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Water Policy Research

Highlight

Water Poverty and Economic Development:
Cross-country Analysis and Implications for Policy Reform

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Global water discussions are dominated by the 'water-scarcity-determining-water-poverty' hypothesis. But a new global database compiled for the Water Poverty Index shows that Water Access Poverty is strongly related to Human Development Index, and more specifically, with per capita GDP (adjusted for Purchasing Power Parity) and very weakly with water resource endowments of countries.

Poor access to water and a highly informal water economy are characteristics of low income countries at early stages of economic growth. Analysis suggests that the 'level of informality of the water economy' may well be the key determinant of how much can developing countries 'leap-frog' in crafting water policies and institutions that work only with high level of formalization; it may also determine both the feasibility as well as the priority of a country's water sector strategy.

Water Poverty and Economic Development: Cross Country Analysis and Implications for Policy Reform[1]

Research Highlight Based on a Paper Titled: The Nature of India's Water Economy : Fitting Institutions and Policies to The Context

Water Poverty Index (WPI)

In 2003, researchers from Keele University and Centre for Ecology and Hydrology, Wallingford, UK published a new water poverty index covering 147 countries (Lawrence, Meigh, and Sullivan 2003; Sullivan, 2002; Sullivan and Meigh, 2003). The approach and methodology used were similar to those used for computing the Human Development Index (HDI). 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 (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 to 100; higher the value, lower the water poverty.

Table 1: Structure of Water Poverty Index

WPI Component and its Weight	Sub-components
Water Resource Availability (20 percent)	Internal freshwater flows External inflows Population
Access to Water (20 percent)	Percentage of population with access to clean water Percentage of population with access to sanitation Access to industrial water relative to need Access to irrigation relative to need for irrigation
Capacity (20percent)	Purchasing power parity (PPP) adjusted per capita income Under-five mortality rates Education enrolment rates Gini coefficient for income distribution
Water Use efficiency (20percent)	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 (20percent)	Indices of Water quality Water stress (pollution) Environment regulation and management Informational capacity Biodiversity based on threatened species

[1]The research covered by this IWMI-Tata Research Highlight was carried out with generous support from Sir Ratan Tata Trust, Mumbai, under the IWMI-Tata Water Policy Program. The paper can be downloaded from the IWMI-Tata Website http://www.iwmi.org/iwmi-tata.

Drivers of Water Poverty of Nations

Despite its many limitations, the WPI is a much-welcome contribution and an improvement over earlier indices, such as Falkenmark's index of water stress using absolute values of per capita water availability. Giving equal weights to each of the five components needs explaining; but since the authors provide component indices as well, one might argue that the water access index (WAI) is a better indicator of national water poverty than even the WPI, if water access deprivation is taken as the essence of water poverty.

Water Access Poverty (WAP) is strongly related to per capita GDP (adjusted for PPP) and very weakly with water resource endowments of countries.

Now that we have such a tool based on a global data-set, the first question that arises is: 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" (Sullivan, 2002; Lawrence, Meigh and Sullivan, 2003). Global water discussions too are dominated by the water-scarcity-determining-water- illfare 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 strangely suggests no direct relationship between

