Rationale for Participatory Groundwater Management as emerging from the Field Experiences

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Approach:

Dependence on groundwater for drinking water and irrigation purposes is growing in India (urban and rural areas). Groundwater is an essential input for rural economy. It is important to develop principles, protocols, practices that demonstrate equitable and sustainable use of groundwater resources at community level. For this purpose, it is important to demystify the knowledge of groundwater behavior in different aquifer systems. It is also essential that public investments and private investments on groundwater are harmonious with each other.

WASSAN believes in the following guiding principles for groundwater management.

- Groundwater is a Common Pool Resource (CPR)
- Groundwater problem should be clearly defined in terms of quantity and quality, particularly with regard to equity of access and aquifer sustainability.
- Principles and processes of management should cut across different uses like drinking water, irrigation etc.
- Minimum unit of management can be the local aquifer and maximum unit of scale should be system of aquifers (watershed scale) in hard-rock regions, including mountainous regions.
- Minimum unit of management can be ‘community’ or ‘villages’ tapping an aquifer and maximum unit could be the regional aquifer or even an aquifer-system in sedimentary settings.
- Long term engagement of at least 8 years

- Planning, management and monitoring to be executed by the community with the support from external agencies
- Science, local knowledge, education through demystification of science should be prioritized.

Rationale for Participatory Groundwater Management

As a resource support organization, WASSAN is providing technical and planning support to watershed management projects for a long period of time. During this process, WASSAN supported its partners in conservation and harvesting of rain water, at numerous sites. The technical options for rain water conservation are largely – farm ponds; check dams, percolation tanks, mini- percolation tanks and so on.

WASSAN also conducted several studies on watershed projects in different parts of India. Out of these, three specific studies focused on investments made at watershed level by government (public investment) and farmers (private investment) on water. The following inferences could be made from these studies.

- All studies have identified similar trend and pattern in investments.

- Through watershed management projects, significant public investments being made on water conservation activities.

    - The five watersheds in Andhra Pradesh indicate that 30% to 65% of works component is spent on water resource development works. (Ravindra and Bakka Reddy, 2004, "Understanding Impacts of Watershed Development Projects in Andhra Pradesh", Water Conservation Mission, Government of Andhra Pradesh)

    - 70% of investment in watershed projects is on water conservation related activities in Anantapur District. These activities focus on new and repairing of old structures (MV Rama Chandrudu, 2011, "Comprehensive Study of Impact Assessment of Investment on Watersheds Development Projects in Anantapur District of Andhra Pradesh" (Unpublished); NIRD, GoI.

    - About 40% to 60% of expenditure on works is on water resources conservation. This insight is generated from assessing the investment in 25 watersheds in seven states of India. (MV RamaChandrudu, etc, 2006, "Understanding Processes of Watershed Development Program in India", Volume 3 – In-depth View of Critical Themes – Institutions, Finances and Equity – WASSAN).

- The investments from farmers on digging bore wells are also observed in all these villages, during and after the watershed projects. This competitive digging of bore wells is leading to over exploitation of groundwater and unsustainable agriculture in watershed villages. It is found that groundwater is exhausted very quickly in watershed villages leading to severe water scarcity in watershed villages.

As these two investments are working at cross purposes and leading to zero sum game, there is a need for looking at groundwater management more systematically. As groundwater is the main source of irrigation for large areas under rain-fed conditions, it is also important to ensure that most/ all farmers under rain-fed agriculture are able to access groundwater, for critical irrigation. Similarly, drinking water human beings and livestock continues to be a challenge, where groundwater is the main source. There are several habitations where quality of groundwater is a main concern. With this backdrop, the participatory groundwater management is increasingly becoming critical intervention in development processes. This realization helped WASSAN to focus on groundwater management issues in a systematic manner. In this process, communities and resource organizations such as ACWADAM, CRIDA, Arghyam Foundation, Government of Andhra Pradesh and others provided necessary support to WASSAN.

