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Evolution of Property Rights Regimes in the Groundwater Economy of India –Constraints on moving towards a common property regime.

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Despite the fact that the famous model of natural-resource use, especially espoused by biologist Garret Hardin, the “tragedy of commons” has been thoroughly debunked by social scientists of most stripes, the model’s assumptions- that selfish individuals using a common pool resource will over consume to the detriment of all have not only survived, but fruitfully multiplied, as if driven by higher laws of natural selection (Goldman, 1997)

Groundwater will be the enduring gauge of this generation’s intelligence in water and land management (Australian Groundwater School, Adelaide)

Abstract

The “open access” nature of groundwater has resulted in the over-exploitation and depletion of the resource. Negative externalities are encountered by the users due to the self-interest maximising behaviour of individual agents which increases the social cost of extraction. There is excessive groundwater exploitation occurring in the country, which had led to a policy concern that there is a need for shift of groundwater resources to a Common Property Rights regime. We review the “model” central and state government bills, pertaining to groundwater, through a conceptual framework and discuss the Andhra Pradesh experience in developing governance mechanisms. A Schema for crafting of a nested governance regime is discussed. We conclude by identifying research gaps and argue for the urgent need of piloting certain interventions, from which there should be a continuous process of learning to refine the governance regime.

Key Words: Groundwater Governance; Common Property Regime; Nested governance; India

JEL Classification: P14; Q32

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1. Introduction

The benefits of groundwater irrigation are manifold. India is one of the world's largest groundwater users in terms of both absolute volumes pumped and the total number of users. There are approximately 20 million wells which are increasing at approximately at one million per year (Mukherjee and Shah, 2005 and Scott and Shah, 2004). Irrigation by Groundwater accounts for 60% of the irrigated area in the country and approximately 85% of the additional irrigated area since 1970 is accounted for by groundwater (Kulkarni and Shankar, 2009). Irrigation through groundwater sources, besides increasing the cropping intensity and productivity of crops, the timely access that it provides, increases the demand for agricultural labourers and the wage rates. The increased affordability of food grains due to the higher wages that they earn help the rural poor to cross the poverty barriers (Narayanamoorthy, 2007)². Many of the irrigation systems constructed in Asia over the past four decades, it is explained would have become bad investments, were it not the dynamic pump irrigation economies which support them by recharging the groundwater aquifers³. Further, they act as insurance against drought and facilitate stabilization of agricultural production and enhance employment generation; They also help the non-well owning farmers, through the operation of the water market (Shah, 1993).

However, the 'open access' nature⁴ of groundwater has resulted in the over-exploitation⁵ and depletion of the resource. Negative externalities are encountered by the users due to the self-interest maximising behaviour of individual agents which increases the social cost. The importance of groundwater in the agricultural development strategy for India is clear as yields in groundwater irrigated areas are higher by one third to one half than in areas irrigated

² The conclusions reached in the study are based on the analysis of the state wise cross-section data covering five time points: 1973-74, 1977-78, 1983, 1987-88 and 1993-94 to examine the groundwater irrigation and rural poverty nexus.

³ Overview Sustainable Groundwater Management Theme <http://www.lk.iwmi.org/groundwater/index.htm>
Viewed on 13th February 2009.

⁴ The extraction of groundwater by the farmer takes place from the open access groundwater resource, the resources is in the nature of a common pool good as it possesses the characteristic of difficulty in exclusion and is subtractable as the extraction by one person leads to reduced quantity available to others.

⁵ Groundwater exploitation as a concept deals with the negative aspects of groundwater development which includes - large and continuous drops in groundwater levels over long time periods, large seasonal drops in water levels and the drying up of wells in the summer season and substantial increase in the cost of groundwater extraction (Kumar and Singh, 2008, p.299-300).

with surface water (Moench, 2000). However, there is excessive groundwater exploitation occurring in the country, which had led to a policy concern (GOI, 2000) that there is a need for shift of the property rights regime of groundwater to a Common Property Rights regime⁶.

The purpose of this paper is to contribute and extend the discourse on the groundwater economy in India that has been taking place recently in the *Economic and Political Weekly*⁷. The paper is structured as follows. In section 1, we introduce the problem and state our normative concern. Section 2 discusses the social system characteristics of Groundwater. In Section 3, we present the framework for discussing the groundwater property rights regimes. In Section 4, we review the model central and state government bills pertaining to groundwater and discuss the Andhra Pradesh experience in developing governance mechanisms. We present the Schema of a nested governance regime in Section 5. We conclude in Section 6 by identifying certain research gaps and argue the need for piloting certain interventions from which there should be a continuous process of learning and refinement of the governance regimes.

The Expert Group of the Planning Commission (GOI, 2007) has undertaken a very comprehensive exercise to examine the status of the groundwater resources in the country and also has reviewed the experience of some of the states in the country in regulating groundwater extraction. The report has provoked an interesting debate in the *Economic and Political Weekly*. Narasimhan's (2008) contention is that there is need for managing groundwater based on the available and evolving scientific information and the Expert Group has not taken cognizance of this knowledge that is available. While the Expert Group, recommends that there should be caution exercised in devolving management responsibilities to user cooperatives and Panchayat Raj Institutions (PRIs) and pilot testing is required, Narasimhan (2008) contends that efforts towards such decentralized initiatives should not be

⁶ While policies towards undertaking community management of groundwater as a common property resource have been initiated in Spain and Mexico, this shift in the property right regime has not lead to much success in these countries due to 'resistance' from the stakeholders. Similar problems would be encountered in the Indian context due to the coordination and collective action problems involved in regulating the behaviour of dispersed individual agents across geographical locations.

