention by the States. For all these matters, a legal backing to the CADP is needed.

There have been several evaluations of the CADP. By and large the finding is that while CADP has undoubtedly improved the utilization of the created irrigation potential, it has failed to achieve some of the larger objectives behind the undertaking of the programme. The main emphasis has been on physical works such as the construction of field channels, OFD works, land-levelling, etc. Organizationally, the unification and integration of different functions has not come about to the desired extent. Departmental compartmentalization and lack of coordination continue in most places. Some crucial disciplines such as agronomy, social sciences, etc, have not been inducted into the management. Extension services and the management of demonstration farms are areas that need attention. The promotion of agro-industries has not been marked. The CADP has not brought about significant improvements in water-use efficiency or in agricultural production. Several studies have also indicated that the weakest aspect of CADP is the failure to involve the farmers in the programme. The general `top-down' approach of the State Water Resources Departments continues. (NCIWRDP, 1999).

Participatory Irrigation Management

If the `utilization gap' problem led to the CAD Programme, the failure of the major and medium projects to provide satisfactory irrigation service to the farmers led to the idea of PIM. The dysfunctionality of the system and a growing feeling even within the government that it could not really run these huge, far-flung irrigation networks efficiently and render proper service, combined with the dissatisfaction of the farmers, led to the idea of transferring parts of the system to the farmers themselves for management. It became fashionable to talk about "farmers' participation", though the `participation' envisaged was limited, was being reluctantly invited under the pressure of circumstances, and at a late stage in the operation of projects earlier planned and executed by the state in an essentially non-participatory manner. (Underlying this line of thinking in recent years has also been the ideological consideration on the part of some, particularly the international financial institutions, of reducing the role of the state.) Be that as it may, the entrustment of the management of the system below a certain level to the users themselves was a necessary and desirable proposition in the given circumstances, and PIM has become an important measure of reform in the major / medium irrigation sector.

There were early anticipations of what is now called `PIM'. Passing over earlier history we may note that the National Water Policy 1987 stressed the involvement of farmers in various aspects of the management of the irrigation system, particularly in water distribution and the collection of water rates. The Committee on the Pricing of Irrigation Water (Government of India 1992) recommended not merely the revision and rationalization of water rates but also improvements in the service as a necessary accompaniment, and for bringing this about, it strongly advocated farmers' participation in the management of irrigation systems. The Eighth

Plan, recommending “greater user participation in major and medium projects both at system level and the local level”, observed: “Local initiatives by users or non-government organizations to set up users’ organizations to manage water below government outlets will be actively supported by the Government.” The Working Group on PIM for the Ninth Five-Year Plan identified legal, institutional, and financial aspects as being crucial to the effective implementation of PIM programmes. It concluded that the efforts made so far had been tentative, and that in the absence of clear legal provisions Water Users’ Associations (WUAs) remained weak. It suggested that legislative backing for PIM should be provided as early as possible. By the beginning of 2002, several States - Andhra Pradesh (which played a pioneering role in this regard), Karnataka, Madhya Pradesh, Maharashtra, Tamil Nadu, and Rajasthan - had enacted laws to promote PIM and the formation of WUAs.

Turning to actual implementation, fourteen States have pilot or full-scale PIM programmes: Andhra Pradesh, Assam, Bihar, Gujarat, Haryana, Himachal Pradesh, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Orissa, Rajasthan, Tamil Nadu, and West Bengal (Navalawala 1995; Raju and Brewer 1996; INCID 1996a). These ranges from minimal changes proposed in Haryana to more ambitious programmes in Maharashtra and Gujarat. The proposed WUA functions include O & M functions in seven States, dispute-settlement in only one State and the collection of water charges in seven States. Perhaps the most dramatic changes are proposed in Bihar, where farmers are to assume maintenance responsibility for distributary commands of up to 10,000 ha, and can retain 70 percent of the irrigation charges. Here again, severe fiscal crises which precipitated a clear breakdown of the Government's ability to deliver irrigation service has been responsible for the most sweeping changes (Brewer et al. 1997).

Despite the range of policies, cases can be classified according to two critical dimensions: level of water users' organizations and changes in the collection of irrigation charges. The first is important because some form of farmers' organization is necessary if users are to take over O&M activities, thereby contributing to the objectives of improving efficiency of management and/or reducing government costs. The second is aimed at reducing financial deficits, either by increasing the collection of charges or reducing state expenditure on collecting water charges.

The level of organization indicates the level at which users are expected to take on an active role. Haryana proposes to have water users' organizations only below the outlet (as is currently found in most States).[18] A number of States (Andhra Pradesh, Madhya Pradesh, Karnataka, Rajasthan, Bihar, Gujarat, and Maharashtra) propose transferring O&M responsibilities to WUAs at distributary or minor level. This approach implies a somewhat greater degree of change, as it generally requires the formation of new organizations to co-ordinate between outlet-level groups, and a greater level of responsibility for farmers in O&M. This could reduce marginally the fiscal deficits of the States if the State agency withdraws from O&M at the distributary level, and it can improve performance if farmers do the work more effectively than the government agency had done. However, in many cases the Government does not fully withdraw, so any `farmer involvement’ often becomes a supplement to the agency. The transfer of O&M responsibilities to a three-tiered structure of WUAs and joint management committees (JMC) with the Government is proposed in Tamil Nadu, Andhra Pradesh and Kerala. JMCs are committees made up of farmers’ representatives—often selected by WUAs—and government officials. Participation in the JMCs gives farmers a somewhat stronger voice in management and allocation.

