

A Comparative Study of Groundwater Institutions in the Western United States, France and Peninsular India for Sustainable and Equitable Resource Use

- Some lessons for India

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Issues in GW Management

- Of late, in most countries the groundwater depletion and quality impairment have become major issues
- These problems have been addressed by a combination of market and non-market institutional approaches
- Discussion themes:
 - Legal status of GW in India
 - Institutional Management in Western US
 - Key components responsible for the success of URNRD programs
 - French Model of Water Management
 - Policy lessons for Peninsular India

Legal status of groundwater in India:

- The legal status of Groundwater in India is unclear
- The Easement Act of 1882, recognized customary community rights in surface water based on long use and allowed private usufructuary rights in groundwater by viewing it as an easement, inseparably connected to land.
- Groundwater is attached like a chattel to the land, without any limits on extraction.
- Since water is a state subject, the groundwater laws are to be enacted by the states. Unfortunately, no state has enacted any groundwater legislation so far barring Gujarath.

- The 1976, National Commission on Agriculture suggested criteria to be used for specifying individual rights in groundwater on a physical and quantitative basis, but also in identifying the administrative frame work necessary for their enforcement (Similar to correlative rights system prevalent in Western US).
- In India, lack of effective groundwater institutions at local level to deal with emerging problems in groundwater development and use has resulted in intergenerational, inter-temporal and inter-spatial misallocation and severe overdraft.

Nature of Property Rights for Irrigation Structures in India.

Type of well	Rights Structure	State Rights
Wells (private)	Absolute ownership	No rights
Wells (public)	Customary rights of groups/communities	State has power to regulate
Bore-wells (private)	Absolute unlimited rights to extract water beneath his land	No right to own/regulate
Bore-wells (public)	Usufruct right granted	State has power to regulate

Source: Singh, 1993

- At present there are no institutional interventions pertaining to issue of permits, number of wells to be drilled and the volume of water extracted in general.
- The model bill (*groundwater control and regulation Bill, 1992*) was under severe criticism, as there is no representation from user groups in the management structure.
- The only regulatory mechanism for the state to check overexploitation is the restriction of finance through NABARD for well development in overexploited areas and enforcing spacing norms between the wells, besides limiting electricity connections.
- In case of privately financed wells there is absolutely no mechanism to control overexploitation

Changes in groundwater irrigation sector in Indian over last 4 decades:

- Increasing depth of wells, failure of all three types of wells namely dug, and dug-cum-bore-wells, bore-wells,
- Disappearance of traditional lifts,
- High density of wells per unit area without regard to spacing norms, increased irrigated area under commercial crops,
- Increased investments on well improvements and coping mechanisms,
- Increased extraction cost, reduced well yields,
- Reduced gross area under irrigation and shift to dryland agriculture in some cases.

Thus the lack of sustainability is evident

Institutional Management in Western US:

- Each state in the western US, has its own selection of groundwater laws and regulations.
- Under the beneficial use concept, individual own water use rights as long as use is accepted as "beneficial". Reasonable use concepts further limits rights to overlying users unless injury to other overlying owners can be avoided.
- In addition to this, "public trust" concept being used in western US as a non-legislative approach to initiating water management.

Institutional Policy instruments

According to water code, all water within the state is the property of the state, but right to use may be acquired by appropriation

These include formation of Natural Resource Districts with varying responsibilities over groundwater issues,

Creation of an enabling framework specifying user rights

Correlative rights to a reasonable use,

Issue of permits for extraction, allocating quotas and

Declaration of moratorium on new wells in the critical area

These regulations enables to set an upper boundary for extraction and made GW legally scarce

Groundwater Management approaches - A case of Upper Republican Natural Resource District in Nebraska

- Compared to other western states of US, Nebraska is heavily dependent on groundwater.
- About 90 % of the total water withdrawn annually is being used for irrigation.
- Over-drafting has been a serious problem in many parts of Nebraska besides quality degradation.
- Nebraska State legislature created a framework to manage the groundwater resource in 1972.
- This legal framework enabled to establish Natural Resource Districts (NRDs) which are unique to Nebraska with local leadership responsibilities for protecting groundwater from overuse and pollution.

