The PDF version of this Consolidated Reply can be downloaded at http://www.solutionexchange-un.net.in/environment/cr/cr-se-wes-food-12030801.pdf (Size: 400 KB).
Mr K A S Mani's conclusions and way forward for the Action Group are available at http://www.solutionexchange-un.net.in/environment/resource/gw_conclusions.pdf (Size: 46 KB).

Environment

Water Community

Food and Nutrition Security Community

Solution Exchange for the Water Community
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E-Discussion Summary

Paradigm Shift in Groundwater Governance

Compiled by Nitya Jacob and Gopi Ghosh, Resource Persons and Ramya Gopalan and T N Anuradha, Research Associates

Issue Date: 9 August, 2008

From K. A. S. Mani, Andhra Pradesh Farmers Managed Groundwater Project (APFAMGS), Hyderabad

Posted 12 March 2008

I work with the Andhra Pradesh Farmer Managed Groundwater Systems (APFAMGS) Project that operates on the key premise that behavioral change is necessary for voluntary self regulation. APFAMGS is a partnership with farmers for implementing Demand Side Groundwater Management. In seven drought prone districts of Andhra Pradesh, India, thousands of farmers in 638 habitations have taken the lead to reduce exploitation of groundwater. During the Visioning Workshop of the Water Community, March 2007 (Word Size: 240 KB), we discussed the need for a paradigm shift in groundwater governance based on community participation. This will ensure sustainability of groundwater as well food and livelihood security of rural communities. It was suggested that we collate information on examples of where this has happened to evolve a working model that could be taken up by interested parties in other areas of the country.

Groundwater in India is the lifeline for Indian agriculture and for meeting the rural drinking water needs. Over the years surface water based sources have become unreliable due to preferential transfer of surface water to urban cities. Likewise surface irrigation sources are fast declining and currently more than 65% of farmers have come to depend on the unseen subsurface water for all their drinking water, irrigation and cottage industry water needs. Thus, groundwater has emerged as the principle drinking water and irrigation source, which has reached to untouched

and environmentally difficult terrains. Expansion of groundwater development will continue to play a lead role in meeting drinking water supply, health sanitation and food security needs. Evidence indicates that access to protected drinking water and irrigation needs generate many positive externalities in the overall household micro-economy. The reliability and sustainability of groundwater sources is emerging as a critical parameter in socio economic and irrigation development. Overdependence on groundwater is a grave risk, as its continued availability in required quantity and quality is closely linked to the management of the rainfall received, quantity of water harvested, recharged, quantity of fertilizer, pesticide uses and more critically the handling of the industrial and domestic waste water against polluting the aquifers.

Groundwater management is still considered the purview of the government, while all investments towards groundwater development have been privately funded. Governance continues to be driven by regulations rather than rational understanding of the ground realities. Groundwater acts passed by the different states have not taken off due to difficulties in field level implementation. This stalemate needs to be broken and viable alternatives need to be explored. Continued delay will directly affect rural drinking water, sanitation, health, and food production. With the issues of climate change knocking on our doorstep one cannot but paint a grim picture of the future of groundwater availability.

Number of alternative approaches on water governance need to be explored by international funding agencies and United Nations partners involved with rural drinking water, sanitation, health, food and nutrition. The Food and Agriculture Organization of the United Nations (FAO)-funded APFAMGS Project is an enabling intervention for reinforcing the internal strength and coping mechanism of groundwater dependent communities through new knowledge and skills to collect data on groundwater, rainfall and water use for different crops to explore and find out stable solution to the issues of managing ground water depletion through self-regulation. The project integrates scientific technology with social transformation, women's economic empowerment and institutional change. Over four years of involvement with the community has led to reduced groundwater pumping (without coercion) for agricultural use (principle water use) to impact the total groundwater draft in 19 of the 31 Hydrological Units spread over 7 districts in Andhra Pradesh. A 50% reduction in area under paddy from 10,915 acres to less than 5,000 acres has been witnessed. Adopted crop diversification and improved economic returns per unit of water pumped. Overall improvement in drinking water availability, reduced groundwater pollution, improved food and nutrition status and set into motion new groundwater governance that is acceptable while taking care of individual needs.

To this end, through this e-discussion we will attempt to identify the various options for ensuring groundwater sustainability and governance with community participation that can be built into drinking water, health, sanitation, food and nutrition programmes. Specifically, members may like to discuss the following:

- What models are members aware of for community-managed groundwater resources? Are there case studies available that describe the approach, results and lessons learned?
- What are your own experiences with these models? For example, can you describe problems they faced and how were they overcome? What suggestions would you give to someone interested in starting up a similar initiative?
- Do you know of cases where groundwater laws have been adopted and adapted by communitis? Why did the community pick a particular law? What aspects were modified and used, and why? What were experiences with the process of adoption/adaptation?

Members are invited to study the APFAMGS field areas while exploring other alternatives. Refer: http://www.apfamgs.org/

Using the discussion points raised, the model evolved from this action group will be shared with the Community members.

Responses were received, with thanks, from

1. **Sarbeshwar Sahoo, Kalpataru, Angul, Orissa**
2. **K V Peter, Kerala Agriculture University, Thrissur, Kerala**
3. **Abhishek Mendiratta, Consultant, New Delhi**
4. **Surekha Sule, Independent Journalist/Researcher, Pune**
5. **Devanshu Chakravarti, Intercooperation, Hyderabad**
6. **Mrinalinee Varanase, Ecological Society, Pune**
7. **A Gurunathan, DHAN Foundation, Madurai**
8. **Shashidharan Enarth, Development Support Centre (DSC), Ahmedabad**
9. **Judith D'Souza, Auroville Water Harvest, Auroville**
10. **Sacchidananda Mukherjee, Madras School of Economics, Chennai**
11. **K.J.Joy, Society for Promoting Participative Eco-system Management (SOPPECOM), Pune**
12. **M C Mahant, Assam**
13. **Chan Mahanta, Assam**
14. **Shital Lodhia, Centre for Development Alternatives, Ahmedabad**
15. **V. Kurian Baby, Tsunami Rehabilitation Programme, Kerala**
16. **Jasveen Jairath, CapnetSA, Hyderabad**
17. **N. Lakshmi Narayana, Dakshinkya Institutes, Guntur, Andhra Pradesh**
18. **N.K. Agarwal and Mandira Agarwal Geological Survey of India (GSI), Dehradun – (Response 1, Response 2)**
19. **K.G.Mathaikutty, Lutheran World Service – India, Kolkata**
20. **Shrikant D Limaye, UNESCO-IUGS-IGCP Project "GROWNET" and Ground Water Institute, Pune**
21. **Bharat R Sharma, Groundwater Governance in Asia, International Water Management Institute (IWMI), New Delhi**
22. **S. Vishwanath, Arghyam and Rainwater Club, Bangalore**
23. **Ombeer Singh Tyagi, International Development Enterprises India, New Delhi**
24. **R.Jagadiswara Rao, Retired Professor of Geology, Sri Venkateswara University, Tirupati, Andhra Pradesh**
25. **Ashok Jaitly, The Energy & Resources Institute (TERI), New Delhi**
26. **Jürgen Tümmler, Regional Support Office South Asia, Humanitarian Aid Department – ECHO, European Commission, New Delhi**
27. **Himanshu Thakkar, South Asia Network on Dams, Rivers & People, New Delhi**

Further contributions are welcome!

Summary of Responses

The discussion on a paradigm shift in groundwater governance raised issues concerning the existing community-managed models, members' experiences with these models and suggestions for scaling up, and instances where communities have adopted or evolved groundwater laws or regulation. Participants contributed several models and experiences, while noting the existing legal framework at the national and state level remained largely under-utilized.

Several communities in different parts of India have evolved their own specific models for groundwater management. Hiware Bazar in Ahmednagar district, **Maharashtra**, the sarpanch created a trust with villagers as members, headed by a committee from the village. They tried experiments for groundwater recharge with dramatic results, and the village rose to prosperity more than a decade ago.

This model is similar to the one adopted by Anna Hazare in **Ralegaon Sidhi**, in the same district. Villagers decided not to construct individual wells downstream from check dams and members were issued "ration cards" that assured them of a certain quantity of water. They also decided not to cultivate water-intensive crops including sugarcane.

Elsewhere in the country, members noted that Tarun Bharat Sangh (Alwar district, Rajasthan), Jal Bhagirathi Foundation (Rajasthan), and Ozar Water Users' Associations (WUAs) in **Nashik District** (Maharashtra) have also evolved local models of community-driven groundwater and surface water management, that are well-documented. This is an example of WUAs taking charge of the source of water, in addition to being responsible for its distribution.

In a village near Nashik, 200 farmers sorted out their water problem themselves. They collected rainwater in their field and pumped this into a government-built percolation tank. When they required irrigation water, they simply pumped the water from the tank into their fields, especially for winter crops such as grapes. They formed a cooperative to sell grapes, recovering the cost of their equipment.

In **Auroville**, **Tamil Nadu**, an organization protects groundwater through community participation and creating assets such as irrigation tanks, ponds and other artificial recharge structures. The model looks at institution-building, training and changing farming methods. Groundwater is monitored scientifically for quality and quantity to provide a tool for watershed management. This model demonstrated the efficacy of the system, and has reduced the ingress of sea water into the aquifers.

In **Gujarat**, members highlighted several models to arrest groundwater depletion and deterioration. NGOs have carried out efforts to restore the ecological health of aquifers in the coastal Mangrol Taluka of Junagadh. Some of these models can be scaled up.

The Lutheran World Service implemented a model in Purulia, **West Bengal**, and Mayurbhanj, **Orissa**, to provide groundwater for irrigation and human consumption by drilling 1,000 borewells. This was implemented along with health, agriculture, social forestry and groundwater recharge; the project succeeded in meeting the human and agrarian needs for water while maintaining groundwater levels.

In **Punjab**, the International Water Management Institute (IWMI) studied the hydrological setting in selected several districts. In Hoshiarpur, it found two distinct patterns of groundwater access through shared wells and groundwater markets. In Kurukshetra, the canal irrigation system is undependable and inequitable and groundwater plays an important role in irrigation.

The Institute found in **Bihar**, despite the abundance of groundwater, only a third of the resource has been tapped because of small landholdings, high cost of power and equipment, and the small investment capacity of farmers. There is rising inequity in water availability and access owing to the rising demand for irrigation.

An example from **Uttar Pradesh** illustrates how to maximise benefits from government investments in irrigation. Surface water can be used for groundwater recharge rather than

making it available for irrigation as has been done in the Madhya Ganga Canal Project. IWMI found the new strategy has enabled farmers grow two crops.

Sharing experiences from these diverse models, members emphasized the need to conserve groundwater, and expand rainwater harvesting to recharge aquifers in all regions, especially where there is excessive groundwater extraction. Even in areas irrigated by canals, groundwater resources are over-exploited as canal water is supplied irregularly and often does not reach the tail-end of the command system. The farming community is the largest user of groundwater and has to become more efficient by adopting new methods such as the system of rice intensification.

In Maharashtra, the Irrigation Commission estimated that nearly 40% of the groundwater irrigation is in command areas. This underlines the need to distinguish between irrigated areas and those solely dependent on rainfall. In irrigated areas, the number of wells in the command area goes up, according to anecdotal information.

Groundwater sources are often polluted, form both point sources and non-point sources, and seldom monitored for quality. Members noted farmers will not incur a private cost to ensure public benefit, blurring the distinction between polluter and victim. Farmers in Mehsana, Gujarat, are aware of the consequences of over-extraction of groundwater, but will not stop doing so in the absence of a workable, predictable institutional framework, policies and laws that support collective action. This shows that mere awareness of the problem and its consequences is not enough to stop the practice.

Farmers may adopt environmentally friendly farming techniques if they clearly perceive the link between groundwater pollution caused by pesticides and fertilizers, and the impact on their health. Farmers have not been interested in groundwater conservation through changing cropping patterns or tank rehabilitation. The first is because of the immediate economic returns from water-intensive crops, that are water-intensive, such as sugarcane and better varieties of paddy. The second is because they have invested in personal borewells. Even where water availability increases, such as through canal irrigation, the extra water is wasted on cash crops.

Regulating pumping through organized social capital in the form of WUAs has limitations. Here, Information Education Communication (IEC) tools can create awareness of the ill-effects of over-exploiting groundwater as Dhan Foundation's experience shows.

Groundwater is a common property resource, members noted, and therefore, is perceived as government property. However, the panchayat has a role in groundwater management as was demonstrated in Plachimada, **Kerala**, where a multinational corporation exploited the groundwater resources to the detriment of the villagers.

Community management of groundwater is essential for policy implementation, said members. However, existing laws are ineffective since they do not recognize this basic premise. Successful models of community-based groundwater management have incorporated elements of these laws such as cropping patterns, recharge and equity of access.