⁷ Based on the contributions of Kulkarni and Shankar, 2009, Shah, 2008, Narasimhan, 2008; flowing from the Expert Group report (GOI, 2007).

embarked without results from such pilot initiatives, being available. Kulkarni and Shankar (2009) contribute to the debate and specify certain steps, which would lead to an aquifer based management system (ibid, p.15-16). They state that the purpose of their intervention has been only to identify critical processes required for a groundwater governance regime to emerge and *not* to suggest a governance structure for groundwater management. The purpose of our contribution is with the intention of taking the discourse forward by suggesting the steps leading to the development of a nested governance regime. We hope that the paper would not only lead to academic debate among the academic, policy and practitioner community, but also lead to piloting of some ‘experiments’ in evolving such governance regimes in the country. We argue based on the learning’s from some interesting ‘experiments’ that Andhra Pradesh could possibly be a ideal state for such pilot projects to be undertaken.

Normative concern

Our concern is that the groundwater governance regime should work towards increasing the welfare of the present generation without decreasing the welfare of the future generation. This concept is referred to as ‘Pareto Sustainability’⁸ (*sustainability concern*). We are interested in the maximization of current well being, within sustainable ecological and economic water extraction (*efficiency concern*). We are concerned in ensuring inter-generational equity across class (defined in terms of land holding).

2. Social system characteristics of Groundwater that complicates the evolution of a nested governance regime

2.1 Bounded rationality, information asymmetry

The assumption that individuals are ‘infinitely rational’ does not hold true. In reality, rationality is bounded and is individual specific, based on the information available and cognitive capacity of the person. Decisions therefore made by individuals are based on the limited understanding and information that they have and their cognitive ability in rationally processing the available information. To illustrate, a farm in semi-arid India who has

⁸ See Dasgupta and Mäler (2000) .

encountered frequent failures to get water while attempting to dig a borewell and has been indebted to moneylenders, still attempts to dig a fresh bore well. This is based on the 'blind hope' that another attempt might lead to a success, which will enable him to recover all the losses incurred. The information asymmetry problem pertains to the decision making based on a random guess of a particular spot wherein groundwater would be available and not based on a scientific assessment of probability of success in his plot⁹.

2.2 Missing Institutions, Scale Mismatches and Incorrect scale of information

Since Groundwater as a resource is available at the aquifer scale, whose size varies across geographical regions, we need, to tailor-make the institutional set up (for a CPR based governance regime) in a nested manner in congruence with the physical spread of the aquifer. Another issue is to tailor-make the institutional arrangement based on the differential incentive structure and therefore the appropriate level of incentives/disincentives for the users, become relevant. This would differ based on the nature of the aquifer in question. The management implications should be based on the aquifer-groundwater relationship which is discussed by Kemper (2007, Table 8.1, p.157)¹⁰. In the Indian basin, where the aquifer is extensive, but has low permeability, it is explained that there are high transaction costs due to the high density of users, but transaction costs could be minimized as aquifers could be managed as local units (Kemper, 2007). Such an institutional set up does not exist in the groundwater context, as there are only local level institutions, which are 'too local' while the higher-level organisations, the institutions of the state machinery (State Groundwater Authority) are 'too non-local'.

The need for an effective institution within the micro level, the micro watershed level is complicated by the fact that the micro watershed in some cases covers more than a village, while in some cases a village might have multiple micro watersheds. The institutional set up therefore requires coordination and congruence at both horizontal (within the

⁹ This is again based on a further assumption that for a scientific assessment, the geologist has sufficient information and cognitive capacity to make an informed opinion on the probability of success.

¹⁰ Also, See Chapter 6 titled 'Aquifers and Institutions' in Shah (2009). The incentive structure and the behavioural pattern (that we could hypothesise) of individual users is largely influenced based by the possibilities of cooperating/not cooperating for the use of the groundwater resource. A detailed discussion on this issue is beyond the scope of the paper and an arena for further theoretical and empirical hypothesis formulation. Interested researchers could use the valuable contributions of Shah (2009), Specifically Chapter 6 and Kemper (2007) as a starting point.

microwatershed/village level) and vertical integration to higher levels (Grama Panchayat¹¹ or an area larger than the Panchayat based on the nature of the aquifer in question). Another issue pertains to horizontal linkage among the CBOs within the village level, ex: Tank Users Committee, *vis-à-vis* a watershed committee, *vis-à-vis* the Grama Sabha.

Scale mismatch refers to the inappropriate form of decision-making occurring at an inappropriate level. This could be due to *missing connections*, which refers to missing linkages at different levels, which in the Indian Groundwater context, for example could mean the lack of linkage between the Ground Water Cooperation Committee (GWCC)¹² and the Watershed Development Committee or/and Tank Users Committee. Another problem that emerges, due to *missing institutions* and scale *mismatch* is the incorrect scale of information gathering/flow which leads to decision making at an inappropriate level, in the nested institutional structure (either a level too local or too non-local¹³). Appropriate decision-making would take place only if there is an agreement that the decision making at a particular level is desirable to ensure the effectiveness of the decision making process. By effectiveness, we mean the decision making at a particular level is based on sufficient information available at that level which would also ensure effective action by stakeholders if the decision is actually implemented.