Past Experiences:

- **AP Drought Adaptation Initiatives (APDAI):** Andhra Pradesh Drought Adaption Initiatives (APDAI – Karuvu Kavacham) was a pilot project that was supported by Government of Andhra Pradesh and World Bank. This pilot was implemented in two phases, from 2006 to 2009, for 3.5 years. Commissionerate of Rural Development, Society for Elimination of Rural Poverty, Mandal Mahila Samakhyas and WASSAN are partners in this initiative. WASSAN functioned as Lead Technical Agency and provide strategic and design inputs in this project.

  Some of the key objectives of this initiative are the following
  - Facilitate integration of different programs and institutional mechanisms for delivering drought-resistant assistance to these communities;
  - Design and test innovative methods, institutional mechanisms and instruments for helping selected communities to adapt to drought;

  This project was implemented in 5 mandals (Kosgi, Daulatabad and Bommaraspet in Mehbubnagar district and Gandlapenta and Nallacheruvu in Anantapur districts).

Specific Objectives of Pooling of Bore wells

As part of this pilot, WASSAN conducted systematic analysis of farming systems of these mandals and arrived at Drought Adaption Matrix. The groundwater based irrigation systems are an important of the farming systems in these mandals. Groundwater resources can potentially buffer the drought risks. Low rainfall and prolonged gaps in rainfall result in substantial crop losses in rainfed agriculture. Kharif the only crop for rain-fed farmers is at high risk. Some of the critical concerns related groundwater resources in these villages are - open access to digging of bore well, huge support for sprinklers/drip, huge power subsidy, absence of social regulatory norms for ground water usage resulted in competitive digging of bore wells thus ground water exploitation. WASSAN intended to demonstrate a pilot where judicious use of groundwater by moving from irrigated to irrigated dry to dry crops; protective/ critical irrigation methods; adopting micro irrigation techniques; following social regulations for accessing ground water are integrated at a single location. This pilot is expected to demonstrate the process/ system of protecting large areas of rainfed agriculture from the vagaries of rainfall fluctuations. The groundwater related pilots under this initiative had these objectives.

- Protecting the kharif crop by providing protective irrigation
- Increasing the rain-fed acreage & income
- Minimizing ground water exploitation by controlling competitive digging of bore wells
- Increasing the ground Water Use Efficieny

Process Followed:

- Sensitizing the farmer about the ground water depletion status. Analysis on the problems and opportunities for pooling of bore wells were discussed with farmers
- Rainfed patch with few bore wells were identified for demonstrating the pilot
- Rainfed area was demarcated. Pumping test for water adequacy and water quality analysis were carried out to assess the suitability for pooling of bore wells

Saliant Features of MoU

- No new bore wells for at least next 10 years
- Crop planning based on the availability of ground water in agreement with members of CIG (priority to food and fodder crops)
- Reducing area under paddy or no paddy. Crop shift from irrigated crop to irrigated dry to dry crops
- One bore well will be at rest every day (reduces usage of water by about 20%)
- Water must be shared to non-bore well farmer to protect the kharif crop of non-bore well farmers
- Creating general fund for maintenance of pipeline, repairs etc by the CIG

- For the first experimenting batch(at Chellapur village in Daultabad mandal of Mahabubnagar district), farmers were taken to an exposure visit to ‘Social Regulation Project’ of Centre for World Solidarity organization and to the ‘APFAMGS’ project in

Anantapur where the ground water issues were addressed. The subsequent batches were taken to APDAI project site at Chellapur

- Farmers interested for pooling of bore wells were organized in to Common Interest Group (CIG)
- Meetings were organized to draw the water sharing modalities and MoU prepared
- MoU was signed among the CIG group on bond paper, Mandal Revenue Officer (MRO) as witness.
- Digging of trench as contribution from CIG while project supported cost of pipeline network.
- Bore wells of all farmers (who agreed to be part of this initiative) are networked with a grid of pipe lines and regulatory system. This enabled all the farmers within the group to share/ access water, irrespective of bore well ownership.
- Provided micro irrigation sets to farmers at subsidized cost
- Motivated the farmers for crop diversification from irrigated crops to Irrigated dry to dry crops
- CIG opened bank account and a common fund for future maintenance of the structure was deposited as farmers' contribution
- Organised training programs on micro irrigation techniques, crop water budgeting, water sharing norms etc.
- Providing hand hold support and conflict management if any for 2-3 years