The role of laws and regulations is limited since India's water sector is largely informal. In **Tamil Nadu,** the government enacted the TN Groundwater (Development and Management) Act, 2003, but it has not been implemented due to the high cost of compliance. Similarly, the licensing system introduced a decade ago by the Central Ground Water Board has not been enforced. The policy framework for harnessing surface water for irrigation also needs modification.

The legal situation is confounded by different laws that treat groundwater differently. The Indian Easement Act 1882, links groundwater with land ownership. However, the Supreme Court has ruled that "groundwater is a national wealth and belongs to the entire society…. These resources cannot be converted into private ownership." However, most investments for groundwater extraction are privately owned, and water trading is increasing.

State laws for governing the use of groundwater prescribe a command and control model for granting permissions. This has only increased red-tape and corruption, while groundwater depletion continues as before. These principles run counter to the decentralized, community-based management systems being promoted by the new the paradigm, to be managed by PRIs. As a result, these laws remain on paper. Even CGWA has been weak, owing to the impracticality of a central outfit trying to control a huge and diverse resource with a weak data base.

Another factor that has undone the legal framework is the subsidy on power and diesel. Both act as incentives for further extraction of groundwater while irrational price support policies encourage farmers to grow water-intensive crops. Institutional arrangements at the state and local levels often work at cross purposes and are exploited by the rich and powerful. While Panchayats are supposed to regulate minor irrigation, water management and watershed development, they have been not been resourced or trained to do so effectively. WUAs often conflict with Panchayats as they are created by competing line departments.

Suggesting ways to start a community-managed groundwater scheme, members said a strong advocacy campaign, backed by grassroots involvement, is the first step. The community has to feel an integral part of the water resources system, going beyond the village and aquifer. There have to be credible norms for transparency, accountability, participation in planning, decision-making, implementation and management of water resources. A community-based regulatory approach is important to change the behaviour of farmer.

The best practices should be integrated with PRIs and supported by harmonization of funds at the block level. Participatory audits of groundwater extraction with environmental monitoring by PRI-centric community action is essential. Technology, wherever used, such as underground checkdams, should be modified to suit local conditions and acceptable to the community.

Members underlined the fact evolution of a groundwater model is a slow process and requires constant inputs of awareness and capacity building. The challenge is to ensure the measures stay on course, given the long lead time for benefits to accrue. The models from Maharashtra and elsewhere have succeeded because of strong and committee sarpanches and a sincere watershed and groundwater management committee with women members.

In conclusion, members suggested for a model to work, it must suitably adapt existing laws and work in tandem with local government institutions that have been suitably resourced and trained. Communities have to take ownership of the model's lifecycle and need specific training on groundwater recharge, quality monitoring and cropping patterns.

Comparative Experiences

National

Kerala

Exploitation of Groundwater, Plachimada *(from K V Peter, Kerala Agriculture University, Thrissur, Kerala)*
In Plachimada, Palakkad district of Kerala, the Coca Cola company tried to exploit groundwater to the detriment of the local community. This sparked an agitation that led to closure of its factory. Read more.

Maharashtra

New Role Model in Community Management of Natural Resources, Hiware Bazar, Ahmednagar district *(from Abhishek Mendiratta, Consultant, New Delhi)*

The Sarpanch, Popat Pawar, created an NGO in the village with all villagers as members, which undertook plantation on forest, grazing and private land with community participation. Cattle grazing was prohibited in the 70 acres of hilly area and gradually water levels rose. The village economy boomed and in 2007, it sold onions worth nearly Rs 1.5 crore, while several dairy farmers make over Rs 4000 a day. Read more.

Recirculating Rainwater, Nashik *(from Surekha Sule, Independent Researcher, Pune)*
A group of 200 farmers got together and with pump sets, channeled stagnant rainwater into a government percolation tank. When they need water for irrigation, they drew from this tank. In two years, they recovered the cost of the pump sets and pipelines.

Nirmal Ganga Abhiyan, Pune *(from Mrinalinee Varanase, Ecological Society, Pune)*
The Nirmal Ganga Abhiyan helped to demonstrate how village people respond to using local vegetation to assist in water percolation for recharging aquifers. They appreciate the importance of long-term treatment measures. In a few places, hard and soft engineering options have to be used in tandem and percolation tanks become excellent wetlands. Read more.

Group Wells and Checkdams, Ralegaon Sidhi *(from K J Joy, SOPPECOM, Pune)*
Here too Anna Hazare and villagers opted for a very simple norm of not constructing individual wells below check dams. Instead they constructed group wells near the check dams and the members were given assured water using a system of something like a ration card. This did not give rise to "pumping raise" which we normally see with watershed development. They also decided not to take water intensive crops like sugarcane. Read more.

Tamil Nadu

IEC Campaigns Change Behaviour, Madurai *(from A Gurunathan, DHAN Foundation)*
The organization created awareness of the ill-effects of over-using groundwater among farmers through folk media and video films. This helped trigger the process of change. What was clear is the fact that IEC campaigns need to be long-term, and not one-shot operations. Read more

Gujarat

Workable Institutional Framework Needed, Mehsana *(from Shashidharan Enarth, Development Support Centre, Ahmedabad)*
Low awareness of the effects of over-exploitation of groundwater is not always the reason why farmers pump out excessive amounts. In Mehsana, farmers misuse this resource in the absence of a workable institutional framework, policies and laws that support collective action. Water Users Associations have also had mixed results in Gujarat.

Restoring Ecological Health of Aquifers, Mangrol taluka *(from Shital Lodhia, Centre for Development Alternatives, Ahmedabad)*
In Mangrol taluka of Junagadh district, NGOs have successfully restored the ecological health of aquifers. One of the challenges relates to technological interventions that have to be acceptable at the community level. The second & the most important issue is a community based regulatory approach to change the behaviour and attitude of farmers. In Mangrol taluka, farmers were asked to change the cropping pattern gradually so as maintain their income levels. Read more.

Pondicherry

Integrated Approach, Auroville *(from Judith D'Souza, Auroville Water Harvest)*
The organization has worked to protect groundwater through community participation and creating community assets such as ponds, tanks and other artificial recharge structures. It has

focused on institution building among water users, rehabilitation and training in proper irrigation. It was noticed that farmer over-irrigate their fields. Organic farming has also helped to reduce the amount of water required. Read more.

West Bengal and Orissa

Integrated Water Drilling Project, *(from K G Mathaikutty, Lutheran World Service – India, Kolkata)*
In the late 1970s, the Lutheran World Service India initiated a water drilling project in Purulia district in West Bengal & Mayurbhanj district in Orissa that were facing a drought. It drilled around 1000 bore wells. Other components included social forestry and groundwater recharging schemes. Groundwater levels were maintained at a safe level with recharging measures. Over 7-8 years, the project ensured no major drought occurs in the area. Read more.

Uttar Pradesh

Madhya Ganga Canal Project, *(from R Jagadiswara Rao, Sri Venkateswara University, Tirupati, Andhra Pradesh)*
The best way to maximise benefits from large governmental expenditure towards various irrigation projects is to reorient them wherever feasible to harness surface water for groundwater recharge rather than making it available for irrigation by gravity flow. This strategy was adopted in the Madhya Ganga Canal Project (MGCP) between the upper and lower Ganga canal commands in Uttar Pradesh. Read more.

From Bharat R Sharma, International Water Management Institute, New Delhi

Multiple States

Groundwater Governance in Asia
IWMI is implementing a large capacity building and cross-cutting research project on "Groundwater Governance in Asia" in the Indo-Gangetic Basin. Surface irrigation systems have lost their historical importance to groundwater irrigation that is decentralized and more equitable. However, the development of groundwater markets, agricultural production and social benefits has been uneven and depends on the hydrology and socio-ecology of the region. Read more.

Legal Regime, *(from Ashok Jaitly, The Energy and Resource Institute, New Delhi)*
The Indian Easement Act 1882, links groundwater with land ownership. However, the Supreme Court has held groundwater is a national wealth. However, if the state is to regulate groundwater extraction, can it determine what is excessive. Several states have passed, or are planning to pass, groundwater acts. But these will again be ineffective because of supply of free or heavily subsidized energy to farmers.

Irrigation Benefits, *(from Himanshu Thakkar, SANDRP, New Delhi)*
Between 1991-92 and 2003-4, India spent some Rs. 99,610 crore on irrigation projects but the area irrigated by them dropped by about 3.14 m ha., while groundwater irrigation has increased to 37 m ha. The water-electricity nexus in groundwater, pollution, non-performance, corruption and collusion are well known. Communities can control groundwater along with institutions at various levels. Read more.

International

Participatory Groundwater Monitoring, *(from Nitya Jacob, Resource Person)*

This can help to overcome lack of understanding of limitations to local groundwater resources and come to common local agenda on groundwater management. This powerpoint presentation, that can be downloaded, explains the different steps of Participatory Hydrological Monitoring (PHM). This indicates that users themselves keep track of changes in the hydrological cycle. Read more.

Related Resources

Recommended Documentation

There has been no addition to canal irrigated areas for 12 years (*Himanshu Thakkar, South Asia Network on Dams, Rivers & People, New Delhi)*

Paper; by Mr. Himanshu Thakkar; SANDRP; New Delhi
Available at
http://www.sandrp.in/irrigation/100000_crores_spent_no_irrigation_benefits_SANDRP_PR_Oct2007.pdf (PDF 120 KB)

> *The paper examines irrigation data over 12 years from government sources in different states and gives and insight on the current status of irrigation in India.*

From Sacchidananda Mukherjee, Madras School of Economics, Chennai

Management of Groundwater Resources through Community Participation Approach in the Coastal Saline Region of Gujarat
Paper; by Dr. Shital Lodhia; Centre for Development Alternatives;Ahmedabad; 2006
Available at
http://cfda.ac.in/download/Management%20of%20Groundwater%20Resources%20through%20Community.pdf (PDF 1 MB)

> *The paper suggests community-based regulatory approaches are most effective in checking excessive withdrawal of groundwater.*

Women's Collective Action and Sustainable Water Management: Case of SEWA's Water Campaign in Gujarat, India
Paper; by Ms. Smita Mishra Panda; CGIAR Systemwide Program on Collective Action and Property Rights; Washington DC, USA; 2006
Available at http://www.capri.cgiar.org/wp/capriwp61.asp

> *This paper discusses the case of Self Employed Women's Association's (SEWA) Women, Water and Work Campaign which began in 1995 in the semi-arid regions of Gujarat.*

The New Institutional Economics of India's Water Policy
Paper; by Dr. Tushar Shah; Presented at the international workshop on African Water Laws; Plural Legislative Frameworks for Rural Water Management in Africa; Johannesburg, South Africa; January 2005.
Available at http://www.nri.org/projects/waterlaw/AWLworkshop/papers.htm (PDF 11 MB)

> *The paper examines India's water policy and the economic viability of institutions handling water supply and distribution.*

Factors Influencing Farmers' Willingness To Protect Groundwater from Non-Point Sources of Pollution: A Case Study in the Lower Bhavani River Basin, Tamilnadu
Paper; by Mr. S Mukherjee; IWMI; ICRISAT; Patancheru, Andhra Pradesh; April 2008.
Available at C/o ICRISAT, Patancheru, AP 502 324, Andhra Pradesh, India. Telephone: 91-4030713071 Fax: 91- 40 30713074-5; iwmi-southasia@cgiar.org

What motivates farmers to protect their groundwater from pollution caused by agriculture and similar sources.

Large Reservoirs: Are They the Last Oasis for Survival of Cities in India?
Paper; by Mr. S. Mukherjee; IWMI; Patancheru; April 2008.
Available at C/o ICRISAT, Patancheru, AP 502 324, Andhra Pradesh, India. Tel: 91-40-30713071 Fax: 91-40-30713074-5; iwmi-southasia@cgiar.org

What role do large reservoirs play in the water supply systems in large cities, and how effective are they in groundwater recharge.

Groundwater Pollution and Emerging Environmental Challenges of Industrial Effluent Irrigation in Mettupalayam Taluk, Tamilnadu
Paper; by Mr. S Mukherjee and Prakash Neliyat; IWMI; Colombo.
Available at Available from the International Water Management Institute, 127, Sunil Mawatha, Pelawatte, Battaramulla, Sri Lanka.P. O. Box 2075, Colombo, Sri Lanka. Tel: 94-11-2880000, 2784080. Fax: 94-11 2786854; p.mccornick@cgiar.org

Case study of Mettupalayam taluk where industrial effluents adversely affected groundwater quality.