3. Framework to examine problems relating to common pool resource management

Groundwater as a resource, which currently exists in India, could be classified as a common pool resource, since it possesses the characteristics of (a) difficulty in exclusion and (b) subtractability. It is well recognised that efforts by external authorities to impose similar solutions to CPR management issues have only lead to institutional problems and failures (Ostrom, Gardner and Walker, 1994). When rules are crafted, it is rightly argued “these rules,

¹¹ The institutional set up pertains to the Indian context, wherein the lowest administrative set up is the Grama Sabha level, which is a village body of all adult members, while the Grama Panchayat is the administrative body for 4-5 villages, which is represented at the village level by the respective Grama Panchayat member. These members are either members belonging to any caste or elected based on positive discrimination (Scheduled Caste/Scheduled Tribes) or women.

¹² This is the mandated institutional set up suggested at the village level as per the Expert Committee of the Planning Commission (GOI, 2007).

¹³ The nested institutional making structure would be based on the principle of *Jurisdictional parsimony*, which means that jurisdictions should be no larger than necessary, therefore “never globalise a problem when it can be dealt with locally” (Murphee, 2000).

frequently turn out to be incompatible with the specific physical characteristic of the resourceö Schalager, Blomquist and Tang (1994, p.294). In the Groundwater governance context, even before, any rules are even thought of, there is a clear need to understand the differential nature of aquifers and the likely behaviour of the individual agents based on the socio-ecological conditions for the given aquifer¹⁴.

According to Bromley (1991:2), “Property is a benefit (or income) stream and property right is a claim to a benefit stream that the state will agree to protect through the assignment of duty to others who may covet, or somehow interfere with the benefit stream” Therefore, property is not just a physical object, but also a social relation involving income streams, property right holders and duty bearers. A property right is the authority to undertake particular actions related to a specific domain (Commons, 1968) and for every right an individual holds, rules exist that authorise or require particular actions in exercising those property rights. The term “rules” refers to generally agreed-upon and enforced prescriptions that require, forbid or permit specific actions for more than a single individual (Ostrom, 1986). The rules could be either, (a) Collective choice rules, which refers to those rules which specifies as to who may participate in changing operational rules¹⁵. (b) Operational rules are authorizations for individual users as specified by the collective choice making body¹⁶. The relevant operational-level property rights are “access” and “withdrawal” which refers to the right to enter a defined physical property and the right to obtain the products of a resource respectively. The crucial distinction is that individuals who have access and withdrawal rights may or may not have extensive rights authorizing participating in collective

¹⁴ Shah (2009, Table 6-1, p.154) presents a clear presentation of the hypothetical response of individual agents to a given aquifer characteristic. To illustrate, it is stated that if there is a hard-rock aquifer with low aquifer storage and some recharge possible, there would be “rivalrous gaming” This means that as farmers know that the groundwater table is declining, there would be a competitive race to exploit the groundwater. The farmers tend to feel that any further delay would mean that the groundwater table, would have further declined due to the exploitation by other farmers. Therefore there is a “competitive race” to exploit the groundwater.

¹⁵ These rules in the groundwater context could be either made by a highly centralized authority, which is the Groundwater authority established at the State level or it could be as localized as the water user’s association at the village level.

¹⁶ In the groundwater context, this would mean the authorization given to the farmer relating to (a) permission to install a borewell (b) depth of the well and (c) horsepower for the motor, etc.

choice decisions, the authority to devise operational-level rights is what makes collective-choice rights so powerful (Schalager and Ostrom, 1992:p.250).

The collective-choice property rights include the following. (a) Management-The right to regulate internal use patterns and transform the resource by making improvements. (b) Exclusion-The right to determine who will have an access right, and how that right might be transferred. (c) Alienation- The right to sell or lease either or both of the above collective choice rights.

The following category of users could be classified based on the rights that they possess.

- a. Authorized user-Individuals holding operational rights of access and withdrawal.
- b. Claimant-Individuals who have the same right as authorized users plus the collective choice right of management.
- c. Proprietor- Individuals who possess collective choice rights of management and exclusion

The rights associated with these set of users are as follows.

Table 1
Bundles of Rights associated with Positions

	Owner	Proprietor	Claimant	Authorised User
Access and withdrawal	X	X	X	X
Management	X	X	X	
Exclusion	X	X		
Alienation	X			

Source: Schalager and Ostrom, 1992, p.252.

The universal problems associated with common pool resources are appropriation problems and provision problems (Ostrom, Gardner and Walker, 1994). The appropriation problem relates to the allocation of the yield of a resource, equitably and efficiently among different users, while provision problems relate to the optimal size of the stock of flow units as well as the productive nature of the resource. Appropriation externalities arise from excessive

harvesting of the flow units from a resource leading to increasing harvesting costs per unit of output. Excessive harvesting in one year may also reduce or destroy the availability of resource units in future years. Schalager, Blomquist and Tang (1994, p.296).

The provision problems relate to the maintenance problem involved in maintaining the stock of flow units which arise due to deficiencies involved in developing and maintaining the common pool resources. The lack of investment in maintaining either the physical facility or stock of the flow units could mean the deterioration of the productive capacity of the resource. Therefore, typically any common pool resource¹⁷ management situation would face the following problems, (a) severity of the appropriation and provision problems resource users face, (b) the relative use to which users can resolve these problems, and (c) the kinds of institutional arrangements they are likely to develop and implement.