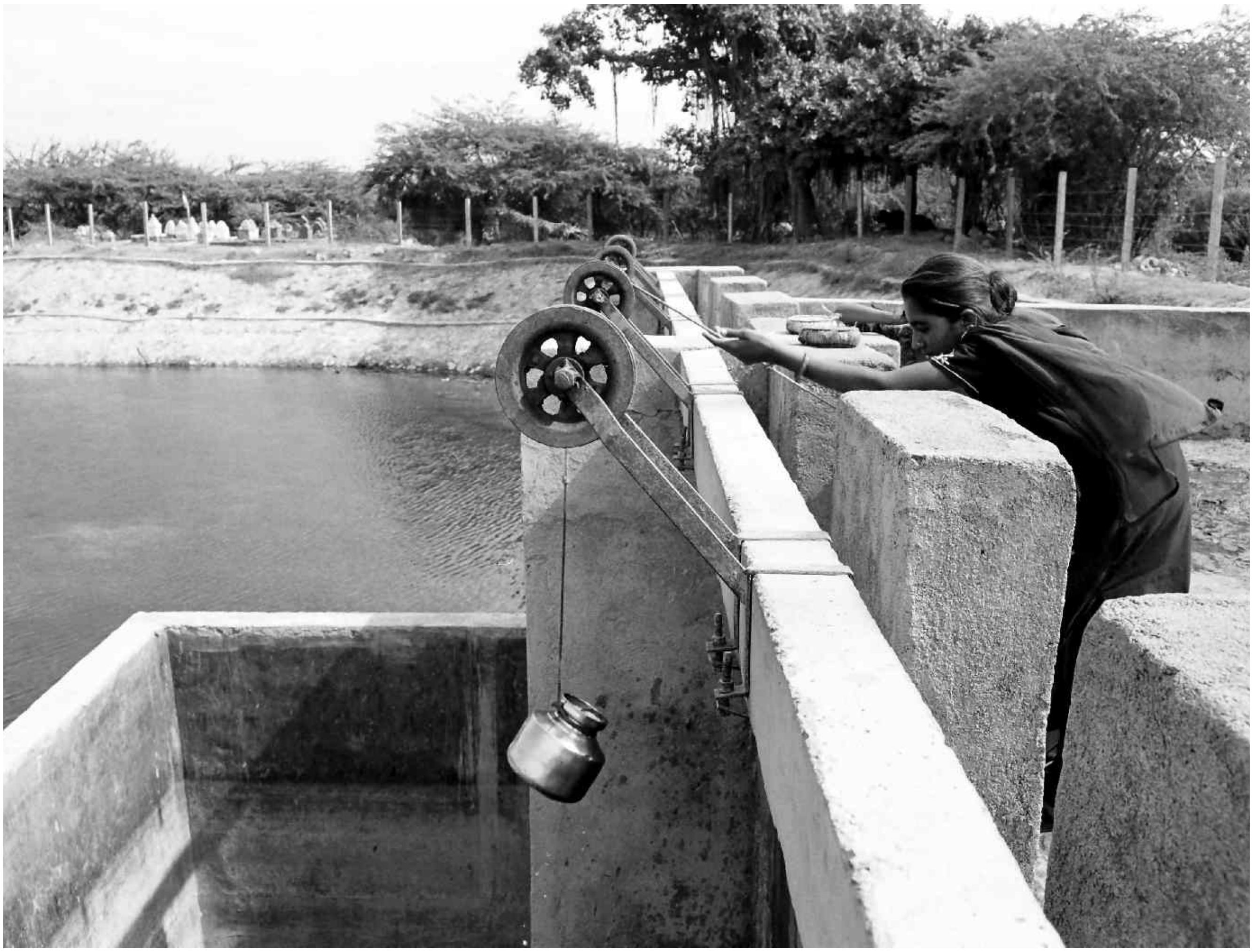


Figure 1: Does Water Poverty have much to do with Water Scarcity?

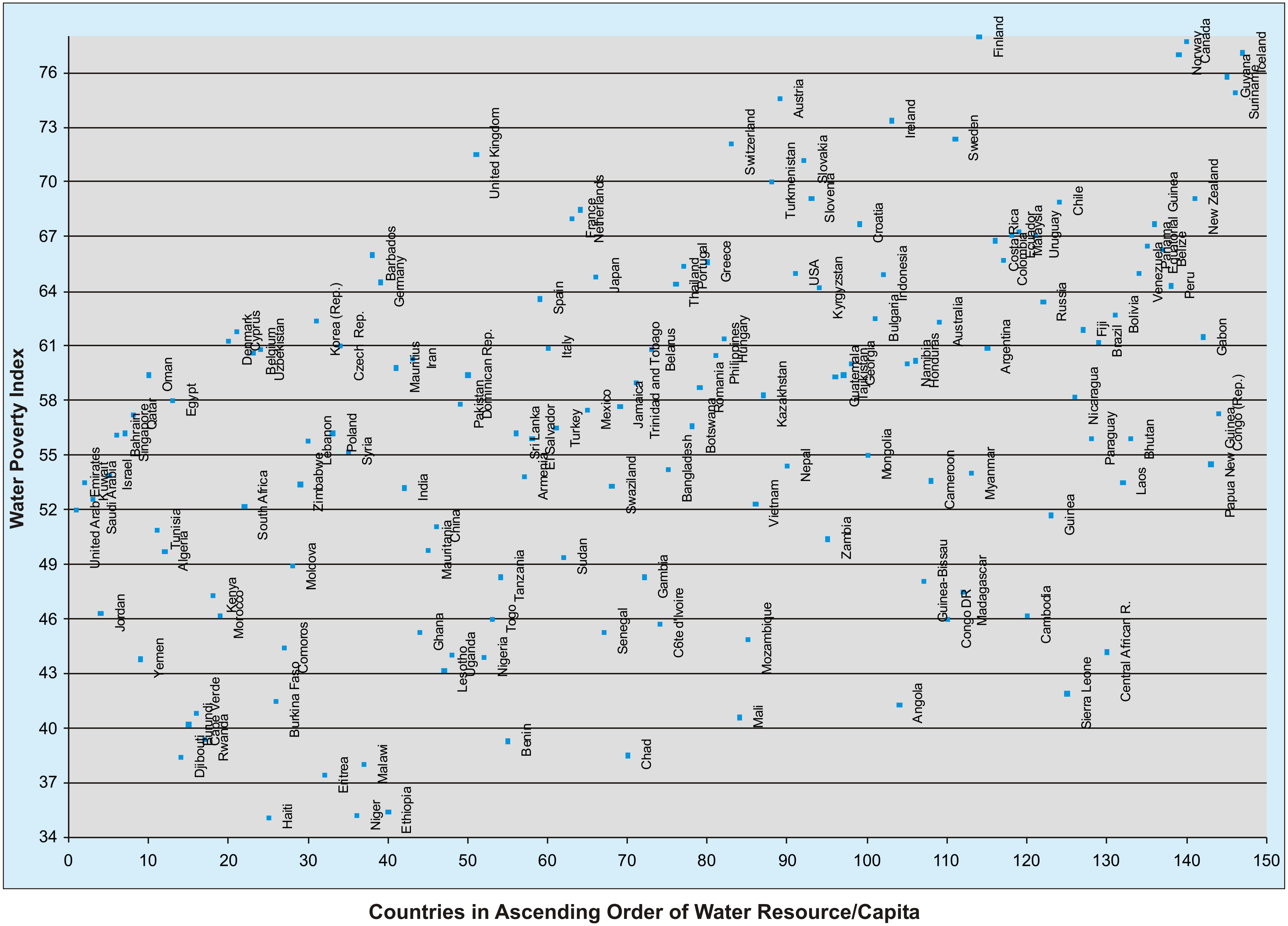


Figure 2: Water Access Poverty and Water Scarcity: How Little they have to do with Each Other

