GROUNDWATER GOVERNANCE IN ASIA
The Challenge of Taming a Colossal Anarchy

I. THE CHALLENGE OF GROUNDWATER GOVERNANCE IN ASIA

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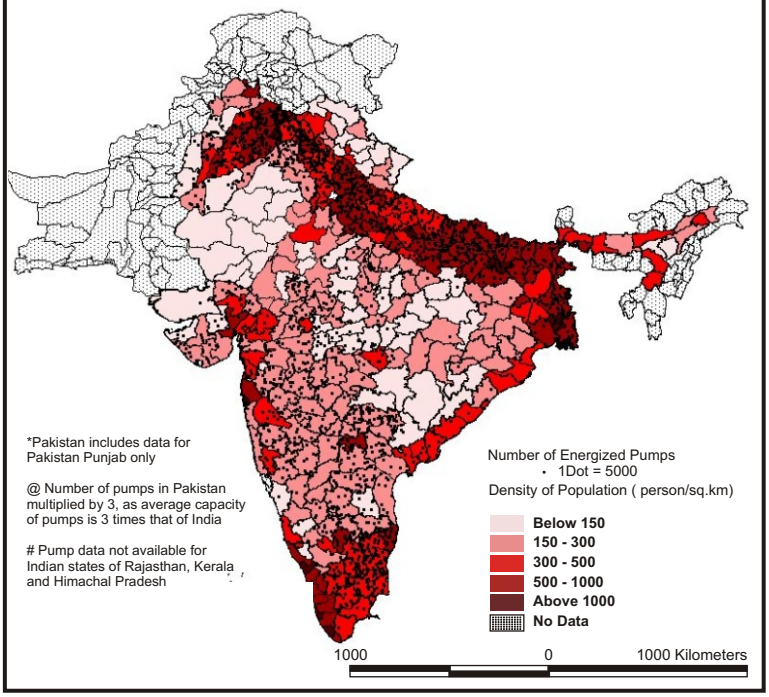
"*Groundwater will be an enduring gauge of this generation's intelligence in water and land management*"[1]. Nowhere will this intelligence be put to a harder test than in Asia which uses some 500 out of the world's total use of 750 m^3 of groundwater in agriculture. US, Australia and Europe also use groundwater a lot, but largely for municipal and industrial uses. These too face the challenge of balancing the demand with availability; but the Asian groundwater challenge is altogether different, more serious and intractable. Africa has modest reserves of groundwater; but it still uses only a small fraction of what it has; Africa's challenge is to use its groundwater to promote livelihoods of the poor but in a sustainable manner. Many problems Asia is now facing might have been avertedor, at least, amelioratedif it had acted in good time; Africa has that opportunity to hasten slowly on the path of groundwater-induced agrarian boom, which in many parts of Asia is ready to bust, especially since the geographic spread of the growth in groundwater irrigation has followed human population density rather than resource availability (Figure 1).

Figure 1: Density of Population and Distribution of Energized Pumps in India and Pakistan



Groundwater irrigation in South Asia and North China has emerged as big business (Table 1). Rapid growth, during the 1970-95 period, of groundwater irrigation in South Asia and North China plains has been at the heart of their agrarian growth; but with growing problems of resource depletion and/or deterioration, Asia's groundwater socio-ecology is under siege. Much concern about the problems of groundwater depletion, pollution and quality deterioration is fueled by worries about their environmental consequences. These are indeed serious; however, equally serious are their consequences for the sustenance of agrarian economies and millions of rural livelihoods that have come to precariously depend upon

