presentation made at Ministry of Water Resources Government of India, New Delhi, India, 12 ... 2005.

Nature of India's Water Economy: Fitting Institutional and Policy Reform to National Context

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Abstract

Water scarcity has emerged, especially during the past decade, as an important theme in discussions on India's future. Global discourse suggests the India can respond to water scarcity by slowing down expansion in irrigation which is increasingly seen to be in competition with nature; by honing the social capacity of communities and societies to *adapt* to water scarcity; and above all by implementing Integrated Water Resources Management (IWRM), a package of best practices for improved management of water resources with strong emphasis on demand management.

This paper addresses five questions about the IWRM paradigm with respect to India: [1] is water poverty caused by poor management of water resources? [b] would implementing IWRM help alleviate India's water poverty? [c] to what extent is implementing IWRM feasible in India in today's context ? [d] what might be the challenges of implementing IWRM India-wide at this stage? And, finally, [e] what should be the priorities and roadmap for improving the working of the water sector in India?

I. Responses to Water Scarcity

Water scarcity has emerged, especially during the past decade, as an important theme in discussions on India's future. Indeed, by 2025, by many accounts, much of India is expected to be part of the 1/3rd of the world which is expected to face absolute water scarcity (Cosgrove 2003; Cosgrove and Rijsberman 2003; Rosegrant, Kai and Cline 2002). The intensification of water scarcity is expected to play out in myriad different ways with variegated consequences. A major implication will be for the capacity of the country to produce food for its growing population. Another is the escalation of conflicts around water at local as well as river basin level amongst user groups, sectors, rural and urban areas. A third is the growing competition for water between man and nature, and the concern about productive uses taking too much water away from nature.

Global analyses and discussions about ways to cope with and overcome water scarcity in the developing countries have resulted in a widely shared consensus over three aspects: [a] slowing down investments in water infrastructure, especially, irrigation which is increasingly seen to be in competition with nature; [b] honing the social capacity of communities and societies to *adapt* to water scarcity (Ohlsson and Turton 1999; Wolf and Brooks 2003); and [c] Integrated Water Resources Management (IWRM). IWRM has been subjected to a variety of definitions and formulations (Biswas 2004); however, it is centrally about building capacities and institutions at different levels in a society for *direct* management of sectoral and aggregate water *demand,* something which is

completely or mostly absent in many developing countries. This is particularly so in agricultural water use, which often is the prime cause of water scarcity as in India. Since 1950's, the supply-side focus of public policy action in water sector —of governments as well as donors—has been on 'developing' the resource by investing in infrastructure. IWRM discussions emphasize the need to focus on 'managing' the resource by turning attention to the demand-side approaches. In particular, IWRM includes a clutch of instruments that include:

- ***Pricing water,*** especially outside life-line uses so that it is efficiently used and allocated to high value uses;
- ***Appropriate legislative and regulatory framework*** for co-ordinated action for sustainable water resources management;
- ***Creation of appropriate property rights*** so that negative externalities of 'open access' are mitigated;
- ***Participatory Resource Management*** so that 'water becomes everybody's business';
- ***River Basin as the unit of water resources management*** *and creation of River Basin Organizations* in place of territorial/functional departments to improve basin level water productivity;
- ***Enunciate a clear Water Policy*** so that there is a cohesive, well-understood normative framework to guide all decision makers in the sector.

The IWRM discourse also jives well with emerging global discussion on improving and strengthening the governance of river basins through Integrated River Basin Management (IRBM). This, it is hoped will help alleviate *water poverty* by improving access to water and minimizing environmental ill-effects associated with current patterns of water resources development in developing countries like India (Lawrence, Meigh and Sullivan 2003). Improved governance of river basin involves working on three pillars of the water institutional framework: water policies, water laws and water administration (see, e.g.Bandaragoda and Firdausi 1992; Merrey 1996; Frederickson and Vissia 1995; Holmes 2000; Saleth 2004; Saleth and Dinar 2000). There are shades of variations in the discussions about IWRM, IRBM, improved water governance and reform of water policy and institutions. However, central to all these views is a dominant paradigm—which we will keep referring to as the IWRM paradigm—and which emphasizes the criticality of enhancing the potency and effectiveness of the three pillars of water institutional framework—law, policy and administration—in managing the water affairs of a society through a new emphasis on water demand management.

This new class of concerns have put on the backburner an earlier class of concerns which dominated water policy discourses in India and many other developing countries during the 1980's and early 1990's. These had to do centrally with the need for and the efficiency of appropriate water infrastructure and services, promoting their financial and social sustainability, improving the performance of irrigation, and water supply and sanitation projects along several dimensions: techno-economic efficiency; cost recovery; spatial and social equity in access to project benefits; investment in O and M, and so on. There were major issues of institutional reforms in public irrigation projects as well as

rural and urban water supply and sanitation projects with emphasis shifting back and forth between reforming the bureaucracy to user-participatory management to public-private partnerships. Even before these issues have even begun to get resolved, the IWRM paradigm has begun to shift the focus of policy discussions from improving *water infrastructure and services* to improving the management of *water resources* at the level of river basins.

This paper addresses five questions about the IWRM paradigm with respect to India: [1] to what extent is India's water poverty caused by poor management of water resources? [b] would implementing IWRM help alleviate India's water poverty? [c] to what extent is implementing IWRM feasible in India (and other similarly under-developed countries) ? [d] what might be the consequences of implementing IWRM India-wide at this stage? And, finally, [e] what should be the priorities and roadmap for improving the working of the water sector in India?

II. Water Poverty and Economic Development

The Water Poverty Index covering 147 countries published by researchers from Keele University and Centre for Ecology and Hydrology, Wallingford, UK in 2003 provides a readymade global data base to answer at least the first of these five questions (Lawrence, Meigh and Sullivan 2003; Sullivan and Meigh 2003). The approach and methodology used were similar to those used for computing the Human Development Index (see, UNDP 2000). The index was constructed by combining five component indices that cover water resource endowments, access to water, human capacity, water use efficiency, and quality of water environment (see annex table 1). Each of the five component indices was given equal weight to generate the Water Poverty index that takes values in the range of 0 and 100, the higher the value, lower the water poverty.

What determines the level of a country's water poverty? The authors of WPI are clear about the direct relationship between water scarcity and WPI when they say their aim was to 'express an interdisciplinary measure which links household welfare with water availability and indicates the degree to which water scarcity impacts on human populations' (Lawrence, Meigh and Sullivan 2003). Global water discussions too are dominated by the 'water-scarcity-determining-water- ill-fare' hypothesis. Is this seemingly obvious direct relationship between 'water poverty' and 'water scarcity' borne out by global database compiled for the Water Poverty Index?

Figure 1, which plots countries according to their per capita water resources and their water poverty suggests no direct relationship between the two. It might be argued that the real indicator of water poverty is "Water Access Poverty (WAP)" which, unlike WPI, does not have any of the HDI components in it. So in figure 2, we plot WAP against per capita water resources; and here too, the results are no different. For nearly every level of per capita water resource endowments, we find countries which are at the bottom as well as top of the WAP index. The least-square line fitted is virtually flat, suggesting no relationship of quantitative significance between water endowments and water welfare of nations. Laos, Nicaragua, Cambodia, Bangladesh, Sierra Leon have much higher per

Figure 1 Does Water Poverty have much to do with Water Scarcity?