In regard to irrigation charges, the earlier situation in most States was for the Revenue Department or a special wing of the Irrigation Department to collect charges from individual farmers. Plans to involve WUAs in the collection of irrigation charges are a response to the recognition that state agencies are failing to collect even the relatively low level of charges

[18] Some will question whether the Outlet WUA policy proposed by Haryana is a transfer policy at all since the pre-transfer policy in Haryana (and in all of the other States) is that farmers are collectively responsible for O&M below the outlet. The only features that qualify it as a transfer policy are that some maintenance now done by the State will be transferred to the WUAs and there will be formal registered organizations of farmers rather than informal groups below the outlet.

assessed. Bihar, where government expenditures on collection have exceeded the revenues collected (Bhatia 1989), proposes to involve WUA in the collection of charges. Several States (Gujarat, Maharashtra, Karnataka, and Rajasthan) are experimenting with volumetric wholesaling (i.e., bulk supply and billing by volume) of water to mid-level WUAs.

Whatever the organizational structure, most PIM policies focus primarily on shifting responsibilities from the state to farmers. Only volumetric wholesaling proposes to change the basic allocation principles and to give farmers more control over decisions about water. Under this approach, mid-level WUAs pay for water by volume and assume responsibility for allocating it among their members and for collecting the charges. As the user group pays for water by volume, it has an incentive to conserve water collectively. However, individual farmers are the ultimate water users, and this approach depends on the group to motivate individuals to use water efficiently.

The success of PIM policies must be measured not in the number of recommendations or programmes, or even in registered associations, but in the level of constructive involvement of farmers in improving the performance of irrigation systems. The critical question is whether and how farmers respond to government overtures to increase their participation. Pilot projects show that much can be achieved, but whether these pilot activities can be scaled up to cover large areas remains a question. There is a need to identify factors that tend to affect farmers' willingness to participate in irrigation systems.

Training

Eleven major States in India have established Water and Land Management Training Institutes (in some states Irrigation Management and Training Institute). These were envisaged as important agents of change. Over the years, for a number of reasons, these institutes have failed to play a key role in most of the States. On the whole, the WALMI idea has not been a successful reform measure and seems to have run out of steam. The idea needs to be thought through afresh at both State and Central levels and re-formulated or re-energized.

Pricing of Irrigation Water

This is essentially a problem relating to the pricing of irrigation water supplied from public major/medium projects. In general, irrigation water rates in this country (for water supplied by the state from canals) are unduly low, and even charges at those rates are not fully or always collected. Rates for irrigation water supplied from canals are fixed at the State level on a crop-area basis in nominal rupee terms, and remain unrevised for years, sometimes for decades. The rates in Tamil Nadu have remained unrevised for over 25 years. Towards the late 1990s, there was an effort to raise water rates: Andhra Pradesh has tripled its irrigation water charges in 1997, Maharashtra has announced a gradually rising rate for the next five years, and may other States are contemplating similar moves. However, the overall the picture during the period 1960 to 1997 is not a reassuring one (Svendsen, Gulati and Raju, 2003).

Poor revenues from public irrigation systems created at great cost are among the many factors responsible for the severe resource constraint faced by most State Governments. The result is poor maintenance of systems, which tend to fall into disrepair, and an unreliable and unsatisfactory service. That leads in turn to poor revenues, thus setting in motion a vicious cycle. If even maintenance suffers there can hardly be any resources for further investments in this sector. Apart from this, the low pricing of irrigation water encourages an extremely wasteful use of this precious and scarce resource. There is also an equity consequence: the profligate use of water by the head-reach farmers results in the no-availability of water for the tail-end farmers.

It is now well recognized that there is a substantial under-recovery of costs in the major / medium irrigation sector, and that most of these projects are loss-makers in financial terms. (It must be noted that from the fifties onwards, financial return has ceased to be a criterion for the approval of major / medium irrigation projections. The investment decision in such cases is

based on a `benefit-cost ratio'.) The Committee on the Pricing of Irrigation Water (GoI, 1992) estimated that the total unrecovered costs on account of major and medium irrigation projects had increased fivefold in a ten-year period from Rs. 2800 million in 1977-78 to Rs. 15250 million in 1986-87.

Successive Commissions and Committees (Irrigation Commissions, Finance Commissions) have stressed the importance of recovering at least the O&M costs if not the capital-related charges, but these have not been acted upon. The National Water Policy 1987 stated that irrigation water rates should be such as to cover the O&M costs fully and make a partial contribution towards capital-related charges (the extent of this was not specified) but this too, like many other principles laid down in the NWP, remained non-operationalized. The National Water Policy 2002 makes a similar observation.

A crucial question in this regard is whether irrigation water rates are a tax or a `user charge'. If it were a tax, there need be no connection between that tax and the cost or quality of the service rendered, and the budget provisions for O&M would have nothing to do with the tax: the latter would be part of the general revenues, and the former would be independently provided. This question was gone into by the Committee on the Pricing of Irrigation Water (the Vaidyanathan Committee) in its Report (GoI,1992). The Committee came to the firm conclusion that the benefit of canal irrigation went to an identifiable group of beneficiaries; that it was therefore not a public good available to all; and that irrigation water rates were clearly not a general-purpose tax but a user charge recoverable from the beneficiaries.

The Vaidyanathan Committee recommended a two-part tariff, in the first phase, comprising a fixed charge of Rs. 50 per ha for the entitlement arising from membership of the command area and a variable charge to recover the annual O&M cost and one per cent interest on the capital cost (adjusted to remove the costs attributable to inefficiency). The objective was to move towards full cost recovery. The change was to be brought about in three phases, ultimately leading to rates on a volumetric basis, linked to an improvement in the service, and the creation of autonomous, financially self-reliant entities at the system level, with participatory management by users. The Committee also suggested that while the change to fully volumetric charges would take time, a beginning could be made by shifting from the present crop-specific area-based rates to rates related to area irrigated in each season (irrespective of the crop grown) so that differences in irrigation requirements between seasons are taken note of. Unfortunately, ten years after the Report, it remains largely unimplemented because of the lukewarm response from the State Governments. This was doubtless due to the fact that the implementation of the recommendations would have meant a substantial (more than fivefold) increase in rates even in the first phase. However, as mentioned earlier, some States have revised their water rates to varying degrees.