Pilot coverage in APDAI Project					
S.No	**Village**	**Mandal**	**Acres covered Acres**	**No. of Farmers**	**No. of bore wells pooled**
Mahabubnagar district					
1	Chellapur	Daultabad	48	5	5
2	Nagireddypalli	Bommaraspet	36	16	2 open wells
3	Gundlapalli	Kosgi	48	36	1
Anantapur district					
4	Gorantlavaripalli	Nallacheruvu	250	42	13
5	Karanamvaripalli	Gandlapenta	78	25	33

Outcome / Impact of the system

The following are the key observations from the ground water sharing pilot in the Challapur village, which are documented for three seasons, after the pilot was implemented.

- Irrigated area doubled
- 12 acres (40%) of the kharif crop given protective irrigation (as dryspell was over)
- 240% Increase in grain production: Total value of 3320 Kg additional grains worth about Rs.28,240-
- fodder production increased three times (358% Increase in total)
- Increase in Gross returns by 248% i.e. Rs. 31,250 of additional return
- Additional gross returns Rs. 7812- per bore well (i.e. gross returns increased by 248%)
- Total investment for collectivisation of borewells was Rs.2,10,000/- and Unit cost per acre is around Rs.5000/-. Costs inclusive of installation of pipeline, trenching and sprinklers (margin money).
- Increased crop diversity. (Additional 3 crops).
- About 25% of pumping hours saved.
- Water extraction is within safe yield limits (As indicated by ACWADAM's field study)
- The entire rainfed patch provided with protective irrigation of all farmers including farmers who do not own a bore well is saved
- Timely sowing of crops is possible because of assured water supply (even for the farmers who do not own bore wells) especially in the delayed monsoon season. It also resulted in reduction in pest incidence.
- Distant rainfed lands of the bore well farmer were also accessed water otherwise were completely rainfed.
- Crop diversification is practiced. No paddy resulted in saving of water
- Competitive digging of bore wells is controlled
- There is a back up arrangement (as every day one bore well is kept at rest) in case any of the bore well fails

Why bore well owners agreed to share water with farmers, who do not have a bore well?

These pilots demonstrated that win-win situation could be created by motivating owners of bore wells to share water with farmers, who do not own a bore well. The following are the reasons for sharing water.

- No reduction in the acreage of the farmer who owns bore well
- Large area (even the distant rainfed area of bore well farmer) will be accessed for irrigation/ protective irrigation
- No threat of new bore wells in the vicinity that may lead to drying of his own bore well
- Need for competitive digging will be reduced. Saving in investments
- Access to Micro Irrigation System at subsided cost for increasing the Ground Water Use Efficiency
- Huge support for pipe line network because of water sharing

- Pipe lines net work reduced the labour time for irrigating the crop (seven hours to one hour).
- Water use efficiency increased due to the micro irrigation techniques followed

National Agriculture Innovation Program (NAIP)

National Agriculture Innovation Program (NAIP) is funded by World Bank and executed by Indian Council of Agriculture Research (ICAR). Component-3 of the project is implemented by CRIDA (Central Research Institute for Dry land Agriculture) in consortia mode with NGOs, ICRISAT, ANGRAU and private companies. WASSAN is one of the consortia partner through its Livelihood Resource Centre, Pargi and is anchoring Ibrahimpur cluster in Rangareddy district. The overall objective of NAIP is to address the issue of rural livelihoods holistically by piloting innovations to optimize the use of natural and human capitals and by building institutional capability to sustain the gains through convergence of expertise at watershed/ cluster level.

A Tiny Hamlet with Limited Resources

WASSSAN initiated groundwater pooling pilot in Malkaipetathanda, which is part of Ibrahimpur panchayat. This is a small tribal hamlet, with Lambadi community. Agriculture is their main source of livelihood. It has a population of 475 with 91 households. 78 out of 91 households belong to small and marginal farmers. With limited water resources, they seasonally migrate to nearby towns to meet their livelihoods.