We now proceed to discuss the latest model bill of the Government of India and various state government bills using the above framework as a lens

4. Review of the model groundwater bill (GOI, 2005) and state groundwater bills

The bill prepared by the Ministry of Water Resources in 2005, clearly reflects that the envisaged need for a shift of groundwater to the common property regime is not reflected and the usual *modus operandi* of the Indian state based on command-and-control mechanisms are reflected in the policy document (GOI, 2005). The command-and-control nature of the bill is clearly reflected in the following section of the model bill.

to direct any user of groundwater who does not comply with the provisions of this Act and rules framed there under to close-down the extraction of groundwater, disconnect its power supply and demolish any hydraulic work found to be illegal according to provisions of this Act and the rules framed there under

Section 12(h)

¹⁷ Possessing the characteristics of (a) difficulty in exclusion and (b) subtractable yield.

The provisions of the Code of Criminal Procedure, 1973 (2 of 1974) shall so far as may apply to any search or seizure under this section as they apply to any search or seizure made under the authority of a warrant issued under section 93 of the said code.

Section 12(3)

Further, the act specifies that nobody can claim any compensation from the government for the loss sustained due to the enforcement of the act (Section 14) and no prosecution could be instituted except by the written consent of the authority or a person authorized in this behalf by the authority (Section 18). The Model Bill of the Ministry of Water Resources (GOI, 2005) reflects the clear distinction in terms of the collective choice rules vested with a centralized authority at the Central level vis-à-vis the individual user, the farmer at the village level. In the design principles which we develop based on the principle of nested governance structure, we attempt to develop a more inclusive decision making process. In Table 2, we provide a description of the various bundles of rights associated with various positions of various state government bills using the framework of Ostrom and Schallager (1992, p.251).

Table 2 Bundles of Rights associated with Positions – Comparison of the 2005 Model Groundwater Bill and State Government Bills

Government of India/State	Owner	Proprietor	Claimant	Authorized user
Government of India Model Groundwater bill (2005)	Groundwater authority (GWA)	GWA has the mandate of management and exclusion, with the right to transform the resource by making improvements without the right to regulate internal use patterns	The user has access and withdrawal rights, while management is the mandate of the GWA and the user	Person or an institution/ company or establishment (Government or non-governmental)
Maharashtra Act no.xvii of 2005	Maharashtra Water Resources Regulatory Authority, River Basin Agency	Individual water entitlements (surface and groundwater) would be issued by River Basin agency to water users association, distributory level	The access and withdrawal rights would be with the 'users' The management rights, pertaining to internal use	Water user entity-individual, water users association, industrial users association, or any other group authorized by the authority to

Government of India/State	Owner	Proprietor	Claimant	Authorized user
		and canal or project level associations, Sub-surface water users association. The internal use patterns would be regulated by the concerned local associations.	patterns is with the local associations, while the overall entitlement is decided by the River basin agency	receive and utilize a water entitlement.
West Bengal Ground water Resources (Management, Control and Regulation) Act, 2005	Groundwater authority State or district level	Groundwater authority State or district level. District/corporation level authorities can permit well with extraction capacity upto 50 and 100 cubic meter per hour respectively. Otherwise permission from state level authority is required.	The user has access and withdrawal rights, while management is the mandate of the GWA at the state/district/corporation level	Individual, institution, organization or establishment, whether or not owned, maintained and managed by state or central govt; a company including govt. company; a industry- major, medium or minor
Goa Groundwater Regulation Act, 2002	Groundwater authority	Groundwater authority	The access and withdrawal rights would be with the users while management is the mandate of the GWA.	Person or persons or an institution including a company or an establishment, whether Government or not
Karnataka Groundwater (Regulation and control of Development and Management) Bill, 2006	Groundwater authority	Groundwater authority	The access and withdrawal rights would be with the users while management is the mandate of the GWA.	A person or an agency in the business of sinking of well for exploration of water resources or extraction of water
Kerala Ground water (Control and Regulation) Act, 2002	Groundwater authority	Groundwater authority	The access and withdrawal rights would be	Any person using ground water from a

Government of India/State	Owner	Proprietor	Claimant	Authorized user
			with the users while management is the mandate of the GWA.	pumping well for any purpose including domestic purpose
Tamil Nadu Groundwater (Development and Management) Act, 2003	Groundwater authority	Groundwater authority	The access and withdrawal rights would be with the users while management is the mandate of the GWA	A person or an institution including a company or an establishment, whether Government or otherwise, who uses groundwater for any purpose, other than domestic purpose either on a personal or community basis.
Andhra Pradesh Water, Land and Trees Act, 2002	Water, Land and Trees authority	Water, Land and Trees authority	Water, Land and Trees authority	Not specified
Himachal Pradesh Groundwater (Regulation and control of development and management) Act, 2005	Groundwater authority	Groundwater authority	Groundwater authority	A person or an institution including a company or an industry or an establishment, whether Government or not, who or which use ground water for any purpose excluding domestic use;

Review of the Andhra Pradesh Experience

In this paper we restrict the discussion to the Andhra Pradesh experience. We review the evidence pertaining both to the state initiative with respect to groundwater governance-implementation of the Andhra Pradesh Water, Land and Trees Act, 2002 and also examine various non-state initiatives that are ongoing in the state. These non-state initiatives, we believe, offer crucial insights on how to move ahead with respect to developing governance mechanisms for regulating the 'fugitive' resources¹⁸.