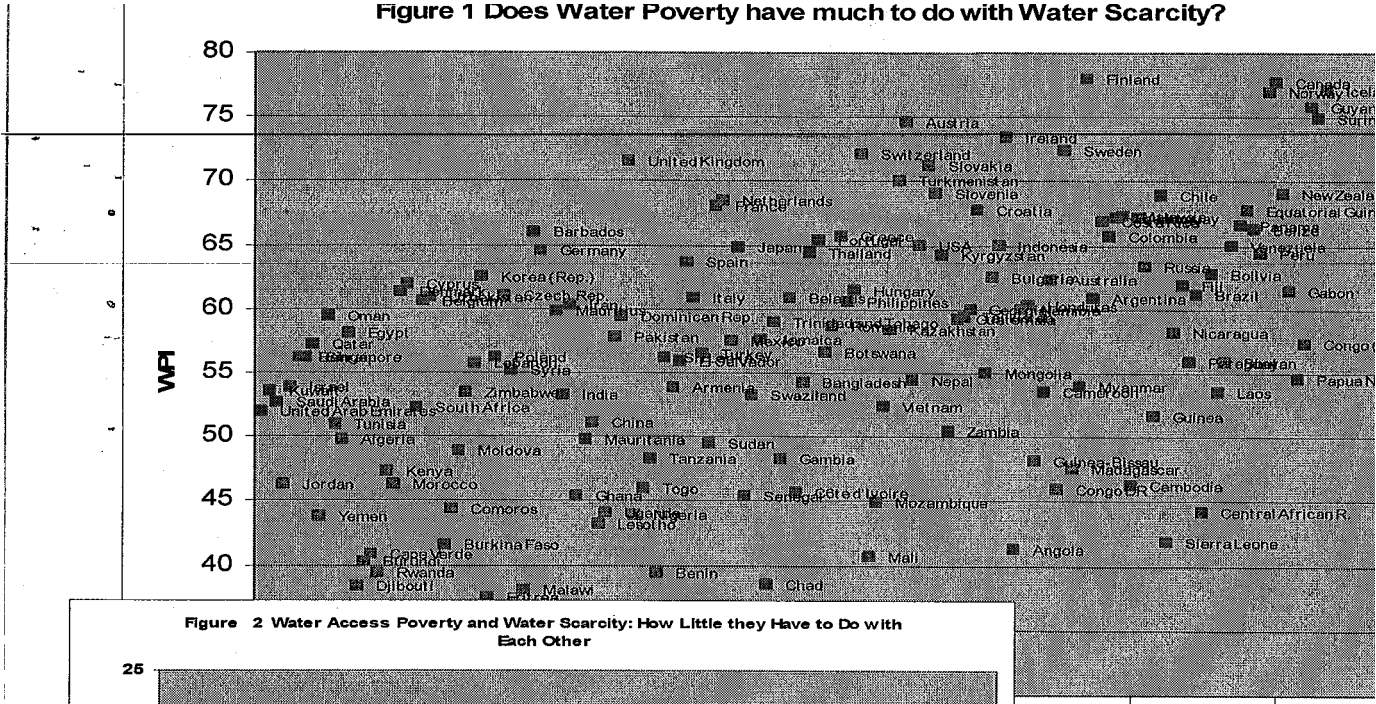
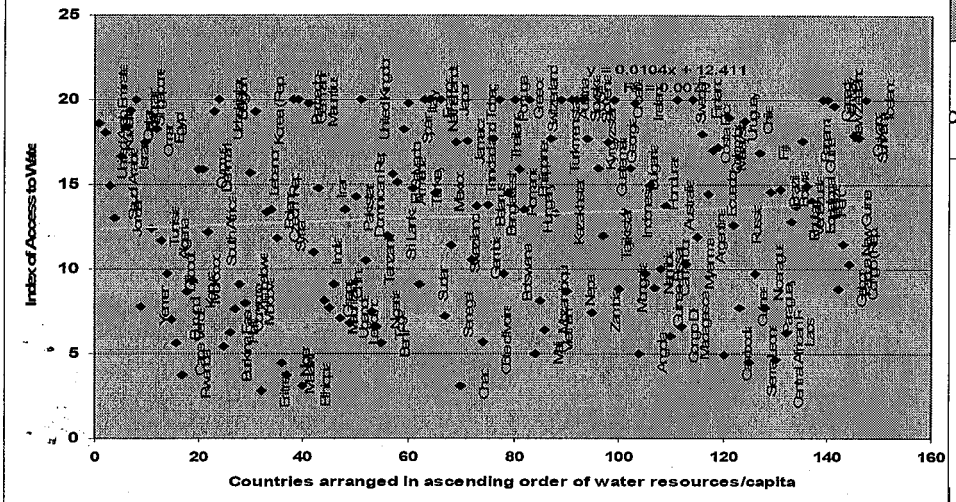


Figure 2 Water Access Poverty and Water Scarcity: How Little they Have to Do with Each Other



capita water endowments compared to Egypt, Saudi Arabia, UK and Mauritius; yet the former are far more 'Water Access Poor' than the latter.

Figure 3 Correlates of Water Poverty: Water Scarcity or Underdevelopment?

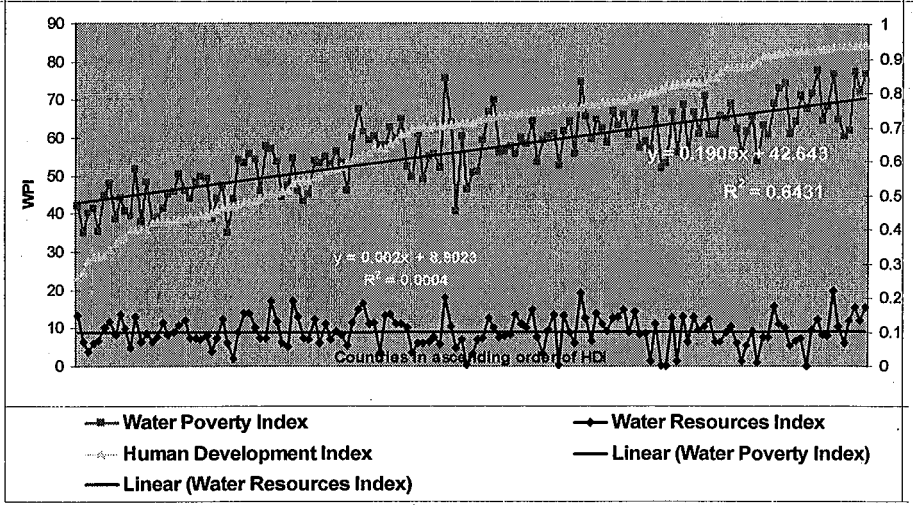
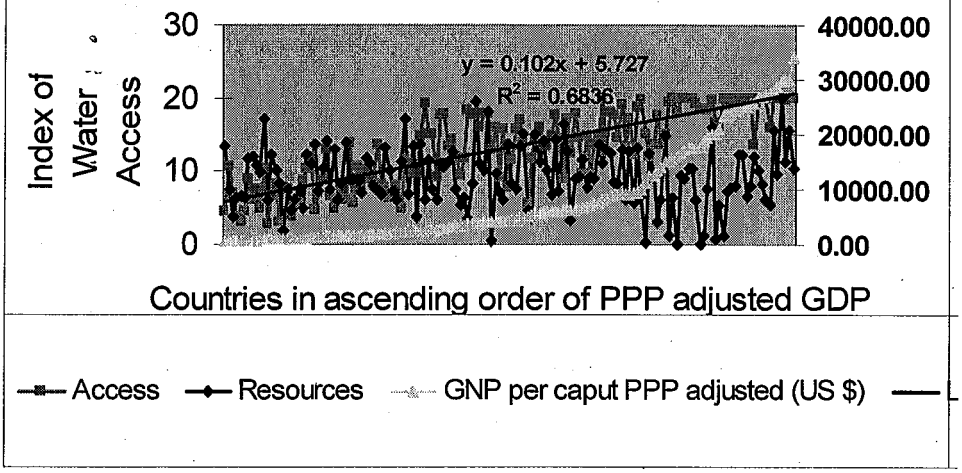


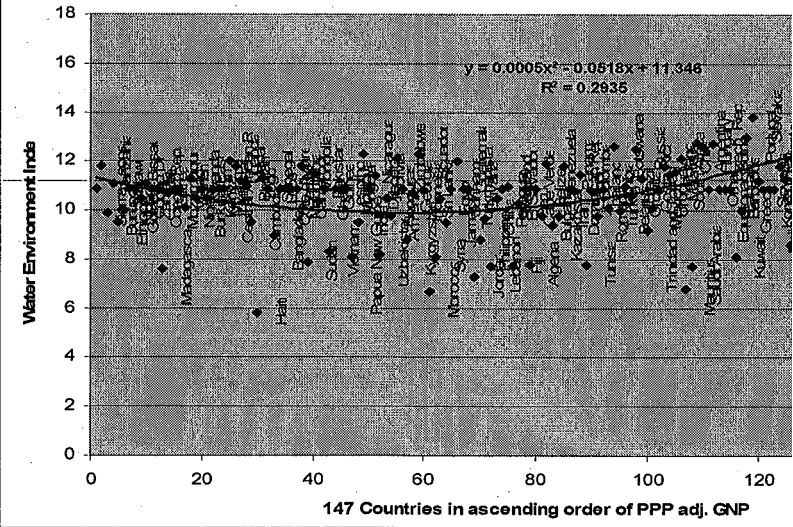
Figure 3 plots the water resources per capita, WPI and the Human Development Index for the 147 countries covered in ascending order of their HDI values. It shows that water endowments of countries have no correlation with the HDI; however, WPI is strongly and positively related to HDI. The higher the HDI, lower the water poverty, *regardless* of the country's water endowments. Figure 4 tests a bolder hypothesis; and suggests that Water Access Poverty is strongly related to per capita GDP (adjusted for Purchasing Power Parity) and very weakly with water resource endowments of countries.

Figure 4 Water Access Index and PPP-adjusted GNP/capita (US $)



In exploring the relationship between the quality of environment and levels of economic development, researchers have already postulated and tested the 'Environmental Kuznet's Curve' which would suggest that as countries begin from low levels of economic growth, the quality of their environment first declines as intensive growth uses natural resources as 'factors of production'(Bhattarai and Hammig 2000). However, as levels of living improve, growing demand for 'environmental amenity' generate pressures to seek avenues for economic growth that are light in the demands they make on scarce natural resources—what Gliek (2002) calls 'soft water path'. If this were true, an index of environmental quality would show an inverted U relationship with levels of economic growth. Figure 5, which plots the Index of Water Environment against ppp-adjusted GDP per capita of the 147 countries lends support to the Kuznets Curve hypothesis for water environment as well (the higher the value of the index, lower the quality of water environment). It suggests that in the early stages of the process of economic development, water environment deteriorates; but as levels of material well-being improve for a majority of a country's people, need for clean water environment would become a concern for the majority rather than just the environment groups.

Figure 5 Water Environment Index and PPP adjusted GNI



When I first presented these results in an IWMI-Tata Partner's meet, these were regarded by some as chicanery of the Excel charts. To meet these charges, I present in table 1 below multiple regression results corresponding to the charts presented so far. The data set for 147 countries used is the one compiled by Laurence et al (2003) and is available in public domain. The regressions use the WPI and component indices as dependent

variables; HDI as well as ppp-adjusted GDP are from UNDP 2003. Figures in brackets below B-coefficients are standardized B-coefficients and represent the relative significance of included explanatory variables in explaining the variations in the Dependent variable.[1]

	Dependent Variable	Intercept	B- Co-efficient for				
			Index of Water Resource Availability (0-20)	Human Development Index (0 to 1)	Index of GDP/capita (PPP adjusted in '000 US $) (0 to 1)	square of GDP per capita in US $)	
1	Water Poverty Index (0-100)	17.761 (12.261)	1.086 (0.433) [13.048]	43.283 (0.796) [24.022]			0.
2	Water Poverty Index (0-100)	20.646 [12.765]	1.205 (0.482) [12.508]		39.574 (0.764)		0.
3	Index of access to water (0-20)	-3.491 [-3.743]	0.037 (0.029) [0.691]	24.307 (0.867) [20.95]			0.
4	Index of access to water (0-20)	-1.862 [-1.845]	0.103 (0.080) [1.721]		22.22 (0.831) [17.863)		0.
5	Index of Water Environment (0-20)	7.215 [12.331]	0.138 (0.292) [3.962]		3.804 (0.388) [5.273]		0.
6	Index of Water Environment (0-20)	15.09 [10.806]	0.149 (0.314) [4.773}		-23.778 (-2.425) [-5.191]	21.638 (2.842) [6.082]	0.