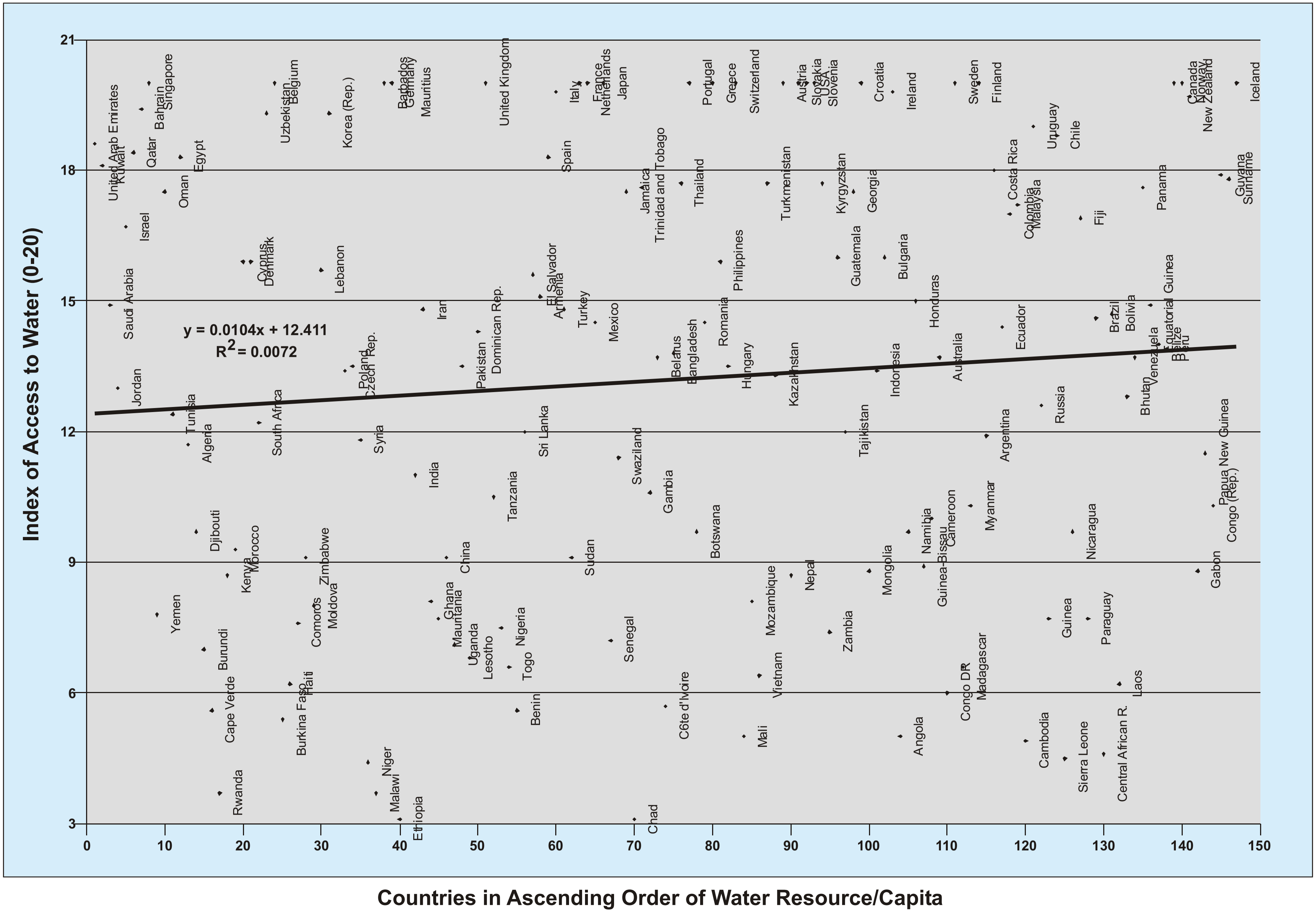


Figure 3: Correlates of Water Poverty: Water Scarcity or Underdevelopment?

