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Pollution of Groundwater

Lessons from Andhra Pradesh Farmer Managed Groundwater Systems (APFAMGS) Project

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The Issue

- Increasing groundwater pollution – Flouride, Arsenic, Agric. Pesticides, Industrial Wastes (heavy metals), Sewage discharges
- Public in-access to scientific data/information
- Depleting groundwater levels
- Futile investments in failed bore wells due to quality issues
- Entry into food chain
- Occurrence of dreaded diseases

Why this is important?

Increasing dependence on groundwater

- 65% irrigated area under groundwater
- 85% Rural Water Supply dependent on GW – direct impact on health
- More than 20 million wells existing now in India
- New irrigated area is coming from GW alone - in Gujarat (last 10 yrs) 35 lakh Ha is added from GW
- 10% agriculture growth in Gujarat possible only due to GW
- 1/3rd of Worlds Population is dependent on GW

into Food Chain?

Recent FAO study in Bangladesh on Arsenic shown;

- **The possibility of arsenic from groundwater entering the food chain through its accumulation into rice, the rice straw that is used as animal fodder, as well as in other crops**
- **The recognition that in addition to cancers, arsenic can lead to significantly increased mortality from heart attacks and other cardio-pulmonary diseases**
- ***Arsenic in vegetables and other crops -*** Leafy vegetables like amaranthus and Indian spinach, etc. accumulate more arsenic than fruity vegetables, namely eggplant, tomato, etc..