The subject was gone into again by the NCIWRDP in its Report (1999). It broadly followed the Vaidyanathan Committee's recommendations but made a few modifications and refinements. It also laid down some broad guidelines and principles. The NCIWRDP's recommendations do not seem to have received serious consideration so far.

The question might be raised whether poor farmers would be able to pay increased water charges. The short answer to that question is that irrigation increases productivity and production, and the resulting increase in income will enable the farmer to pay the water charges which will be only a small fraction of the value of the output (as pointed out in the Vaidyanathan Committee's Report). In any case, if (as argued earlier) irrigation-water rates are essentially user charges and not a tax, they will necessarily have to cover running costs and eventually capital-related charges. Poverty is not to be taken as an unalterable given and accommodated through subsidies on water or electricity, but reduced through income-generating measures, of which the extension of irrigated agriculture is an important one. Integrated watershed development schemes in rainfed areas are also primarily livelihood-enhancing programmes. Those are the answers to poverty.

Financing of Projects: Bonds, Privatization

The paucity of funds for new investment is forcing State and Central Governments to explore alternative sources of financing for developing and rehabilitating irrigation projects, such as the tapping of the capital of private investors, private borrowing through revenue-backed instruments, and the mobilization of local capital through investments by farmers in the systems that serve them (Svendsen, Gulati and Raju, 2003).

The raising of resources from the market through the issue of bonds was initiated with the sale of Narmada Bonds in the mid-1980s. Bonds were also sold to support the Upper Krishna Project in Karnataka. Under both of these schemes, secured, redeemable, non-convertible bonds were offered at a fixed rate of interest guaranteed by the respective State Governments. A pre-requisite for this is the establishment of corporate bodies for managing specific projects. Examples are the Krishna Bhagya Jala Nigam Limited (KBJNL) in Karnataka, Sardar Sarovar Nigam in Gujarat, and Maharashtra Krishna Valley Development Corporation (MKVDC) in Maharashtra.

The rates of interest on such bonds are very high, as high as 17.5% in some cases. This makes it a very costly source of credit. No irrigation or even multi-purpose project can service such a debt. The liability necessarily falls on the Government, and constitutes an addition to its already heavy burden of debt-service. It is a delusion to think that this is an `innovative' resource-raising method. The debt will sink either the project or the Government's budget. If such capital- and resource-intensive projects are to be undertaken at all, the proper course would be for the Government to do so out of the budget. This would clearly call for a very selective approach and a most stringent scrutiny with reference to hard criteria. There are no soft options.

Private sector participation in irrigation financing is an idea that has been favoured by both the Planning Commission and the Ministry of Water Resources. The revised National Water Policy (GoI, 2002) advocates private sector participation in the planning, development and management of water resources projects wherever feasible. Private sector participation is expected to help in introducing innovative ideas, generating financial resources, speeding the construction process, introducing corporate management modes, and improving service efficiency. However, there are questions as to the likelihood as well as the desirability of this course.

Taking likelihood first, even the most pro-business States such as Gujarat and Maharashtra have not been able to elicit much private sector interest in irrigation projects. State Governments have not asked for expressions of interest from potential bidders, nor has any State Government formally declared willingness to sell stakes in irrigation projects. In practice, private sector participation is likely to encounter several problems (Svendsen, Gulati, and Raju, 2003): large investments, long gestation periods, modest or low returns, high financial risks, likely political interference in project management and water-rate assessment, the political influence of farmers' lobbies, the difficulties in raising water rates and collecting them effectively, and so on. The much-advocated idea of private sector participation has made hardly any headway in power projects, and there is no basis for thinking that it would be more successful in irrigation projects.

Turning to desirability, privatization can mean allowing a private entity to build dams and reservoirs on rivers, or exploit surface water bodies (e.g., lakes) or an underground aquifer for commercial purposes. Even assuming that the private sector is interested in investing in such capital-intensive, long-gestation, modest-return projects, how are the environmental and social impacts (which have presented serious difficulties to the state in past projects) going to be handled by the private entrepreneur and manager? Supply may match demand but resource conservation may receive scant consideration; resettlement and rehabilitation aspects are likely to be given grudging attention only to the extent that resistance by those affected and public opinion compel such attention; and it is naïve to imagine that market forces will obviate conflicts

or provide a magical route to their resolution. Further, there are questions not merely of equity and sustainability but also of control over natural resources. (That does not mean that one is arguing for a dominant role for the state; but merely that the alternative to the state is not necessarily the corporate sector.)

There is also the basic conflict between regarding water as an `economic good' in which tradable rights can be created (which is a pre-requisite for private corporate investments) and regarding it as a life-supporting element and therefore a basic right (now recognized as a human right in the UN context). Many would argue that water is more appropriately treated as a common pool resource to be managed by the community, than as a tradable commodity. It is not easy to reconcile those two conflicting approaches to water.

One important question that will need consideration in this context is whether allowing the domestic private sector to exploit national natural resources, particularly water, will make it difficult to deny a similar right to foreign investors in terms of the WTO regime and the principle of `national treatment' of foreign investors, and if so, whether there is a danger of our losing control over our own natural resources, as some have argued.

Revival of Traditional systems

A significant reform that is still to realize its full potential is that of revival of traditional systems. Over the years, a few leading NGOs (e.g, Dhan Foundation in Tamil Nadu) have made strenuous efforts to mobilize local communities in restoring the role of traditional systems such as tanks. Some State Governments (e.g, Karnataka, Andhra Pradesh, Rajasthan, and Madhya Pradesh) have also initiated large-scale programmes to rejuvenate tanks. Karnataka State has taken a much-needed initiative to rehabilitate the minor irrigation tanks. The proposed project has plans to rehabilitate some 5,000 tanks on a pilot basis all over Karnataka through a community-based approach. A somewhat similar approach, supported by SIDA, was designed for 4,100 tanks in Rajasthan. The European Economic Commission and others have supported the NGO-initiated approach in various parts of Tamil Nadu. DHAN Foundation has taken up this programme mainly in Madurai and Ramnathapuram districts. This programme is also supported from rural development funds of the State Government. Their main focus has been on small tanks (below 40 ha) with a view to improving the livelihoods of marginal and small farmers, besides landless families.