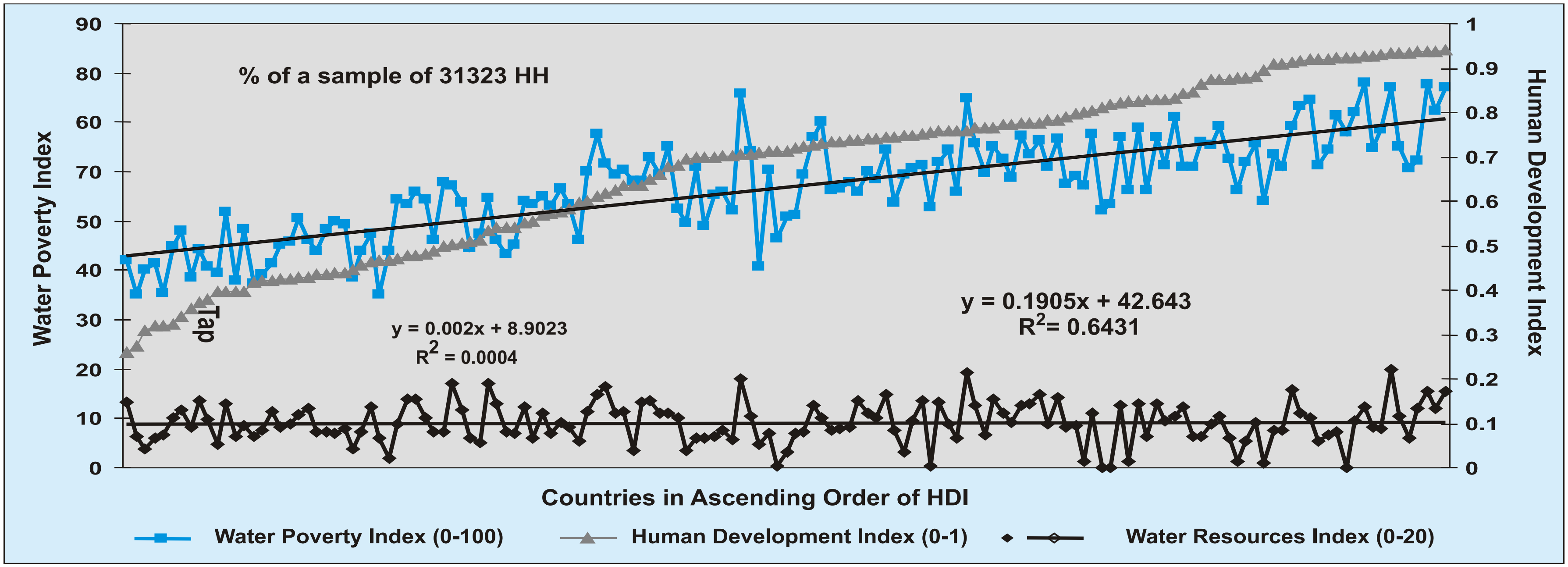
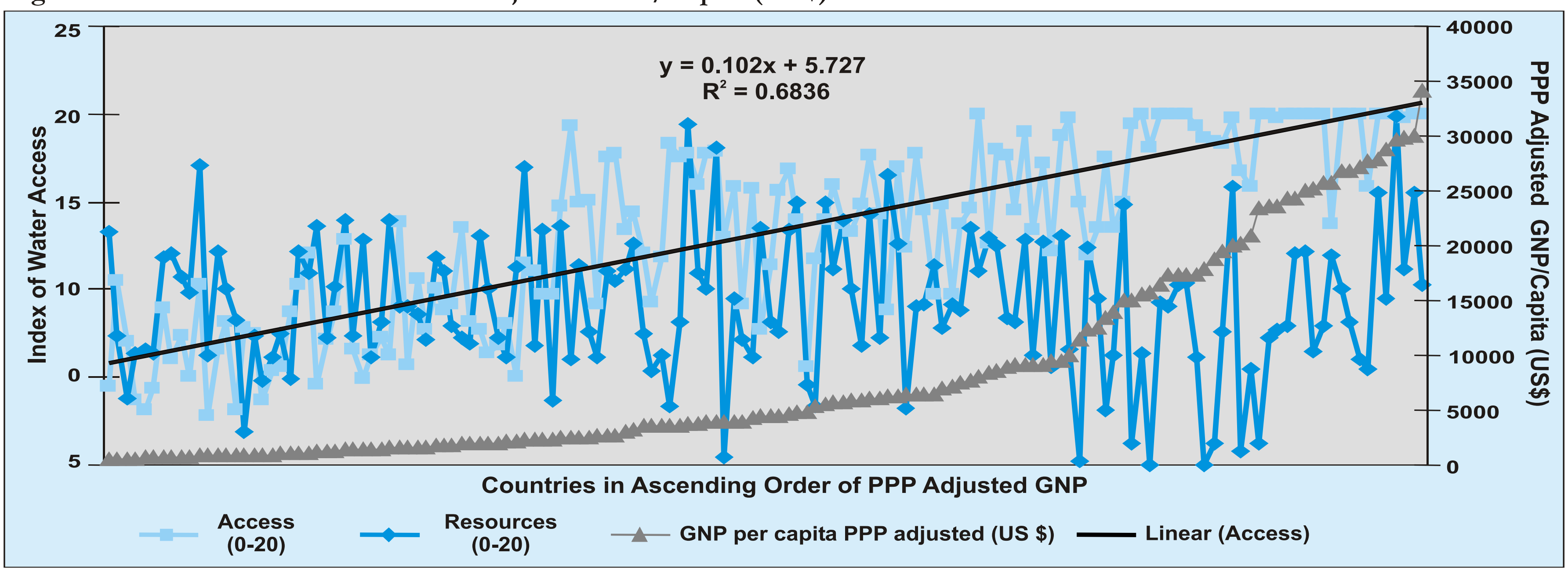


Figure 4: Water Access Index and PPP Adjusted GNP/Capita (US $)



the two. It might be argued that the real indicator of water poverty is 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; 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 endowment and water welfare of nations. Laos, Nicaragua, Cambodia, Bangladesh, and Sierra Leone have much higher per capita water endowments compared to Egypt, Saudi Arabia, UK, and Mauritius; yet the former group of countries are far more water access poor than the latter.

Figure 3 plots water resources per capita, WPI and HDI for the 147 countries covered in the ascending order of HDI. It shows that water endowments of countries have no correlation with HDI; however, WPI is strongly and positively related to HDI. Higher the HDI, lower the water poverty, regardless of the country's water endowments. Figure 4 tests a bolder hypothesis that water access poverty is strongly related to per capita GDP (adjusted for PPP) and very weakly to water resource endowments of countries.

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 produce 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.

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, 2001). However, as levels of living improve, growing demand for environmental amenity generates pressures to seek avenues for economic growth that are light in the demands they make on scarce natural resources—what Gleick (2002) calls a 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 (higher the value of the water environment 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.

When I first presented these results in an IWMI-Tata Partners' meet, they were regarded by some as chicanery of the Excel charts. To meet these charges, I present multiple regression results corresponding to the charts presented so far (Table 2). The data set for 147 countries used is the one compiled by Sullivan (2002) and Lawrence, Meigh and Sullivan (2003) and 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.