The Water, Land and Trees act is quite different from the usual command and control approach of other state government acts. The crucial nested feature of the act is that the process of registration of the wells has to take place at the *mandal* level, which is administrative unit, below the sub-district *taluk* level. Since the geographical purview of the regulatory authority is smaller, this would mean that there would be a greater possibility for the authority to play a more effective role. The prior permission for digging new wells has to be obtained from the revenue authorities at the *mandal* level. The authority can compel the groundwater user to enhance groundwater by recharge or rainwater harvesting and appropriate directions can also be issued to deal with competition and overcrowding of borewells. However it was found that, while the act was successful in registering most existing wells, the disincentive provided by the penalty fees for drilling of illegal wells did not check the growth in the number of new wells (Ramachandru, 2008). A crucial observation made is that

the community or the local gram panchayat had no recognized role in the water governance at local or regional level. *People were mainly revenue generators for the state by paying registration charges for borewells and drilling rigs, permission fees for new wells and penalties for violating the law* (ibid, p.10, *emphasis mine*)

Further, it is rightly argued that the act was not an 'enabling law' as it did not provide incentives for not going in for a new borewell or encourage farmers to save and use groundwater efficiently. Regarding the composition of the authority, it is noted that the

¹⁸ A qualifier in this regard is required. The inference that we have drawn is based on the review of the literature on these experiments and not based on any first-hand investigation. Such an investigation is required by independent researchers and an arena for empirical enquiry.

authority is headed by a cabinet minister (Minister of Panchayat Raj), which is unusual. In other states it is either a senior government official (Tamil Nadu) or a retired High Court Judge (Maharashtra). The Director of the State Groundwater authority is not even a member of the authority (Narayana and Scott, 2004). A significant omission in the authority is the participation of power sector officials whose presence is important, as groundwater extraction is exacerbated by the power supply policy. However with the Andhra Pradesh government having taken the populist route of announcing the free power supply to farmers, the efforts in terms of the governance mechanism to check groundwater exploitation through the Andhra Pradesh Water, Land and Trees Act is weakened.

Another serious problem is of illegal connections. According to a study by APTRANSCO (Transmission Corporation of Andhra Pradesh Limited) at the transformer level in 1997-98, around 30% of the connected connections were found to be illegal (Narayana, 2002). These farmers would not be interested in registering their wells and therefore expose their illegal connections. Although the authority had specified spacing norms, there was no database of existing wells in the state for such a norm to be ensured. An attempt was made in 2001, with the AP electricity regulatory commission (APERC) ordering the APTRANSCO to list all the wells in the state, this activity after some initial work being done was dropped. It is argued that, while the authority envisages a policing function for it, it was not equipped in terms of the database and infrastructure to achieve it. It is suggested:

Instead, if the authority were to liaise with local community institutions created for this purpose and the authority limits itself to managing these, through which it manages groundwater, the institutional mechanism could have been more effective than the efforts it needs to make in getting the wells registered. *By giving the community an immediate stake in groundwater management the checks and counter-balance within the rural socio-economic milieu can be managed to ensure that groundwater is regulated* (Narayana and Scott, 2004, p.15, *emphasis mine*).

The Indo-Dutch APWELL Project was implemented in seven drought prone districts of Andhra Pradesh from 1995 to 2003. The Andhra Pradesh State Irrigation Development Corporation (APSIDC) was the main implementing agency. The project was implemented in 370 villages in 7 districts, bringing irrigation facilities to about 35,000 acres of land belonging to about 14,500 small and marginal farmer families. They were formed into 3,450 Water User Groups (WUGs). It is observed that participatory groundwater management is a

viable concept if introduced in conjunction with groundwater development, agricultural production process and institutional development, and capacity building of farming communities. Well trained and strongly motivated staff of government and non-government agencies working closely with farmers was found to be a necessary condition for the successful implementation of participatory groundwater management. (Sen, 2009). Further in an attempt at replicating and up-scaling, a basin level initiative at the Upper Gundlakamma Basin was initiated in Prakasam District. The APFAMGs project (Andhra Pradesh Farmer Managed Groundwater Systems Project) grew out from the experience and learnings from the APWELs project. The FAO evaluation report on APFAMGs states the following:

óThe APFAMGS Project has been successful in meeting its challenges and expected results were largely achieved. Farmers understand the seasonal occurrence and distribution of groundwater in their habitations and in Hydrological Units as a whole and are able to estimate seasonal recharge, draft and balance. Farmers are capable of collecting and recording rainfall and associated groundwater data. They master the concept of groundwater as a common property resource and are willing to manage it for the collective benefit. This was achieved through strong focus and investment on capacity building and through the process of demystification of science, without compromising on the basic scientific principles of sustainable management. This had a strong empowering effect on participantsô (FAO, 2008, p.5).

The report makes certain strong statements which must be viewed with some caution and scepticism, but for our purpose, the study indicates certain positive trends that need to be taken note and results from an independent assessment is awaited¹⁹ Further it is observed that the project work on the supply side was successful in improving groundwater availability. Based on the above evidence, we would like to state the following hypothesis for testing by interested researchers who would venture into examining the efficacy of the groundwater governance regimes in the country. The hypothesis is: Effective governance mechanisms could be crafted *only if* demand side governance mechanisms (in terms of negative and positive incentives) are complemented with supply side measures of augmenting groundwater. Only when increased groundwater is available due to the incremental

¹⁹ The study has been commissioned by the World Bank and data has been apparently collected from 905 households (project and non-project areas). The study team consisted of Anthropologists and Economists. We eagerly await the findings from the study, which we believe would throw up crucial insights.

availability, would the individual actor- the farmer (well owning or non-well owning) be interested in curtailing his behaviour with respect to increased usage of water and competitive digging/deepening of wells.