Human Exposure to Arsenic

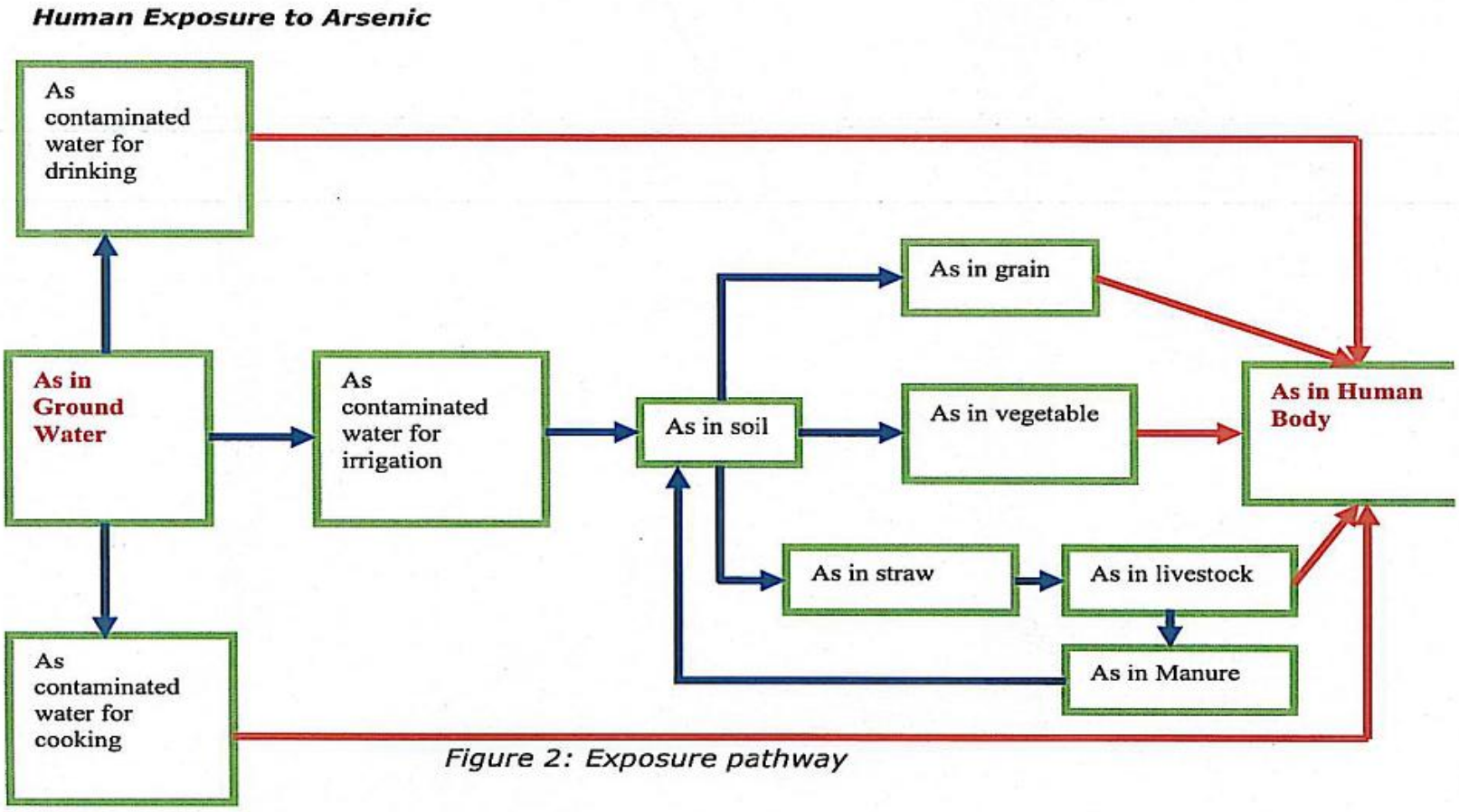


Figure 2: Exposure pathway

How is it addressed now?

Conventional approach

- Technical solutions very sound but did not reduce the problem
- Knowledge about the extent and intensity of the pollution, available only to officials and scientific community
- Legislations available
- Top down approach (Bureaucratic)