Table 1: The Size of Asia's Groundwater Economy

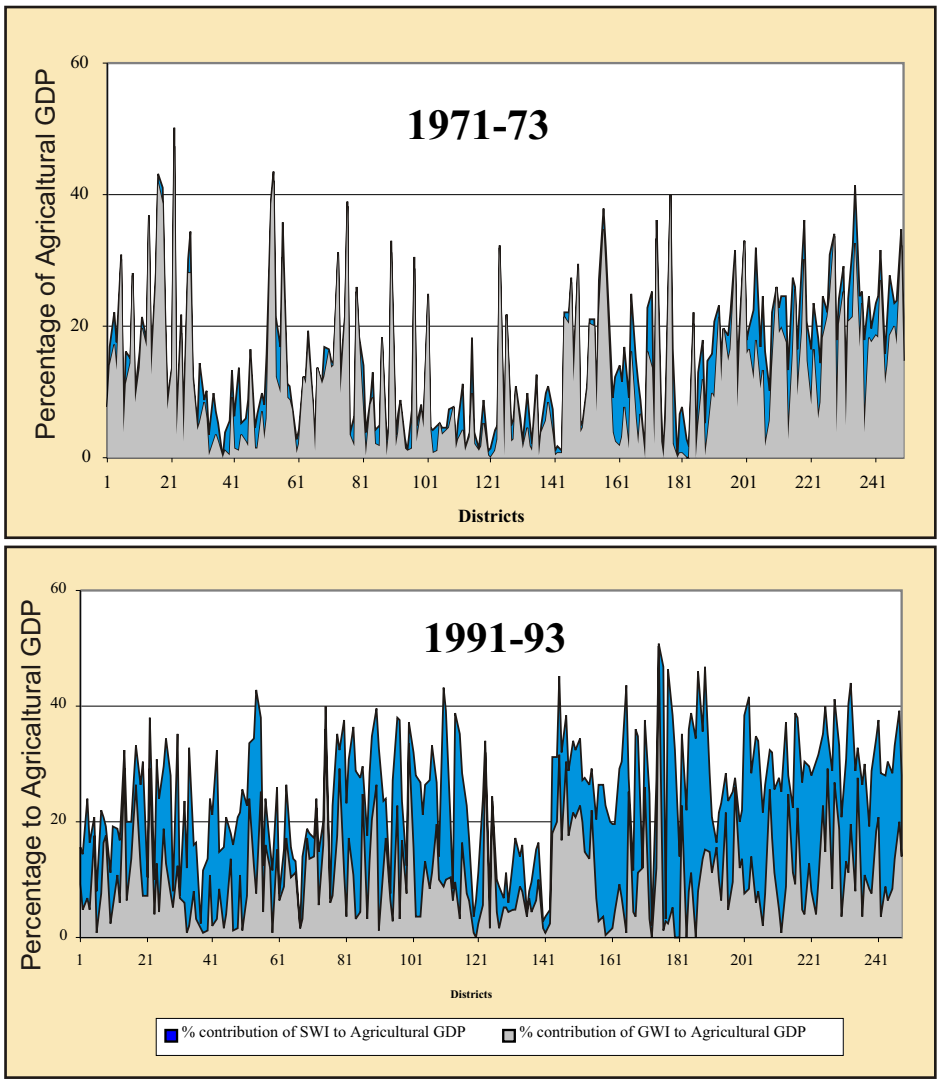
		India	Pakistan Punjab	Bangladesh	Nepal Terai	North China Plains
A	No. of wells (million)	26	0.5	0.8	0.06	3.5
B	Average output/well (m^3/hr)	25	100	30	30	41
C	Average hours of Operation/well/year	330	1090	1300	205	1134
D	Price of pump irrigation (US $/hr)	1	2	1.5	1.5	0.96
E	Groundwater used (km^3)	215	54.5	31.2	0.37	106
F	Value of groundwater used/year in US billion $	8.6	1.1	1.6	0.02	2.5

Source: Estimates by IWMI scientists

[1] The credo of the Australian Groundwater School at Adelaide.

groundwater irrigation, particularly in India, Pakistan, Bangladesh and China. Here, over the past 50 years, public investments and donor funds have been showered over surface irrigation but the bulk of its irrigation and agrarian growth have been delivered by millions of small pumps and wells financed mostly through private farmer investments. New analysis for Indian agriculture, which suggests that in the recent decades, of the agricultural productivity of a 'representative' (or typical) net sown hectare, the portion contributed by groundwater irrigation is very nearly twice contributed by surface irrigation (Figure 2). This analysis has also shown that groundwater development has been spatially dispersed and even where as canal irrigation projects have created small islands of affluence leaving large catchment areas poor and deprived. It is not surprising then that while canal irrigation projects are seldom seen as regional poverty reduction interventions, providing access to groundwater irrigation through pump subsidies or public tubewell programs has been at the centre-stage of poverty reduction programs in South Asia.