The utilization of local knowledge systems enables the communities to participate with the feeling that it is their project, and they take pride in designing the rehabilitation plan and implementation. In the proposed community-based tank rehabilitation project in Karnataka, emphasis has been on local people's perceptions of the tank and its structures and the sustainability of their efforts and contributions. The local farmers believe that if tank rehabilitation is carried out with their active participation, then the design and structures will not require an ISI mark, and the tank will be as clean as a temple. However, experience during the past few decades has been that the design and strategies are evolved elsewhere with little concern for local needs and situations. This being the case, the people evince no interest in such projects. Consequently, the tanks in most Karnataka villages lost their importance in the everyday life of the rural population whom they were meant to serve.

As part of the initiative, the Government of Karnataka has set up a separate organization called Jala Samvardhane Yojana Sangha (JSYS) as a special purpose vehicle and as an autonomous society. JSYS can make decisions faster and simplify procedures for the effective implementation of the World Bank projects. JSYS has initiated some tank-user associations on a pilot basis, and launched different studies to appraise the current situation and to suggest strategies.

Water- Harvesting Movement

Tanks can be subsumed under the wider heading of water-harvesting, to which we now turn. India has a long history and tradition of rainwater-harvesting. Recognising the

importance of capturing the transient and variable rainfall[19], our ancestors had learnt to harvest water in a variety of ways (Agarwal, 2001):

- They harvested the raindrop direct. From rooftops, they collected water and stored it in tankas built in their courtyards. From open community lands, they collected the rain and stored it in artificial wells called kundis.
- They harvested monsoon runoff by capturing water from swollen streams during the monsoon season and stored it in zings in Ladakh, ahars in Bihar, Johads in Rajasthan and eris in Tamil Nadu, to name a few.
- They harvested water from flooded rivers in places like north Bihar and West Bengal.

Considering the enormous land and water resources, and variability of rainfall, the calculations carried out by Agarwal et al (2001) show that the potential of rainwater harvesting is enormous and undeniable. There is no reason whatsoever for thirst in India. The strategy for drought-proofing should be to ensure that every village captures all the runoff resulting from the rain falling over the entire land and the associated government revenue and forest lands, especially during years when the rain is normal, and store it in tankas or ponds or use it to recharge the depleting groundwater. It would then have enough water in its tanks or in its wells to cultivate substantial lands with water-saving crops like millets and maize. Apart from the well-known efforts of villagers in Ralegan Siddhi in the drought-prone Ahmednagar district of Maharashtra (under the leadership of Anna Hazare), the poor, low-rainfall villages in Alwar district of Rajasthan (under the leadership of Rajendra Singh and the NGO Tarun Bharat Sangh), and the villages of Sukhomajri and Dhamala in the degraded Shivalik hills in Haryana (under the leadrship of the late P. R. Mishra), there are numerous other efforts taking place in India and elsewhere to revive the old water-harvesting practices. The above-mentioned examples have clearly shown that rainwater-harvesting is not merely a means of locally augmenting the availability of water but the starting point of an effort to eradicate rural poverty, generate rural employment and reduce distress migration from rural areas to urban areas. However, this calls for a new approach to governance itself: a participatory form of governance rather than a top-down bureaucratic one. So far, these have been scattered local initiatives. What is called for is a national campaign on these lines. The Prime Minister emphasized this strongly in his Address to the National Water Resources Council on 1 April 2002, while commending the National Water Policy 2002 for adoption.

Reforms in relation to Groundwater

The problems in relation to the exploitation and use of groundwater have already been referred to earlier. Broadly speaking, these relate to equity, resource conservation, protection of quality, and environmental sustainability, and these are what reforms in relation to groundwater need to deal with. Difficulties arise essentially in two inter-related contexts: the prevailing law governing the ownership of groundwater, and the emergence of water markets.

Under Indian law, the ownership of land carries with it the ownership of the groundwater under it, subject to regulation and control by the state. It has been said that “groundwater is attached, like a chattel, to land property”, and that “there is no limitation on how much groundwater a particular landowner may draw” (Chhatrapati Singh 1991). It follows that only those owning land can have rights over groundwater; the landless (including communities, tribal and other, who may have been using certain natural resources for centuries) can have no such rights. Further, this legal position leads to inequities of various kinds: a rich farmer can install power-driven tubewells or borewells in his land and their operation can make dugwells in the neighbourhood run dry; he can sell water so extracted to his poorer neighbours even though the water may come from a common aquifer running under their lands; and he can deplete the aquifer through excessive exploitation. The easement right makes regulation difficult.

[19] India’s average annual rainfall is 1,170 mm. It varies from 100 mm in the deserts of western Indan to 15,000 mm in the high rainfall hills of the Northeast. Nearly 12 percetn fo the country recieves an average rainfall of less than 610 mm per annum while 8 per cent receives more than 2,500 mm. But more than 50 per cent f this rain falls in about 15 days and less than 100 hours out of a total of 8,760 hours in a year. The total number of rainy days can range from a low of five days in a year in the desert regions of Gujarat and Rajasthan – though on some of these days there can be high-intensity rainstorms – to 150 days in the Northeast. (Source: Making Wter Everybody’s Business. (ed) Anil Agarwal, Sunita Narain and Indira Khurana. Centre for Science and Environment. 2001).