In regressions 1 and 2, besides HDI and GDP respectively, water resource endowment is statistically significant and has a large standardized B-coefficient, likely because water resource endowment is a component of WPI. In regressions 3 and 4, however, water resource endowment turns insignificant and its standardized B-coefficients are very small, too. In these regressions, HDI and GDP per capita emerge as the key determinants of Water Access Poverty with large t-ratios as well as standardized B-coefficients. Regression 5 suggests resource availability as well as GDP are significant determinants of water environment; but the overall fit of this regression improves greatly (as suggested by the increase in R^2 in regression 6) when the squared value of GDP is added; it emerges as highly significant, turns GDP co-efficient into a negative value thus suggesting better fit for a U-shaped relationship shown in figure 5.

[1] Figures in parantheses are values of the t-ratio; for the sample size of 147, any value of t-ratio above 2.0 might be considered significant.

This analysis suggests, in the extreme, that in the long run, there may not be any such thing as *physical* water scarcity. A more balanced conclusion however is that economic development is a critical 'adjustment variable' in the process by which societies reduce their 'water poverty'. Societies 'manufacture' water scarcity as they grow in demographic and economic terms, and gradually adapt themselves and restructure their economic systems to fit their endowments of natural resources. The focus of science and action should be on understanding the *barriers* to this adaptive process.

III. IWRM in an Informal Water Economy

Many people feel disturbed by these results because it apparently leads them to conclude that low-income countries have little or no scope to improve their water resources management; and that economic growth is the only path for them to reduce their water poverty. Nothing could be farther from the truth.

A more appropriate and logical conclusion to draw from this analysis is that in order to be effective, water resource management strategies of nations have to be *context-specific;* and the defining aspect of the context that matters is the position of a country in the evolutionary process of economic development rather than its water resource endowment. This analysis raises questions about the usefulness of the one-size-fits-all frameworks—such as IWRM-- that dominate global discussions about how can developing countries put their water sectors in order. Use of economic pricing to encourage efficient allocation and use of water, transforming irrigation bureaucracies into river basin organizations for Integrated River Basin Management, enforcing effective laws to regulate groundwater over-exploitation, river pollution, waste-water recycling, wet land protection are some of the stock policy reforms that are commonly recommended, and which generally fail to take off.

Figure 6 % of Urban households dependent on alternative sources for drinking water requirements (NSSO 1999: report 449)

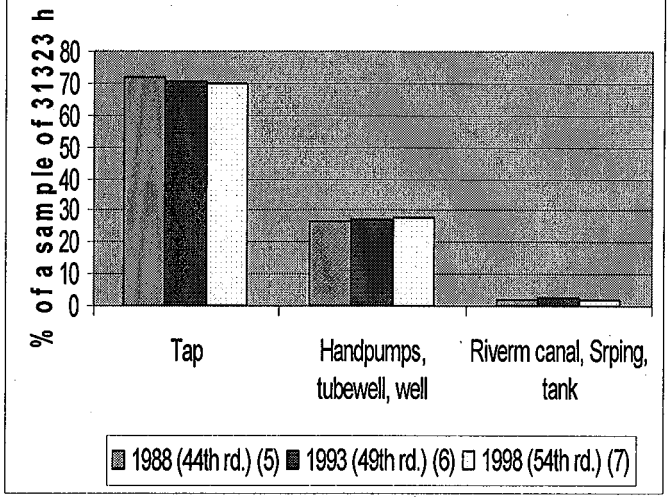


Figure 7 % of Rural Households Dependent on Alternate Sources Drinking water requirements (NSSO 1999: report 449)

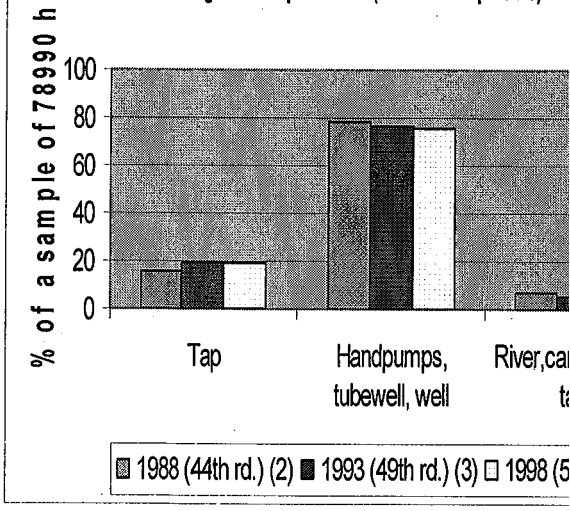
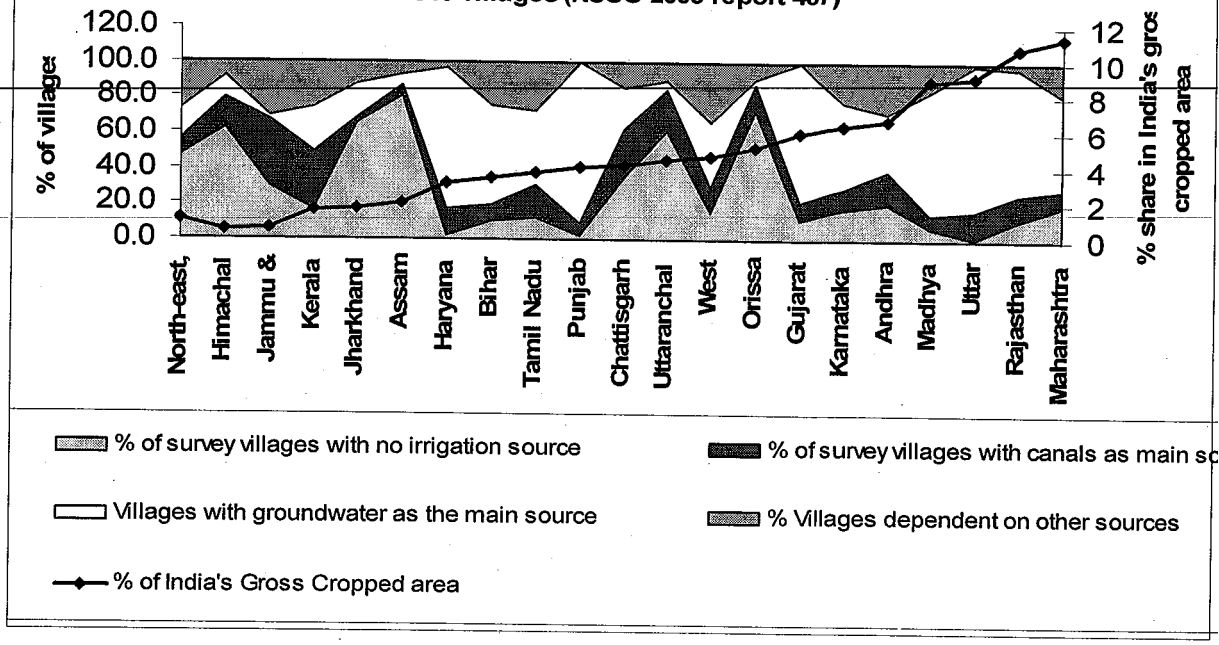


Figure 8 % of villages dependent on alternative irrigation sources: Survey of 4646 villages (NSSO 2003-report 487)



The constraint developing countries run into in implementing these arises from the highly informal nature of their water economies; and this has nothing to do with their water scarcity or abundance but it has everything to do with their being at early stages of overall economic development. Take the case of India. India's 10th Five Year Plan claims that protected water supply covers 95% of the country's rural habitations; yet a large nation-wide survey in 1998 that reached out to some 130,000 rural and urban households showed a different picture as figures 6 and 7 show. Nearly 80% of India's rural households self-supply their domestic water requirements and are not in contact with any service provider or public agency in the formal sector. For urban households, the opposite holds—which suggests that as India urbanizes, growing proportions of its population would come into contact with formal water service providers. Comparing the data across states suggests that in poorer states like Bihar and Uttar Pradesh, all or most rural households self-supply their domestic water, where as in somewhat better-off states such as Haryana, Punjab and Goa, domestic water supply gets increasingly 'formalized', suggesting that even rural households begin getting hooked up to some public supply system as village economies grow, regardless of water resource endowments. IWMI-Tata studies in six Indian cities during 2003 showed that economically strong households were much more likely to be connected to public water supply systems and poorer ones either self-supply or rely on informal sector service providers.

The picture with irrigation is no different. Many researchers have shown that although under the control of government bureaucracies, at the grassroots levels, India's canal systems are barely functioning anarchies, with informal norms ruling the roost. Even so, if we assume that farmers served by canals are in some sense connected to the 'formal' system, a government survey in 2003 of 4646 villages throughout India showed that over 80% of sample villages used irrigation mostly from wells but also from tanks, and streams without being connected with, or under *direct* administrative influence of, either the irrigation bureaucracy or any other formal agency. This is village-level data; but much other evidence can be adduced from household level surveys in support of the fact that there is a great deal more irrigation going on in India than is acknowledged; and over 4/5th of this is in the informal sector. For instance, the NSS 54th round of survey (NSSO

1999, report 452:46) in 1998 of 78990 rural households in 5110 villages throughout India concluded that only 90% of water infrastructural assets used by survey households were self-managed (and owned) by households; only around 10% was owned and/or managed by government or local community organizations.