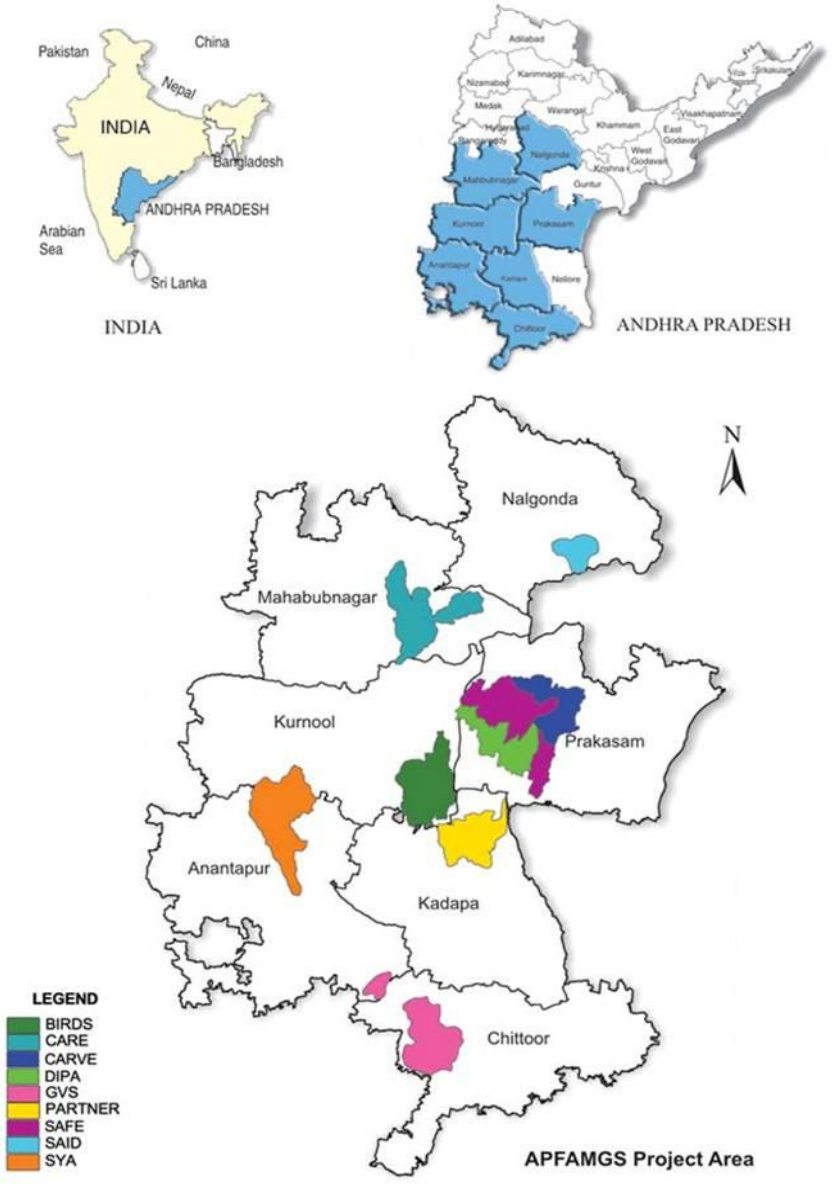
The Alternate Approach

- Free access to data including Environment Audit Reports
- Institution Building to enable end users participate in the governance effectively
- Provide Knowledge and Skills necessary for all actors
- Bottom up approach (Stake holder driven) -Change the way we think about groundwater
- Make Difficult choices

The Idea – experimented by FAO

- Users should be encouraged to monitor and manage their own groundwater system
- Blending of science and indigenous wisdom is possible
- Introduction of simple tools and skills would enable users to monitor & manage their groundwater systems

Location



63 delineated Hydrological Units, covering about 633 habitations, in seven drought-prone districts of the State of Andhra Pradesh in Southern India

Key Strategies

- Participatory Hydrological Monitoring (PHM)
- Demystifying science for the benefit of farmers
- Farmer Water Schools (FWS) – community capacity building – Experiential Learning methods
- Crop Water Budgeting (CWB) – farm level decision making – Water Audit
- Linkage building: farmers-scientist and farmer-government officials
- Building gender-balanced community based institutions around groundwater management

PHM

- Participatory Hydrological Monitoring or PHM refers to a set of activities carried out to keep track of the changes in a hydrological unit by the users themselves with little input from outsiders

PHM

1. Staff training/ orientation
2. Reconnaissance/ meeting with the opinion leaders
3. Delineation of the Hydrological Unit
4. Resource Inventory
5. Base Document

PHM

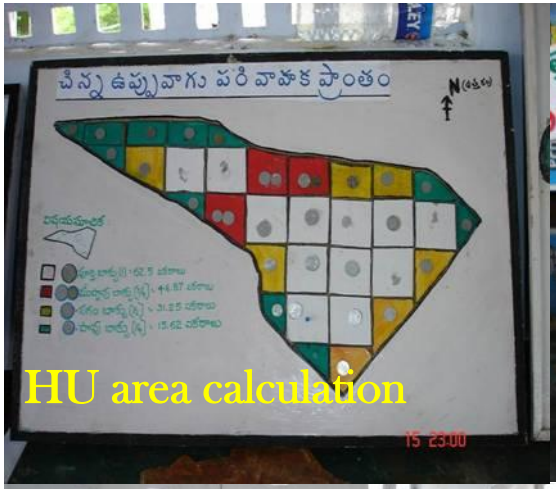
6. Site identification: RG stations and observation wells
7. Social feasibility study
8. Procurement of equipment/material
9. Establishing RG Stations and Observation wells
10. Supply of equipment to the community

PHM

11. Farmer training: PHM Module 1
12. Farmer data collection/ handholding
13. Farmer training: PHM Module 2
14. Farmer data recording/ handholding
15. Erection of Display boards/data display

Demystifying science

- Rural Folk-lore
- Audios
- Newsletter
- Exposure Visits
- Scientist-Farmer meeting
- Farmer Exhibition
- Clay/Wooden models
- Working models
- Banners/Posters