Another interesting 'experiment' was the Social Regulation of Groundwater at Community Level project initiated in 2004 in 3 villages by the Centre for World Solidarity (CWS). The project aimed to promote local regulation and management of groundwater resources with equitable access to all families²⁰. An important realization early on in the project was that there was a need to change the mindset of the farmers from 'competition' to 'cooperation' and to increase the water literacy among farmers. The extent of competition had reached such levels that in Madirepally village in Anantpur district, three neighbouring farmers dug 13 borewells in an area of 0.5 acres over a period of four years in competition to tap the groundwater.

The steps taken for participatory hydrological monitoring of rainfall were the following: (a) participatory hydrological monitoring of rainfall and groundwater levels in selected borewells was done regularly and shared and discussed at village meetings to increase the understanding of the farmers on the behaviour of groundwater in relation to rainfall. A volunteer from the community measured the rainfall from a simple manual rain gauge station installed in the village and recorded the static water levels in 10 sample borewells using an electronic water level indicator and this data was displayed on the village notice board and updated periodically. The following social regulations were agreed by the community: (a) no new borewells to be drilled (b) equitable access to all the families through well sharing (c) increasing groundwater resources through conservation and recharge and (d) efficient use of irrigation water through demand side management.

Small groups of farmers were formed in the project villages which included a borewell owner and 2 to 3 neighbouring farmers who did not possess a well and the owners of these wells were motivated to share the water with others. They were told that if they did not share the water there would be the 'competitive' digging of wells and the water table would go down

²⁰ The project cost was around Rs.2.5 million per year, for a three year period.

stand and every body would stand to loose (ðloose-looseö situation), whereas if they cooperated, everybody stands to benefit (öwin-winö situation).

The review has revealed that the implementation of the AP Water and Trees Act has not been effective while there are some positive results emerging from the various non-state actor led initiatives in the state. The crucial challenge remains in replicating such intuitional design features into the main-stream state led initiatives and the schema that we develop in the next section is an attempt in this regard.

5. A way forward for evolving a nested groundwater governance regime

For evolving nested governance regimes, there is the need for a consensus on the assessment of the resource and how different stakeholders would utilize it (Paranjape, 2008). This would also require that a governance regime developed should utilize the indigenous knowledge of local water users and such a knowledge could be utilized to catalyse collective action processes for governing the groundwater resource (Krishnan, 2007). We incorporate these concerns, while developing our schema. The schema of a nested governance regime for the Indian context is specified in Table 3. This is preliminary in nature and needs to be debated and discussed and more crucially piloted in certain locations. Based on the learningö, there needs to be a continuous process of refinement of the governance regime. The indications in each of the boxes (+++ / ++ / +) indicates the relative importance of a particular institution vis-à-vis other institutions and therefore and higher number of them (+) indicates a greater and primary role for that institution vis-à-vis more secondary responsibilities/roles for other institutions.

The first and most crucial step to be embarked upon is to put in place data collection protocols on various parameters as discussed in an earlier section of the paper. Only a robust understanding would give us the knowledge to proceed further on issues related to defining the CPR boundary at the aquifer and local level. This would help us in arriving at more accurate estimates of the fuzzy concept of ösustainable extraction²¹ö The Groundwater department at the state level in collaboration with socio-economic and technical research

²¹ See Kumar (2007) on the discussion and debate on defining Sustainable Levels of Extraction in the Indian context.

institutions needs to put in place the data collection protocols²² and also crucially undertake robust analysis and inference of the data, which will provide crucial inputs on decision making on various issues. The other organisations to be involved are the regulatory authority at the taluk level, Electricity board and NGOs.

Defining the geographical boundary for a CPR regime for the aquifer and evolving a CPR regime for this would be the primary responsibility of the groundwater department and the support of research institutes with the involvement of other stakeholders at the district and taluk level. Defining, the local CPR regime would be the primary responsibility of the Regulatory authority at the Grama Panchayat level in collaboration with the Groundwater Coordination Committee (GWCC) at the micro watershed level. We suggest that GWCC should compose of the following members- Representatives from the area groups, micro watershed committee, Grama Panchayat members in the micro watershed jurisdiction and regulatory official/s from the Grama Panchayat. A crucial task before the CPR regime is crafted is the sensitisation and training of various stakeholders on the possibilities, constraints and challenges in putting in place a CPR regime. The Groundwater department and research institutions in collaboration with NGOs should take a lead in devising protocols for such continuous interactions and develop feedback and learning mechanism to improve the governance regime based on the concept of learning by doing and embracing error concept (Korten, 1980).

The definition of sustainable extraction levels is a challenging task as discussed earlier. This exercise should be undertaken based on a socially inclusive process of data sharing, reflection and decision making based on consensus. Since this is a highly contentious issue, there are bound to be contextual variations, across communities as to how sustainability is defined. There should be sufficient flexibility for such norms to be evolved. However, due attention needs to be paid to ensure that minimum physical notions of sustainability are ensured, as too much flexibility and autonomy to local communities might lead to diluted notions of sustainability.

The process of evolving rules/norms for groundwater access and extraction should be undertaken in a socially inclusive manner with the GWCC taking a lead in this regard with

²² The first step is aquifers have to be mapped at the right scale. Their actual condition has to be analysed using the required density of wells. For example, in hard rock areas, on an average, the density of monitoring wells should be one well for 25 hectares (Kulkarni and Shankar, 2009).

overall norms being laid down by the Aquifer group, groundwater department with the support of research institutions. The monitoring of the norms, should be an inclusive process with the authorised users (those pumping or buying groundwater) involved in peer monitoring to ensure compliance of the norms²³. The overall monitoring responsibility should be primarily with the GWCC and the secondary responsibility would be with the micro watershed group. The sanctioning power for violation of norms should be the responsibility of the area group, micro watershed group and the GWCC based on the principle of graduated sanctions. The first level of offences should be tackled by the immediate, higher level CBO and progressively moving towards higher CBOs/other organisations in the hierarchy, when there is non-compliance. There is a need to move away from the existing command and control regimes, wherein Criminal Procedure Codes could be potentially invoked upon for violations. We need to evolve community driven norms and sanctioning mechanisms.