Figure 2: Changing contribution of ground and surface water irrigation in Agricultural Output in India's 252 districts: 1971-73 and 1991-93



This good run that many countries of the world, particularly in Asia, are having with groundwater irrigation may soon come to an end. Throughout the world regions that have sustainable groundwater balance are shrinking by the day. Three problems dominate groundwater use: *depletion* due to overdraft; water logging and *salinization* mostly due to inadequate drainage and insufficient conjunctive use; and *pollution* due to agricultural, industrial and other human activity. Groundwater depletion has major environmental consequences; but it has important economic consequences too. Declining water tables raise energy and capital costs of accessing groundwater to prohibitive levels; in some regions, such as North Gujarat or Baluchistan, entire agrarian economies face serious threat of extinction from the decline of groundwater socio-ecologies. Water quality and health problemssuch as very high fluoride and arsenic contenthave similarly immiserizing social impacts in South Asia as well as China.

The pathology of the decline in groundwater socio-ecology in region after region reflects a remarkably similar 4-stage pattern:

Stage 1: Undeveloped groundwater is viewed as a big opportunity for livelihood creation for the poor, resource management goal is to stimulate its development and use;

Stage 2: Agrarian prosperity fired by groundwater irrigation ensues; but institutions and management regimes for orderly and sustainable use of the resource are not in place;

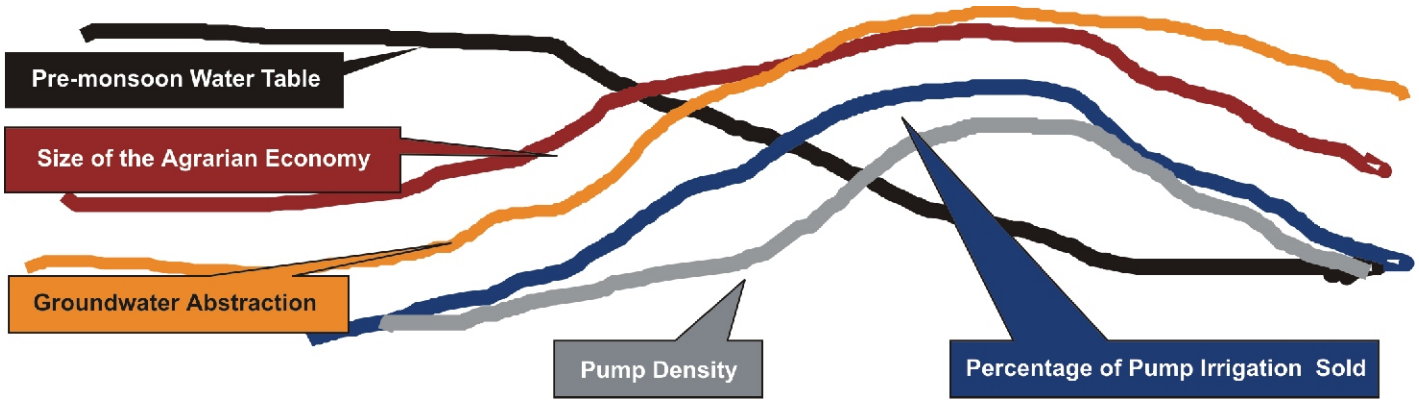
Stage 3: Early symptoms of groundwater over-draft and quality degradation emerge; but irrigators' interests are well-entrenched and they resist attempts at regulation;

Stage 4: Advanced state of depletion and deterioration that threatens the social and ecological fabric of a region leaving immiserizing impacts.

This underpins the typical progression of a socio-ecology from a stage where unutilized groundwater resource potential becomes the instrument of unleashing an agrarian boom to one in which, unable to apply brakes in time, it goes overboard in exploiting its groundwater.

Figure 3: Pathology of rise and decline of a groundwater socio-ecology

STAGES	Stage I	Stage II	Stage III	Stage IV
	The Rise of Green Revolution and Tubewell Technologies	**Groundwater-based Agrarian Boom**	**Early Symptoms Groundwater Over-draft**	**Decline of the Groundwater Socio-ecology with Immiserising Impacts.**