HU area calculation


Crop Water requirement

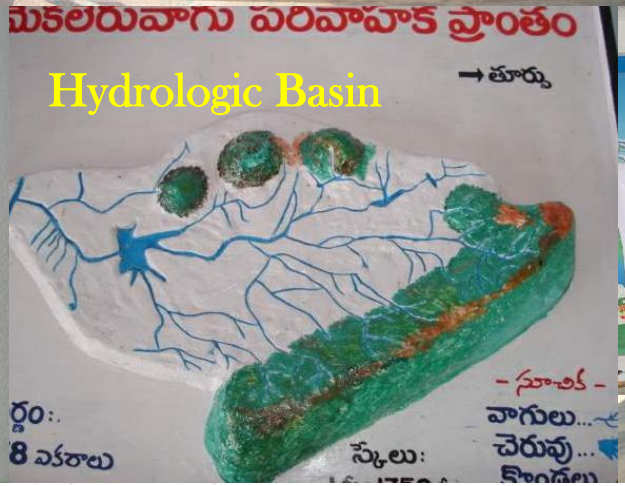

Hydrologic cycle


Borewell discharge measurement


Pumping wells In a basin


100 బిందెలు
11 బిందెలు
Recharge Rate


Land Use Pattern


Hydrologic Basin


Annual Water Balance

Farmer Water School

- Lasts a full hydrological year
- 25 and 30 farmer participants
- Once every 15/20 days
- Primary learning material: HU & farmer field
- Sessions at farmer plots
- Small groups of five to maximize participation
- Experiential, and participatory methods

FWS

- Hydro-ecosystem analysis, special topic, and group dynamics activity
- Compare farmer and experimental plots
- Several additional field studies depending on local field problems
- Ballot Box Exercise: Pre- and post-test
- Field Day: **share learning and results of their studies**

Crop Water Budget

- A set of activities carried out to compare estimated groundwater balance available for Rabi season with farmer crop plans, in a Hydrological Unit

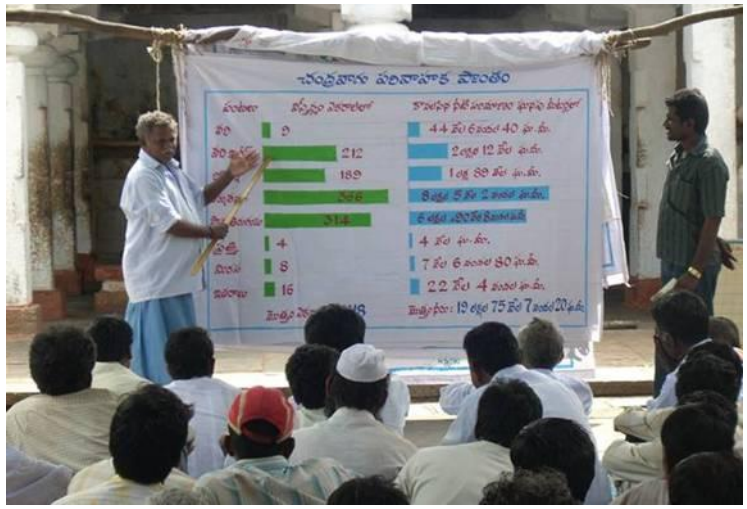
- Estimations are based on:
  - Farmer collected data
  - Groundwater Estimation Committee (GoI) Norms
  - ANGRAU Norms

Pre-CWB Workshop Activities

- Computation of hydrological data
- Resource Inventory Updating
- Crop Plan meetings
- Working with the CWB Package
- CWB Workshop Planning Sessions
- Material preparation
- Invitations (all the groundwater users in the HU)

Pre-CWB Workshop Activities

- Farmer Crop Plan
  - Well-wise, farmer-wise record kept
  - Data updated through group exercises
- Crop-Water Requirement
  - Arial extent of each crop computed
  - Standards of the ANGRAU
- Projection of water requirement for Rabi
- Projection of groundwater requirement for Rabi



CWB Workshop

- Conducted at HU Level
- Anchor and Presenters
- Large banners, clay/wooden models, posters, flexi-boards
- Sequence of presentations:
  - Groundwater Recharge (June-September)
  - Groundwater Draft (June-September)
  - Groundwater Balance, end of September
  - Farmer Crop Plan for Rabi
  - Projected Water requirement for Rabi crops
  - Comparison of demand-supply (deficit or surplus)
  - Comparison with situation in preceding CWB workshops
- Brainstorming: Probable changes in crop-plan
- Scheduling of habitation level follow-up meetings