Ground water irrigation Development

- The groundwater irrigation development in the study region has witnessed 3 distinct pattern of growth.
- From 1940s to 1960s well irrigation was accompanied by flood and sprinkler method of irrigation.
- In the 1970's there was a spurt in the number of wells with widespread use of centre pivots. This spurred unregulated withdrawal of groundwater in the district.
- Since 1980s there has been regulation of well irrigation through the local control of Natural Resource District.
- Currently there are 3200 registered irrigation wells in the district irrigating around 430,000 acres.

Management Structure

Three distinct stakeholders influence groundwater management decisions in the State of Nebraska.

Level 1: State in general - provides a legal and policy framework .

Level 2: The legislature has enacted local control groups in order to effectively manage the groundwater resources by establishing Natural Resource Districts and boards that govern the NRD's

Level 3: The primary level the users are involved in the management

- In order to conserve, protect, develop and manage the natural resources of the state of Nebraska, the legislation established 24 Natural Resource districts in the state based on the approximate hydrological boundaries of the recognised river basins.
- Based on democratic principles, there is some degree of local control over the management system.
- This joint management approach enables various stakeholders to participate in the planning and decision-making process in a democratic way and therefore would legitimate the actions of the board.

Institutional framework for GW management

- Prior to 1975, Nebraska GW law was governed by reasonable use doctrine
- By 1975, this common law framework was slightly amended. Further the state has prioritized the use of GW considering domestic is the highest preference followed by agriculture and industries
- Groundwater Management Act in 1975 gave wide range of powers and basic responsibilities to the local natural resource management districts:
 - to control the groundwater development in addition to soil and water conservation, rural water supply, flood and soil erosion control, recreation, wildlife habitat management and forestry and range management.

- The Natural Resource Districts (NRD's) play a key role in state groundwater policy formulation and implementation.
- Within a designated control area the GWMA provides the NRD's board discretionary options and powers to regulate groundwater development and use.

Management approaches to deal with groundwater management problems

- **Well licensing and permits:** to restrict free access i.e. wells with pumping capacity over 50 gpm in the district require a permit, a meter and an allocation.
- **Allocation procedure:** Each certified acre within an irrigated tract is granted an allocation of 14.5 acre- inch annually. For a 5 year period the total allocation would be 72 AI (basic allocation)
- **Irrigated acres and tracts:** Board approval and certification of irrigated acres to which allocations of groundwater can be applied and reporting of total irrigated acres.
- **Pooling of groundwater:** Board allows for pooling of groundwater allocation across tracts to enable irrigators to annually adjust amount of water applied on individual tracts subject to the condition that the overall allocation is not exceeded as stipulated in the pooling contract.

Water allocated and actual use pattern in URNRD

County	1988-92	1993-97
Allocated (ac. inches)/yr. Dundy:	14.5	14.5
Av. Actual use (ac. inches)	12.6 (13)	12.2 (16)
Perkins: Av. Actual use (ac. inches)	10.3 (29)	9 (38)
Chase: Av. actual use (ac. inches)	12.5 (14)	10.4 (28)

Note: The figures in the parentheses indicate percentage reduction from the allotted quota.

- The actual use between two periods has been less than the allocated water. Another interesting feature is that the average actual use has been reducing between 2 periods.
- This clearly indicates that irrigators are managing the water more efficiently through improved irrigation technology.
- In the study area the land values are directly related to the amount of water conserved out of the allocated quota. Thus, the conservation of groundwater has a profound effect on land values in the region.

Regulatory measures

- Spacing requirements: the board set minimum spacing requirement (600 ft)
- Flow meters to measure the volume of water extracted
- Declaring Critical Townships based on saturated thickness of the aquifer
- Prohibition of supplemental wells in the critical areas
- Moratorium on new wells

Market interventions

- Market interventions like electricity and water pricing are considered to be the strong economic levers that promote adoption of efficient irrigation technologies.
- Efficient technologies may not ensure the protection of the resource unless there is quantity regulation as farmers continue to expand irrigation as long as it is profitable.
- Unlike in India energy is not subsidized for irrigation pump-sets. Hence the energy cost is most important component influencing the amount of water to be applied.

- The case studies indicated that in the district the energy expenditure alone accounted for 17 % of the total cost per acre. The share of irrigation expenditure in the total cost is around 40 % per acre.
- Pricing of energy and quantity restriction on the use of groundwater strongly propelled to go for irrigation efficient technologies such as center pivots.
- Thus the management approaches followed have two fold impacts. The 1st notable positive effect is stabilization of water table over the years. And the 2nd impact is in terms of increasing irrigation cost to the user by way of huge investments on irrigation equipment.
- The regulatory institutional framework enabled to create groundwater legally scarce and thus accomplished the objective of sustainability.