It is against that legal background that water markets have emerged in the context of groundwater extraction through tubewells and borewells. Groundwater markets exist in various forms in many regions of India. They are truly spontaneous institutional responses to emerging and variegated needs in different areas (Shah, 1993). According to Shah (1993) and Shah and Raju (1987) the following factors influence the pace of development of water markets: availability of water resources, scale and quality of adoption of irrigated farming technologies, progress of rural electrification, quality of power supply, and extent of land fragmentation. Nearly 18 of the total 47.5 miilion hectare metres (mhm) of India's groundwater potential were used to irrigate about 28 mha of land in 1992. Ultimate groundwater irrigation potential is put at around 80 mha. In States like Uttar Pradesh, the presence of public tubewells which dominated the groundwater scenario unitl the early 1960s has long since declined to insignificance. At the national level, of the over 21 million groundwater structures less than 50,000 were State-owned tubewells and fewer still were NGO-induced group tubewells. Thus, 95 percent of the area served by groundwater in India is in all likelihood commanded by privately owned tubewells. Undoubtedly, the emergence of water markets helps farmers who cannot afford to invest in tubewells or borewells to buy water and practise irrigated agriculture, and they are not necessarily or always over-charged (Saleth, 1996; Shah and Raju, 1987).

Two case studies presented by Navroz Dubash (2002) indicates that the two villages have moved on from subsistence agriculture and poverty to production for the market and prosperity. However, there has been no great gain in equity or social justice; in fact inequities and inequalities appear to have been accentuated in some ways. The growing commercialization of life and relations benefit some but affect others (poorer people, small and marginal farmers) adversely. There has been an alarming depletion of groundwater aquifers. Much damage has already been done, and even if effective regulation is now undertaken, past damage cannot be wholly undone. In fact, the introduction of effective regulation is enormously difficult, and it is by no means clear that further damage can be arrested. Many farmers expect that the resource will be irretrievably run down and are preparing for the inevitable abandonment of agriculture in the not too distant future.

Efforts to regulate groundwater extraction have been going on for a long time. The Gujarat Government has an Act in place for the regulation of groundwater, but it applies only to nine districts, and even that limited law seems to be moribund: there is a difference of opinion as to whether it is in fact in force. Maharashtra and Madhya Pradesh have Statewide Acts, but only for the regulation of drinking water sources. Tamil Nadu has an Act applicable only to the Madras Metropolitan Area; for the rest of the State, a Bill has been introduced. Andhra Pradesh has an Act of 1996, and an Ordinance of wider scope is under consideration for promulgation. Largely, we are still in the realm of intentions rather than actualities. There is no concerted, nation-wide effort to treat groundwater as a scarce and precious natural resource to be protected and conserved. In the light of the foregoing, reforms in relation to groundwater have to be two fold: (i) the legal position on the ownership of groundwater needs to change, with aquifers being regarded as common pool resources in which only limited use rights (and not property rights) are conferred on individuals or institutions; and (ii) water markets need to be carefully regulated with reference to equity, resource conservation and environmental sustainability.

Drinking Water Supplies

The proportion of urban population has increased from last 5 decades from 17 percent to 28 percent. Of the present 1.02 billion population, 285 Million (27.8% of the total population) live in urban areas, which comprises of 5161 towns an increase of 2.1 per cent over the proportion of urban population in 1991 census. Table 4 shows the increase in urban population. Over a period of time, the proportion of population having access to drinking water has been increased considerably. The improvement has been significant to 90% in 1997 from 75 % in 1981 (GOI, 1999). Table 5 indicates the states receiving the supply for more than 85% and less than 75%.

Supply received by different states

Population provided with water supply (in %)	States
High: more than 85 %	Andra pradesh, Arunachal pradesh, Delhi, Gujarat, haryana, Himachal pradesh, Jammu and Kashmir, Karnataka, Madhya pradesh, Maharashtra, Meghalaya, Nagaland, Rajasthan, Uttar pradesh, West Bengal.
Medium: between 75 to 85 %	Bihar, Goa, Manipur, Panjab,Tamil nadu, Tripura
Low: less than 75 %	Assam, Kerala, Mezoram, Orissa, Sikkim.

Decadal growth in urban population

Source: India's 10th five year plan (GOI,1999)

Year	Increase in Urban population (%)
1961	17.97
1971	19.91
1981	23.34
1991	25.71
2001	27.78

In India's Gujarat and Rajasthan States, groundwater overuse is causing fluoride contamination of drinking water supplies, creating a major public health crisis. In coastal India, overexploitation of groundwater has resulted in high levels of salinity in the water, making it unfit for human consumption or farming.

For example, of the 208 urban local bodies under the Karnataka Urban Water Supply and Drainage Board, 151 depend on river water whereas 47 depend on ground water. Groundwater in the state are fast declining with 34 taluks considered critical due to over exploitation. Besides, maintenance, poor distribution systems have also added to the problem. In the early 1970s, Karnataka's rural population, which constituted about 42 million of the total population of 53 million, could meet its drinking water needs largely from open wells as ground water levels were at an average depth of three to five meters. Presently about 64 percent of rural habitations are covered with more than 55 litres per capita per day of water supply. However nearly 34 percent of the habitations are yet to attain the level of 55 litres per capita per day. One estimate suggests that about three lakh wells dug in the 1970s have gone dry, and shallow open wells have been replaced by deeper tubewells. At present there are about two lakh drinking water tubewells in the State and 12 lakh irrigation tubewells as against about two lakh irrigation wells in the 1970s (Environment report-2003).