Mobilising social energy against environmental challenge: understanding the groundwater recharge movement in western India
Paper; by Dr. Tushar Shah; IWMI; Natural Resources Forum Volume 24, pp 197-209;2000.
Available at C/o ICRISAT, Patancheru, AP 502 324, Andhra Pradesh, India. Tel: 91- 40-30713071 Fax: 91-40-30713074-5; iwmi-southasia@cgiar.org

An outline of movements that have used a variety of methods to conserve and recharge aquifers in western India.

Farmer Managed Irrigation Systems: Indian Experiences
Book; by Mr. K R Datye; Centre for Applied Systems Analysis in Development; India; 1987
Available at www.amazon.com (Priced Publication)

Studies in this book would help in understanding the problems in farmer participation in a variety of socio-economic and physical settings.

The Agricultural Groundwater Revolution: Comprehensive Assessment of Water Management in Agriculture
Book; edited by Mark Giordano and Karen G. Villholth; International Water Management Institute; Sri Lanka.
Available at http://www.waterandfood.org/gga/

The book traces the recent history of groundwater use in agriculture and the interdependence of the two

Hiware Bazar: A 'Model' Watershed experiment
Book; by Mr. K J Joy; SOPPECOM; Sage Publications; Pune; 2007.
Available at www.soppecom.org

This chapter outlines the methods tried out in the Hiware Bazar village in Maharashtra in watershed management

Artificial recharging of river water: an experiment in Madhya Ganga Canal project
Paper; by Mr. R. Sakthivadivel and A. S. Chawla.
Available at
http://www.wca-infonet.org/servlet/BinaryDownloaderServlet?filename=1066304192156_artificial_recharging_madhya_ganga.pdf&refID=122403 (PDF 120 KB)

The paper details a large-scale project on artificial groundwater recharge using excess monsoon flows in Uttar Pradesh

Towards a Learning Alliance - Systemic Rice Intensification (SRI) in Orissa (*from Sarbeswar Sahoo, Kalpataru, Angul, Orissa*)
Report; by C Shambu Prasad, Koen Beumer, Debasis Mohanty; World Wildlife Fund, Hyderabad and Xaviers Institute of Management, Bhubaneswar; 2007
Available at http://www.wassan.org/sri/documents/SRI_in_Orissa.pdf (PDF Size : 1.83 MB)

Presents experiences of farmers in cultivating paddy through SRI that enables them to produce paddy in drought prone land and extensive saving on groundwater sources

Local Action through Area Water Partnerships (AWP)
Study; by Frank van Steenbergen and Lalith Dassenaike; Global Water Partnerships (GWP); May 2006; Available at http://www.gwpforum.org/gwp/library/AWP_Report.pdf (PDF Size: 483 KB)

Concludes AWPs can add to water resource management components; mobilize local communities, draw in non-water players for water governance and its management

Ideas for Local Action in Water Management
Book; by Marten van Ittersum and Frank van Steenbergen; Global Water Partnerships; 2003; Available at http://www.gwpforum.org/gwp/library/Ideasbook%20Local%20action%20in%20water%20management.pdf (PDF Size: 6.3 MB)

Brings together information on activities undertaken by local government, civil society and private sector to facilitate local water management and its governance

Management of Groundwater Resources through Community Participation Approach in the Coastal Saline Region of Gujarat
Working Paper; by Shital Lodhia; Centre for Development Alternatives ; Ahmedabad; October 2006
Available at http://www.cfda.ac.in/download/Management%20of%20Groundwater%20Resources%20through%20Community.pdf (PDF Size: 190 KB)

The study shows community based strategies and local governance have drastically reduced withdrawal of groundwater

From Devanshu Chakravarti, Intercooperation, Hyderabad

Groundwater Management
Film; Water, Land and People; Swiss Development Cooperation; Berne, Switzerland
Available at http://www.waterlandpeople.net/en/stories_india_video02.htm (Duration 4 minutes)

Presents the case of groundwater governance by farmers through sprinkler method for sharing water among farmers in Andhra Pradesh

Participatory Hydrological Monitoring
Film; Water, Land and People; Swiss Development Cooperation; Berne, Switzerland
Available at http://www.waterlandpeople.net/en/stories_india_video03.htm

Showcases simple measures by community to manage their groundwater sources like adopting rules and regulations and conducting regular monitoring of water levels

N M Sadguru Foundation : Community Wate Resource Development (*from A. Gurunathan, DHAN Foundation, Madurai, Tamilnadu)*
Programme Details; Water Forum; IndianNGOs.com
Available at http://www.indianngos.com/issue/water/projects/nmsadgurufoundation1.htm

Programme details of motivating communities for small-scale water resources management through construction of checkdams for groundwater recharge

Community-Based Natural Resource Management (CBNRM) : Issues and Cases from South Asia (*from K. J. Joy, Society for Promoting participative Eco-system Management (SOPPECOM), Pune)*
Book; by Ajit Menon, Praveen Singh, Esha Shah, Sharachchandra Lele, Suhas Paranjape and K.J. Joy; Vedams eBooks (P) Ltd.; New Delhi; 2007; Priced Publication, write to vedams@vedamsbooks.com to order a copy
Available at https://www.vedamsbooks.com/no52332.htm

Concludes CBNRM efforts have made significant contributions to sustainability of groundwater resource use, and in terms of democratic decentralised governance

Net Area Irrigated from Different Sources and Gross Irrigated Area *(from R. Jagadiswara Rao, Retired Professor of Geology, Sri venkateswara University, Tirupati, Andhra Pradesh)*
Data; Department of Agriculture and Cooperation, Ministry of Agriculture, Government of India; New Delhi; June 2007
Available at http://dacnet.nic.in/eands/slus/2003-04/lus-yr-table-2.1.htm

Presents date on the area irrigated by different sources in India indicating the need to drastically modify present strategy of surface water use and groundwater governance

Coke vs People: The Heat is On in Plachimada *(from Nitya Jacob, Resource Person)*
Article; by Mr. C Surendranath; India Resource Centre; 2004.
Available at http://www.indiaresource.org/campaigns/coke/2004/heatison.html

The article gives an overview of the Coca Cola bottling plant at Plachimada, Kerala, and the agitation of local people to get it shut down, along with links to related sites.

Community Based Water Laws and Water Resource Management in developing Countries *(from Ramya Gopalan, Research Associate)*
Book; by Barbara van Koppen, Mark Giordano, John Butterworth; CABI; Cambridge; 2007
Available at http://www.cabi.org/pdf/books/9781845933265/9781845933265.pdf (PDF Size: 253 KB)

Critically examines interface between community based water laws and formal water laws of ongoing groundwater resource management reform

Ground Water Management And Ownership *(from T. N. Anuradha, Research Associate)*
Report of the Expert Group; Planning Commission, Government of India; New Delhi; September 2007
Available at http://planningcommission.nic.in/reports/genrep/rep_grndwat.pdf (PDF Size: 3.8 MB)
Examines legal provisions of issues relating to groundwater management and suggests a sustainable ground water management approach

Recommended Organizations and Programmes

Watershed Support Services And Activities Network (WASSAN), Secunderabad*(from Sarbeswar Sahoo, Kalpataru, Angul, Orissa)*
H.No 12-13-452, Street No:1, Tarnaka, Secunderabad 500017, Andhra Pradesh; Tel: 91-40-27015295, 27015296; Fax: 91-4027018581 wassan@eth.net; http://www.wassan.org/sri/default.htm

Promotes various cultivation practices and crop varieties that require less water input like the promotion of systemic rice intensification method to curb groundwater extraction

Aga Khan Rural Support Programme India *(from A. Gurunathan, DHAN Foundation, Madurai, Tamilnadu)*
P.O. Box 2049, 1-3 Avenue de la Paix, 1211 Geneva 2, Switzerland; Tel: 41 22 9097200; information@aiglemont.org; http://www.akdn.org/India/aboutus_india.html

Programmes include ensuring closer proximity to safe drinking water, by restoring groundwater resources and helping women to use their time more productively

Society for Promoting Participative Ecosystem Management (SOPPECOM), Pune *(from K. J. Joy)*
16, Kale Park, Someshwarwadi Road, Pashan, Pune 411008, Maharashtra; Tel: 91-20-2588 0786; Fax: 91-020-25886542 soppecom@vsnl.com; http://www.soppecom.org/publications.htm;

Supports organising people into legal associations as user groups for participative management of groundwater resources enabling local governance of natural resources

Andhra Pradesh Farmer Managed Groundwater Systems, Hyderabad*(from R. Jagadiswara Rao, Retired Professor of Geology, Sri venkateswara University, Tirupati, Andhra Pradesh)*
Block No. A-2(c), First Floor, Huda Commercial Complex, Tarnaka, Hyderbad 500007, Andhra Pradesh; Tel: 91-40-27014730; Fax: 91-40-27014937 info@apfamgs.org; http://www.apfamgs.org/Default.aspx
Equips groundwater farmer users with the necessary data, skills and knowledge to manage groundwater resources available to them in a sustainable manner

Centre for Water Resource Management, Auroville*(from Judith D'Souza, Auroville Water Harvest, Auroville)*
http://www.auroville.org/environment/harvest/harvest.htm.

Auroville Water Harvest is a non profit organization in Villupuram District, Tamil Nadu working to combat sea water intrusion and promote integrated water management.

Lutheran World Service India *(from K.G.Mathaikutty, Lutheran World Service – India, Kolkata)*

84, Dr. Suresh Sarkar Road, Kolkata 700 014; Tel: 91-33-22849200/9730/9731; Fax: 91-33-2244 3062 lwsi@vsnl.com; http://www.lwsi.org/

The main objective of LWSI is to empower women and men of disadvantaged communities to enhance their quality of life by cultivating self reliance.

Recommended Portals and Information Bases

Groundwater governance in Asia, IWMI, New Delhi *(from N.K. Agarwal and Mandira Agarwal Geological Survey of India (GSI), Dehradun, response 1)*
http://www.waterandfood.org/gga/contact.htm; Contact Dr; Bharat R Sharma; Senior researcher; Tel: 91-11-2584 0811/12; B.Sharma@cgiar.org

The paper deals with the very varied systems of groundwater system in Asia, some of which are community-based

From S. Vishwanath, the Rainwater Club and Arghyam, Bangalore

Youtube
http://www.youtube.com/v/cpINxY6F6t0&hl=en (Film: Size 14 MB)

Film shows how a bore well can be used to recharge groundwater and effective management of natural resources

Youtube

http://www.youtube.com/v/uNwv72SxFv0&hl=en (Film: Size 14 MB)

Showcases a simple meter for measuring what is withdrawn from the well helping monitor the groundwater extraction towards sustainable management of the resource

Related Consolidated Replies

Urban water supply from water impounding and aquifer recharging, from Rahul Banerjee, Aarohi Trust, Madhya Pradesh (Comparative Experience). Water Community, Delhi,
Issued 19 July 2005. Available at http://www.solutionexchange-un.net.in/environment/cr/cr-se-wes-19070501.htm

Explores relevant potential experiences in the context of water impounding and aquifer recharging system

Improving irrigation efficiency for crops using groundwater, from K A S Mani, APFAMGS. Water Community, Delhi,
Issued Issued 26 May 2006. Available at http://www.solutionexchange-un.net.in/food/cr/cr-se-food-wes-08060601.htm

Provides experiences on improving efficiency of water use for agriculture with suggestions on appropriate measures to improve groundwater efficiency in growing crops

Gender Equity in Participatory Irrigation Management, from M.S. Prakash, DHV-MDP, New Delhi . Water and Gender Communities, Delhi,
Issued Issued 28 July 2006. Available at http://www.solutionexchange-un.net.in/gender/cr/cr-se-gen-wes-28070601.htm

Deliberates on legal, political, socio-cultural & capacity building constraints that prevent women from being active members of Water Users' Associations

Impact of Industrial Pollution of Ground Water on Agriculture, from Saugat Ganguly, Gamana, Hyderabad . Water Community, Delhi,
Issued 23 April 2004. Available at http://www.solutionexchange-un.net.in/food/cr/cr-se-food-wes-03040701.pdf (PDF, 200 KB)

Experiences of environmental and social impacts of industrial effluents on groundwater and agricultural production, along with technical, legal and social mitigation measures

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Responses in Full

Sarbeshwar Sahoo, Kalpataru, Angul, Orissa

Ground Water Management often becomes a problem when it is utilized for irrigation. Utilizing ground water for drinking, sanitation would not be a big problem. Hence the top priority should be to avoid water intensive crops and that too in a drought prone region. It is economically and ecologically unsustainable. As discussed by you crop should be diversified or it should be replaced by more effective crop. One such example is the SRI (System of Rice Intensification), Bidhi, a system rice intensification process. This paddy is more productive and consumes comparatively less water compared to traditional method of paddy cultivation. This method has been adopted successfully by Chattisgarh Government and now Bihar Government is adopting this method. There are many other such practices like Jatropha, Castor where excess consumption of water can be avoided and hence stress on Ground Water. For information please visit Watershed Support Services and Activities Network (WASSAN) - http://www.wassan.org/

K V Peter, Kerala Agriculture University, Thrissur, Kerala

Community Management of Groundwater is essential a priori to an effective and sustainable policy by the Government. Ground water is a public property and belongs to the Government. Acts on ground water use are enacted. The act is more often violated to the long term disaster of the people. Village panchayat has a role in ground water management. Plachimada in Palghat District of Kerala is a classic case where an MNC tried to exploit ground water to the detriment of the neighbourhood, which ultimately led to agitation and closure of the company. If the present act is not sufficient to protect long term conservation of water, it needs to be amended. A discussion on the act itself will be desirable. An act by legislature is more sacrosanct than any orders/statements by vested interests. We have a duty to the future generation to keep underground water as a reserve as now done for crude petrol and gas.