In regressions 1 and 2, besides HDI and GDP respectively, water resource endowment is statistically significant and has a large standardized B-coefficient, possibly because water resource endowment is a component of WPI. In

Table 2: Regression Results of Water Poverty Determinants based on Data for 147 Countries

Dependent Variable	Intercept	B- Coefficient for: Index of Water Resource Availability (0-20)	Human Development Index (0 to1)	Index of GDP/Capita (PPP Adjusted in '000 US $) (0 to 1)	Square of GDP/ Capita (in US $)	R^2
1 Water Poverty Index (0-100)	17.761 (12.261)	1.086 (0.433) [13.048]	43.283 (0.796) [24.022]			0.842
2 Water Poverty Index (0-100)	20.646 (12.756)	1.205 (0.482) [12.508]		39.574 (0.764)		0.788
3 Index of Access to Water (0-20)	-3.491 (-3.743)	0.037 (0.029) [0.691]	24.307 (0.867) [20.950]			0.754
4 Index of Access to Water (0-20)	-1.862 (-1.845)	0.103 (0.080) [1.721]		22.22 (0.831) (17.863)		0.691
5 Index of Water Environment (0-20)	7.215 (12.331)	0.138 (0.292) [3.962]		3.804 (0.388) [5.273]		0.227
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]	0.387

Note: Figures in parentheses are values of the t-ratio; for the sample size of 147, any value of the t-ratio above 2.0 might be considered significant.

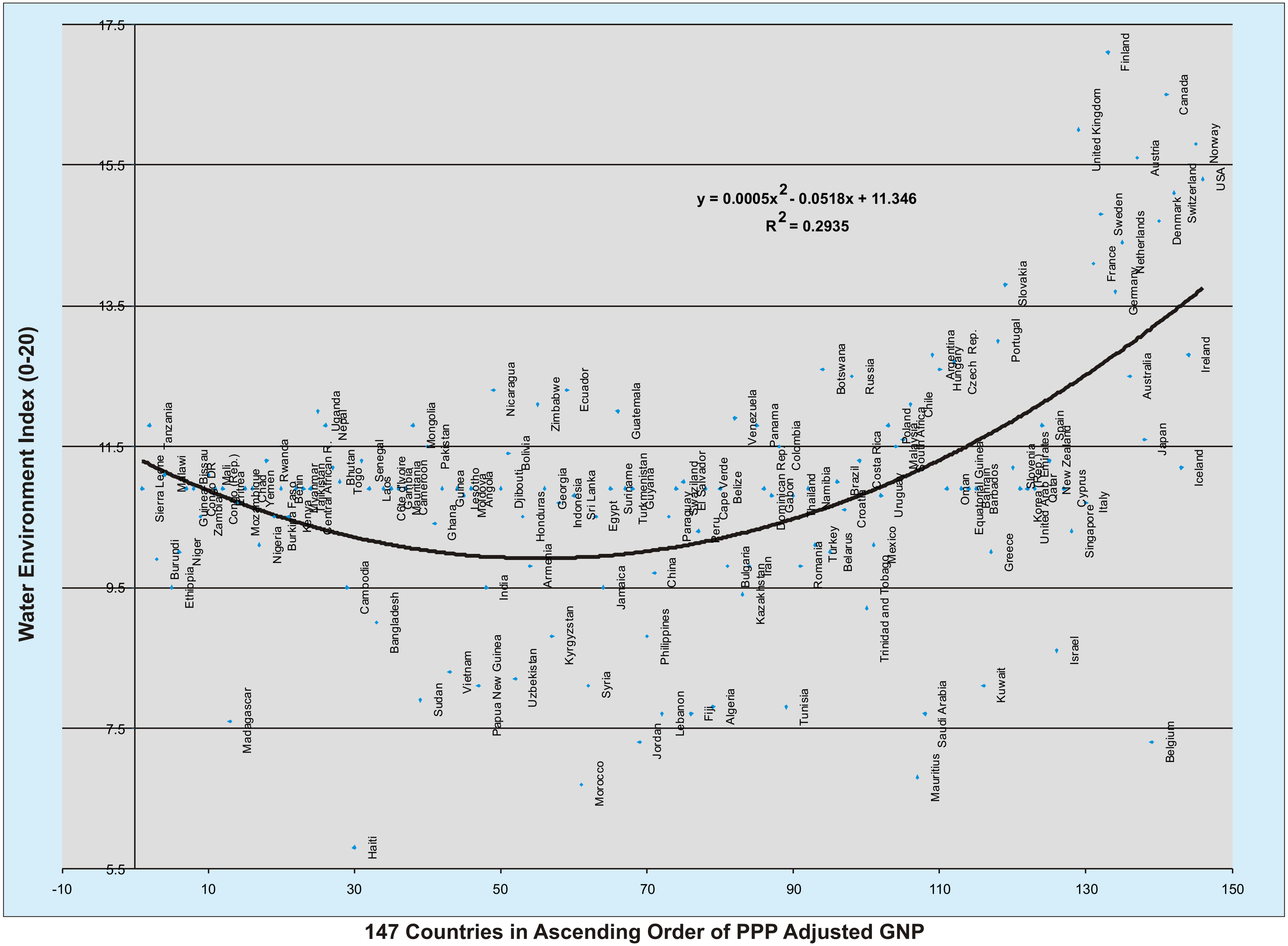
regressions 3 and 4, however, water resource endowment turns insignificant and its standardized B-coefficients are very small too. In these regressions, HDI and GDP per capita emerge as the key determinants of water access poverty with large t-ratios as well as standardized B-coefficients. Regression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

The Case of India

Many people feel disturbed by these results because it apparently leads them to conclude that low-income countries have 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.