Groundwater serves 85 percent of the rural population's requirement of drinking water and nearly half of the urban and industrial requirements in Karnataka. Over the years, groundwater utilization in 21 taluks of the state has exceeded 85% limit and 22 taluks between 65 to 85% and 29 taluks has exceeded by 50% causing rapid depletion of aquifers. The National Family Health Survey indicates that only 3 percent of households in 1998-99 made use of surface sources compared with 11 percent of households in 1992-93. In Punjab, Haryana and Western Rajasthan, the main consequence has been salinity; in North Gujarat and Southern Rajasthan, it is fluoride contamination of groundwater; in hard-rock Southern India, it is declining well yields and increasing pumping costs arising from competitive deepening of wells. In West Bengal and western Bangladesh, the consequence is arsenic contamination. In West Bengal and western Bangladesh, the consequence is arsenic contamination. In coastal areas, the most serious consequence of intensified pumping of groundwater for irrigation is saline ingress into coastal aquifers. All these problems will impair the region's capacity to feed its growing population. In South Asia, the urban groundwater scene is reaching a melting point: large cities like Ahmedabad and Jodhpur in Western India and Chennai in the South Indian state of Tamilnadu support thriving private groundwater businesses that draw water from tube wells in the neighboring hinterlands for supplies to high-income residential areas because groundwater tables in the cities are falling at a rate of 7–10 ft/yr.

Rural Water Supplies

Rural Water Supply is one of the major challenges that has been addressed by the Indian government and attempts made towards tackling the crisis in providing safe and adequate water to the rural people. Lately, the problem has become particularly severe in rural areas. A review of the government's efforts in implementing various programs, policies adopted has shown that there has been progress but has not been successful in providing adequate quantity of potable water to all persons. Several factors like, increased urbanization leading to negligence of traditional water sources, poor water management, resource depletion due to over exploitation of existing resources, poor co-ordination between departments and poor institutional setup in addressing the problem have led to the severity of the problem over the years (Raju, Das, and Manasi, 2004).

Various dimensions of the problem have been addressed for effective implementation of rural water supply, which is dependent on a number of factors- Social, Technical, Economic, Institutional, Environmental, Legal and Political. It is important to understand the existing situation and the complexities in order to address the problem in the context of project design and implementation and factors affecting sustainability of Rural Water Supply (RWS) programs. One of the major causes seen is the reversal of environmental quality supply-demand relationships in just a few years. This is mainly due to economic growth accompanied by population increases, over exploitation and mismanagement of natural resources, and urbanization and its cumulative effects are resulting in decreasing the available supply of clean water and other environmental goods.

With resource becoming a major constraint, the awakening to water management in a holistic way through water quality maintenance, water allocation to different sectors, decentralization in water allocation, sustainable use of water, improvement of sanitation, water pricing, institutional set-up, technical solutions and education and awareness are being addressed. Conserving water and using it judiciously has come about only with increasing shortages, depletion of water resources and extremities in weather conditions causing disparity in water availability.

Considering the bare situation, since the First Five-Year Plan (1952-57), $6.5 billion have been invested in India by the central and state governments to provide potable drinking water in rural area. However, according to latest survey (NSSO, 1998), 69 per cent of the households have access to modern sources of potable water, (see Table below) and much less in case of rural area. According to the National Family Health Survey (1998-99), 74.5 per cent of urban and 25 per cent of rural households have access to piped water supply. Hand pump as a source of drinking water figures after piped water. 18.1 per cent of urban households and 47.3 per cent of rural households depend on it. The remaining household still depends on unsafe water sources. Thereby, the problem of rural drinking water supply and sanitation has not been fully resolved.

Access to Principal Sources of Drinking and Domestic Use of Water
(Per centage Distribution of Households - 1988, 1993 and 1998)

Source	Principal source of drinking water			Principal and Supplementary for different purpose 1998					
	1988 (44th round)	1993 (49th round)	1998 (54th round)	Cooking		Bathing		Washing utensils	
				PS	SS	PS	SS	PS	SS
Modern	54.3	63.4	69.0	69.6	45.1	60.1	43.3	64.9	44.7
Traditional	45.1	36.5	30.7	30.0	53.3	39.2	55.5	34.7	53.9
Others	0.6	0.3	0.2	0.4	1.6	0.4	1.2	0.3	1.3
All India (rural)	100	100	100	100	100	100	100	100	100

Source: Computed from 44th, 49th and 54th Round of NSSO data.
PS: Principal Source, SS: Supplementary Source

Picture is unclear about coverage of villages. Agencies indicate contradictory figures. For instance, NCAER (1994) survey concludes that about one-half of all villages in India do not have

any source of potable drinking water which is contrast to the official claims that in 1994 more than 80 per cent of villages were provided with adequate potable water. The Eighth Five-year plan (1992-97) had set a target of achieving 100 per cent coverage in providing safe drinking water by the turn of the century. At the end of Eighth Five-year plan (1997), the approach paper to the Ninth Plan (1998-2002) claims "efforts will be made to provide access to safe drinking water facility to the entire population in urban and rural areas in the next five years". Besides, puts the requirement of funds at a staggering sum of Rs 40,000 crore; Further, it recommends for involvement of the private sector on the lines of Sri Satya Sai Trust of Puttaparthy in Andhra Pradesh. This change in policy argument is due to resource constraint and magnitude of the problem; for instance, the estimates based on expenditure data, indicate that if the present rate of budget allocation is followed, the amount is just enough to meet the expenses on replacement of old systems, operation and maintenance activities (Pushpangadan and Murugan 1998).

The seventh five-year has identified the strategies followed in the existing modes and indicated two factors contributed to the failure: One, it was essentially a supply driven, top-down approach that did not take into account the pattern and intensity of demand for this service. Second, the lack of community participation in provision of this service rendered it inefficient and unsustainable. To overcome these problems, it was suggested making beneficiaries share a portion of capital cost and pay for services to maintain the assets. In support of this, the eighth five year plan policy paper stressed the need for devolution of responsibility to grass roots levels and recommended a change in mind set, through four stages of intervention; viz., a) creating awareness; b) developing action plan to ensure the decision making management and financial autonomy; c) strengthening the institutions and; d) improving monitoring, accountability and transparency of the sector (World Bank 1999). Further providing logical support, policy instances were cited from worldwide experiences showing a positive correlation between beneficiary involvement, on the one hand, and the efficiency of implementation and the effectiveness of the project sustainability on the other (David Hymer and Ashok Mody, 1997, Pushpangadan and Murugan, 1998). Forty-eight per cent of the recent World Bank projects have included community participation in their design as a way to increase project efficiency (Churchill 1994) and reduce cost. Recent literature on water supply systems shows that, proper institutional framework and collective action improve the efficiency (Narayan, 1993). In state led planning, old paradigm of centralized decision-making and bureaucratic allocation is fading fast to pave way for a decentralized allocation and stakeholder participation (Saleth and Dinar, 1999).