Abhishek Mendiratta, Consultant, New Delhi

The Hiware Bazar case study is one of the outstanding examples of Ground Water Aquifer Management by community participation.

Case Study of Hiware Bazar, Tal- Nagar, Dist., Ahmednagar, Maharashtra

Article I. Hiware Bazar in the Ahmednagar district of Maharashtra has emerged as a new role model in community management of natural resources, starting with groundwater. Located 17 km from Ahmednagar, it was surrounded by barren land, dry wells and its 1000-odd inhabitants were prone to alcoholism. The village school was in a shambles and it suffered from a perennial water problem.

Article II. The Sarpanch, Popat Pawar, decided to create an NGO at the village level with all villagers are members to access funds, called the Yashwant Agri Watershed Development Trust. It is headed by a 11 member committee drawn from the village. The Trust undertook plantation on forest, grazing and private land in the village through an integrate process including contour bunding, building earthen check dams, percolation tanks and concrete check dams through community participation. Cattle grazing was prohibited in the 70 acres of hilly areas and gradually water levels in the wells went up.

Article III. The village is located on an area where there is hard basalt. To speed up groundwater recharge, for the first time an experiment was tried where explosives were used to split the rocks on flatland, to allow for water percolation into deeper aquifers.

Article IV. Alongside this, the villagers changed their cropping pattern to grow more dryland crops in keeping with the rainfall available in the village. Sugarcane is only grown for domestic use and most of the people grow vegetables, coarse grains and some cereals. In 2006, an estimated Rs 1.5 crore worth of onions were sold from Hiware Bazar. Some farmers who have made dairying their business, make up to Rs 2500 a day selling milk. Farming, which was totally rainfed earlier, has now become more dependent on groundwater and it is possible to grow a mix of crops through the year.

Article V. The people of Hiware Bazar have been prosperous for nearly a decade now and this shows in the brick houses, the concrete roads and the school that is up to class 7 with a computer centre.

Address: Hiware Bazar, Tal- Nagar, Dist.- Ahmednagar, Maharashtra

Article VI. Background	Total Sanitation Campaign was sanctioned for Ahmednagar District in October 2002. At this time, the Government of Maharashtra adopted a new sanitation strategy, which was decided to be piloted in Ahmednagar district. The revised approach in the TSC project emphasize more on IEC activities to increase the awareness in order to enhance options through alternate delivery mechanisms with beneficiaries participation. The TSC project is being implemented with focus on community and people centered initiatives. As a people oriented campaign, this is a pioneer to make the community as a whole to realize the real problem caused due to the absence in safe sanitation and hygiene practices. WSP-SA has made a major contribution while designing this policy. The area was barren.
About the village/Project site	Hiware Bazar, 17 Km from Ahmednagar, was surrounded by barren land and dry wells. Its people were prone to depression and alcoholism. Hiware Bazar, with its 226 households and 1141 inhabitants, would have been no different from most other villages in Maharashtra, where cleanliness is not something that receives prime importance, and open defecation is accepted as water for even the most basic needs provided the perfect excuse to overlook 'superfluous' needs like latrines and sanitation.

Sr. No	Particulars	Details
1	**(a) General Information**	
	Population	1141
	Males	589
	Females	552
	Families	226
	APL Families	175
	BPL Families	51
2	**Community Building.**	
		01
	Village Panchayat	01
	Anganwadi	01
	Z.P.Primary School	04
	Community Hall	01
	Library	
3		
	Commumity Based Organisation	01
		01
	Village Water & Sanitation committee	01
	Social Audit Committee	
	Women Development Committee	01
	Self Help Groups	01
	APL Groups	03

	BPL Groups	01
	Mahila Mandal (Women Clubs)	01
	Youth Club	01
	Bhajan Mandal	
	Education Committee	
4	***Drinking Water Facilities***	14
	Hand Pump	05
	Bore-Well	
	Water Supply Scheme	
5	**(b) Waste Water Management**	
	Gutter under ground	150 metres
	Soak Pits (Ind.)	30
	Soak Pits (Community)	00
	Kitchen Herbal Garden	180
	(c) Soild Waste Management	
	Vermi-compost	06
	Dustbin (Ind)	50
	Dustbin (Community)	20
6	**(d) Sanitation**	
	Toilet (Ind.)	226
	Toilet (Community)	02
	Community Building	03
7	**Other Schemes**	
	Yashwant Gram Samradhi Yojana	
	Shivkalin Pani Sathavan Yojana	
	Mahatama Fule Jal Bhumi Abhiyan	
	Akshay Prakash	
	Dalitwasti sudhar yojana	-
	Adarsh Gaon Yogana	
	Water shied	
8	**Community Participation Programmes**	
	Ek Gaon Ek Ganpati	
	100 % ODF	
	Santh Gadge Baba GRam Swachata Abiyan.	
	100 % Dedication	
	100% Prevention of Child Marriage	
	100 % Waste Water Management	-
	Implementation of all Govt. Schemes.	
	100 % Ban on Plastic use.	
	100% ban on Elecrtic bore-well	
	100% ban on tree cutting	
	100% ban on smoking	
9	Awards.	

	Santh Gadge Baba Gram Swachata Puraskar Nirmal Gram Purshkar Sannt Tukaram van gram purshkar Adarsh Gaon Purshkar Jalbhumi purshkar	III[rd] divisional Level (03-04)
Activities on the ground	• Several meetings were held to create awareness regarding the importance of sanitation and motivate the villagers • A film show on the topic was also held which contributed greatly towards motivating the people • Regular coordination meetings of the motivators were held to ensure close follow up of the works, responsibilities were divided and care was taken to enlist the participation of all sections and groups of the village. • The participation of the youth was particularly ensured through constant personal contact. School children, who became ambassadors of cleanliness in their homes, were also involved in the program. • Women being the ones who faced the most problems because of open defecation were only too willing to cooperate and their support was enlisted through their self-help groups which already existed in the village • Once all their questions had been satisfactorily answered, the villagers gradually started warming up to the idea and became keen to taken on this new challenge. • Material would be purchased collectively this would both solve the problem of individual households having to cart the material all the way from the town, as well as enable them avail of discounts on bulk purchases	
Results and impact	Village is free from open defecation and now community is aware of cleanliness and all the households are using toilets and this habit had reduced lots of their health problems. The development schemes such as Water Harvesting, Programs, Yashwant Gram Smrudhi yojana, Akshay Prakash & SJSY are being implemented in the village. Community participation is increased in development activities. Women participation in Gram Shabha & village activities is increasing. Gram Shabha is taken regularly. Hiware Bazar shows the way, unopposed elections are the message.	

Surekha Sule, Independent Journalist/Researcher, Pune

I came across many PIM cases but one I am impressed with is in a village near Nasik. Here about 200 farmers got together and without any help from any government or NGO, set out to solve their water scarcity problem. They simply put motors in their fields to pump arrested rainwater into a faulty government percolation tank. For rabi, they reversed the system by putting motors now at the tank and drew water for winter crops - mainly grapes. They formed cooperatives to export the grapes and in just two years, covered the cost of pump sets & pipelines.

Devanshu Chakravarti, Intercooperation, Hyderabad

Intercooperation facilitated the capitalization of experiences in land, water and people in Bolivia, India and Mali (funded by SDC).

Two short videos on groundwater management are available at web addresses mentioned below.

1. Groundwater Management (4'02")
http://www.waterlandpeople.net/en/stories_india_video02.htm

2. Participatory Hydrological Monitoring (4'45")
http://www.waterlandpeople.net/en/stories_india_video03.htm

Mrinalinee Varanase, Ecological Society, Pune

Good to know that new action group is started and the discussion is lead by Mr. Mani. I read the note on ground water issues and moderator's specific interest in models of community managed ground water resources, experiences of working with communities and any laws or system the communities have adopted for water management.

I would like to share few things based on my experience of working with villages in Maharashtra on water management issues:

- The relationship between surface and ground water is to be understood from the ecological perspective. Rainfall (distribution and intensity), surface runoff, strata and structures that help percolation and ground water recharge needs to be studied from landscape perspective and not just for those places where water can be collected with hard engineering structures, in wells and used for irrigation or drinking. I making a specific point here to understand the role of cover types in reducing the velocity of runoff and help water to percolate for recharge, and retain moisture in the soil. All these processes are linked with each other and make a huge difference in planning and managing water resources. Generally in watershed work, only hard engineering structures are emphasized and soft engineering methods to enhance the quality of water and recharge ground water are neglected. All sources of first order streams, riparian corridors, and difficult areas on slopes, need to be covered with vegetation. This does not need to be only tree and can include grasses and weeds that provide excellent stoppage and sieves for surface runoff. Natural vegetation is to be encouraged in pockets, clusters and on farm bunds.
- My experience with Nirmal Ganga Abhiyan was helpful in understanding how villagers respond to this approach because it does not give any striking results in a short time. Natural processes take time to yield results. The Ecological Society is getting good response from the villagers to implement such techniques and they understand the importance of long-term treatment measures. At a few places we had to combine soft engineering options with hard engineering structures for better results. We suggested measures even for backwaters of small bandharas. There can be diversity in and around these waters which is very productive. If managed, percolation tanks serve as the best wetlands.
- Thirdly, we found that many a times we do not think about appropriate use of water before we build dams or dig wells. As a result, even though water availability increases it is all wasted on cash crops like sugarcane. We are working with one village in Maharashtra, where the ground water level increased but sugarcane cultivation also increased. Ultimately the land became saline and farmers had to face setbacks due to the fluctuating prices of sugar. This happened because there was no 'budgeting' of water.
- Once, the 'phad' system was widely followed in Maharashtra for equitable distribution of water, and this still exists in some villages. In this system, resources and lands are owned by people but the planning of cultivation is done at the community level. This is one of the ideal systems of water resource management in my information. I will definitely provide more info after I find out these villages and their system.

- Last but not least, water for industries is a burning issue! Industrialization in new areas (which is planned through SEZs) does not look feasible in the present condition. It will have a long term impact on drainage patterns and water supply and distribution. We don't have any immediate solution to this problem, but we discuss these issues with villages to assess what they think and also make them aware of certain facts.

We are preparing a manual for ecological management of water resources where all these 'soft engineering' techniques are described in detail. It is going to be in Marathi, but I will share the key chapters in English with the community. In fact, the very first chapter of this manual is about the ecological survey of watersheds. If the organizations working in the field have baseline data and want to implement these surveys, we would be willing to work with them.

A Gurunathan, DHAN Foundation, Madurai

Wells are in the private domain and regulating pumping through organized social capital in the form of Water Users Associations has its own limitations. On the other hand, if you create awareness about the ill-effects of over exploitation of ground water practiced by private companies and individual farmers in a mass gathering through IEC Campaigns, Street Plays, Screening Video films, Awareness camp in association with State and Central ground water Boards, there will be a situation to trigger the change process.

It should be on a continuous effort but not a one-shot operation. Dhan Foundation motivates the community to augment the supply side for recharging ground water by undertaking community owned tanks/ponds rehabilitation programme on a cascade level and tank based watershed development in tank intensive micro watersheds. From our experience, the results are encouraging.

You may have to approach agencies like AKRSP, N M Sadguru Foundation which work in Gujarat for successful models since Gujarat is one of the states in the country where ground water has been very highly extracted, and this has made water quality undrinkable.

The state groundwater departments and Central Groundwater Board have to be made aware of the APFMAGS model, as has been done in the case of Ralegaon Siddhi, Tarun Bharat Sangh and Hiware Bazar.

Shashidharan Enarth, Development Support Centre (DSC), Ahmedabad

When property rights for commonly accessed resources such as groundwater are less defined and non-excludable than privately owned means of extraction (wells/pumps etc), we tend to attribute it to low awareness among water users. While it cannot be denied that most water users have inadequate knowledge of finer hydrological details of groundwater, I have always wondered if this inadequacy is a significant cause for poor governance. The farmers of Mehsana district in Gujarat will tell you the cause and consequences of unrestrained water mining. Many of them have incredibly sound answers to the crisis. But in the absence of a workable, predictable institutional framework and policies and law that supports collective action, few of them, if any, wanted to stop the damage. In fact they continued to drill deeper.