This predominantly informal nature of India's water economy raises questions about the reach of the three pillars of water governance: policy, law and administration. It also raises questions about the practicality of implementing water pricing, basin level water allocation, and water legislation. How to collect a water price or use river basin agencies to allocate water amongst sectors and users if by far the majority of users self-provide their water needs without being connected to any formal agency? Likewise, how does any administration effectively enforce a groundwater law if 20 million farming households owning irrigation wells are strongly opposed to it, and the rest are indifferent or weakly opposed to it, especially when the administration is an instrument of a State that styles itself as a democratic welfare state?

V. The Nature of the State and Informal Water Economies

The nature of the state also enters the picture here. China's rural water economy is nearly as informal as India's. However, the Chinese state has greater wherewithal to rein in its informal water economy than India's in three respects:

[a] Under China's single party political organization, it has strong village level authority structures that are largely absent in South Asian countries (Shah, Giordano and Wang 2004). Like India's *Gram Panchayats,* China too has elected Village Development Committees whose chairman enjoys popular support. However, when it comes to enforcing regulatory instruments, these would be as toothless as India's *Gram Panchayats* but for the Village Party Secretary who is nominated by the upper echelons of the Party hierarchy. The party secretary enjoys formidable coercive power and is a potent instrument for implementing government policies at the village level.

[b] Then, the Chinese water bureaucracy is several times larger than in South Asia and has a wide reach and deep presence right to the village level. In India, for example, at the village or even taluka level, there is no government functionary in charge of water resources other than a public tubewell operator or a canal *chawkidar.* China has at least one but often more functionaries at the village level exclusively in charge of water resources management; and the town, country and prefecture level water bureaus are like nothing we find in other developing countries. Pakistan has retained the institution of *numberdars* who play some limited role in collecting irrigation fees (Shah, Hussein and Saeed 2003); but most other countries including India have none.

[c] Finally, Chinese farmers have dense financial transactions with the state; they pay a wide range of taxes and levies, including the salaries of village level functionaries. It may well be that the Chinese farmers pay more taxes than they receive as subsidies and other financial support from the government. In India, the financial relations between the state

and the farmers have become a one-way traffic; the State provides all manner of subsidies but hardly collects any taxes or even user charges.

With its greater reach and coercive authority as well as politico-administrative apparatus going down to the village level, one would think that China should be able to potentially enforce regulations on its informal water economy more effectively compared to the Indian state or most South Asian states. However, if controlling groundwater abuse is taken as a litmus test, then the success of the Chinese state in dealing with groundwater depletion in North China plains has been only marginally better than in South Asian countries. Indeed, there are no examples anywhere in the developing world of effective regulation of groundwater use that have worked on a significant scale for a reasonable period of time. Oman, is perhaps the only example (Van der Gun, pers. Comm.); here the popular Sultan has been able to use his authority to significantly regulate groundwater use for irrigation. Saudi Arabia too has been able to reduce agricultural use of groundwater but only by paying farmers an attractive price to divert their pumpage to urban water supply schemes (Wahid Abderrehman ?). Mexico has been trying local groundwater user associations (called COTAS); these have performed useful educative role, but are far from proactively managing groundwater use in agriculture (Shah, Scott and Bucheler 2004). Indeed, when one probes them deeper, one finds that the Western US success stories in groundwater management often involve supplying newly developed imported surface water to farmers in lieu of groundwater pumping. But this is no demand management.

In predominantly informal water economies where most users self-provide their water needs by directly diverting it from nature, pricing of water to move it to higher value uses has proved as difficult to implement as regulating groundwater draft in India and China through permits and quotas. Indeed, the only case I have come across of a recent large – scale success, that of Tanzania, is interesting to understand what it takes to make IWRM paradigm work in an informal water economy and whether it was worthwhile. Soon after Independence, Tanzania declared free water as the fundamental right of the people. Since then, however, its development philosophy has been swinging from one extreme to the other. During the 1990's, however, it embraced the IWRM paradigm; and its Water Law of 1997 provided for universal pricing of water, the formation of Water User Associations in every village, and their nesting into Catchment Committees and Basin Organizations. This looked like a make-believe reform that would be well nigh impossible to implement in India. However, in a recent field trip to a few of the 24 villages falling in the Mkoji river catchment (in Rufiji basin) in South-western Tanzania, we found this was actually working there (van Koppen, Sokile and Shah 2005). The villages we visited seemed poor, backward and under-capitalized even by Bihar and Jharkhand standards. However, each village had a (nearly registered) Water User Association with a written constitution that mandated compulsory universal membership of everyone above the age of 18. There was hardly any public investment in water infrastructure in these villages; all households drew water from the river; irrigation was done through small diversion structures farmers made and operated themselves. There seemed nothing the government offered which justified a water fee; yet, in Inyala, one of the larger villages we probed in some detail, over 80 percent of all men and women

above the age of 18 were paying since 2000 an annual water fee of 500 shillings each (about $ 0.5). The Inyala WUA contributed sh. 50,000 (Us $ 50)/year to the Catchment Committee as annual membership fee; and sh 146,000 (US $ 146) to the Basin office towards the use of water. At a half-day's earnings of an able bodied person, the money involved is small; the issue, however, is what they get in return. When the Basin Office first came to Inyala in 2000 to sell IWRM, people of the village were promised new infrastructure, more donor funds, and better resolution of their internecine conflicts with upstream irrigators through the Catchment Committee. However, if anything, Inyala people felt worse off. At peak irrigation times, upstream villages modified their earthen diversion structures to appropriate more water, leaving less for downstream Inyala. Once Inyala began paying water fees when upstream villages were not, its WUA asserted its superior right to get water. Thereupon, upstream villages too began paying; but they now asserted their right to keep the entire river to themselves, leaving even less water for Inyala than they did earlier. Much to their chagrin, instead of disciplining upstream villages, the Basin office commended to Inyala a rotation of canals to achieve more equitable distribution of such water as was available. This Inyala irrigators did to their benefit; but this meant that channels which earlier always had some water for domestic users now began to remain bone-dry for several days; and households which had long depended on them for their domestic water needs now have to go much farther. While paying the same water fee as irrigators, domestic users felt cheated by IWRM. Despite all these, we came out of Inyala convinced that the reforms so far implemented can continue because Tanzania has the institution of Mgambo[2], or village government militia,

[2] During the cold war years, civil defense was a popular item on the agenda of nation builders like Nehru of India and Nyrere of Tanzania. The idea was that defence of the nation is too important to be left to the army; every citizen must be involved. India created a nation-wide corps of home-guards soon after independence; but this decayed and eventually atrophied. Tanzania, a one party system under strong Maoist influence, created the institution of Mgambe which has continued to flourish till date. Mgambo, which originally were envisaged as the frontline of the army in war, have now emerged as the militia of village governments. Its members are trained by the military in physical fitness, use of small arms and martial skills; and Mgambo are an extension of the police, and as such, an arm of governance. In each village, the Mgambe are controlled by a Commander who is the chairman of the Village Security Sub-committee of the elected Village Committee. Mgambe are not regular employees; but they can be pressed into service on demand—such as domestic violence, rowdy behaviour, but above all, for recovery of taxes and levies. The Mgambo operate under a code of conduct: the act only at the behest of the Commander and the Village Committee; their mandate invariably is to read out the summons issued by the Village Committee to the 'accused' and thereafter produce him/her before the latter. However, the institution also has built in incentives that impart a vitality to it. Every accused the Mgambo is asked to summon has to instantly pay a fixed 'Mgambo service fee' which the Mgambo retains. In Inalya, this was sh 500; but in another village, the Mugambo service fee was sh 2000. In a rural economy where daily wage rates for farm work is sh 500-1200, service fee can be an important source of supplementary income for Mgambo, especially because the job is often easy for them. When approached with summons by a Mgambo, the accused has strong incentives to comply without resistance because if he does, the Mgambo returns to base and shortly therafter comes back with 3 other Mgambo, each of whom has to be paid the service fee instantly.

Thanks to the institution of Mgambo, Tanzania has been able to establish a key principle that, as an economic good, everyone must pay for it. However, this has also generated expectations that the Basin Authority has not been able to fulfill. Growing disaffection led Inyala WUA to refuse payment of water fees to the Basin Authority in 2003. In retaliation, the Basin Office locked the inlet letting water to the village. Inyala farmers one night went up and broke the locks. The Basin Office sent armed police

the like of which few other countries have. Although originally created as an institution for civil defense, the Mgambo has now emerged as a powerful rule-enforcement-cum-tax-collection mechanism for village as well as national government.

My impression from the villages we visited was that the Mgambo are quick and efficient in securing compliance with the Village Committee's decisions. Mugambo are the reason why *every* Tanzanian, rural or urban, regardless of his/her income, was made to pay an income tax until it was abolished for farmers last year; why every adult of Inyala forks out Sh 2500/year to finance the primary school. They are also the reason why 80% of Inyala's adults pay Sh 500/year by way of water fees; the remaining 20% are so poor that the Village Committee exempted them from paying fees.

Tanzania's Mgambo, Oman's Sultan, and China's village party secretary are exceptions that prove the rule that regulating the behaviour of water users in a predominantly informal water economies require authority structures of the kind India has eschewed. In designing water governance strategies for India, it seems more sensible to take the 'nature of the state' as well as the nature of the water economy as given in the immediate run rather than assume that the nature of the state will change to resolve water sector problems. Failure to do this produces reform that results in a maze of distortions without producing any more effective water governance.