There should be a continuous process of data collection from the wells/borewells and therefore flow meters should be installed in each well and data should be collected at periodic intervals (based on data collection protocol requirements that need to be developed). The installation of such meters should be the primary responsibility of the Electricity board at the local level with the assistance of the GWCC. Day-to-day resource management involves the participation of the authorised users in ensuring compliance of the norms and in peer monitoring with the primary mandate being with the GWCC. Water audits need to be conducted at periodic intervals at the aquifer level and at the local CPR level. There should be an extensive and inclusive process of data sharing, reflection and discussion, with corrective steps being taken by appropriate authorities. For the audit at the aquifer level, the primary responsibility should be with the Aquifer group. The water audit at the local CPR level should be the responsibility of the regulatory authority at the Gram panchayat level with

²³ There are interesting insights that emerge from the work of Aggarwal (2000) based on data from two villages of Mahbubnagar district of Andhra Pradesh. The study examines the possibilities and limitation of small groups in managing group owned wells. The management of existing group wells requires, explicit/implicit arrangements about (a) Allocation agreements that specify, the quantity and timing of water withdrawal by owners/Purchasers and (b) Provision agreements that specify the contribution (cash/kind) towards maintenance and expansion of productive capacity (Associated with this are the transaction costs of negotiation, monitoring and enforcement; see Ostrom, Schroeder and Wynne, 1993). The study points out that there are certain activities which are well managed by these groups, for example, every day allocation of water and routine maintenance, while for other activities, such as investing in a new well the probability of collective action is far lower. The maintained hypothesis, the author states that the higher the costs, lower is the probability of collective action.

support from the Electricity Board²⁴, NGO/s and GWCCs. The Aquifer Group needs to be constituted with representation of members from the GWCC, regulatory authorities at the taluk and district level, electricity board officials, representative of bore well drilling companies, Groundwater department, NGOs and researchers. The intra-group dispute resolution process should be a graduated process with area groups, microwatershed groups being involved in the initial stages, while the inter-group dispute resolution processes could take place at all levels in the hierarchy of institutions. In the CPR based governance regime, we believe that disputes should be settled within the suggested nested institutional set up and there should be no judicial involvement. If such a judicial involvement does take place, we believe that the strength of the governance regime would weaken in due course.

6. Conclusion and need for embarking on the learning curve

The main arguments of the paper are the following. There is a need for a shift from the command and control type of regulatory mechanisms as it exists in the model common bill (GOI, 2005) and most of the state government bills towards nested governance regimes. However the challenge remains: when we are not able to build robust and sustainable institutions even in the context of non-nested Community Based Organisations, particularly to address issues related to natural resource management, we now expect (under a nested governance regime) to build certain CBOs, which have a wider mandate to coordinate action across different scales. However, we believe that possibilities for learning exist, from the interesting experiments that are ongoing in Andhra Pradesh. The challenge however remains in upscaling from developing robust institutions at the local level, who could act in synergy with supra-local institutions. Many of these institutions, do not exist, in the first place; they need to be crafted and made robust for them to undertake the challenging task of developing synergy across institutions both higher and lower in the hierarchy. The schema that we develop, is a first-step in moving towards a nested governance regime.

²⁴ In this paper, we have not discussed the complexities involved in the power sector as a determinant of groundwater extraction in the country. A detailed discussion is beyond the scope of this paper. Discussion on these issues is available in Dubash (2007, 2008). However we would like to point out based on the evidence from Somanathan and Ravindranath (2006) that a rational power sector pricing policy would play a very important role in controlling the excessive groundwater exploitation in the country. The evidence from the above study suggests that pricing could act as a negative incentive to curb exploitation. However the evidence on this remains cannot be generalized and is an arena for further enquiry. Another useful contribution with evidence from Gujarat is the study by Shah and Verma (2008).

There should be no rigidity in the institutional structure and there should be flexibility to experiment, learn and innovate with the nested institutional set up adopting the principle of 'learning by doing' and 'embracing error' (Korten, 1980). We need to remember what David Hume said, 'When men are most sure and arrogant, they are commonly mistaken'. Only by getting our hands dirty in working with the institutional set up would we learn and evolve better and hopefully more robust institutional arrangements to manage the fugitive resource. Based on the discussion in this paper, Prakasham District in Andhra Pradesh could be a useful starting point for evolving the nested governance structure, building upon the efforts of APWELLS (Andhra Pradesh Groundwater Bore well Irrigation Schemes Project) in the district. A useful contrasting pilot could be undertaken in a semi-arid district in the state and we would suggest Anantpur as a pilot district as this district has seen the implementation of the Water, Households and Rural Livelihoods (WHIRL project) in Kalyandurga mandal and there are certain good NGOs in the district, who could play a crucial supportive role in helping the state develop such nested governance mechanisms²⁵.