Even in the relatively easier surface-irrigation, Water Users Associations in Gujarat has been successful to the extent they have evolved compelling incentives for farmers to comply with collectively agreed rules and regulations. Those WUAs that were able to infuse confidence in their members about their ability to enforce fair and predictable water distribution has done well.

Those WUAs that were tightly controlled by a leader or two were vulnerable to abuse and capture by the well-muscled.

Similar arrangement for groundwater is even more challenging, given the difficulties in measurement and monitoring. As Gurunathan suggests, IEC campaigns can enhance knowledge not only about groundwater dynamics, but also about essential elements of collective action. Water users, as also water managers, must now face up to the reality that the users have as important a role to play as technology and money. They have to find ways of evolving sound rules and then mechanisms to adhere to them.

Judith D'Souza, Auroville Water Harvest, Auroville

The organization I work with, Water Harvest based in Auroville, Tamil Nadu, looks at protecting ground water through community participation and creation/rehabilitation of community assets like the irrigation tanks, ponds and other artificial recharge structures. Our operational area is at an immediate risk of saline intrusion due to the over exploitation of ground water through improper irrigation methods like deep bore wells. The water table in this area has dropped 63 meters in 30 years. We have approached this issue through 1) a community centric model with asset creation and 2) scientific investigation 3) groundwater recharge infrastructure. All three combined have given us good results.

The **community centric model** looks at institutional building among the various water users. Rehabilitation of the tank (with active participation of the wetland farmers) along with clearing the field channels to ensure that the last farmer can also access water, we also provide hands on trainings on soil and water conservation methods and proper irrigation practices. In most cases, what I have seen is that the farmer tends to irrigate his field almost 5 times more than what is needed. Organic farming has also shown good results in reducing the quantity of water utilised. Pond renovation is also a part of the model. Rehabilitating ponds and tanks ensures increased storage capacity and helps in recharging the area. Our outreach program involves street theatre, poster exhibitions, farmers' forums, screening relevant documentaries etc.

The **scientific investigation** is done through regular monitoring ground water levels and quality parameters. Hydrological data is extracted using automatic metrological stations, and a detailed topography of the area is laid out using high accuracy differential GPS technology. All of this data is compiled in a database. The collected information is processed in GIS for further modeling. This provides us with thorough and up-to-date tools for watershed management. We have also set up weather stations at the village level and have trained people to monitor weather and water levels in the surface water bodies. This information is then written on a board which is placed in the centre of the village so that all can access the information.

Artificial ground water recharge structures like check dams, tanks and ponds, recharge wells and ponds are part of the efforts to reduce the ground water exploitation. Many of the structures are included in the community centric model where they function as community assets.

Due to the changing cultivation scenario where farmers are turning to cash (water guzzling) crops, we face problems in organising them for issues of equitable distribution of irrigation water from the tank. Most are uninterested in tank rehabilitation as they have personal bore wells. There are also instances where farmers have sold agriculture land as real estate. All this is due to bigger forces at play which need to be included into the loop when addresses water / land / people / livelihoods.

However, as depleting ground water in rural areas is not an issue that Tamil Nadu government really wants to recognize, we still have some industries that not only suck up copious quantities of ground water but also discharge their effluents into wells nearby. This in turn affects life around them. There are also cases where villages have been given permission to sell their ground water. Though some important aspects of ground water have been touched by most state acts, the issue of equity is still not addressed. This is probably the most critical issue - how much, who can, use...

Sacchidananda Mukherjee, Madras School of Economics, Chennai

I will address the issue of groundwater protection (qualitative) from the rural water supply perspective.

Since India's water sector is predominantly informal, role of formal rules and regulations to protect water resources is very restricted (Shah, 2005). In 2003, for example, the Government of Tamil Nadu enacted the Tamil Nadu Groundwater (Development and Management) Act, 2003, but since then there has been hardly any attempt to implement it in practice. Shah argues that due to high transaction costs involved with the compliance of such rules and regulations, public support for such regulatory policy is meager. Perhaps, this shows that there is a need to adopt an alternative institutional framework to protect groundwater resources (van Steenbergen, 2006). Voluntary participation of the local community could be an alternative institutional approach which could protect groundwater from quantitative depletion and qualitative degradation (Mukherjee, 2008). Community based groundwater recharge movements and some other success stories have been reported from comparatively water stressed States in India like Gujarat and Andhra Pradesh (van Steenbergen, 2006; Mishra Panda, 2006; Lodhia, 2006 and Shah 2000).

Like cities and towns in India, in rural areas dependence on surface water resources is also increasing to meet demand for drinking water. In the arid and semi-arid regions of India, rural water supply schemes are gradually becoming dependent on surface water sources (reservoirs, rivers, etc). And unlike urban centres, where dependence on surface water sources are mostly due to inadequacy of local sources (e.g., groundwater, tanks, lakes, etc.) to augment water supply to match the demand from growing urban population (Mukherjee and Shah, 2008), in rural areas dependence on surface water sources is mostly due to water quality related problems.

Protection of drinking water sources is the first step towards meeting the demand for drinking water in rural areas. Regular monitoring, assessment and dissemination of groundwater quality information to the stakeholders are very important for informed decision making. Risk perception, assessment and communication are continuous process where characteristics of the message, messenger and receiver are very important. In rural areas, neither the local governments nor the drinking water supply agencies have the capacities to monitor and regulate the quality of supplied water, as a result large section of our rural population gets unmonitored and unregulated water supply. Major challenges that rural water supply sector in India are facing today are not only to meet the large investment requirements to augment water supply, but also an additional investment burden to tackle water quality related problems.

Achievement of equity and greater access to safe drinking water for a large section of the populace will remain a distant dream if we cannot protect our drinking water sources from pollution. Since groundwater serves as a decentralized source of drinking water in rural areas, the rural population becomes vulnerable to various water-borne diseases when it is polluted. And it is mostly the poor and marginal sections of the population who suffer the most, as they cannot afford to protect themselves from the impacts of pollution. If the pollution continues unabated it

could pose serious risks not only for current generations but also for future generations to meet demand for safe drinking water at a reasonable cost.

A large section of the population still does not have access to adequate quantity of water of desirable quality and is exposed to various water borne diseases. It is important to know the sources of pollution of groundwater, before taking any curative measures. The major sources of groundwater pollution in rural areas is from human and animal sources, inadequate access to safe sewage and sanitation services – resulting in indiscriminate defecation and urination, inadequate storage and disposal facilities of animal wastes and application and nitrogenous fertilizers and pesticides. Industrial water pollution is mostly restricted to the areas surrounding the industrial locations (Mukherjee and Nelliyat, 2007), however groundwater pollution is rural areas is mostly from the above sources. Apart from groundwater, non-point source pollution from agricultural lands, livestock population and human wastes result in eutrophication in traditional drinking water sources e.g., tanks, lakes, reservoirs, ponds etc., as a result these water systems are disappearing very fast and/or getting converted to other land use practices. Therefore, to protect local sources of drinking water in rural areas which has the capacity to meet the local demand for drinking water, there is need to understand the people's willingness to protect drinking water sources.

Researchers argue that unless farmers foresee any positive distinctive private economic benefits in the adoption of environmentally benign agricultural practices, they will not adopt any practices to protect groundwater resources which are mostly under open access regime. Unlike other natural resources which fall under local common pool resources (like forestry, fisheries, grazing land, and irrigation water), the private benefits of protecting groundwater are not distinct and cannot be parceled out to individuals involved in conservation. Since in India, groundwater falls mostly under free access regime and some of the services it provides have characteristics of a public good, farmers will not incur any private costs to ensure public benefits (safe drinking water).

My argument is that, unlike in developed countries where small number of farmers having large land holdings and homogeneous cropping patterns, in developing countries like India, a large number of farmers having small land holdings and heterogenous cropping patterns. In developed countries farmers are provided with economic incentives (conservation reserve programme, countryside stewardship programme, etc.) to protect groundwater for comparatively large urban and semi-urban consumers. Therefore, the polluter and victim (consumer) difference is distinct in developed countries and consumers' willingness to pay is often studied instead of the polluters' willing to pay (incur costs) to protect groundwater from farming activities.

But in India, the difference between polluter and victim (consumer) is not clear, as the polluters (farmers) themselves are victims (consumers of groundwater). Therefore, we have to treat individual farmers as consumers and not as producer and study their willingness to pay (incur costs) in terms of adoption of Best Management Practices to protect groundwater. Our argument is that farmers will adopt environmentally benign farm practices to protect groundwater provided they perceive that their groundwater and drinking water is polluted and that could pose health hazards or risk to his/her own and family members. Farmers' perceptions about groundwater and drinking water quality and possible health hazards are important which could influence their willingness to adopt measures to protect themselves individually (point of use purification) or collectively (groundwater protection or community water treatment plant).

A starting point would be a primary household survey of the rural population to understand the factors influencing their perceptions about the problems (quantitative depletion and qualitative degradation of groundwater) and their willingness to take measures either individually (e.g., through adoption of organic farming, bio-fertilizers, bio-pesticides, biogas plant, bio-composting,

sanitation facilities, water saving technologies like micro irrigation and enhancing crop water productivity, etc.) or collectively (through supporting the local government to facilitate agricultural extension services - e.g., soil and water testing facilities, etc., - at a lower transaction cost)). It is important to understand farmers' perception about risks of consuming contaminated drinking and their willingness to protect drinking water sources from all possible sources of pollution. It is important to study the factors/conditions which induce the emergence of collective action institutions (like APFAMGS, *Pani Pachayats,* etc.) in environmental management in general and groundwater management in particular. There are a few studies in India which look into the issue. However, there is need for more case studies in various parts of India by taking into account the groundwater hydrology in arid, semi-arid (hard rock areas) and humid and sub-humid regions (alluvial areas).

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K.J.Joy, Society for Promoting Participative Eco-system Management (SOPPECOM), Pune

First of all thanks a lot for initiating this discussion on ground water issues as both commonly agreed upon knowledge and practice/experience in this area are pretty limited.

Right at the outset I should confess that I (or for that matter the organization I work with, SOPPECOM) have not done much work on the groundwater issues. Whatever limited experience or insights we have come more from watershed development efforts or certain efforts at co-management (in official parlance conjunctive use) of surface and groundwater.

There are two general points that I would like to make:

One, most of the groundwater acts that are already in place in different states or that are being formulated/debated see ground water as a private property resource to be extracted and used by private individuals as if they own that resource. Unless this basic framework is changed and see ground water as a common pool resource -- to be managed and used collectively and for the time being we may not get into the ownership issue, though it is very important, -- and frame policy, rules and practice accordingly one may not be able to make a dent.

Two, we need to make a distinction between areas which are served by irrigation projects and area which are generally called dryland regions or areas which depend on local rainfall. One of the impacts of irrigation projects is that the number of wells in the command or service area of the project goes up and very often we do not have disaggregated data on what is the contribution of irrigation projects in groundwater development. Groundwater seems to be the single largest source for both drinking/domestic use and for irrigation. But we really do not know what proportion of wells are located in the irrigation command areas. The Maharashtra Irrigation Commission (known as the Chitale Commission) has estimated that nearly 40% of the ground water irrigation is actually in the command areas, meaning it is recharge water from canals and irrigated fields. The point here is that we need to discuss the issues of groundwater use and management for these two different regions separately as the issues are different to some extent and more importantly the management strategies would also differ considerably.

In terms of actual experience of groundwater regulation in Maharashtra I do not think that there is any experience which may be comparable (not only in terms of scale, but also in terms of the way the regulation is done) to what APFAMS has been able to do in AP. However there are a few isolated cases that I know or have been part of or have researched like:

1) Hiware Bazar in Ahmednagar district: here the context is watershed development and the community agreed on two norms of groundwater use: one, no borewells for irrigation, two, no water intensive crops like sugarcane. These two norms seem to have worked quite well and as a thumb rule one can say that they have been able to manage the water use within sustainable limits as even in drought years there have been no water tankers going into that village where as in some of the adjoining villages, though watershed development has been taken up there, had to be supplied drinking water through tankers. There is quite a bit of literature available on this and one of the recent studies is: "Hiware Bazar: A 'Model' Watershed experiment" in the book *Community-based natural Resource Management: Issues and cases from South Asia* ; Ajit Menon, Praveen Singh, Esha Shah, Sharachchandra Lele, Suhas Paranjape and K. J. Joy; Sage 2007.