With a geographical area of 692.7 acres, this hamlet is mostly covered by grass, scrub and forest lands. There is an irrigated area of 161.7 acres (nearly 65 hectares), out of which nearly 100 acres is rainfed. It is also highly undulating and degraded land. The drainage pattern is of dendrite type. Soil erosion is high. Majority of the area is of mixed red soils. This area receives an average rainfall of 938 mm, but this rainfall is erratic. The mean maximum and minimum temperature vary from 40° to 14°C.

Groundwater table varies from 13 to 36 feet below ground. As failure of monsoons is a regular phenomenon, there is less chance of recharging. The yield prospects of 20 cubic meters per hour and depends on the morphology of the area. There are 2 tanks for irrigation; which also serves as recharge sources of groundwater. There are 54 borewells in the area, with a maximum depth of 250 feet. The farmers depend mostly on groundwater for irrigation (nearly 83%). The cropping season in rainfed lands is limited to kharif only. Paddy, Green gram, Cowpea and combination of Red gram + Jowar, Red gram + Maize are the major crops grown in this season while they grow groundnut, cowpea, paddy and vegetables in Rabi season under borewell and tank irrigation. The productivity of maize and red gram is also very low.

Focusing on Crisis…

In the situational analysis, WASSAN team found that there were 18 farmers in the hamlet, who share their pattas (land ownership certificates) in a stretch of 45 acres of land. Out of these 18, 7 farmers, with an area is 13.5 acres, have 4 bore wells. The other 11 farmers do not own bore wells. These farmers have 31.5 acres of land in the identified block. Of these 45 acres, paddy was being cultivated only in seven acres during Kharif and 2 acres in Rabi. In the remaining rainfed land, they used to grow Red gram and Maize, nearly in 25 acres during Kharif. In Rabi, Groundnut was the only crop and the sowing area was 11 acres. Of the existing 4 borewells, 3 were functional and one was defunct.

During the discussions with farmers, a proposal was mooted to convert the individual borewells for common sharing. Initially there was some disinclination among the farmers to share the resource, they were very skeptical about giving water to farmers who do not have borewells. With lot of efforts through consistent discussions, exposure visits and workshops, they finally agreed to the proposal, by cutting down the acreage under paddy. A group was formed with these willing farmers, named as '*DuddalamJalu Ground water Sharing User Group*'.

An analysis of existing ground water resources and cropping pattern in the village was carried out by CRIDA. Basing upon which the feasibility of providing critical irrigation to an area of 45 acres was confirmed. Meanwhile, the defunct bore was also repaired, making the 4 existing bores available to the farmers. Apart from these bores, there were also 2 'common' borewells, which were dug, during the implementation of a Government funded program – Comprehensive Land Development Program (CLDP), which was also facilitated by Livelihoods Resource Center WASSAN, Parigi. Thus there were 6 borewells, for which the common sharing proposal was designed. CRIDA developed a design for pipeline network to pool the water from these 6 borewells and distribute the water through sprinkler irrigation system. There were also negotiations, both with the borewell and non borewell farmers on

water regulation and shramadan for pipeline installation. An agreement was signed on Rs.100/- bond paper, in the presence of Village Sarpanch, for this purpose.

The laying of pipeline network work was implemented and monitored by stakeholders group with technical support of NAIP team. Project provided entire costs (nearly about Rs 4 Lakhs) for the pipe network, including sprinkler systems. The 6 bore wells were interconnected to one main pipeline and water is distributed from this main pipe to the identified rainfed patch, through 20 sub-lines and 10 sprinkler units. Quotations were called from reputed PVC pipes supply companies and a work order was placed for short listed company. And the work was executed by the CIG members themselves, with the support of CRIDA, District Water Management Agency (DWMA) and WASSAN.

Later a training programme was organized by NAIP team for the group members on operation and maintenance of pipeline and sprinkler system. User charges were fixed for borewellowners and farmers who do not own bore wells. .