CWB Workshop - glimpses

Water Audit

- Habitation level sharing of CWBW results
- Creating platform for decision making
- Listing of agreed changes
- Encouraging women participation
- Crop Adoption Survey (CAS)
- Analysis of changes in cropping, irrigation, etc.
- Computation of groundwater balance, based on CAS
- Comparison of CAS data of the present year with that of previous year

Reducing water demand

- CWB and later GMC meetings used as platform to trigger discussion on demand and availability
- Introducing water saving techniques/methods
- Introducing water saving devices
- Long-term experiments as part of FWS

Linkage building

- For post-intervention sustainability
- Between CBOs and the Government for accessing programs
- Between CBOs and the scientific community to forge partnership for mutual benefit
- Raising resources for Operation and Maintenance of community assets

Community based institutions

- Farmer Volunteers
- Groundwater Monitoring Committee – Habitation
- Hydrological Unit Network – HU
- District Level Network
- State Level Network

Results of the Approach

- Hydrological Monitoring Networks established
  - 190 rain gauge stations
  - 1948 observation wells for measuring water levels
  - 890 observation wells for measuring water levels and discharge
  - 90 observation wells for measuring **daily** water levels
  - 60 Stream Gauge Stations for measuring daily run-off from 63 HUs
- Farmers trained in groundwater management tasks
  - 4436 farmers in data collection
  - 3163 farmers in data recording and display
  - 1192 farmers in book keeping
  - 1866 farmers in Crop Water Budgeting

Results of the Approach

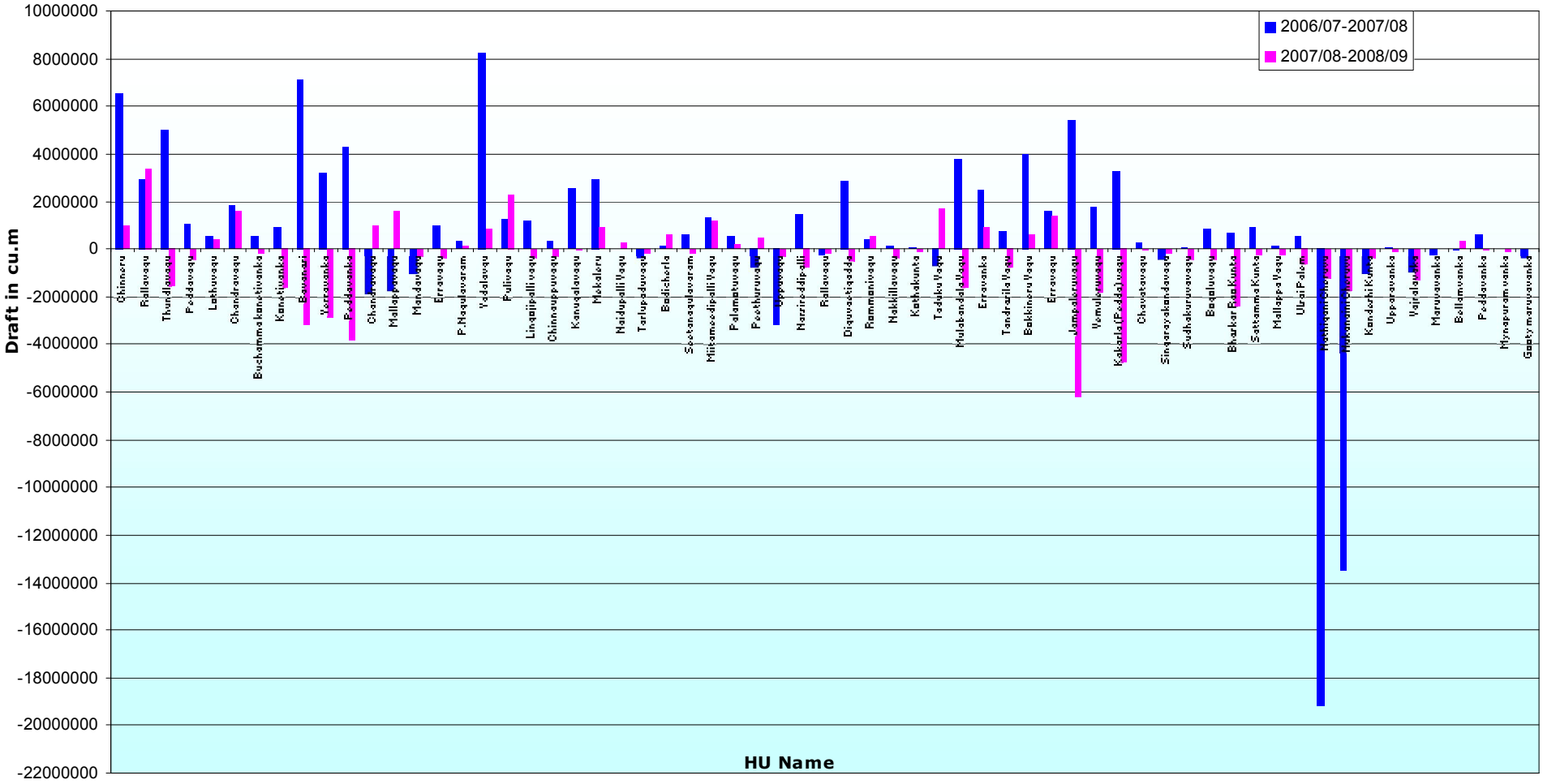
- Hydrological Information shared openly through:
  - 580 water level data display boards
  - 589 rain fall data display boards
  - 123 HU information display boards
- Trained farmers conducted Crop Water Budgeting exercise with all groundwater users (about half a million) in 63 HUs
- Farmers identified *47 over exploited aquifer zones*