Discernible impacts of groundwater regulations in URNRD

Year	Water extracted & applied(ac.ft)	Area irrigated (in acres)	Average use per acre	Yield per acre (bushels)	Water used per bushel of corn
1975-80	520,000	419,920	14.86	-	-
(Average)					
1988-92	436,000	442,000	11.8	151	0.08
(Average)					
1993-97	398,000	455,000	10.5	200	0.05
(Average)					
% change from:					
1980-92	-16.0	+5.2	-20.0		
1992-97	-9.0	+3.0	-11.0		
Overall change	-23.0	+8.3	-29.0		

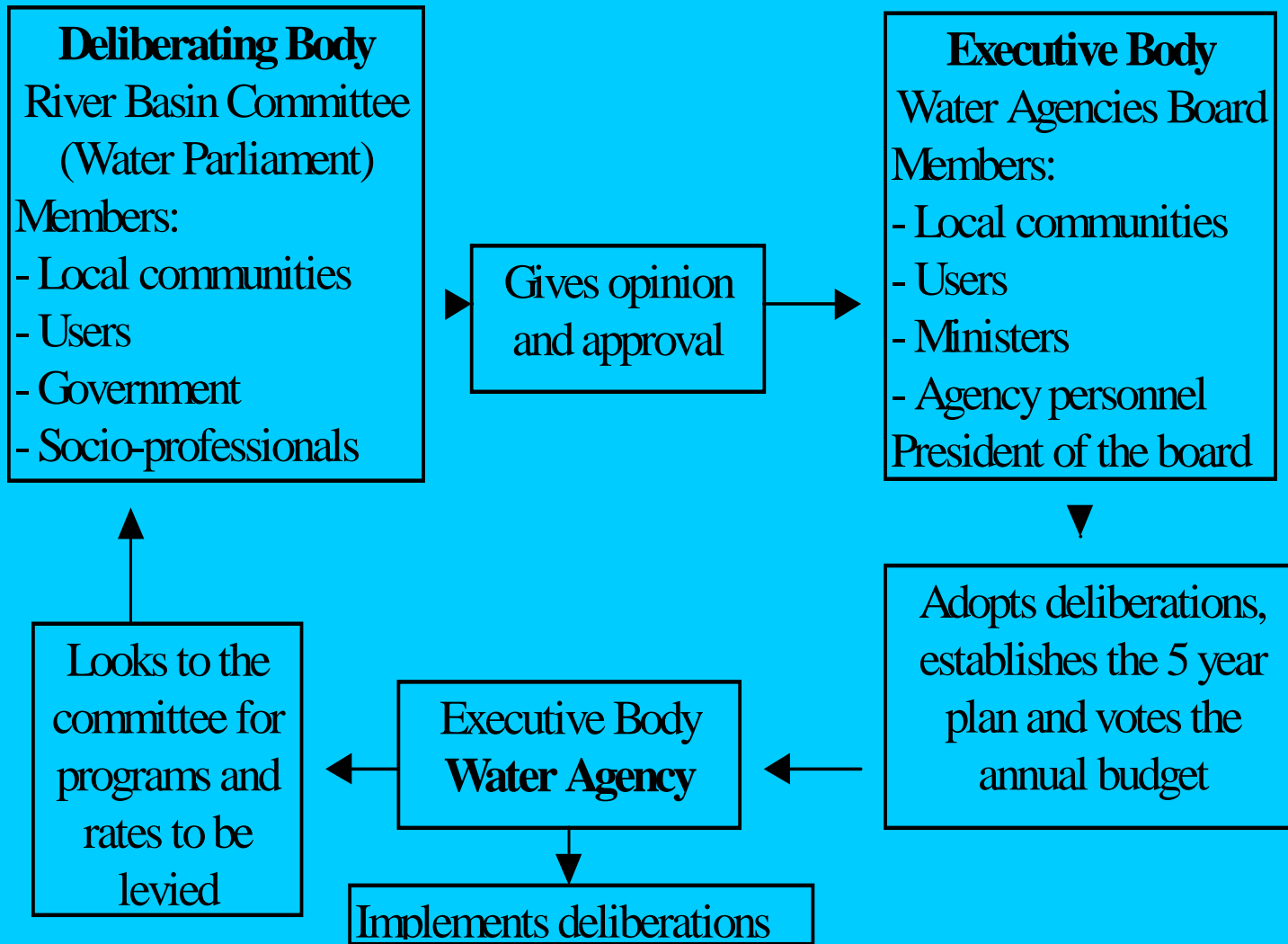
Key components responsible for the success of URNRD programs are outlined as below