Nearly 80 percent 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.

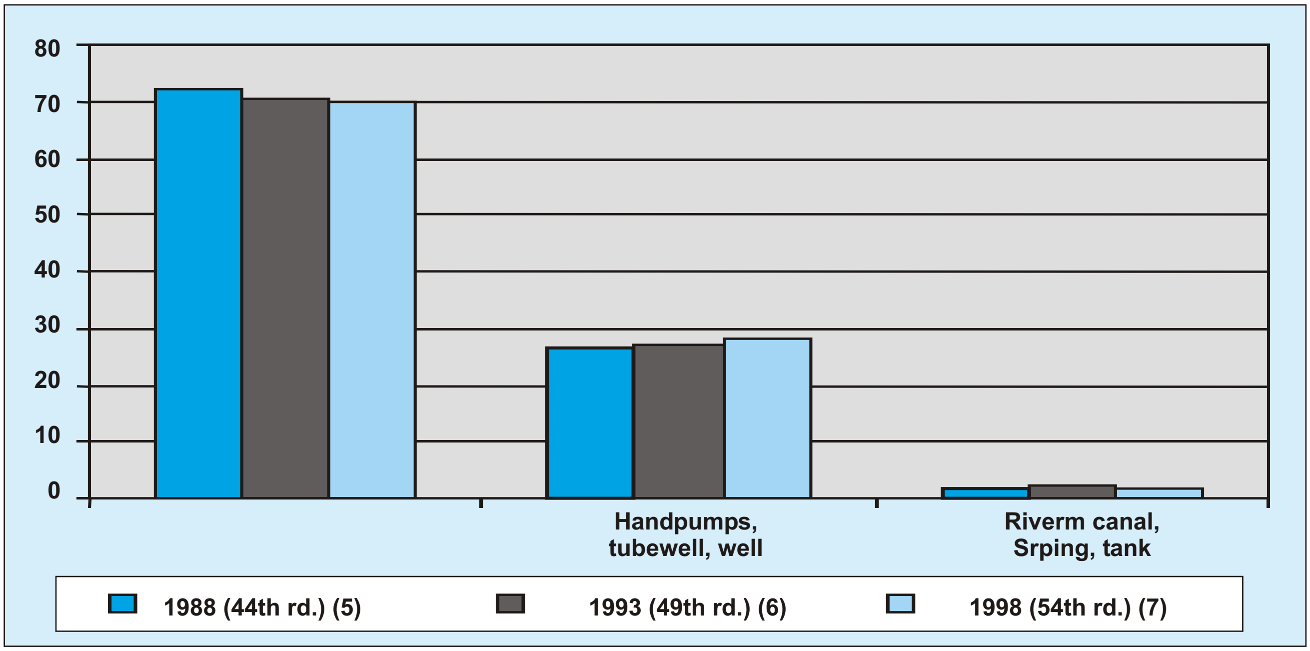
Figure 5: Water Environment Index and PPP Adjusted GNP



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 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 overexploitation, river pollution, waste-water recycling, and wet land protection are some of the stock policy reforms that are commonly recommended, and which generally fail to take off.

The constraint developing countries run into while implementing these strategies 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 tenth five year plan claims that protected water supply covers 95 percent 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 percent 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, whereas in somewhat better-off states such as Haryana, Punjab, and Goa, domestic water supply gets increasingly

Figure 6: Percentage of Urban Households Dependent on Alternative Sources for Drinking Water Requirements