V IWRM in Africa: Lessons for India

During the past decade, the government of Sri Lanka has made two bold but abortive attempts to push through bold IWRM-style reforms in the water sector. The latest draft water policy and water law provided for establishing state ownership of all water, institution of water use rights through withdrawal permits, pricing of water in all uses, transferable water permits to encourage trade in water rights, replacement of existing water organizations by river basin organizations—in short, copybook IWRM reforms. The media and civil society however took to the turf bitterly opposing the very logic underlying the proposed reforms (Samad 2005). The government withdrew the reforms in a hurry; however, little thought was given to how exactly would the new provisions be implemented had the new water policy and law were passed.

Many South Asian countries—notably, Thailand, Indonesia and Vietnam and other Mekong countries—however, faced no such opposition from media and civil society and swiftly passed water laws that incorporated key IWRM instruments including river basin organization, registration of users and withdrawal of permits as a mechanism for creating tradable water rights, participatory management of irrigation systems through service contracts between agencies and users, and so on (Molle 2005). Molle finds little match between the reality of the water economies of these countries and the reforms borne our of 'a global water discourse largely driven by international organizations'. His review of the experience with IWRM in Mekong led him to emphasize "a gap between formal and state-centered initiatives and reality on the ground, which proceeds at a different pace. Lessons learned elsewhere are certainly

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thereafter, locked the inlet again, and issued a warning that violators would be fired at. Inyala was denied water for a month, and brought to submission.

important but cannot be adopted indiscriminately and must not be allowed to crowd out the emergence of endogenous and condition-specific solutions."

Similar feeling was echoed in a recent African Water Law workshop (see Shah and van Koppen 2005). With the onset of the 1990's, many African countries took to IWRM wholesale. Almost everywhere, thinking about improving the functioning of the water economy involved little effort to understand reforms to the local reality. Almost everywhere, water reforms declared water as state property, instituted water withdrawal permits, made water pricing mandatory for all but domestic uses, resulted in formation of river basin organizations in water economies where the bulk of the water diverted and most of the water users are in the informal sector with little or no direct contact with formal water agencies. Institutional reforms take a long time to sink and produce desired impacts; in Africa, however, evidence is already piling to suggest that IWRM reforms seem to have done little to usher in effective IWRM in most countries that tried them. In particular, the Workshop identified four problems: [a] the aims that the water reforms seemed designed to achieve did not reflect the water sector priorities of the countries as viewed by national policy makers and citizens; [b] the reforms touched only a small segment of the water economy and a tiny proportion of water use and users; as a result, their impacts on the water sector were neither deep not broad; [c] they posed serious threats to customary laws and institutions evolved and used by communities; these are never ideal, but they are time-tested, robust and perform their basic functions well; and [d] they also created serious distortions, threatened disenfranchisement of larger numbers of poor, and created new vested interests; these potentially deleterious impacts were limited only by the fact that almost everywhere reforms failed to stick, laws remained largely unenforced, water prices remained uncollected.

What, then, went wrong with Africa's water reforms? Several things, it seems. Many countries just copied laws made elsewhere, just as several states in India have blindly copied Andhra Pradesh's law on participatory irrigation management, and Pakistan Punjab has copied the water law of the state of Colorado. In Africa too, Tanzania has almost blindly followed water reforms Ghana has been implementing for the past 8 years. Without consultation, public participation, and a serious attempt to fit reforms to the context, the impact of these reforms was bound to be negative if at all. And now, Ghana is having second thoughts on its reform strategy and going back to the drawing board.

Another major influence seems to have been of international agencies and global thinking. Tanzania is a case in point; its 1999 water policy identified water development and provision as a key national policy goal and argued for more water storage creation. However, creating new storage and infrastructure was anathema to international donors; so, as we saw earlier, Tanzania ended up doing what donors would support: IWRM, which included legal institutional reform, river basin organizations, WUAs, but no attempt to get what its people need most, better and more infrastructure. One researcher commented that Tanzanians all along had plans to build storages but were secretive about it for the fear of donor reprimand. In implementing the first phase of the World Bank project, however, the political leaders figured that what Tanzania's rural communities need are domestic water supply systems, improved irrigation water control and better

hydraulic infrastructure. Apparently, the Water Resources Minister wants the phase II of the project to do more of these rather than IWRM, Mgambo style.

The only country in Africa where water reforms have produced improved governance of the water resource is South Africa, which has emerged, during the past decade, as a model, exemplifying best practices for IWRM type water sector reforms in an emerging economy context. South Africa is interesting because of its first-world-third-world duality. In terms of income inequality, South Africa is next only to Brazil. 54 percent of South Africa's water use is in agriculture; and 95 percent of its farm lands are owned by a small minority of white commercial farmers. In general, 90% of its water use is in the formal sector; but 90 percent of its water users are in the informal sector.

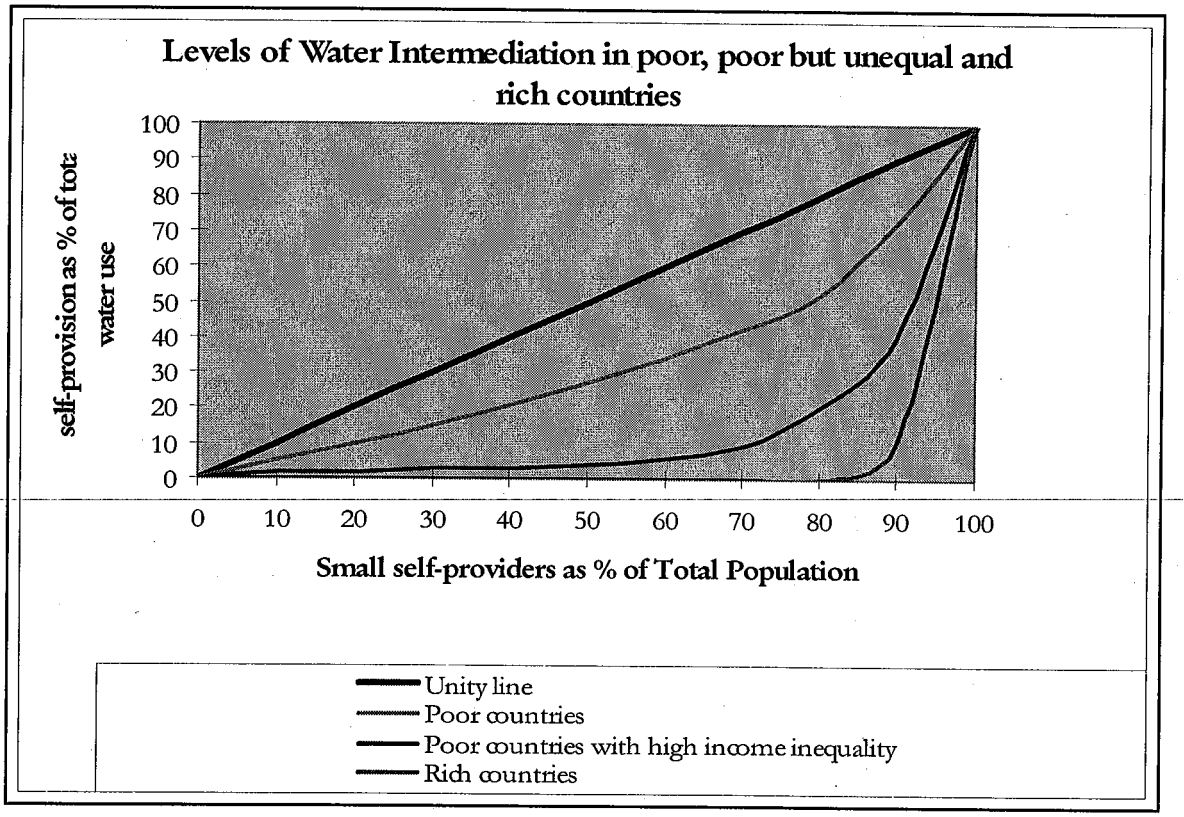
South Africa's path-breaking water law (chapter 4 of the Act: section 21) specifies following uses and brings them within its IWRM mandate:

[a] taking water from a water resource;
[b] storing water
[c] engaging in a stream-flow reduction activity, such as forestry
[e] control activities. E.g., irrigating with wastewater
[f] discharging of wastewater into a water source through a pipe, canal, etc

All those using water for the above purposes have to obtain a permit, pay water tariff as well as water resource fee. South Africa has all of 62,000 authorized, billable water users (or registered primary diverters) that account for 11 billion m^3 of water allocation for (mostly commercial) agriculture, 5 billion m^3 for industry and municipal; 9 billion m^3 for forestry. Government of South Africa generates around 2 billion rand/year as income from water tariffs. Managing these users has presented unique challenges: it is difficult to ascertain actual volumes used; some users did not register and some registered use could be unlawful under existing water law. This has impact on tariff determination and collection. There are serious problems of tackling unlawful water users. Many commercial farmers have extended their irrigated areas unlawfully. When confronted, they argue they are using their water allocation more efficiently. A critical issue for officials is whether to rely on voluntary compliance or evolve a system of policing.

Interestingly, however, the South African IWRM leaves 95% of its people out of its ambit. All of 2.3 billion m^3 –about 10 percent—of total water use is allocated to the so called schedule-1 users, mostly rural black South Africans, who include some 18 million primary diverters of water for domestic use and gardening. Their water use is neither subject to permits nor billable. If anything, everyone agrees, the crying need is to increase the access to and productive use of water by these users; yet the entire rubric of IWRM interventions is finding it hard to meet this need.