- The legal and physical boundaries of the groundwater resource are generally delineated based on hydrological rather than on political lines. This has facilitated more ease for effective management
- Framework that is responsive to the local conditions and water management needs of the community formed a hallmark of URNRD.
- Thus the process of control and command has been replaced by collective and coalesced action locally. The rules evolved and crafted collectively by the board are transparent enabling for the development of the groundwater management system.
- The two important technological components enabled for better management are; shift in irrigation technologies from flood to center pivots and access and availability of technical information relating to water tables, extraction and recharge rate of groundwater.

French Model of Water Management

- According to water laws, water is considered to be a resource, as a milieu and as an environmental good to be shared among the different users including nature itself. The water management aims at protecting the overall resource, improving the reliability of supply and promoting water conservation.
- The French Water Law of 1964 created Water Agencies and Basin Committee's
- Basin committee is like a Water Parliament

Water Management in France



The growing problem of groundwater over-exploitation

- Ever since 1976, the critical problems pertaining to groundwater are the depletion of aquifers and the pollution of water with nitrates, due to intensive application of chemical fertilisers and herbicides.
- From the perspective of farmers, the quality aspects of water are completely diluted, but depletion problems are paramount.

Measures based on water table status over a period of time

In France, the three distinct actors concerning the management of water include:

- 1) The Water Agencies (which applies economic instruments as per the norms of Basin Committee);
- 2) The State in general (which acts as a regulatory authority through the Basin Committee), in terms of issuing permits, discharge of aqueous effluents and fixing quotas as and when situation warrant);
- 3) Local users at the micro level (user groups). The water users association active participation is equally essential to deal with the open access problems such as groundwater. Further, they should have an access to information concerning the dynamics of the resource in order to understand the gravity of the problem.

Background for Organising User Groups and Participatory Action to Manage Aquifers

Context	Crisis	Meeting	Method of management
Since 1976, there has been exponential growth in the development of groundwater irrigation	Water table has steeply decreased in drought years hence, high social pressure.	Between <ul style="list-style-type: none">- Administration (Prefet head of the Basin Committee)- Irrigators- Pisciculturists- Tourism representatives- Other professionals.	<ul style="list-style-type: none">- Definition of threshold level of water table- Putting restrictions for extraction on a daily fixed time- Fixing quotas of 80 mm of water per hectare, irrespective of the crop during drought

Policy lessons for Peninsular India

- The Nebraska's case provides a classic example of local control over the resource to deal with overdraft issues as well as efficient allocation and use, tuned to the local needs and context of the people.
- To replicate to the peninsular India, institutional reforms mainly in the sphere of legal issues and the formation of user groups are required.
- Further, physical and hydrological boundaries of the resource have to be delineated on a basin or aquifer level.
- The Natural Resource District model, a joint management approach with active people participation could be a promising solution to the Indian context. This could be developed at the regional or a cluster of village's level based on aquifer or watershed, where there is acute overdraft problem.

- The district initiated programs and controls for recharge and discharge and other regulatory measures such as spacing norms, control of new wells and regulation of water intensive crops - monitored through elected board directors.
- The NABARD can explore the possibility of funding seed money for establishment of such NRD institutions initially.
- Designation of critically overexploited fragile areas as done in the case of Nebraska is very important for regulating further overexploitation. In these areas there is a need for regulation of bore-well drilling in terms of declaring a moratorium till the water tables are improved.
- The districts can also regulate the new wells, spacing of wells and well drilling agencies by issuing permits. For all unauthorized wells without permit system power supply can be stopped penalties imposed.

- The real cost of extraction of groundwater has been increasing over time having serious equity implications for small farmers hence the special programs to improve equity needs to be designed to support small farmers.
- Supply of electricity may be made available on a preferential basis to these farmers who venture in-group investments.
- The approaches such as the participation of user groups in the decision making process, the creation of Basin Committees, the imposition of regulatory measures such as issuing of the permits and submission of feasibility reports to drill the wells, the dissemination of vital technical information pertaining to resource use and status, have yielded some degree of success in French context, suggesting to replication of some of these approaches to Indian context.

Thank you !