EXAMPLES	North Bengal and North Bihar, Nepal Terai, Orissa, Vietnam	Eastern Uttar Pradesh; Western Godavari; Central and South Gujarat; Northern Sri Lanka; Chao Phraya in Thailand; Baluchistan	Haryana, Punjab, Western Uttar Pradesh, Central Tamilnadu; Bangladesh; Pakistan Punjab	North Gujarat, Coastal Tamilnadu, Coastal Saurashtra, Southern Rajasthan; Hebai, Shanxi, and Henan Provinces in North China
CHARACTERISTICS	Subsistence Agriculture; Protective Irrigation Traditional crops; Concentrated Rural Poverty; Traditional Water Lifting Devices using Human and Animal Power	Skewed Ownership of Tubewells; Access to Pump Irrigation Prized; Rise of Primitive Pump Irrigation `Exchange' Institutions. Decline of Traditional Water Lifting Technologies; Rapid Growth in Agrarian Income and Employment	Crop Diversification; Permanent Decline in Water Tables. The GW-based `Bubble Economy' Continues Booming; But Tensions Between Economy and Ecology Surface as Pumping Costs Soar and Water Market become Oppressive; Private and Social Costs of GW use Part Ways.	The `Bubble' Bursts; Agri. Growth Declines; Pauperization of the Poor is Accompanied by Depopulation of Entire Clusters of Villages. Water Quality Problems Assume Serious Proportions; the `Smart' begin Moving out Long before the Crisis Deepens; the Poor Get Hit the Hardest.
INTERVENTIONS	Targeted Subsidy on Pump Capital; Public Tubewell Programmes; Electricity Subsidies and Flat Tariff.	Subsidies Continue. Institutional Credit for Wells and Pumps. Donors Augment Resources for Pump Capital; NGOs Promote Small Farmer Irrigation as a Livelihood Programme.	Subsidies, Credit, Donor and NGO Support Continue Apace; Licensing, Citing Norms and Zoning System are Created but are Weakly Enforced. Groundwater Irrigators Emerge as a Huge, Powerful Vote-bank that Political Leaders can not Ignore.	Subsidies, Credit and Donor Support Reluctantly go; NGOs, Donors Assume Conservationist Posture Zoning Restrictions begin to Get Enforced With Frequent Pre-election Relaxations; Water Imports begin for Domestic Needs; Variety of Public and NGO Sponsored Ameliorative Action Starts.

The critical issue for Africa is: can it put in place an institutional and policy framework that can stabilize its emerging groundwater irrigation economy at stage 2 or 3? Are there adaptive policies and management responses early on that can generate a steady-state equilibrium, which sustains the groundwater-induced agrarian boom without degrading the resource itself?