For the purpose of distribution of water, the selected block of 45 acres was made into 5 compartments. Accordingly CIG was also divided into 5 sub groups. Critical irrigation was provided basing upon these sub groups, on weekly rotation basis. Subsequently, a crop planning and regulation mechanisms was also evolved. A water regulation committee was formed at village level, with one or two persons looking after water distribution. Outlet wise scheduling of water distribution was prepared during times of critical irrigation and water was disturbed on fixed days for each sub group. Thus, irrigation cycles followed with an interval of 8 days each, with 6 hours of supply each time.

Water Sharing Norms - Pooling up of bore wells through a common pipeline network for sharing

- Water to be shared among all irrespective of having the ownership of bore well
- Crop plans based on availability of water in agreement with members of CIG (priority to food and fodder crops)
- Reduction of area under paddy
- Sharing the water to protect the kharif crop of non-bore well farmers.
- Ensuring the acreage of bore well owner
- Creating general fund for maintenance of pipeline, repairs etc within the CIG Bank Account

The bore well owners contribute Rs 200 per acre of irrigated land and other water users from the pooled water resources will pay RS 1000 per acre per year. Every month meetings will be held and the expenses made and deposits received will be reviewed.

Enabling through 'Farmer Field School (FFS) concept:

Farmer Field School platform helped many semiliterate and illiterate farmers in understanding groundwater science and its dynamics. These non-formal methods maximized the participation of men and women and made them to learn more on measuring water levels, estimation of water balance, crop water requirement and crop economics.

Participatory Crop Water Budgeting (CWB)

All farmers collectively worked out a Kharif & Rabi crop action plan for year 2009-10. They agreed to cultivate 45 acres in Kharif and 25 acres in the Rabi season (groundnut). Irrigation schedule and calendar were also prepared based on crop requirement. Borewell owning farmers agreed to reduce their paddy cultivation area and restrict it to the level of the household consumption. They also agreed to raise irrigated dry crops.

While the farmers who do not own bore wells had to go for intercropping with rainfed crops; Maize, Sorghum, Pigeon pea and Green gram during Kharif and Groundnut during Rabi.

Crop Water Budgeting was done at the beginning of Rabi season. It involved estimation of the groundwater balance based on the total annual recharge and draft. This estimation helps farmers make informed decisions on the crops to be sown.

Observed impacts

The initiative provided protective irrigation for selected rainfed patches. It ensured timely sowing, especially in the delayed monsoon season (because of assured water supply). There was significant increase in crop area under the pooled bore wells.

On an average 25-30% of pumping hours were saved, resulting in saving of both the ground water and power consumption.

Prior to pipeline networking, the paddy acerage was 7 acres, which belonged to bore well owners. After establishing norms in pipeline networking, it has come down to 5 acres, within one season. Earlier the net cultivable area during Kharif was 32-34 acres, which was increased by 10-12 acres, within one year. While the Rabi acerage was almost doubled in the same period.

All the farmers in the pipeline network have installed sprinklers for taking up groundnut in Rabi. The pipelines have considerably reduced the labor time for irrigating the crop, apart from increasing water use efficiency.

There was also significant increase in Groundnut production during Rabi. Whileit was 6623 Kgs in 2008-09, it increased to 10470 Kgs in 2009-10 Rabi season.

Cropping Pattern (Season Wise)

SEASON	CROP	2008-09	2009-10	2010-11
Kharif	Paddy	6.5	4	4.5
	Redgram	11.2	11	13
	Maize	13.5	14	4
	Green gram	0	5	18
	Cow pea	0	0	5
	Total	**31.2**	**34**	**44.5**
Rabi	Paddy	1.5	2	2
	Groundnut	11.2	16.5	21
	Total	**12.7**	**18.5**	**23**

Conclusion

As water is a limited resource, production per unit of water has emerged as an important concept. For a farmer with a scarce supply, strategies to increase the productivity of water may lead to more income and better nutrition. This type of enabling interventions would reinforce the internal strength and coping mechanism of farmers to explore and find out stable solution to the issues of ground water depletion and its adverse consequences. It could also arrest the competitive digging of bore wells.