Strategy for Future

The global challenges of sustainable development also reflect India’s sustainable water use. The challenges are also faced by the governments- both at national and state level, and institutions concerned with developmental assistance. Thereby, in future, the policies, programmes and investments should support, not only economic development, but also: a) distribute the gains of development in a more equitable manner, with a particular focus on reducing poverty, b) avoid sacrificing the interests of future generations to meet the need of the current generations, c) build on emerging global consensus that natural resources and other valuable environmental assets must be managed sustainably.

The strategy has to cover interrelated objectives like

a) Improving livelihood systems both in rural and urban areas through
    a. better management and improved productivity of water resources
    b. support for institutional reforms, incentive structures, and improved governance, particularly decentralization efforts
    c. improved infrastructure, including access to safe and adequate drinking water, and access to adequate and timely supplies for agriculture.
    d. Improved access to efficient and adequate energy sources and alternative renewable fuels
    e. Enhance support to initiatives to eliminate the gender gap and foster inclusive institutions.

b) Reduce environmentally related health risks by
    a. Providing access to safe and reliable drinking water supplies both in rural and urban areas
    b. Institutional reforms to improve service delivery, fiscal sustainability and public-private partnerships.
c) Reduce vulnerability to natural and environmental disasters through
    a. Changes in land use planning,
    b. Disaster preparedness
    c. Community involvement and awareness creation,
    d. Water conservation and management
    e. Social protection measures to protect people who are vulnerable to natural disasters.
d) Improving the prospects for and the quality of growth through
    a. Integrating water resources availability and access into all developmental plans and programmes at all levels
    b. Mainstreaming sustainable water use in all developmental sectors
    c. Enhancing water resources projects quality through strengthened implementation of safeguard policies
e) Protecting the quality of the regional commons through
    a. The management of shared river basins across states – e.g., between Punab and Haryana, Tamil Nadu and Karnataka, Maharashtra, Karnataka and Andhra Pradesh.
    b. Enhance cooperation among riparians on other internationally shared river basins- e.g India and Bangladesh.

As part of the implementation arrangements it is necessary to adopt the following steps:

a) Prioritise the investments and project components. Need to focus on mainstreaming water resources use into sectoral development plans.
b) Promoting participatory and community-driven development approaches (in watershed, irrigation and drainage, wastewater treatment, groundwater use, rural water supplies, rain water harvesting and roof water harvesting – both in rural and urban areas), private sector participation, particularly in urban water supplies.
c) Enhancing water resources project implementation, operation, maintenance and monitoring quality through.
    a. Establishment of an independent safeguard review and compliance monitoring team.
    b. Systematic upstream review and input into project design beginning with the project concept stage.
    c. A project risk management and compliance monitoring system.
    d. Thematic joint social and environment reviews focusing on groundwater, surface water, and traditional sources.
    e. Periodic skills enhancement for all state, river basin and project level staff.
    f. Enhancement of local ownership and consensus building.
    g. Continuous policy dialogue and training.

d) Intensify the use of sectoral-regional environmental and social assessments by building on the experience of the past three years in the water sector.
e) Strenthen analytical and advisory activities through
    a. Filling critical gaps in knowledge and information by undertaking new analytical work. e.g., impact of declining groundwater table, potential of roof water harvesting both in rural and urban areas, rejuvenating traditional sources across the country, promoting community-driven approaches in water sector.

b. Addressing institutional priorities by focusing on helping build state level water resources department staff and users capacity in critical areas such as policy, incentives, and monitoring and enforcment
c. Promoting techniques that foster cross-sectoral integration, such as improved monitoring and evaluation of impacts and spatially based analysis of projects and policies.

Vision

At the outset, the water vision should be a shared vision. Separately at the national level and for each state. The vision has to be locally evolved and shared with the people, their communities, government agencies, non-governmental organizations, and civic groups. But first, there should be a thorough review of the water sector both at the national level. Clear examples are available both at state level prepared by the government agencies (e.g, Andhra Pradesh), and by the Area Water Partnerships[20] at the river basin level (e.g, Bhima river in Aurgangabad and Tampraparani river in Tamil Nadu). These vision documents have been designed locally after wider public consultations and taking care of emerging demands from the competitive sectors. The shared water vision of all stakeholders should indicate:

- clean, hygienic, accessible, affordable and secure drinking water supplies for the entire population.
- Sustainable levels of water extraction from rivers, tanks and groundwater – without jeopardizing their future use of vital ecosystem functions.
- Conservation of rainwater and its efficient use for agriculture, plantations, livestock and groundwater recharge.
- An efficient, well-managed and sustainable irrigated agriculture sector- enhancing value and ensuring farming livelihoods, but also avoiding wasteful use of water. Of great importance is the efficient use of water in agriculture – maximizing the return on water and the social benefits of efficient water-use.
- Mitigation of the effects of droughts, with short-term emergency responses and long-term planning.
- Prevention of the pollution of water resources used by people and livestock, agriculture and industry.
- Integrated governance of water- reflected by effective legislation, efficient government services that work in a coordinated manner, sound water information and data sets, adequate monitoring and applied research – so that we know where we are and what options are available to us.
- Participatory water management through effective institutional arrangements. Greater concern for water management at every level- individual, community, and government. Special emphasis on the participation of women and landless persons in decision-making.