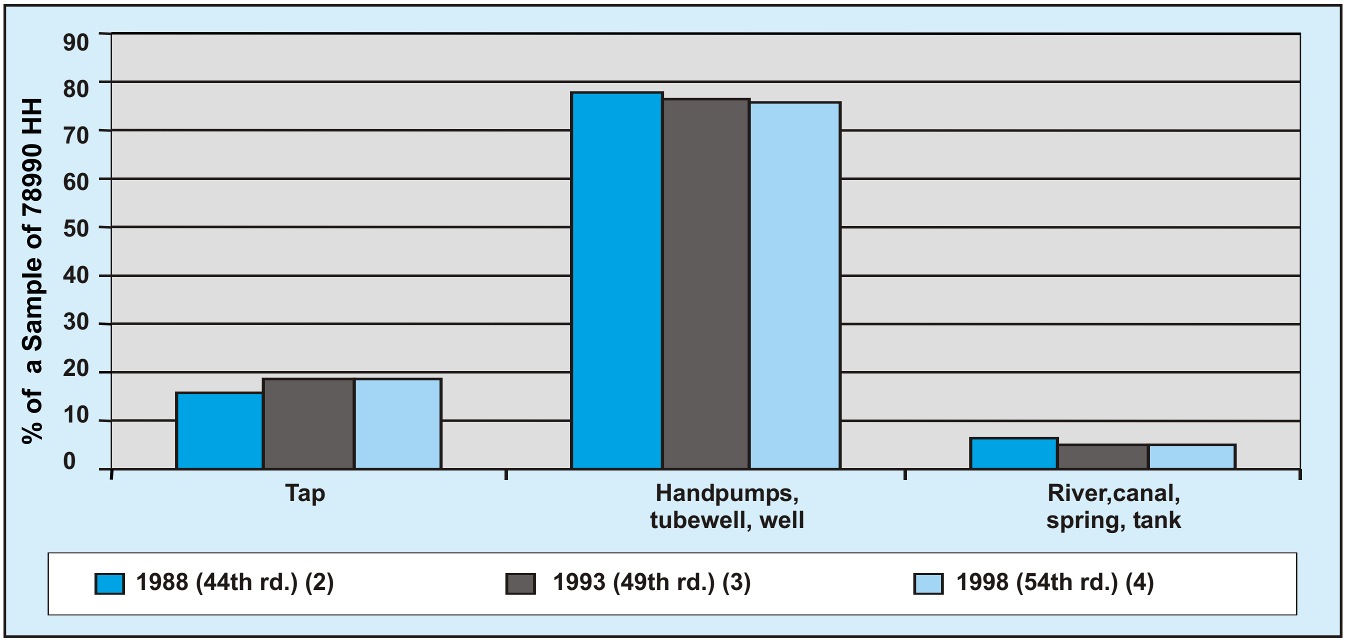


Source: NSSO, 1999: report 449

'formalized', suggesting that even rural households begin getting linked 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 grassroot level, 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 percent 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.

Figure 7: Percentage of Rural Households Dependent on Alternate Sources for Drinking Water Requirements



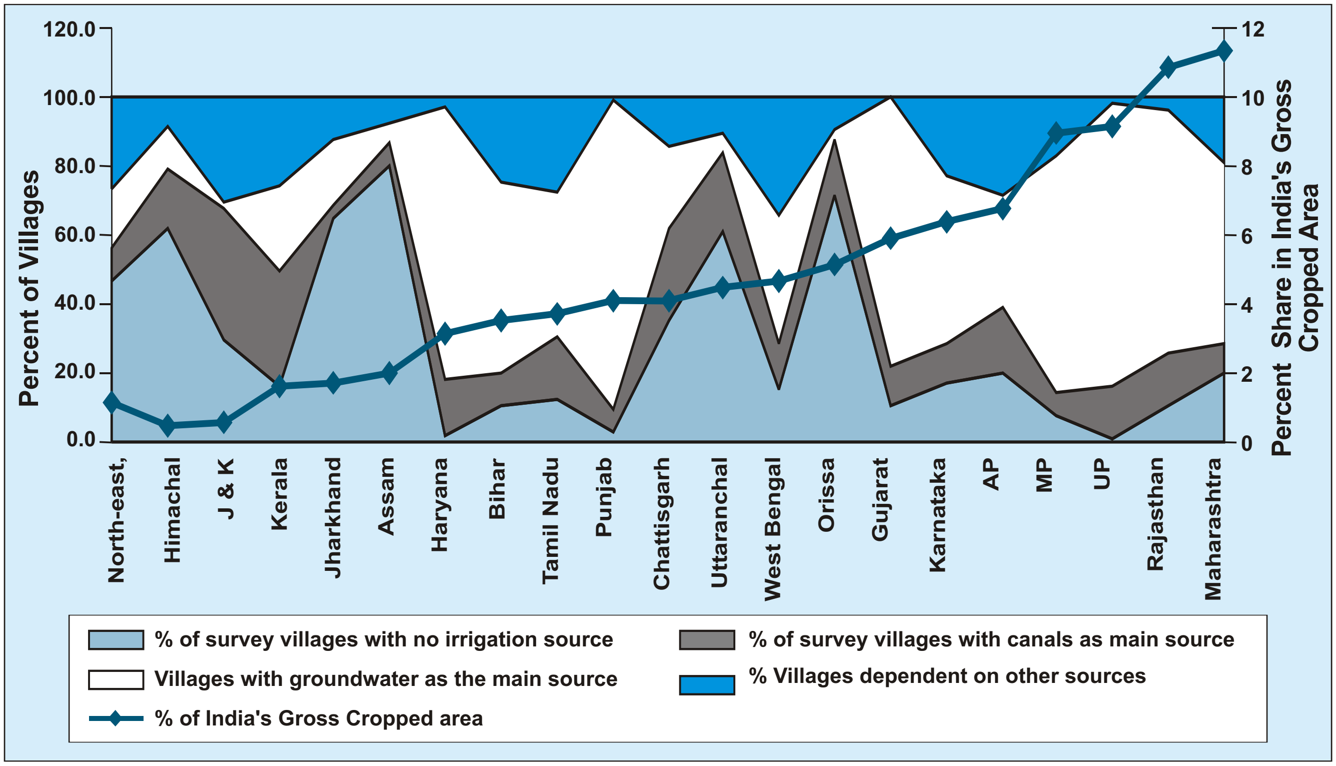
Source: NSSO, 1999: report 449

(Figure 8) 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 four-fifth 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 90 percent of water infrastructure assets used by survey households were self-managed (and owned) by households; only around 10 percent was owned 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 weakly opposed to it, especially when the administration is an instrument of a state that styles itself as a democratic welfare state?