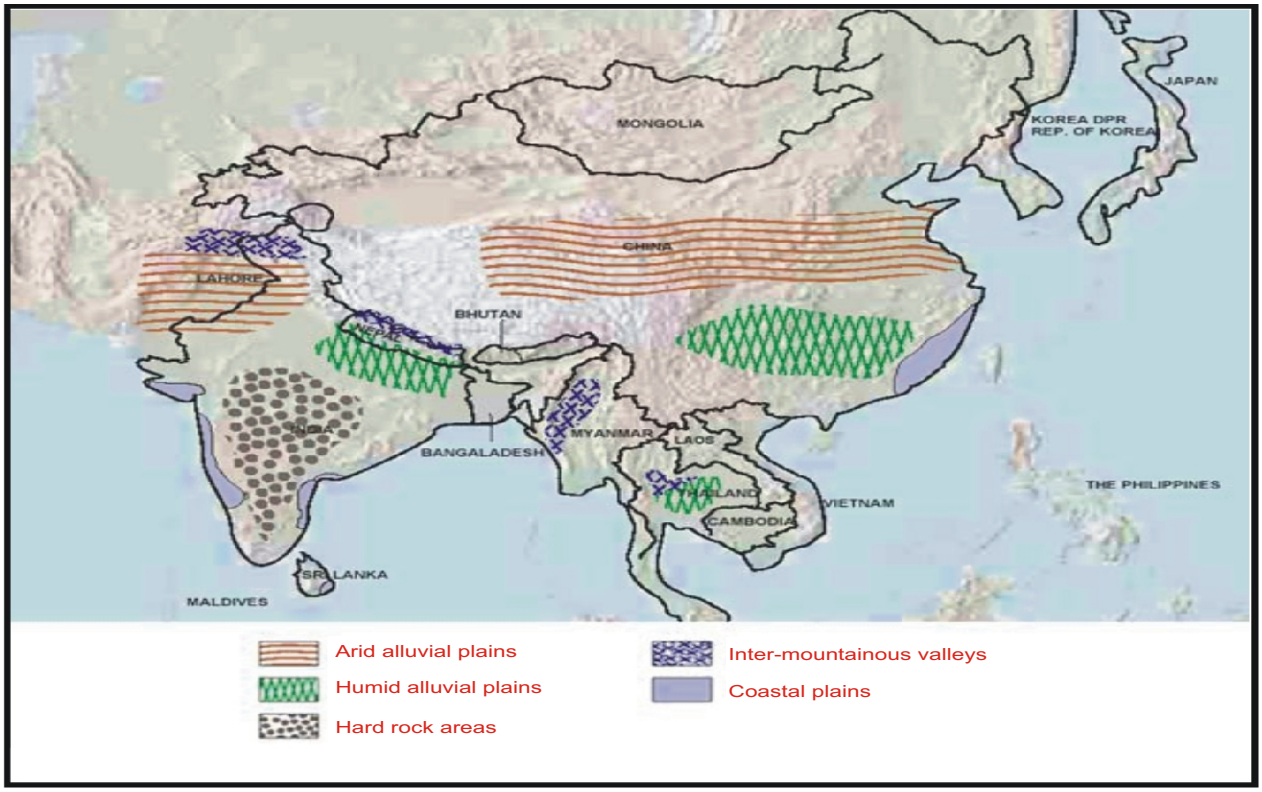


Figure 4: A groundwater-based typology of Asia

The critical issue for Asia is: does stage 4 always have to play out the way it has so far in many areas of Asia? More pertinently, what might be done to sustain groundwater socio-ecologies under threat and keep them from falling over the edge of the precipice?

The Asian groundwater scene is albeit not uniform. In humid alluvial plains of the Ganga-Brahmaputra-Meghna basin, in Mekong as well as in Yangtzee basin in China, vast reserves of unutilized groundwater resources offer major opportunity for agricultural growth and poverty reduction. The challenge of sustainable groundwater management arises in arid alluvial plains of the Indus and Yellow river basins and in the hardrock regions of peninsular India. Many of Asia's coastal aquifers too face serious threat of depletion and saline intrusion.

Nobody has worked out a complete answer to this question that is also practical and implementable in diverse conditions obtaining in the developing world. But a cursory overview of global experience suggests that strategies used by different countries for sustainable groundwater management are determined *inter alia* by their stage of economic development.

Table 2: Challenges of Sustainable Groundwater Management

HYDRO-GEOLOGICAL SETTINGS		SOCIO-ECONOMIC AND MANAGEMENT CHALLENGES			
		Resource Depletion*	Optimizing Conjunctive Use**	Secondary Salinization ***	Natural Groundwater Quality Concerns
Major Alluvial Plains	Arid	• •	• o	• • •	•
	Humid	•	• • •		• •
Coastal plains		• •	•	• • o	•
Inter-Montane Valleys		•	• •	o	•
Hardrock Areas		• •	O	•	• • •

Note: No. of dots suggest the magnitude of the challenge

II. GROUNDWATER SOCIO ECOLOGY OF SOUTH ASIA: RESULT OF A SURVEY OF 2630 TUBEWELL OWNERS IN INDIA, PAKISTAN, BANGLADESH AND NEPAL