Key Challenges in the water sector

- The water needs for drinking and domestic use are relatively insignificant load on the available resources, but the availability or quality of drinking water is often jeopardized by overuse of pollution in other sectors.
- The demands for municipal and industrial needs are on the increase, and these will have to be met from the present allocation to the agriculture sector. Agriculture is by far the largest water consumer in India. More efficient use of water in agriculture is therefore a top priority.

[20] Area Water Partnerships were set up under the Global Water Partnership through India Water Partnership.

- Equally important, the harvesting and efficient use of rainfall is necessary to augment and retain an adequate freshwater resource base, including roof water harvesting both in rural and urban areas for drinking water.
- Rapid contamination of water supplies – due to increasing municipal, industrial and other uses (including aquaculture) – is reducing the amount of already scarce and good-quality water supplies. Proactive measures are therefore a priority to control or contain such pollution threats.

Water actions are therefore urgently required in many critical areas – improving the efficiency of irrigation water use, and removing the incentives that encourage wasteful water use (with special attention to rice, which is a high-water-requirement crop); protecting drinking water sources; preventing water pollution; controlling water logging and soil salinity; reducing the over-exploitation of groundwater; stopping the deterioration of water quality in rivers and in coastal areas; improving the use of rainfall for agriculture; protecting the water bodies in urban areas, and improving the management of tanks of various sizes in rural areas.

The sustainable development of water resources in the country will depend on four key activities, as listed out by the water conservation mission in Andhra Pradesh: a) securing drinking water demands in terms of quantity and quality, b) development of water planning, river basin management and prioritizing for sustainable water extraction, c) water resources development with respect to other state priorities in Vison –2020 of the India and of respective states, d) the development of an efficient and well-managed water sector. This approach to sustainable development requires a significant change in governance, involving policy development, organizational reform, use of economic measures, strengthening of legal frameworks and development of monitoring and regulation procedures. This approach nees to be supplemented with research and development, and capacity building (both community and government) through education and training.

Integrated Water Resources Management (IWRM)[21] is the preferred approach to water management. But IWRM requires a range of inputs like:

a) State-level policy decisions,
b) Initiatives at the district level,
c) Legal and institutional frameworks,
d) Capacity building, research and development,
e) Engaging wider society.

Central to IWRM is the coordinated development and management of water, land and related resources to maximize social development and economic growth while safeguarding important ecological values. The preferred approach for using IWRM includes:

- Managing all available water and determining sustainable limits of use.
- Using stakeholder participation at all levels of decision-making.
- Reorienting government services to deliver coordinated action at district and village levels.
- Moving water to its most efficient use.
- Developing water policy and a state IWRM plan.
- Facilitating resources for research and development.
- Improving water information in order to achieve effective water management.

As part of the action plan strategy requires to design:

a) short-term recommendations
    a. constituting water conservation missions at state level
    b. developing a state-level action plan for the next one/two years
    c. initiating several district level pilot projects
    d. initiating river basin level pilot projects

[21] Global Water Partnership has developed a toolbox to evolve IWRM plans and practice, available in www.globalwaterpartnership.org.

e. establishing a monitoring and learning procedures to assess the implementation of water vision.

b) Long-term recommendations
   a. Develop
      i. State water policy
      ii. Integrated water resources management plan
      iii. River basin management plan
   b. District action plans
   c. Water research programme

Institutional strengthening

For the Institutional strengthening of the actors in water management and planning, Vaidyanathan and Oudshoorn (2004) suggest the following as essential to enhance research on:

a) the existing legal framework, and its underlying concepts; interpretations thereof, reflected in case law and tribunals awards, and implementation of judicial decisions;
b) the elements of a framework of laws and institutions to facilitate and promote negotiated settlement among claimants for water;
c) the structure and functioning of existing irrigation and water management institutions in selected systems, the perceptions of concerned interests (different user groups, managers, those adversely affected) regarding defects and their attitudes to alternative ways of organization;
d) a critical assessment of the experiments with user participation and their lessons;
e) collate and evaluate experiences of participatory, integrated management in other countries and their lessons for design of better institutional arrangements in India.

Further, based on the performance of the river basin boards in the Netherlands and France, India can take up action research studies of the legal, institutional, and operational aspects of participatory planning and management of water along the lines of the Water Boards of the Netherlands and the French River Basin Planning Authorities.

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(incomplete)

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General

- Come up with a menu of policy suggestions to be taken up for consideration by the government, and hence focus on practical recommendations for policy reform. The policy suggestions need to be clear-cut, precise, and feasible, and backed by sound reasoning and analysis.
- Focus on a few important policy suggestions
- Discuss ways and means of operationalising the reform suggestions. Keep in mind issues of accountability.
- Should distinguish between policy reform suggestions for immediate action, the medium term and the long term. Should clearly define a timeframe for reform at the onset.
- Emphasis should be given to the emerging situation
- Relevant comparisons across states should be considered in the studies in order to derive best practices. The methods and innovations should be assessed in terms of their feasibility for replication. Also pertinent comparisons with other countries should be considered in order to draw on international best practices.
- Need for consistency in policy suggestions made across the papers.

Specific to Water use:

- Water has to be looked at in the perspective of food security and diversification of agriculture.
- The paper should study the available practical and well performing examples in improving water availability and water management, and draw lessons thereof. The paper should examine ways of operationalising the issues and suggestions in terms of a technology matrix and a policy matrix. This should be developed keeping in mind a suitable timeframe for reform in the water sector.
- The author should prioritise and focus on certain options for reform. Moreover, the recommendations should be precise and concrete, with a clear distinction maintained between short and medium term suggestions.

Summary

- Consider water for food security and diversification of agriculture.
- Look at examples of best practices in a) improving water availability, b) water management. Draw lessons.
- Comparative study of states and scaling up of best practices.
- Ways of operationalising the issues and suggestions in terms of technology matrix and policy matrix.
- Reform options and prioritization.
- Time frame for reform in water sector
- How to bring in accountability
- Recommendations and policy suggestions: a) short term, b) long term.