Not that South Africans are not trying; but they are only now embarking on the hard part of doing IWRM in an informal water economy. An excellent case study on rural South Africa—18 million people ruled by 800 chiefs and 13000 village headmen, complete with their customary law and traditional institutions—found their water economies predominantly informal; water law does not reach here; self or community provision galore. Under the National Water Policy of 1997 and Water Act of 1998, entire rural South Africa was to be covered by 19 Catchment Management Agencies (CMAs). All these were to be formed and operational by now; but only 1 has been formed so far; and that too is far from assuming the variegated roles it was expected to perform. Formation of Catchment Management Agencies, turning over of small-holder irrigation systems to Water User Associations, reform of rural water services—all central to improving the lives of the vast majority of South Africans—remain major challenges that the country's water reforms are yet to begin to meet. These are also the challenges facing India, Bangladesh, Nepal and numerous poor countries. IWRM is working in European South



Africa, but the African South Africa has to begin at the beginning.

The lesson India needs to learn from the experience of Sri Lanka, Mekong countries and the African Law Workshop is centrally about the gap between the precept and practice of IWRM. There can be little questioning the basic IWRM premises such as that water should be priced to reflect its scarcity value, that it is best managed at basin level, that reform of property rights will promote its efficient and sustainable use. The question is how to make these stick in India or in much of Africa whose water economies are predominantly informal. All the evidence from around the world suggests that these

work easily and produce desired impact in highly *formalized* segments of water economies where: [a] primary water diverters are large, body corporates and few in number; [b] most water users are supplied by organised service providers; and [c] capital accumulation in terms of infrastructure creation is already high. On the other hand, no matter how carefully designed and implemented in a participatory manner, IWRM reforms prove difficult to implement and produce uncertain outcomes in highly informal segments of national water economies where:[a] most of the country's households are primary water diverters; [b] most self-supply their water requirements directly from source; and [c] capital accumulation in water infrastructure is very low. There was little discussion also of the distinct possibility that whether water economies are formal or informal has little to do with their water endowments or their water management institutions but it has, in general, a great deal to do with their level of economic development.

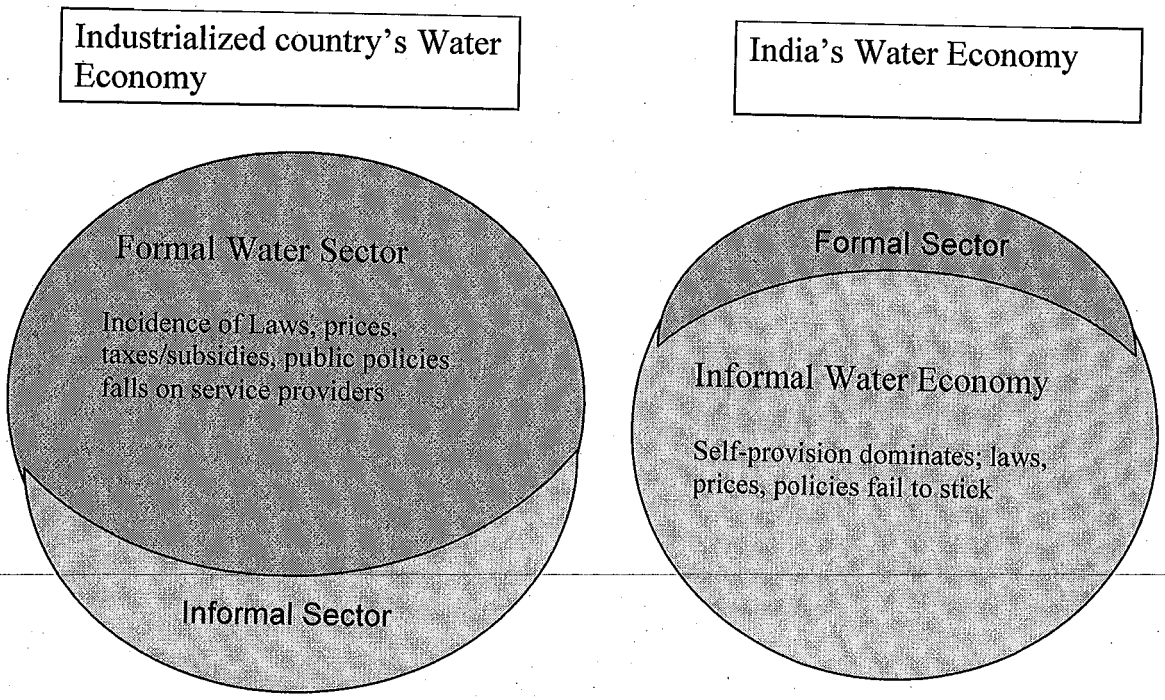
The IWRM paradigm neither responds to the priorities of the poor in poor countries, nor does it resonate with their ground conditions which make implementing water pricing, reform of property rights, allocating water at basin level work. The key factor often ignored are the numbers of primary diverters of water from nature. As figure 9 shows, in rich countries, these are often just a very small number of body corporates—water companies, utilities, municipalities, co-operatives--who serve the water needs of all users that are no longer primary diverters. In low-income countries with high level of income inequality such as Brazil and South Africa, IWRM works well in the rich, modern, formal segment of the water economy but can actually leave the poor worse off by destroying their traditional institutional arrangements while replacing them by poorly functioning modern ones. In any case, IWRM deflects attention of policy makers in these countries from what ought to be their their key priority—which is to deliver improved and better managed water infrastructure and services. In poor countries like India, as I showed earlier, a majority of rural and a sizeable proportion of the urban population self-provide their water needs by diverting water from nature. A core value of IWRM is people's participation in water resources management: its popular slogan 'make water everybody's business' is illustrative. In reality, the fact that diverting water from natural water bodies countries like India. A condition necessary and sufficient for effective implementation of IWRM is that diversion of water from nature is the business of relatively few, large users and service providers who can be brought within the ambit of public policy with relative ease.

V. The 'Three Pillars' and the People

The IWRM paradigm , that places all the burden of water sector reform on the 'three pillars' law, policy and administration, overlooks the notion increasingly influential in the new institutional economics (NIE) of institutions as 'formal rules, informal constraints (norms of behavior, conventions, and self-imposed codes of conduct) and the enforcement characteristi of both'; and also the notion that 'if institutions are the rules of the game, organizations are t players' (North 1990). NIE provides a useful distinction between *institutional arrangements* (IA's) and *institutional environment* (IE). Thus, the 'three pillars' represent, mostly, IE in NI except for the operating levels of IE (irrigation department *chawkidars,* operators of public

tubewells) which sometimes interact closely with IA's. Outside the IE, however, there lies vast world of *Institutional arrangements* (IA's), which 'are the structure that humans impo on their dealings with each other' (North 1990). In the particular context of the Indian wat economy, by *institutions* or *institutional arrangements* (IA's), we refer to things like groundwater markets, tubewell co-operatives, water user associations, Rajendra Singh's *jo* movement in Alwar (CSE?), groundwater recharge movement in Saurashtra (Shah 2001), t fishery contractors in Bundelkhand (Shah 2002), emergence of defluoridation plants in cot sector in North Gujarat's towns (Indu 2002), and such like.

Figure 10 Structure of water economies of rich and poor countries



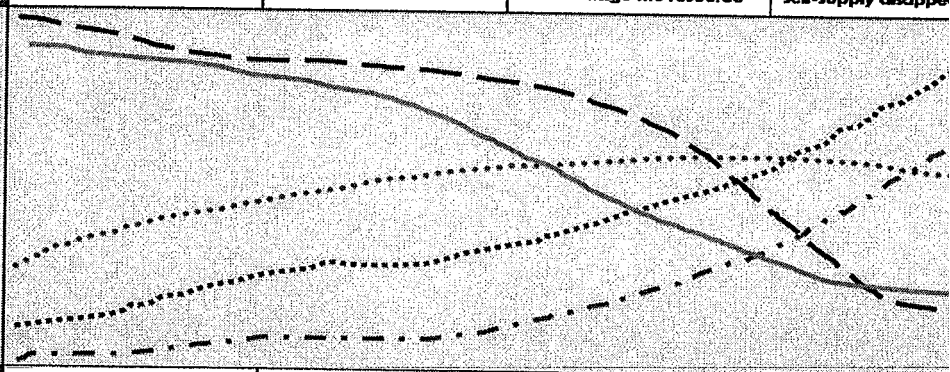
As figure 10 caricatures, the difference between the water economy of a rich industrialized country and a poor, agrarian one is the relative scale and significance of the informal sector. the former, the formal sector includes all or most of the water economy; in the latter, the informal sector rules the roost. The defining feature of an informal economy is that it is outside the ambit of the 'three pillars'. [3] The level of formalization of a country's water sect

[3] Formal and informal economies are a matter of elaborate study in institutional economics. Fiege (1990) summarizes a variety of notions of informality deployed by different researchers. According to Weeks (1975) cited in Fiege (1990, footnote 6), "The distinction between a formal and informal sector is based on the organizational characteristics of exchange relationships and the position of economic activity vis-à-vis the State. Basically, the formal sector includes government activity itself and those enterprises in the private sector which are officially recognized, fostered, nurtured and regulated by the State.. Operations in the informal sector are characterized by the absence of such benefits.". According to Portes, Blitzer and Curtis (1987 cited in Fiege 1990, foot note 6), "the informal sector can be defined as the sum total of income generating activities outside the modern contractual relationships of production. According to Portes and Saassen-Koo (1987 cited in Fiege 1990, foot note 6) in formal sector activities are ' not

is best indicated by the low level of interface between its water IA's and its water IE—or b what North (1990) calls the 'transaction sector'.[4]