Faysee (2005) based on the review of literature on the commons has identified certain areas for future research, some of which this paper attempts to fulfill, as a 'first-cut' attempt. The direction for future research identified include: (a) The need to base CPR analyses on models using a bounded rationality approach (b) models need to be built with a large number of players and (c) There is a need to quantify in a simple way the benefits of several rules for the different rules for different groups of users within a community as well as the transaction costs. We believe that we have made a start with respect to (a) and (b), while (c) remains an uninvestigated arena and the ongoing experiments with various approaches in Andhra Pradesh, provides an ideal field setting for such an enquiry to begin. There is enormous scope that exists to continue such enquiry on Common Pool Resources in India and probably in the South Asian context and more crucially 'learn' first-hand from empirical experiments and attempts. This needs to feed-back into the theory on the possibilities and limitations of evolving nested governance regimes.

The purpose of this paper would be served only if there is a *provocation* for a more enriched discourse not only among the academic, policy and practitioner community, but certain

²⁵ However, there are structural issues like the issue of free power supply provided to farmers which needs to be reexamined. Only when there is a right enabling policy environment, such governance mechanisms would be effective. See Somamathan and Ravindranath (2006) EPW for evidence on how the 'right' price for electricity facilitates the 'appropriate' levels of groundwater extraction.

concrete experiments in evolving nested governance mechanisms are actually grounded in a few pilot states in the country²⁶. An arena for further research is to fine-tune the governance regime based on the nature of the socio-economic environment in a particular based on the hydrological regime prevalent there²⁷.

²⁶ We also hope that further contribution in this arena emerges based on concrete hypothesis formulation of relevant theoretical and empirical questions. To start the process: A question that could be pursued is: How does define the boundary for crafting a CPR regime in the context of Hard-Rock areas?.

²⁷ The discussion in the chapter "Aquifer and Institutions" (p151-186) in Tushar Shah's latest book (2009) would be a useful starting point, for such an enquiry to begin. The contribution by Krishnan (2007) on the different stakeholders involved in the implementation and decision making on the location of wells in Gujarat is *compulsory reading* for researchers venturing into the arena of evolving nested governance mechanisms in the country.

Table 3 Role of different institutions for different functions in the groundwater extraction regulatory mechanism

<i>Function</i>	<i>Organisational Forms</i>														
	Groundwater pumping households ²⁸	Ground water Purchasing households	User group and Area Group	Micro water shed group	GWCC	Sub-committee of Gram Panchayat	Regulatory authority at Gram panchayat level	Federation of GWCC	Borewell drilling companies	Electricity board	Regulatory authority at Taluk level	NGO At taluk level	Aquifer Group	Ground-water dept	Research institutes
<i>Data collection and inference of various hydrological parameters</i>							+			+	+	+		+++	++
<i>Defining the geographical boundary for the aquifer and the CPR regime</i>							+			+	++	+		+++	++
<i>Defining the geographical boundary for the 'local' CPR regime</i>	++	+	++	++	++	++	+++	+	+	+	+				
<i>Sensitisation and training of stakeholders for functioning of a CPR regime</i>					+	+	+	+	+	+	+	++	+	+++	++

²⁸ The household which owns a well often may not be a unitary category. The well might have multiple owners within the family with brothers owning a stake in the well. In some cases, these co-owners have independent pump-sets from which they draw water from a single well. Quite a few disputes in India, arise out of the claims being made for the piece of land, where the well is located, when family lands gets partitioned. In quite a few cases, wells remain unused and land remains fallow due to such intra-family disputes. This insight based on the field work undertaken in Bidar district of Karnataka in South India. We point this out to demonstrate the complexities involved in the ownership and useage of the well in the Indian context, which throws up further challenges for developing governance regimes.

<i>Function</i>	<i>Organisational Forms</i>														
	Groundwater pumping households ²⁸	Ground water Purcha sing househ olds	User group and Area Group	Micro water shed group	GWCC	Sub- committee of Gram Panchayat	Regulato ry authority at Gram panchayat level	Federati on of GWCC	Borewell drilling compani es	Electric ity board	Regulator y authority at Taluk level	NGO At taluk level	Aquifer Group	Ground -water dept	Resear ch institut es
<i>Defining 'sustainable' extraction levels</i>	++	+	+	+	+		++			++	++	+	+	+++	++
<i>Evolving rule/norms for groundwater access and extraction</i>	+	+	++	++	+++	+	+					+	+	++	+
<i>Monitoring of compliance of norms</i>	+	+	+	++	+++	+	+								
<i>Graduated sanctions for violation of norms</i>			+	++	+++	+	+								
<i>Installation and data collection from flow meters</i>					++		+++	+	+	+++	+	+		++	+
<i>Day to day resource management</i>	+	+	+	+	++										
<i>Water Audit at Aquifer level</i>					++	+	+	+	+	+	++	++	+++	++	++
<i>Water audit at local CPR level</i>			+	+	++	+	+	+	+	+					
<i>Data sharing and discussion of water audit reports</i>	+	+	+	+	++	+	+	+	+	++	++	+	++	++	+
<i>Intra-Group</i>			+	+	+										

<i>Function</i>	<i>Organisational Forms</i>														
	Groundwater pumping households ²⁸	Ground water Purchasing households	User group and Area Group	Micro water shed group	GWCC	Sub-committee of Gram Panchayat	Regulatory authority at Gram panchayat level	Federation of GWCC	Borewell drilling companies	Electricity board	Regulatory authority at Taluk level	NGO At taluk level	Aquifer Group	Ground-water dept	Research institutes
<i>Dispute resolution</i>															
<i>Inter-Group dispute resolution</i>					+		+	+		+	+	+	+	+	

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