Results of the Approach

- Farmers reduced groundwater draft in 36 over exploited aquifer zones through:
  - Switching to low water consuming crops
  - Practicing water efficient irrigation practices
  - Use of water saving devices
  - Organic farming

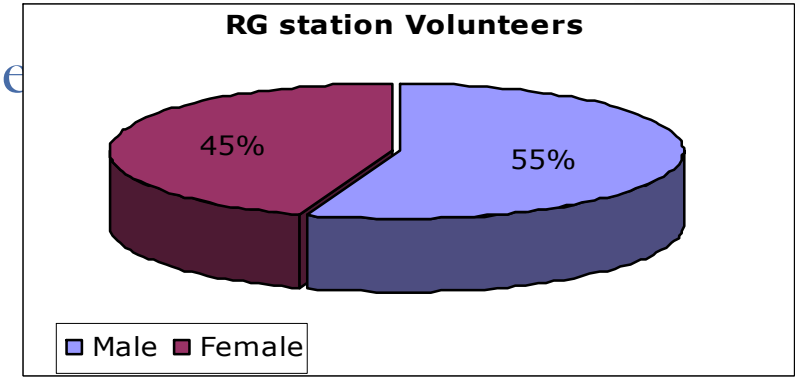


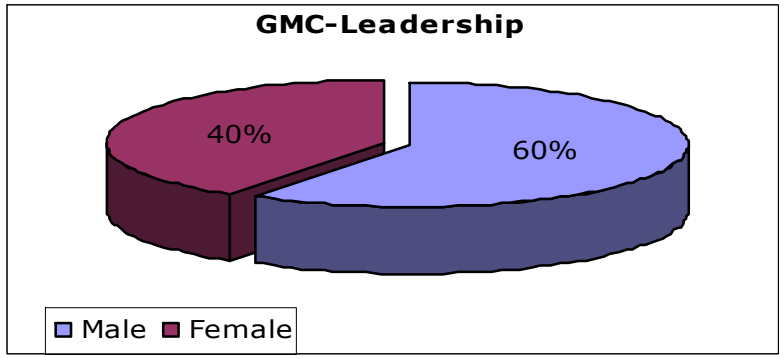
Results of the Approach

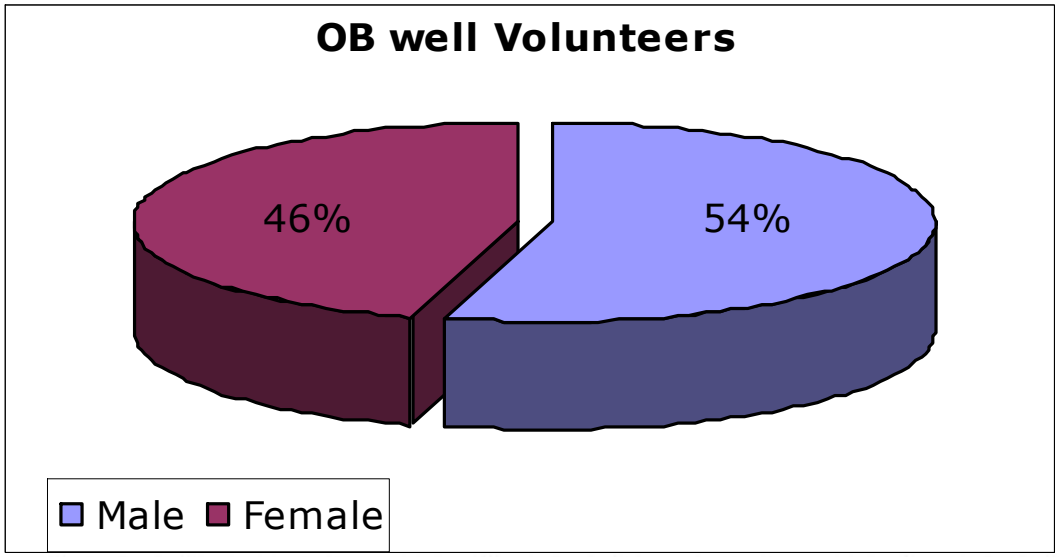


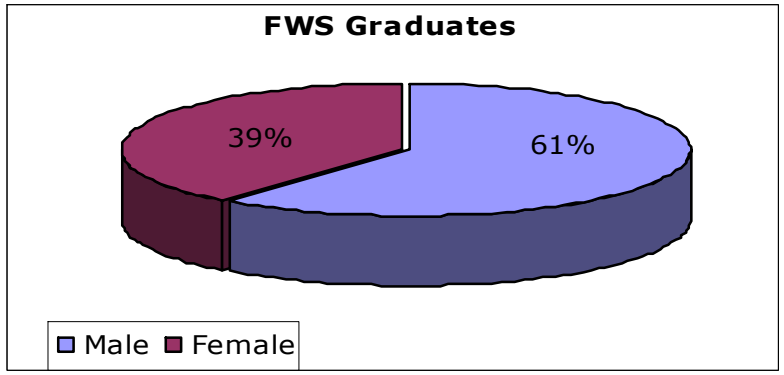
Results of the Approach

- Groundwater Management Committee formed:
  - 559 at habitation level
  - 63 at Hydrological Unit level (Registered)
- Gender balance









Unforeseen Benefits

- Farmers used hydrological data to lobby with the Government
- Farmers benefited indirectly through linkage building activity in terms of
  - Seed and other agricultural inputs
  - Subsidy on water saving devices
- Farmers share hydrological data freely with several government departments for scientific interpretations
- HUNs raised money (US$ 3,000)through data sales to:
  - The World Bank Study Team
  - National Geophysical Research Institute
  - Australian Council of International Agricultural Research

Response from External Environment

- Nominated for the Japan Water Prize in the World Water Forum IV at Mexico
- The World Bank carried out an independent Evaluation of the initiative
- The initiative is going to feature in the next World Development Report

Response from External Environment

- International Training on Demand Side Management of Groundwater conducted for Officers from 14 countries
- DSMG also conducted for Officers/farmers nominated by four State Governments (AP, Orissa, Maharashtra and TN)
- Exposure trip organized for the Hon'ble Speaker of the Rajasthan Assembly and 14 members of the house

Way Forward.....

- Initiate data collection by communities to improve data wealth and better understand the situation
- Real time data sharing – share the results of analysis with the communities
- Partner with local leadership, local governance bodies, local NGOs and agencies
- Share the Environment Audit Reports systematically to raise awareness and improve accountability
- Concepts that are relevant anywhere: HU, PHM, CWB, FWS and methods of rural communication

- **Thank U**

For further details,
visit http://www.apfamgs.org