The transition of nations from predominantly informal to formal water economy has little t with their water abundance or scarcity but everything to do with the pace and pattern of gro of its economy. Water institutions that exist or can be externally catalyzed in a country depend, besides several other factors, on the stage of formalization of its water economy wh in turn depends upon the overall economic evolution of that country as outlined in figure 1 As the economy of a nation develops, the proportion of rural and agrarian population declin self-provision of water is increasingly replaced by service providers, financial cost of water service increases although labour used in water acquisition declines, scientific and economi

Transformation of informal water economies in response to overall economic growth

	Stage I: Completely informal	Stage II: Largely informal	Stage III: Formalizing	Stage IV: Highly Water Industry
% of water users in the formal sector	<5%	5-35%	35-75%	75-95%
Countries	Sub-Saharan Africa	India, Pakistan, Bangladesh	Mexico, Thailand, Turkey, Eastern China	USA, Canada, West Europe, Australia
Dominant mode of water service provision	Self-supply and informal mutual-help community institutions	Partial Public Provisioning but self-supply dominates	Private-public provisioning; attempts to improve service and manage the resource	Rise of modern wate industry; High inform self-supply disappe
Human, technical and financial resources used by water sector % of total water use self-supplied Rural population as % of total Cost of domestic water as % of per caput income Cost of water service provision				
Concerns of the Government	Infrastructure creation in Welfare Mode	Infrastructure and Water services, especially in Urban areas	Infrastructure and service in towns and villages; Cost recovery; Resource protection	Integrated mgt. o Infrastructure, ser and resource; Re protection
Institutional Arrangements	Self-help; mutual help and feudal institutions dominate	Informal Markets; Mutual help and community management institutions	Organized service providers; self-supply declines; Informal institutions decline in significance	Self-supply disap all users get serv modern water in

resources devoted by the society per km^3 of water diverted increases. Along with these changes, water institutions too undergo profound change. Water IA's we find in India, Pakis and Bangladesh—such as, say, pump irrigation markets, urban tanker water markets--are unlikely to be found in Australia or Spain because they would serve nobody's purpose there. Likewise, water IA's that are standard in industrialized countries—high net-worth water

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intrinsically illegal but in which production and exchange escape legal regulation." To most researchers, an informal economy is marked by the 'absence of official regulation' or 'official status'.

[4] North (2) defines the transaction sector as 'that part of transactions that goes through the market and therefore can be measured' and according to North, rapid growth in the transaction sector is at the heart of the transformation of a traditional economy into a modern one.

companies managing a city's water supply system --would not begin to work until Dhaka a water service market evolved, at least, to Manila's or Jakarta's level[5].

Does this mean that little or nothing can be done to improve the working of India's water economy? This is certainly not the case; however, to understand what would work and wha would not, it is imperative to understand how things actually work—"warts and all". In N the most interesting aspect of study of institutional change is about 'why economies fail to undertake the appropriate activities *if they had a high pay-off*' (North 1990). Transaction c of institutional change are often the answer. India's water sector is replete with situations where appropriate activities can potentially generate a high pay-off and yet fail to get undertaken; in contrast, much institutional reform being carried out will likely not work because it entails high transaction costs and low pay-off.

Examples abound of institutional initiatives that have failed to produce broad and deep cha in the functioning of India's water sector during the past five decades. Five situations obtai

[a] reformist measure is proposed, discussed and shelved. The draft Groundwater Regulati bill is the case in point. It is tossing around for 35 years; yet has found few takers because f political leaders are willing to absorb the transaction costs (including political costs) of seriously implementing it;

[b] a bold reformist measure is proposed, discussed and diluted by removing all difficult-to- implement elements, resulting in paper reform. India's Water Policy announcements of 198 well as 2002 are good examples. Nothing in the way India's water sector function has chang as a result of these.

[c] a bold reformist measure is proposed, discussed and launched but cold-stored in the face popular opposition or insurmountable difficulties in implementation. Efforts by many Chie Ministers to meter electricity supply to tubewell irrigation during recent years is a good example. So are Maharashtra's 10 year old law to protect drinking water wells from groundwater overdraft by irrigation wells, and Andhra Pradesh's more recent land, water an trees act.

[d] a bold reformist measure is introduced and enforced to produce desired outcomes. Examples of this are rare; Chennai's groundwater law, which has begun to bite, is an exampl Another is West Bengal's enforcement of permits for new electricity connections for irrigati wells (Mukherjee pers.com). In Chennai's case, extreme water scarcity has likely created popular support for strong measures. In West Bengal's case, restrictions began to be enforce long before well irrigators organized into a powerful political force.

[e] finally, there are examples of reform ideas that refuse to die despite recurring evidence of their failure to deliver. Participatory Irrigation Management is one such; India has been tryin

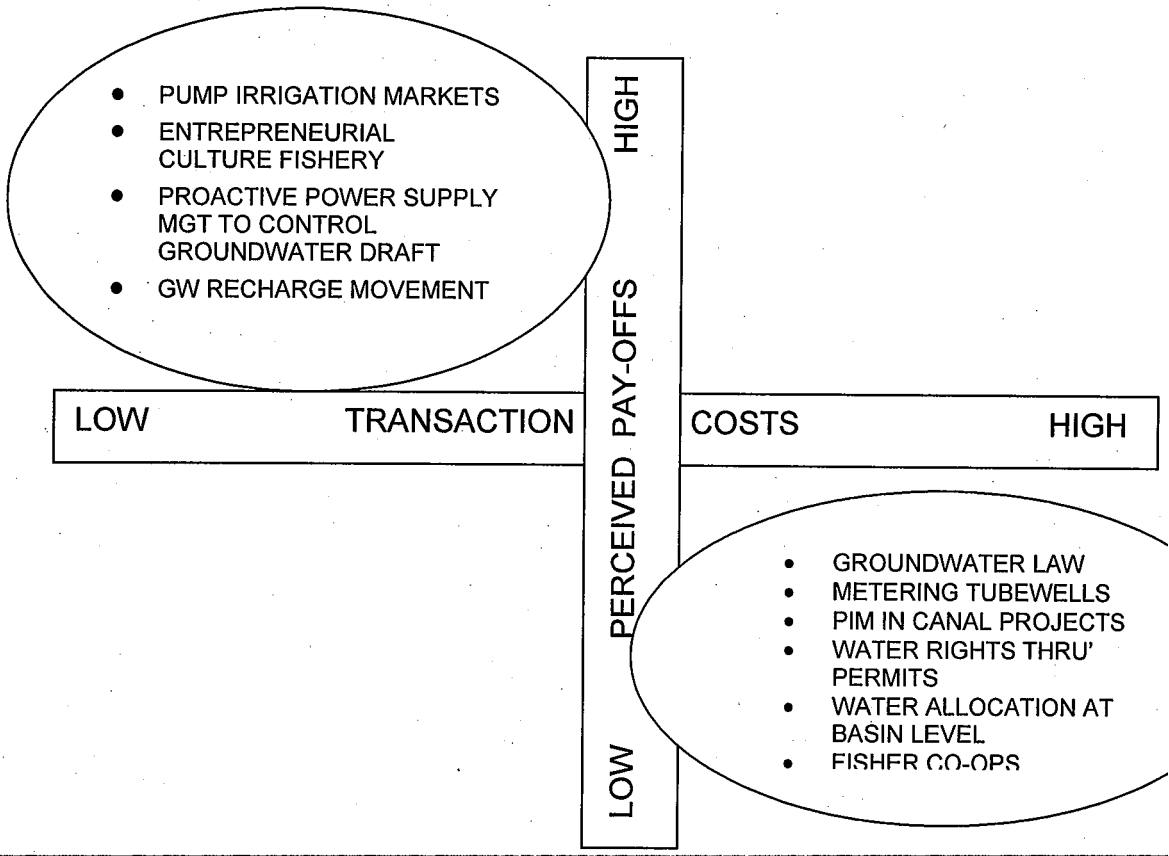
[5] If recent accounts of the travails facing global water companies like Vivendi and Thames Water who are forced to wind up even in these increasingly affluent east- Asian cities is any guide, we must conclude that South Asian cities have a long way to go before they can afford water supply systems of European or North American quality (see, The Economist, August 15-21, 2004).

farmer management or irrigation for nearly 150 years. While there are islands of excellen there is no evidence of WUA's having produced sustained performance improvements on significant scale. Similar communitarian models have dominated for decades institutional discourse in culture and capture fishery, watershed management, water supply systems. Countless studies show that fishermen co-operatives are almost always fronts for contracte that watershed associations seldom maintain structures after funding runs out.

Against these depressing examples, there are groundswells of spontaneous institutional formations which have erupted and sustained to create value for water users. Informal, decentralized pump irrigation markets today serve 1/3rd of India's gross irrigated areas (Mukherjee 2005), as much as the share of all public irrigation projects. There is a boomin culture fishery in the making in small common property ponds and tanks throughout India providing livelihoods and improving nutrition of millions of rural households. New technologies and stocking material created the potential for a boom; however, it is the myri changes that have occurred in the institutional arrangements for leasing of small water bodi that have energized the boom. Where state governments dogmatically adhered to the communitarian ideal, the boom has remained muted; where they have adopted an entrepren friendly approach, the culture fishery economy has swollen. In the famous Sardar Sarovar Project on river Narmada, planners had planned that the government would build lined min going up to each Village Service area commanding 200-600 ha; a Water User Association v build sub-minors and distribution network within each WSA by mobilizing local resources. it has turned out, planners proposed; and farmers have disposed. Of the 1100 odd VSAs so covered, not one has a WUA that built the distribution system. However, this has not stoppe irrigation in SSP command; thousands of farmers have invested in diesel pumps and rubber pipes; pump irrigation markets have sprung up everywhere. It is certainly not the best soluti planners do not like this irrigation anarchy; but then farmers do not like to lose precious farr land and invest own funds for building a distribution system (Talati and Shah 2004). Groundwater depletion is one of the most complex challenges India's people and water IE fa However, the responses of the two groups of players have tended to differ and remain mutua exclusive: the IE thinks primarily in terms of ways to reduce groundwater draft; people have steered clear of demand restriction but have mobilized resources to increase supply. Rural communities in western India—notably, Saurashtra and eastern Rajasthan—have taken to water harvesting and decentralized groundwater recharge in a big way as a mass movement. southern states, there is growing tendency to convert irrigation tanks into percolation tanks b sealing the sluice gates of tanks.