2) Ralegaon Siddhi: here too Anna Hazare and the villagers opted for a very simple norm of not constructing individual wells below check dams. Instead they constructed group wells near the check dams and the members were given assured water using a system of something like a ration card. This did not give rise to "pumping raise" which we normally see with watershed development. They also decided not to take water intensive crops like sugarcane.

3) Ozar WUAs in Nashik district: here the context is that of three Water Users' Associations (WUAs) going beyond the conventional roles and functions of WUAs and devise a system of co-management of surface and ground water and local (meaning water from the local rain

fall) and exogenous water (meaning water from a medium irrigation project called the Waghad project). In fact it is an interesting system and has the potential of going beyond the artificial boundaries of local and exogenous water and surface and groundwater. The WUAs have brought the wells in the command area under the purview of the WUAs, monitor regularly the water levels and also charge the well owners in proportion to the recharge they get in their wells. They also build many checkdams on the nallahs (streams) which have a double functions: one, it harvests local water and allows for percolation and two the WUAs put a part of the water they receive from the dam into these checkdams and then tap it through the wells. They have also devised very efficient system of water rotation. They alter the rotations from canal and the wells. There is a research paper on it which can be got from SOPPECOM website (www.soppecom.org) or in case anybody wants we can send it.

M C Mahant, Assam

Groundwater is the life line for Indian agriculture, but this cannot last for ever unless it is recharged. Rainwater recharge is inadequate, and therefore, Shannon dams are an alternative, built completely through local initiatives. They can be build at elevation differences of just 1 m. This will ensure round-the-clock water availability for agriculture and also for recharging groundwater, while maintaining 80% of the natural flow of water.

A Shannon Dam is a self-Operating Open or Shut gate fabricated from metal, ferrocement or wood, which is used extensively in small irrigation canals/Rivers/Streams, but has not been tried in India. The gate of the dam opens or shuts depending on the difference in water levels on both sides. If the difference in water levels between the river side and the inland side is high the gate swings open under pressure of the water from the river. Once the levels equalize, the gate shuts. By designing the level differences between the two sides, it can ensured that river or stream flows are maintained, and there is enough water diverted for agriculture. The system uses no power and can last for several decades.

It is possible to reverse the damage done to rivers, through excessive extraction of water, damming and pollution. Cities have to manage their water consumption better because there aren't unlimited supplies of river water available anymore.

Chan Mahanta, Assam

I feel damming rivers, whether at 1m elevation difference with Shannon dams, or any other engineered solution, is not a solution to increasing groundwater recharge. Such solutions increase siltation rates, and therefore their life is also reduced. They will also result in inundating low lying farm lands and homesteads for the better part of the year. These reservoirs will also change the cycles of water flow, especially through the dry season. In the rainy season, they will become cesspools of disease and rotting vegetation. Further, they will also affect navigation.

Good engineering is not one dimensional. Damming up rivers by dams of any size are examples of bad engineering undertaken to solve one problem, but creating many more in their wake and destructive of the balance that is so sorely lacking all around us, all over the world.

Therefore, recommending 1 m high dams on all rivers along their trajectories is not a workable solution.

Shital Lodhia, Centre for Development Alternatives, Ahmedabad

I am very happy that Mr Mani has raised a very significant query in terms of today's situation with ground water resources. Gujarat is facing severe ground water depletion and deterioration. This has resulted in faster ingress of saline water into aquifers. The saline water has affected the quality of ground water has affected the livelihood of local people and out migration has become very common in the coastal areas.

I feel technological solutions along with correct institutional backing can play very important role in this direction. Although the scaling up of such micro studies seems to be difficult at first, one can replicate such efforts in other similar areas. Such scaling up of micro level efforts needs to consider the various micro-level models along with the areas where they can be scaled up. Rapid scaling up may not be possible, but a graded increase in geographical coverage, and a step wise scaling up strategy can ensure more efficient solutions to ground water management.

In Gujarat's coastal areas, NGOs have carried out efforts to restore the ecological health of aquifers. One such effort has been carried out in the Mangrol taluka of Junagadh district. I would like to share the lesions learnt from such successful case studies that indicate there are two major challenges prevailing in making people work for ground water management.

The first challenges relates to technological interventions. Although there are solutions available, they are often not adequate and acceptable at the community level. Therefore, they need to be modified to suit local conditions. For instance, micro level irrigation techniques in the coastal saline areas need modification to prevent salt deposition in micro tubes.

The second and the most important issue is a community based regulatory approach. It is very important to change the behaviour and attitude of farmers. Farmers will not change their decisions regarding cropping patterns and irrigation unless and until they see an economic benefit. For instance, plantation of horticultural crops such as Chickoo require less water but the lead time for payback is long. In case of the Mangrol taluka intervention, farmers were asked to change the cropping pattern gradually so as maintain their income levels. The formation of village level institutions played very crucial role in reducing ground water withdrawal in villages of the taluka. I have to underline that this is a slow proces. The constant inputs through community awareness and capacity building programmes has the potential to change the behaviour of farmer in reducing the overdraft of groundwater. Results from Kukaswada village were encouraging, where the reduction in gross draft was as much as 69%. The technological intervention through informal institutions in this village played very important role to reduce the gross draft.

V. Kurian Baby, Tsunami Rehabilitation Porgramme, Kerala

Indeed grateful for starting the e-discussion on ground water management by communities. At the outset I must say that, what we can best achieve is to define base models and deterministic parameters. The operational efficiency and relevance of the model would be largely governed by the location specific factors. We all agree that the ground water governance in India, is largely characterized by; (a) competing use, unsustainable extraction and depletion; (b) rapid deterioration in water quality and (c) ineffective and weak governance. Aquifer water quality standards are seldom monitored and enforced, polluter never pays as most of the ground water systems are subjected to unscrupulous chemical and biological contamination, many of our abandoned boreholes are uncapped lading to point pollution. ICTs and advances in technologies are rarely used in developing sustainable aquifer management models. Traditional systems and water sharing practices are undermined by commercial interests, with out corresponding obligations/costs. Subsidies (say power) are often acting as a perverse incentive in encouraging rapid extraction, competing uses leading to salinity and marginal farmers worse off.

We have many models and community efforts in participatory aquifer management, like pani panchayat, Sadguru, JBF, TBS and others, however the experiments are apparently limited by scaling up issues that are mainly regulatory, institutional and managerial. Added to this are the extraneous factors of extraction by non local users and the difficulties in managing unconfined aquifers. Strictly speaking investments in ground water recharge does not entitle a similar right/access in water resources. At the same time watersheds are facing the practical issues of how to minimize the negative effects of the free rider problem as in the case of any common pool resources. In the context of the weak regulatory framework, aquifer management is riddled by the classical prisoner's dilemma leading to the Pareto-suboptimal solution (rational choice leads the members of the community to play defect/cheat even though individual reward would be greater if they cooperate.)

According to me for among the options for scaling up, community best practices are to be integrated with the institutional backbone of PRIs, supported by harmonization finds at the block level to integrate ongoing investments programmes of the river basin. Participatory audit of ground water extraction with environmental monitoring by PRI centric community action is critical. If the State Governments empower PRIs in enforcing regulation and dispute resolution, it would go a long way in sustainable management. As State is a key player in water management and investment, community action shall be synergized with State action and framework support for sustainability. A conceptual construct of a model would comprise inter alia the following:

- The model shall be on the IWRM framework
- River basin planning incorporating cross cutting issues
- Institutional architecture aligned with the PRIs
- Integration of the various watsan committees with only functional /thematic grouping – scope for DWSM widened to IWRM
- Participatory community centric action in land and water resource planning, aquifer management, environmental monitoring and normative resource allocation.
- Regulatory framework operational at the PRI/block level for ground water management, including dispute resolution/conflict management (institutionalized/legalized)
- Conjunctive use plan - Block/GP level water resources plan – demand and supply management supported by ICT and remote sensing tools (in pilots/demo projects)
- Harmonization funds (including NREGS) at block/GP level to integrate ongoing investments in water sector
- Sustainable water resources campaign with capacity building and training led by State (3 -5 years)
- Ground water legislation passed, enforced and coherence committee looking into policy/legal harmony

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Jasveen Jairath, CapnetSA, Hyderabad

The responses to the e-discussion on paradigm shift in groundwater management have been extremely interesting. It is encouraging to hear of examples of groundwater regulation through self-regulation by communities.

However, I feel one basic issue has been overlooked so far. This concerns regulation of groundwater that is linked to the private ownership of land, and is especially important in cases of skewed land distribution where the large farmers or the influential people monopolise groundwater extraction for their personal benefit. This excludes the majority from access to groundwater - that as Joy has pointed - is really a common property resource. The pattern of groundwater usage also reflects the inequity in land ownership and access.

I would like to focus on strategies to bring political pressure to bear on this small segment, that has a virtual monopoly on groundwater. Historically the strong and powerful have never surrendered their monopolies, and therefore such inequity has to be challenged through a political solution.

Appeals to morality, ethics or environmental consciousness have never in the history of mankind motivated the strong and powerful to surrender their monopolies. Inequity has always been challenged through a political struggle. Only a political struggle will help to address inequities and this has to be an integral component of any strategy to challenge the control of groundwater by the landed class. Restricting the activity to "consciousness raising or awareness generation" will not achieve the desired results.

I would like members to share any examples of such political struggles or movements.

N. Lakshmi Narayana, Dakshinkya Institutes, Guntur, Andhra Pradesh

The point under discussion is very important and there is an urgent need to rehabilitate the people living along the in coastal regions through more sustainable approaches. Water is the major determinant of development of any area.

The strategy includes collection of existing information on geology, hydrogeology, geophysical and demand-supply parameters. This has to be followed by meetings and discussions with community members to understand their needs and priorities, attitudes and knowledge. The next step is data analysis to identify the gaps, to be supplemented or filled by a survey and data collection. Finally, a rehabilitation plan is prepared with special reference to the people, natural resources and water harvesting and management.

A strategy can be designed including evaluation & monitoring to manage natural resources for a better and sustainable quality of life for people.

N.K. Agarwal and Mandira Agarwal, Geological Survey of India (GSI), Dehradun *(response1)*

Non-compliance of regulations governing groundwater is no excuse to stop implementation. The chaos in public order, which includes inadequate water availability, is due to the non-implementation and non-compliance of law. Self regulation is a utopian idea. Therefore, policing mechanisms have to be implemented for the public/good.

Surface and groundwater resources are national assets and their exploitation requires a regulatory mechanism which cannot be left to consumers or producers i.e., the public. Water has to be made available to public irrespective of rural/urban distinctions.

The distinction can be for drinking, use, agriculture use or industrial use, etc. and the high transaction costs for implementation cannot be an excuse to avoid implementation of law. Voluntary participation is part of democratic governance process but is no substitute for implementation. Pollution of water bodies is caused by the public only out of ignorance or by flouting laws. The failure or slackness of the policing mechanism has encouraged this.

Water is going to be the most scare resource in near future, and hence its regulation should be in top of the agenda today for our future.

K.G.Mathaikutty, Lutheran World Service – India, Kolkata

The discussion on Paradigm Shift in Ground water governance is very timely and appropriate. In India we have begun to experience the impact of climate change, it is important to link and relate it with the regulation of groundwater. We need sensitization to raise consciousness and awareness generation in restricting the groundwater exploitation. But in the present context, it has to be challenged through political struggle for a desired result.

About 10 years ago, the Central Ground Water Board has introduced issuance of license to agencies, who undertake water drilling activities to check the groundwater exploitation, when the groundwater levels began to fall but the follow up is not clear.

When we consider the groundwater exploration activities, it is important to seek available scientific opinion to. To cite an example the Orissa state and Central Ground Water Board with the help of satellite imagery prepared maps of the state's ground water reserve and its safety level, which was to serve as a guide for exploration of water up to that level.

When Purulia district in West Bengal and Mayurbhanj district in Orissa were undergoing chronic drought for a couple of years during late 1970s, Lutheran World Service India (LWSI) has initiated a water drilling project in 1977 in collaboration with the Public Health Engineering Department of the state concerned. It drilled around 1000 bore wells in these two districts to provide water for human consumption and partly for irrigation. Other components of this project were health and agriculture including social forestry and groundwater recharging schemes under food for work. Over a period of 7 to 8 years of activities, the project has achieved its goals. This groundwater exploration was a balanced approach to address the community needs, while the groundwater levels were maintained at a safe level with recharging measures. Since then no major drought has occurred in those operational area, the water drilling operation was shifted to other problem areas with very cautious approach not to over-exploit the resource.

Nature provides all resources needed for the normal welfare of the world population. But the greed of humans has created problems of scarcity and imbalance uneven distribution of natural resources.