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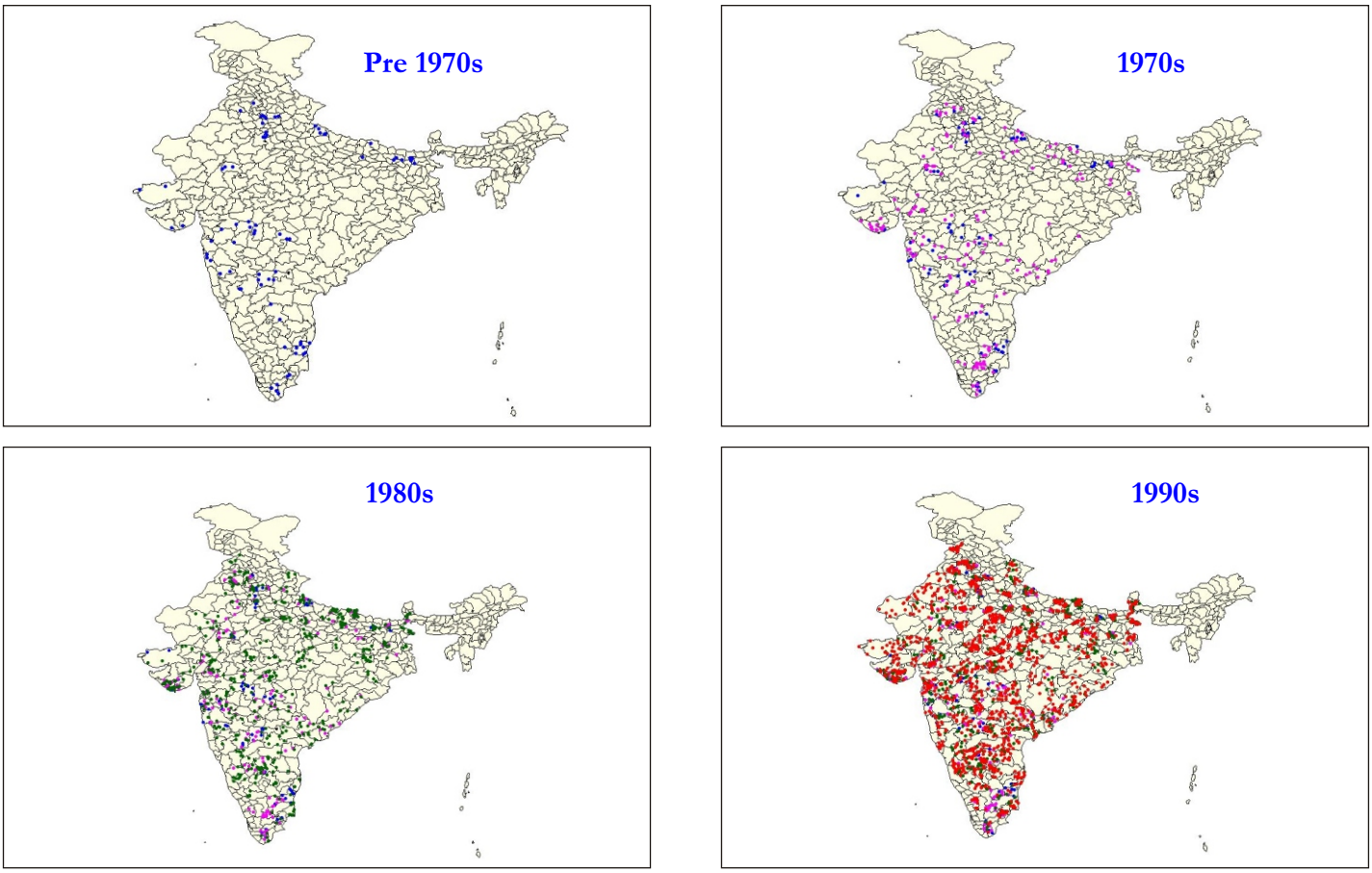
Growing contribution of groundwater in South Asia's agricultural economy remains both underestimated and understudied. However, in recent years there is an increasing awareness about the important role that groundwater has played in fostering food sufficiency in much of this poverty stricken belt of the world. At the same time, there is a realization that much of this precious resource stands the chance of rapid and irreversible exploitation in many parts of South Asia. The issue is: how long can this good run continue without any mechanism for governing this colossus? What kind of governing structures and mechanisms might help? Refined understanding of the (non)existing governance structure in groundwater and further research into fine tuning this understanding in order to try and bring about a modicum of order in the functioning of this booming but anarchic economy is of great urgency. In this quest for better governance, need to understand the spatial variation within South Asia itself is of great importance and indeed was the justification of the country surveys conducted by IWMI in 2002.

The findings, based on an extensive region wide groundwater survey will thus, bring out the salient features of groundwater economy and socio-ecology of South Asia. This survey has helped reinforce several facts regarding groundwater irrigation in South Asia and at the same time has helped challenge some myths surrounding it.

Perhaps the most important finding of the survey is the rapid growth of groundwater economy in the last three decades, with peak in 1990s. Thus, 1990s can very well be designated as the decade of "pump explosion". This survey corroborates the findings of Agricultural Censuses of India in that the ownership of groundwater assets were less skewed than the ownership of land, making groundwater an ideal mechanism for poverty alleviation in the water abundant areas. That groundwater economy is primarily self financed came as a revelation to many who maintained that huge government subsidies, either direct or indirect, has played an important role in spreading groundwater irrigation. Perhaps, what this indicates is that, government subsidies might not have reached the targeted

Figure 5: South Asia's groundwater boom is still in the making



Source: IWMI Survey, 2002