In sum, as figure 12 illustrates, both the Institutional Environment (IE) and the Institutional Arrangements (IA)—the people sector-- are responding to the same class of consequences of increasingly intensive water use in India. However, the former is struggling with change that entails high transaction costs and low perceived pay-offs for the people. The latter is in searcl of ways to efficiently perform activities that have a high pay off by reducing the transaction costs. The big problem—and a potential opportunity—is that the two do not meet.

Figure 12 Matrix of Perceived Pay-offs and Transaction Costs



VI. Conclusion

Water sector reforms in IWRM paradigm are best viewed as a long-term goal than a quick-fix to water sector problems of developing economies. That this essay does not aim to create a paper-tiger out of IWRM and shoot it down is evident in that dozens of countries in Asia, Africa and Latin America have used formulation of water policies and laws to implement IWRM principles; and the results have been disastrous, to say the least. Above all, they have diverted attention of national governments from doing patient work on their hear-and-now problems. We have shown that the IWRM paradigm becomes relevant and useful in water economies which have achieved high levels of *formalization;* and that the pace and pattern of formalization of water economies is linked

to the overall development of the economy of the country rather than its water endowments.

So, if not IWRM, what should be the water sector priorities for India? This is a valid question; and the response to it should grow out of a careful assessment of nature of India's water economy and its problems, and an intelligent reading of the experience of dealing with similar problems elsewhere in the world.

Infrastructure

Investing in creating *appropriate* water infrastructure should remain a critical priority for India for decades to come. What would be *appropriate* is a big question that would require ongoing assessment of past projects; however, it is a question that has begun to fade out of the water policy discourse. However, there can be little doubt that India needs to invest in more storage, more urban and rural water supply infrastructure, in waste-water treatment.

A related priority is developing new models for managing water infrastructure and services. Water bureaucracies in most states are shrinking. And the experiments to transfer irrigation systems to user associations are not doing nearly as well as was expected. A key priority is to promote broader institutional experimentation with greater focus on performance-linked incentives as is being tried out in China for better project management, O & M and cost recovery.

We need to recognize that self-provision of water is the best indicator of the failure of public water supply systems. Tube wells proliferate in canal commands because public irrigation managers are unable to deliver irrigation on demand. Urban households want their own borewells because municipal water service is inadequate and unreliable. In the ultimate analysis, the only way India's water economy will get formalized is by improving public/community water infrastructure and services so that water users have no need to divert water from nature.

India's Groundwater Challenge:

Groundwater management is India's unique challenge. No country depends as much on groundwater for all its water needs as India does; and yet, the groundwater economy is one of the most under-managed segment of India's water sector. The designation of the Central Groundwater Board (CGWB) into Central Groundwater Authority (CGWA) has changed neither the character of the organization nor its effectiveness as the strategic player entrusted with the governance of this economy. The CGWB clamours for strong groundwater laws and their stronger enforcement; however, for a long time, this will be easier said that done. The Chinese, with stronger state commitment to groundwater regulation, with a more elaborate reach and local authority structures have still found it impossible to regulate groundwater overdraft in North China plains (Shah, Giordano and Wang 2004). Nor have the Americans been able to implement real groundwater demand management with their elaborate structure or water rights and groundwater districts, or

have Spaniards and Mexicans with their efforts to promote groundwater user associations.

Where ever we come across success in reducing pressure on groundwater, imported water supplied in lieu of groundwater pumping is invariably implicated. The Chinese have been able to control urban groundwater depletion by sealing urban tubewells; but they managed to do this only after importing water supplies (Shah, Giordano and Wang 2004). The governments in western and central US have succeeded in reducing or controlling groundwater pumping; but only through programs like the CAP (Central Arizona Project) which imported water to substitute it. It is only in small totalitarian states—such as Oman where the Sultan's word is law—that there is evidence of genuine groundwater demand management.

Groundwater constitutes over half of India's total water use, 70% of its irrigated areas and 80 percent of its domestic water supply; and yet, managing groundwater gets less than 10% of public funds at central and state level devoted to water resources. Central and state level groundwater bureaucracies need to be reinvented; they still style themselves as in charge of monitoring water level fluctuations which was their mandate during the 1960's. India needs a coherent strategy, an administrative apparatus, some of the best groundwater science and technology the world has on offer, and a commitment to invest resources commensurate with the role of groundwater in India's water economy.

Indirect Levers of Strategic Management:

The core argument of this paper is that direct management of water demand—through water pricing, water rights, permits, administrative control—is well nigh impossible in India because by far the majority of water users self-provide their water needs rather than depending upon formal service providers such as water companies or municipalities. Doing this will be a pipedream until India's water economy gets formalized; but this is not going to happen in a hurry. In the meanwhile, India needs to develop and hone a range of indirect levers of managing aggregate water demand. One such indirect lever that is already used with some effectiveness by NABARD is restricting institutional credit for private investments in well irrigation in areas where groundwater resource is over-exploited. Electricity supply to irrigation pumps is another even more potent indirect lever. In response to growing burden of power subsidies, many states have during the 1990s begun restricting hours of power supply to agriculture. However, doing this in a more rational manner than at present can reduce subsidies even further, making farmer better off and reducing the waste of water (Shah, Scott, Kishore and Sharma 2005). It is common knowledge that much pressure on groundwater in North-western India—Punjab, Haryana, Western UP, Rajasthan—can be eased if they can be weaned away from the rice-wheat system which is sustained primarily by the public food grain procurement system. In contrast, eastern India which is singularly well-suited to be India's new granary is suffering from poor input and output markets and near-absence of public food grain procurement system. Shifting the incentives for rice-wheat cultivation from north-west to eastern India can produce aggregate incentive structures that are more consistent with relative regional endowments of water which is far more binding a constraint today

than it was during the days of Intensive Agricultural Development Program. Moreover, new farming technologies and practices appearing on the horizon too can help ease agricultural water demand. A case in point is a new way of growing rice known as the System of Rice Intensification (SRI). For thousands of years, we have viewed rice as an aquatic plant which can grow only under ponding. SRI experiments have shown that rice survives—but does not need-ponding. India uses 250-300 km^3 of water every year just to grow rice. And the new clutch of rice cultivation practices—SRI, semi-irrigated rice, double transplanted rice, rice under alternate wetting and drying, aerobic rice—not only offer much higher land productivity, but also drastic reduction in seed and input costs, and a promise of more crop-per-drop. Realising this potential gains, China has already embarked on SRI as a national program; in India, SRI is hardly known amongst water policy makers.

Managing the Water Economy in a Mission Mode:

We often overlook the fact that NABARD, Rural Electrification Corporation and State Electricity Boards have done far more to promote irrigation development in India than Irrigation Departments. Or that the agricultural research establishment under the ICAR can play a powerful role in managing agricultural water demand. Yet, our administrative structure for managing the water economy does not encourage co-ordinated action that involves public agencies holding powerful indirect levers of water demand management. CGWB seldom thinks of linking up with the Electricity Boards to regulate groundwater draft; MoWR and Central Water Commission seldom show interest in horizon technologies like SRI for their potential in water demand management. Precisely to achieve such co-ordinated action, Prime Minister Rajiv Gandhi successfully experimented with the 'mission mode' of sectoral administration. Each mission, set up for a priority sector with well defined targets and a time-bound program, was run by an empowered committee represented by the top most officials of all public agencies involved and usually headed by the Cabinet Secretary.

World-wide, the tendency is towards functional integration of agencies dealing with water. In China, for instance, surface irrigation, reservoir management, groundwater, water supply—all have bee brought under Water Bureaus at different provincial, prefecture and county levels. In India, too, we need to move in this direction, especially at higher echelons of decision making that give primacy to water-sharing and water allocation questions amongst administrative/political units. However, it is even more important to establish mechanism for coordination between the holders of indirect levers of water demand management as we discussed above.

Tightening Up the Formal Segments:

Malfunctioning in public systems—such as municipal bodies and irrigation departments—is resulting into *informalization* of formal water economies. This is true of many Indian towns and cities where growing evidence suggests growing tendencies for households and housing societies to depend increasindly on captive tubewells for supplying domestic water needs. This trend can only be reversed through a massive and

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WPI Component and its weight	Sub-components
Water Resource Availability (20%)	Internal freshwater flows External inflows Population
Access to Water (20%)	% of population with access to clean water % of population with access to sanitation access to industrial water relative to the need access to irrigation relative to the need for irrigation
Capacity (20%)	ppp adjusted per capita income under-five mortality rates education enrolment rates Gini co-efficient for income distribution
Water Use efficiency (20%)	Domestic water use in litres/day Share of water use by industry adjusted by sectoral share in GDP Share of water use by agriculture adjusted by its share in GDP
Environment (20%)	Indices of Water quality Water stress (pollution) Environment regulation and management Informational capacity Biodiversity based on threatened species