Let us hope and work for a better world

Shrikant D Limaye, UNESCO-IUGS-IGCP Project "GROWNET" and Ground Water Institute, Pune

Good governance must originate from Gram panchayat level, with following common rules, agreed upon by majority:

1) All deep borewells which are being used for irrigation must be converted into recharge borewells in the Monsoon. The source water may be runoff water in farm ponds or water pumped from nearby streams into farm ponds.

2) Every year, the depth at which the submersible pumps work in the borewells will be reduced by 5 to 10 feet in summer, i.e., the pumps would be taken up by 5 to 10 ft, depending upon local conditions

3) Village tanks should be desilted and deepened by 5 ft. Water harvesting structures like nala bunds should be repaired

In Maharashtra, some villages have decided only to use dug wells that are 70 feet deep for irrigation and bore wells up to 200 feet deep only for drinking water supply. Drilling of horizontal bores from dug wells is permitted but no vertical drilling is allowed in dug wells. The beneficial effects are visible after 3 to 4 Monsoons. A strong and popular Sarpanch backed by a sincere Watershed & Groundwater Management Committee with women members, has been able to achieve this, by promoting efficient use of ground water pumped from the wells.

Bharat R Sharma, Groundwater Governance in Asia, International Water Management Institute (IWMI), New Delhi

The International Water Management Institute (IWMI) is implementing a large Capacity Building and cross-cutting research project on "Groundwater Governance in Asia" with a major emphasis on the Indo-Gangetic Basin and Yellow River basin. The outcomes of the multi-site cross cutting research during the last year have shown that groundwater governance and its access by communities is an interplay of regional hydrology and local socio-ecology. I shall like to share a small statement on this which forms a part of the larger report under preparation:

The Indus-Gangetic basin covers a very large tract of fertile agricultural lands in India and the production surplus from this basin meets the food deficits of several other populous basins of the country. Though blessed with a vast network of dams, canals and a strong irrigation bureaucracy, the surface irrigation systems have lost their historical supremacy to the more informal, demand-based and equitable groundwater irrigation. However, the development, the use, the sharing and groundwater markets, the agricultural production and social benefits produced by the groundwater resources are not uniform and seem to depend heavily upon the prevailing hydrology and socio-ecology of the given region/state in this vast basin.

The IWMI led 'Groundwater Governance in Asia' project through its Cross Cutting Research component conducted a number of focused studies in the varying agro-eco regions of Punjab (Hoshiarpur), and Haryana (Kurukshetra) of Indus basin, and Uttrakhand (Haridwar), Bihar (Vaishali) and West Bengal (Hooghly, Burdhwan, Bankura) in the Ganges basin for a better understanding of the groundwater governance issues and adaptations at the local level.

In a hydrological setting where all the irrigation needs are met by groundwater (Hoshiarpur, Punjab) two distinct patterns of groundwater access, viz., shared wells and groundwater markets have evolved. Whereas a shared resource helped farmers to have equitable access to groundwater as well as improvement in crop and water productivity; even a very competitive groundwater market does not allow the water buyers to realise the same levels of water productivity as obtained by well owners who also made good profits by selling water from tubewells. The government policy of providing free electricity for the farm sector has provided incentives to the farmers to install additional tubewells leading to competitive exploitation by the farmers.

In most canal command areas, the inequitable and irregular canal water supply has led to shrinkage of the canal irrigated area and groundwater irrigation is playing an important role, (Kurukshetra, Haryana) more so in tail end water courses (72-97 %). With the flat rate tariff regime of electricity the difference in cost of water for paddy and wheat is negligible, whereas amount of water used for paddy is 5-6 times higher than that of wheat. Compared to electric submersible pumps, the cost of water for diesel operated tubewells is higher by 7-11 times for paddy and 1.5-2.0 times for wheat. The analysis showed the gross margin was highest for basmati rice, followed by coarse rice and wheat. This explained that under the prevailing flat rate of electricity and higher returns for paddy, groundwater use shall continue to expand and water tables will continue to decline further. This urgent issue requires urgent attention.

In Bihar, that has abundant groundwater, only about 36% of these resources have been developed due to small and fragmented holdings, low number of water extraction mechanisms (WEM), high cost of energy and low investment capacity of small and marginal farmers (Vaishali district). Though the number of shallow tubewells has increased exponentially, the number of pump sets has not increased in proportion to the number of borings and economically backward farmers continue to extract groundwater through rented pumps, albeit at exorbitant cost. Further, as most of the WEM owners use purchased diesel as the motive power, the rising diesel costs and high demand for irrigation has lead to rapid increase in water prices in the region. Even with abundant groundwater availability, inequity in ownership and access, non-existent rural electrification and rising energy costs have resulted in economic scarcity of groundwater and thus a very slow pace for its further mobilisation. Even the classical success stories of Community Tubewells in Vaishali is approaching its extinction due to weak institutional and policy support and overriding social dynamics.

Besides better understanding of these three widely varying interplays of groundwater hydrology and socio-ecology in the Indus-Gangetic basin, the report shall suggest suitable physical, socio-economic and policy and institutional mechanisms for sustainable groundwater governance in these settings of the basin.

Additional information on this project may also be viewed at http://www.waterandfood.org/gga/

N.K. Agarwal and Mandira Agarwal, *(response2)*

There are already several organizations from the Union Government such as the Central Groundwater Board that monitor the quality and availability of groundwater, so there is no point duplicating efforts. Saline water ingress also needs to be tackled through scientific exploitation of groundwater, and the Board can help in this respect as well. Most problems concerning groundwater seem to be the result of ignoring the Board's advice. They have a rich database of studies that can be used.

S. Vishwanath, Arghyam and Rainwater Club, Bangalore

If we could measure the amount of water we recharged into a bore well and then were entitled to withdraw only that amount, it would help to manage groundwater. A crude recharge measure is catchment area x rainfall x coefficient of recharge.

This video - http://www.youtube.com/v/cpINxY6F6t0&hl=en (Size: 14 MB) shows how a bore well can be used to recharge groundwater and this one - http://www.youtube.com/v/uNwv72SxFv0&hl=en (Size: 14 MB), a simple meter for measuring what is withdrawn from the well.

The key questions remains – who plays the policeman, and who the referee?

Ombeer Singh Tyagi, International Development Enterprises India, New Delhi

There are monitoring agencies keeping watch on the depletion of the ground water which is affecting food production as well as aggravating problem of drinking water in the cities and villages as well. For example Wheat and Paddy growing areas of Punjab are now drilling water from a greater depth than before and still not able to meet their requirements. It is well known that water requirements round the year can not be fulfilled with rain water harvesting and

storage. Agriculture and crop production for major part of the year are dependent on the mining of water as well as in majority of the villages and cities potable water is supplied through mining.

There is need of communication and convergence between monitoring agencies and communities who are dependent on the ground water. Hydrological survey along with other competent agencies may help in capacity building of the villages Panchayats who need to be informed up to what level it is safe to pump water. There are efforts to educate people in many part of India but still there is lot more to be done in this direction. Education about water use, sensitive levels of water tables and recharging of the ground water by rain harvesting will help in bringing change in water scenario.

R.Jagadiswara Rao, Retired Professor of Geology, Sri Venkateswara University, Tirupati, Andhra Pradesh

As a steering committee member of the Andhra Pradesh Farmer Managed Groundwater Systems (APFAMGS) Project, I have good knowledge of the project in seven drought-prone districts of Andhra Pradesh during the last four years involving nine NGOs with Bharati Integrated Rural Development Society (BIRDS) as the nodal agency.

Several knowledgeable earth scientists including K.A.S. Mani, Project Leader, have been involved in the formulation, sanction and/or implementation of the project and in imparting training to farmers in scientific groundwater management. Groundwater conservation through System of Rice Intensification (SRI) process mentioned by Sarbeswar Sahoo has been widely practiced in the project villages. It is worthwhile for other NGOs in India to replicate the methodology adopted in the successful implementation of this gigantic project in other parts of India where there is excessive groundwater exploitation. A wealth of information on this project for emulation is available at http://www.apfamgs.org/.

I wish to point out in this connection that while discussing on the need for a paradigm shift in groundwater governance for irrigation, it is often assumed that everything is fine with surface water governance for irrigation. A perusal of the year-wise statistics on the area irrigated by different sources ever since India became a republic (http://dacnet.nic.in/eands/slus/2003-04/lus-yr-table-2.1.htm) provided by the Directorate of Economics & Statistics, Department of Agriculture & Cooperation, Ministry of Agriculture, Government of India, New Delhi in June 2007 indicates the need to drastically modify the present strategy of harnessing surface water for irrigation.

Despite enormous expenditure, the net area irrigated under major and medium irrigation projects could just more than double from 8.3 million ha in 1950-51 to 17.8 million ha in 1991-92 only to decrease to 15.1 million ha by 2003-04. The net land under minor irrigation projects increased from 6.6 million ha in 1950-51 to a maximum of 7.3 million ha in 1964-65 only to decrease drastically to 4.7 million ha by 2003-04. In contrast to this, the net land irrigated under wells could shows a sustainable six-fold increase from 6.0 million ha in 1950-51 to 35.3 million ha in 2003-04. The contribution of deep tubewells to total groundwater used for irrigation has shown a sustainable increase from zero till around 1959-60 to 69.2% in 2003-04. It is extremely difficult, therefore, to enforce the suggestion of Shrikant D. Limaye for using shallow groundwater for irrigation by reserving deep groundwater for drinking.

The best way to maximise benefits from large governmental expenditure towards various irrigation projects is to reorient them wherever feasible to harness surface water for groundwater recharge rather than making it available for irrigation by gravity flow. This strategy for example could be successfully adopted in the Madhya Ganga Canal Project (MGCP) between the upper and lower Ganga canal commands in Uttar Pradesh. For long this depended exclusively on

groundwater for irrigation leading to steep decline of groundwater levels and increased pumping costs (http://www.janmanch.org/newsletter/sandrp-update-jan2005.htm). The option to provide canal water to this region by storing excess flood flows of monsoon season in a reservoir had to be differed for want of a suitable site. The Irrigation Department and the WALMI in consultation with the International Water Management Institute (IWMI) and WRD & Training Centre of Roorkee University took up construction of the MGCP in 1989 to release excess flood flows into unlined branch canals for subsurface storage of water to fill the depleted aquifers. Apart from growing a kharif crop with local rainfall and canal water, the augmented groundwater through recharge was enough to grow rabi crop. A study by IWMI in the Lakhoti Branch system of the MGCP in 2000 has established that the new strategy gets two irrigated crops instead of one without adverse problems such as water logging, groundwater depletion and high pumping costs due to lowered groundwater levels.

For want of suitable reservoir sites, substantial water is being allowed to flow into sea both as surface and underground runoff from the multitude of big and small rivers. The Japan Green Resources Agency (J-Green) could successfully arrest sizeable underground runoff from rivers flowing into the sea from certain Japanese islands and parts of China, Indonesia and Mexico without involving land submergence or any other adverse environmental changes through construction of subsurface dams (http://www.green.go.jp). Taking inspiration from this work, I have proposed similar construction of subsurface dams across the Indian rivers before they join the sea
(http://www.indiatogether.org/2004/may/env-subsurf.htm).

I have proposed sand dams within inland rivers to harness the 75% dependable surface flows that could not be presently utilised for want of suitable reservoir sites (http://www.indiawaterportal.org/Network/forum/viewtopic.php?t=3008). The sand arrested by these dams could be in part mined for construction while the balance holds sizeable quantities of shallow groundwater for use as irrigation water.

It may also be mentioned groundwater should be conserved at all costs and rainwater harvesting and groundwater recharging should be taken up as a people's movement especially in regions where there is excessive groundwater exploitation. But extension of the same campaign in regions where groundwater development is quite low has led to gross groundwater underutilisation and their backwardness. States with low stage of groundwater use include Chandigarh (0%), Arunachal Pradesh (0.04%), Meghalaya (0.18%), Manipur (0.65%), Mizoram (0.9%), Nagaland (3%), Andaman & Nicobar Islands (4%), Tripura (9%), Dadra & Nagar Haveli (14%), Jammu & Kashmir (14%), Sikkim (16%), Orissa (18%), Chhattisgarh (20%), Jharkhand (21%), Assam (22%), Goa (27%), Himachal Pradesh (30%) and Bihar (39%) (http://planningcommission.nic.in/reports/genrep/rep_grndwat.pdf). A campaign is actually required to motivate farmers in these states to harness groundwater on a large scale.

Ashok Jaitly, The Energy & Resources Institute (TERI), New Delhi

This has been a very interesting discussion on an extremely important subject which is of great concern to all of us working in the water sector.

Both from the responses received and the prevailing scenario, it is clear there are a number of grey areas and contradictory trends in the legal and institutional framework as well as policies and practices on groundwater governance. Unless these are brought out clearly and resolved, even in part (it is unrealistic to expect dramatic changes in the short term because there are deep social and political nuances involved) bringing about a 'paradigm shift' would remain in the realm of good intentions or at best, continue to be scattered efforts by committed civil society interventions.