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, which commands greater coercive authority as well as politico-administrative apparatus going down to the village level, can potentially implement such strategies more effectively compared to the Indian state or most African

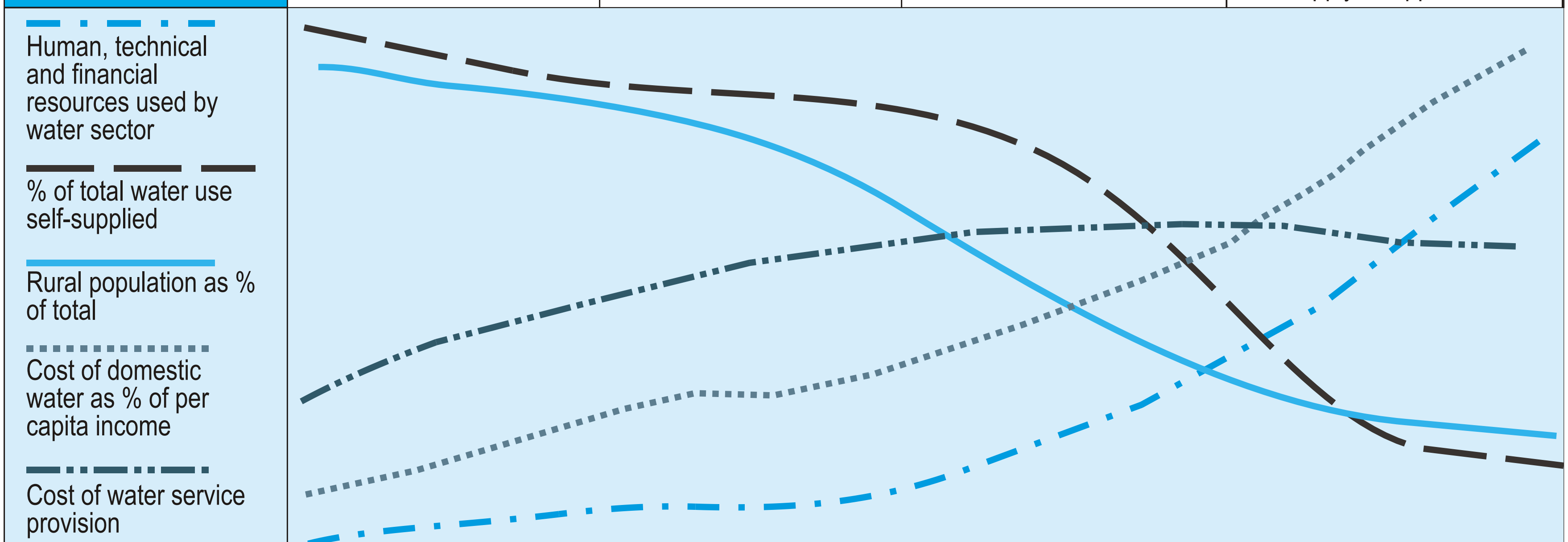
Figure 8: Percentage of Villages Dependent on Alternative Irrigation sources: Survey of 4646 Villages



Source : NSSO, 2003-report 487

Figure 9: 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 Formal Water Industry
% of Water Users in the Formal Sector	<5%	5-35%	35-75%	75-95%
Examples	Sub - saharan Africa	India, Pakistan Bangladesh	Mexico, Thailand, Turkey Eastern China	USA, Canada, Western 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 water industry; High intermediation self-supply disappears



	Stage I: Completely Informal	Stage II: Largely Informal	Stage III: Formalizing	Stage IV: Highly Formal Water Industry
Concerns of the Governments	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 management of water infrastructure, service and resource; resource 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 disappears; all users get served by modern water industry.

states. In learning lessons from China about water sector reforms, it will be futile for Indian strategists to assume that the Indian state can selectively imbibe desirable features of the Chinese state. In designing water governance strategies for India, it seems more sensible to take the nature of the state as given in the immediate run rather than assume that the nature of the state will change to resolve water sector problems.

The predominantly informal nature of India's water economy raises questions about the reach of the three pillars of water governance: policy, law and administration.

IMPLICATIONS

Water poverty and the predominantly informal nature of the water economy are both symptoms of low levels of HDI of nations rather than of their water resource endowments. The water economies of many developing countries today are as informal as Western Europe's perhaps was in the early 19th century; yet, their water policy discussions are heavily influenced by European models of water governance today rather than during the 19th century. It is by no means my case that developing countries should reinvent the wheel and not learn from the experience of the industrialized world. Our analysis suggests that the level of informality of the water economy may well be the key determinant of how much can developing countries leapfrog in crafting water policies and institutions that work only with high level of formalization; it may also determine both the feasibility as well as the priority of a country's water sector strategy. Figure 9 provides a rough caricature of how the structure of water economies changes in response to economic development. Water institutions, the nature of service provision and providers, the structure of water demand—all are likely to undergo change in response to economic development. Adopting in informal water economies of low-HDI countries policy goals and strategies that make sense in industrialized countries would most likely fail, but worse, divert resources and energy away from what would fit the current needs of these water economies better.

Informal water economies face formidable logistical constraints in regulating water withdrawals by users, in undertaking basin-level planning, and allocation of water among different user sectors, and in deploying economic and legislative instruments for water resource management. Doing all these becomes increasingly easier as water economies get formalized and the bulk of the water use is mediated by a class of formal service providers like water companies or utilities or government departments. In contrast, twin challenges facing policy makers in informal water economies is of creating and managing water infrastructure and services on the one hand and of devising effective indirect instruments of reaching out to millions of disconnected water users and influencing their behaviour so that it contributes to overall policy goals of the country.

Our analysis suggests that the 'level of informality of the water economy' may well be the key determinant of how much can developing countries leapfrog in crafting water policies and institutions that work only with high level of formalization.

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IWMI-Tata Water Policy Program

The IWMI-Tata Water Policy Program was launched in 2000 with the support of Sir Ratan Tata Trust, Mumbai. The program presents new perspectives and practical solutions derived from the wealth of research done in India on water resource management. Its objective is to help policy makers at the central, state and local levels address their water challenges – in areas such as sustainable groundwater management, water scarcity, and rural poverty – by translating research findings into practical policy recommendations.

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The policy program's website promotes the exchange of knowledge on water-resources management, within the research community and between researchers and policy makers in India.

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