In the first place, the confused legal regime pertaining to water rights needs to addressed. On the one hand, the Indian Easement Act, 1882, links groundwater with land ownership. On the other hand, the Supreme Court has held that "ground water is a national wealth and belongs to the entire society....The State is the trustee of all natural resources....and is under a legal duty to protect (them)...These resources meant for public use cannot be converted into private ownership." In actual fact, the bulk of investments in groundwater development, particularly for irrigation and industry, have been privately funded and water trading is increasing.

Similarly, the private drinking water market (tankers and bottled water) is growing very rapidly even while a section of activists continue to resist 'privatization' or 'public-private partnerships' in public utilities.

Can this dichotomy be resolved by amending or abrogating the Indian Easement Act and thus formalizing the Supreme Court interpretation? This needs to be studied very thoroughly by a panel of legal experts and, if necessary, submitted as a Public Interest Litigation by concerned organizations. Can a forum be activated for this purpose?

Secondly, even while private ownership and the consequent private extraction of ground water continues, the Supreme Court judgment implies that the State has a right and obligation to regulate 'excessive' extraction. Who decides what is excessive and on what basis? Under the Constitution of India, water falls within the state list and therefore, it is for the state governments to legislate.

Some cases (Kerala, Tamil Nadu, Andhra Pradesh, Karnataka and Maharashtra) have passed laws while others states are planning to do so. However, one common feature of these laws is the overarching command and control model with prescribed authorities for granting permissions. This has only led to more red-tapism and corruption with no impact on depleting groundwater levels. It certainly runs contrary to decentralized and community-based management. The Central guidelines on groundwater legislation need to be revisited with the latter objective in view. The existing legislation is also defective in terms of setting parameters for levels of permissible extraction. The end result is that these laws remain virtually unimplemented.

Thirdly, in what seemed like an effort to circumvent the constitutional constraints, the Union Government sought to increase its interventionist powers through the Water (Prevention and Control of Pollution) Act,1974 and the Environment (Protection) Act, 1996 under which the Central Ground Water Authority was constituted to regulate the existing indiscriminate use of ground water. CGWA has been ineffective (which is not surprising given the impracticality of seeking to centrally control hugely diverse ground situations with a weak data base) and this attempt at centralization violates all principles of decentralized governance. This needs to be disbanded and effective powers devolved to the state and local authorities.

Fourthly, legislation to regulate ground water extraction has been ineffective not only because of the faulty command and control model but has been further negated by heavily subsidized (even free in a few states) electricity and diesel to farmers which works as an incentive for greater extraction. Similarly, irrational price support policies encourage water intensive cultivation even in water stressed areas. It is unrealistic to expect changes in cropping patterns and adoption of water saving technology in such a policy environment. What is even more ironic is that almost all these subsidies benefit the richer farming community and not small farmers who are forced to buy water from large land holders. So far, it has been virtually impossible to reverse these policies despite criticism from several quarters because of political resistance from the strong farm lobby.

Fifthly , the existing institutional arrangements for water governance at the state and local levels are not only confusing but inevitably end up working at cross purposes leaving enough loopholes for the rich and powerful to continue to exploit common resources to the detriment of equity and sustainability. While the 73rd Constitution Amendment and the accompanying Eleventh Schedules provide legislative and administrative control to the panchayats for minor irrigation, water management, watershed development, and drinking water, this has not been effectively operationalized. Different line departments like Irrigation, Rural Development and Public Health Engineering continue to exercise control over their own areas of responsibility.

Even where a degree of delegation of authority has been formally devolved, this is generally not backed with adequate financial resources and technical capacities. Further, the roles of other community-based organizations like Watershed Development Committees and Water User Associations can conflict with Panchayats under the mentoring of competing line departments. Given that there cannot be an one-size-fits-all, uniform organizational structure for diverse circumstances the need for an integrated approach to natural resource management through community based efforts must remain the basis for local level planning and intervention. One option could be for each state to constitute a Water Development Council comprised of experts and different stakeholders to advise on suitable structures for regions/districts/river water basins. The experience gained from several successful interventions in community based management cited by members in this exchange would provide extremely valuable inputs for such planning.

As I mentioned at the outset, in my view a paradigm shift in groundwater governance, undoubtedly essential and clearly overdue, would be possible only through a concerted effort on several fronts and can be expected to be a gradual process. Awareness generation and knowledge dissemination, particularly amongst water users who are also the primary 'victims' of depleting water tables is a necessary but not adequate condition for bringing about the change. Strong advocacy and lobbying at different levels, including the general public, would be equally important to change mindsets and counter entrenched vested interests. The Water Community could play a catalytic role in this.

My apologies for this rather long posting!

Jürgen Tümmler, Regional Support Office South Asia, Humanitarian Aid Department – ECHO, European Commission, New Delhi

With reference to Vishwanath's post, I'm afraid to calculate the recharge. First, a pumping test on the well in question would be needed, ideally based on a 5-step test and an additional yield test over 5 days. Based upon these results, the recharge potential could be calculated if you want to use the well as an infiltration tool to recharge the aquifer. However, these measures tend to be costly and not very efficient.

Usually, aquifer recharge / infiltration is related to the surface available for natural infiltration (varying between 5% and 50% of the rainfall normally; for semi arid climates as in Rajasthan, generally 17% are used as a rough value for estimations). The rates of infiltration can be improved by various technical measures on the surface and tend to be more economic than infiltration wells etc.; they are easier to maintain as well.

Himanshu Thakkar, South Asia Network on Dams, Rivers & People, New Delhi

It has been a very rich flow of messages and reading through them has been a great learning experience for me. Many instances of success stories of community management of Groundwater

have been described (the story of groundwater recharge movement in Gujarat could be added as an instance of a community making efforts on large scale to increase groundwater levels). Others have provided some very good instances of the rules used by/can be used by the community to achieve regulation. The SDC film on the hydraulic monitoring in Madirepally village in Ananthapur district (AP) is an interesting illustration of how communities can be empowered to take informed decisions. A number of studies, analyses and technical proposals have also been provided.

I would just like to raise some broader policy level issues.

One stark thing we need to note at the outset is that the states' attempts to control groundwater have been an abject failure. This, more than a decade after the Supreme Court ordered the constitution of the Central Ground Water Authority with very wide ranging powers under the EPA 1986. One major reason is that this authority had no effective role for the community and even more importantly, this was a top down, unaccountable system. The state legislations have also been total failures for similar reasons. Maharashtra is now trying a new way of doing this through the Maharashtra Water Resources Regulatory Authority, but that too is bound to fail as it uses the same top down methods and moreover it is using the irrigation corporations as models for river basin authorities.

Another important message to note is that there has been a systemic neglect and destruction of groundwater recharge systems: tanks (and other traditional water harvesting systems), forests, wetlands, rivers, flood plains, etc. One does not see a sincere acknowledgement of this crucial fact among the official water resources bodies. Without acknowledgement of the role of these ecosystems and hence a credible attempt to protect them, there is little likelihood of paradigm shift.

It seems to me shocking fact that there is no law in India to ensure a minimum flow in rivers when structures like dams, diversions, hydropower projects, etc., are built on rivers. This, among other things, negates the role of rivers in groundwater recharge. The science of groundwater still is still not well understood by the policy makers at the Ministry of Water Resources and Planning Commission, and the surface water lobby dominates India's Water Resources Development. At least, that scientific understanding cannot be seen in policies and practices.

The Groundwater recharge scheme that was floated in the 2007-08 budget remains a non-starter, it remains to be implemented. It was also a case of too little, very late and yet a welcome first step. The budget allocated for it is symptom of the lopsided priorities of the government. The 11th Plan continues to give dominance to big dams, big irrigation, long distance canal projects. The announcement of increased allocations for Accelerated Irrigation Benefits Programme, the Bharat Nirman Irrigation Component, the National Irrigation Projects and so on is another symptom of wrong priorities.

As many in this discussion have pointed out, groundwater is indeed lifeline of India's water sector. It is also a lifeline of India's food security. We are right now seeing the implications of India's stagnating food production. It is not only the principle irrigation source, it is also a more efficient user of water and also provides greater yields per hectare of irrigation, compared to surface waters. These are well known facts, but worth reiterating.

SANDRP has done an analysis (see http://www.sandrp.in/irrigation/100000_crores_spent_no_irrigation_benefits_SANDRP_PR_Oct2007.pdf (Size: 119 KB), also available in Hindi, for more detailed version, see cover story in Sept-Oct 2007 issue "Dams, Rivers & People" at www.sandrp.in/drpindex). This shows, as Prof R Jagadiswara Rao has also said, that over 12 years between 1991-92 and 2003-4 (the latest year for which such data is available), India has spent some Rs. 99,610 crores on major and medium

irrigation projects. The government claimed that it has completed 210 M&M irrigation projects in this period. However, the area irrigated by these projects at the national level has dropped by about 3.14 m ha during the period. In the meantime, the groundwater irrigated areas increased to a peak of about 37 m ha. (All area figures used in this para are net irrigated area figures.)

Groundwater can also be a great insurance in times of drought, if it is used sustainably.

The water-electricity nexus in groundwater use is also well known, but this equation is also dependent on a number of other parameters like the cropping pattern, geology, topography, etc., Cropping pattern decisions in turn are dependent on other factors like the market, Minimum support price, etc., and this whole complex web needs suitable policy responses, which are lacking. SRI, as has been pointed out by many, can be hugely useful in achieving greater economy in use of groundwater, but this again is does not seem to have sunk very well in the ministries of agriculture and water resources at the central or state levels.

The tales of groundwater quality and pollution issues are also in part tales of non-performance, corruption and collusion. It is also a tale of a top down, non-transparent, unaccountable, non-participatory pollution control mechanism. As Judith D'Souza has said in this discussion, "we still have some industries that not only suck up copious quantities of ground water but also discharge their effluents into wells nearby." This problem is seen many other areas too like Haryana, UP and Punjab. This should obviously be seen as a criminal act and should invite an appropriate response. I would like to know if there is any instance where the pollution control board or other authorities have responded appropriately.

Control of groundwater can only be achieved by communities (with institutions at various levels and a mechanism that has necessary financial, technical, legal and institutional support and also necessary checks and balances to ensure that weaker sections are not marginalized or exploited). Its indiscriminate use by industry and urban areas has to be controlled.

To sustain groundwater resources, we need to make recharge (and management) top priority in policies and plans. This would be true in most areas except where there are problems of waterlogging/salinisation or where groundwater quality is an issue; in such cases this priority may need. Greater groundwater recharge has the potential of reducing the requirement of energy for pumping and hence reducing the global climate footprint.

Success stories need to be put together and published, along with the lessons at various levels. The success stories also include those where due to community efforts water level has gone up. A strong advocacy campaign, backed by grassroots involvement will have to be launched. Jasveen Jairath has noted, "Appeals to morality, ethics or environmental consciousness have never in the history of mankind motivated the strong and powerful to surrender their monopolies."

Joy raised the important issue of how much groundwater used is from the surface water recharge, how much is being used for irrigation in the surface water command area, and what is the reality about the reporting data on surface water VS groundwater irrigation. In this context, one of the important figures to note is that according to the National Commission for Integrated Water Resources Development, of the total of 431.89 billion cubic meters of total replenishable groundwater resources in India in 1995, 89.46 BCM was recharge augmentation from canal irrigation. This is not the complete answer. It should be noted that if groundwater recharge is the objective then long distance canal irrigation is not the most optimum solution in most cases.

Also, for community driven groundwater management to succeed and sustain, the community has to feel it is an integral part of the water resources system going beyond its village and

aquifer. Such integration would require clearly defined and credible norms for transparency, accountability, participation in planning, decision making, implementation and management of water resources projects, which is also lacking today.

V Kurian Baby says, "According to me, among the options for scaling up, community best practices are to be integrated with the institutional backbone of PRIs, supported by harmonization of finds at the block level to integrate ongoing investments programmes of the river basin. Participatory audits of ground water extraction with environmental monitoring by PRI-centric community action is critical. If the state governments empower PRIs in enforcing regulation and dispute resolution, it would go a long way in sustainable management."

Otherwise, as Shashidharan says, "But in the absence of a workable, predictable institutional framework and policies and law that supports collective action, few of them, if any, wanted to stop the damage. In fact they continued to drill deeper."

Many thanks to all who contributed to this query!

If you have further information to share on this topic, please send it to Solution Exchange for the Water Community in India at se-wes@solutionexchange-un.net.in with the subject heading "Re: [se-watr] Query: Paradigm Shift in Groundwater Governance. - Discussion. - Discussion. Additional Reply."
