Participatory Groundwater Monitoring and Management at the Village Level – enabling technology and people to work together for sustainable groundwater futures

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The Groundwater Problem

Groundwater levels have fallen too deep - from 10-15 m deep 50 year ago to now up to 500 m or more in some places;

Water scarcity for agriculture, drinking and industry needs
Some people suggested control the groundwater use by enacting some law and criminalise if someone breaks the law.

Some people have come up with technical solution – such as have a pump that operates when you insert a smart card and allows you to pump out allocated amount and stops when you have reached your limit.

Are the above solutions workable in reality and sustainable?

What kind of technology and technical solution will work?
Why do we have groundwater problem?

- Greed
- Limited knowledge
- Lack of understanding of what we are doing?

✓ So it is a people-related problem.
✓ So, we need people-friendly technical, social and policy solutions.
MARVI project – Key Activities

1. Participatory data collection;
2. Sharing information and building understanding;
3. Engaging with policy makers, government agencies, GW users and other stakeholders.

... see Maheshwari et al (2014) MDPI J Water
Partnership

Nine organisations:

- Western Sydney University
- Development Support Centre
- Arid Communities and Technologies
- MP University of Agriculture and Technology
- Vidhya Bhawan Krishi Vigyan Kendra
- CSIRO Land & Water
- International Water Management Institute
- Mekong Region Futures Institute
- Carnegie Melon University, South Australia Campus

>30 Researchers + 35 Farmer Researchers (BJs)

Running since 2012
Location of study areas

Dharta catchment, Udaipur district, Rajasthan

Meghraj catchment, Aravalli district, Gujarat
The MARVI Approach
Complexity of groundwater management
The role MARVI played
Actors in MARVI

- BJs
- Researchers
- MARVI
- Schools and Village Communities
- Gram Panchayats and State and Central Government agencies
What did we really do in the MARVI project?

Trained BJs and worked with them on ongoing basis;

Collected groundwater depth, rainfall amount, water quality, check dam water level and socio-economic data;

Worked with local schools and community groups;

Worked with Gram Panchayat and State Government agencies;

Developed tools and resources for data collection, analysis and capacity building; and

Connected with policy makers at the State and Central Government levels
Bhujal Jankaars (BJs)

- Engaged local volunteers, called Bhujal Jankaars (BJs); Groundwater Informed’ (25 +10)
- Trainings: basic hydro-geologic concepts, mapping, watertable and water quality measurements;
- Local champions and interface between research team and community
- Empowered and felt valued
Knowledge Transformation Processes for BJs

- Beginning of understanding of village
- Superimposing of topographic and revenue information on one map
- Identification of land mark on map with villagers

- Mapping of grazing land, source wise irrigation etc.
- Area calculation form the map

- Identification of rocks especially aquifer rocks
- Mapping of surface exposures of aquifer rock

- Mapping of existing surface water resource development
- Well inventory
- Beginning of sub-surface
- Understanding of water depth and quality (TDS pH)

- Identification of land foam conducive for water resource development

- Mapping of micro-watershed
- Water demand in each micro-watershed
- Run-off calculation

- Specific strategy for each micro-watershed
- Identification site and activity
Tasks Performed by BJs
Bhujal Jaankars (BJs) were trained in making field measurements and in reporting back to communities.

Kookana et al (2016) – gender and education; Packham et al
Groundwater monitoring by BJs

Example of Weekly Water Level Fluctuation in Rajasthan from July’12 to Jan’13

Depth to water table (m)
Hinta village hydrographs - 20 wells
Depth to watertable in 20 wells, July 2012-Dec 2014

30 metres
Hinta 2014

Hinta-Cumulative inflow, recharge, evaporation and concurrent storage volume in Hinta recharge structure, Jul 14- Jan 15

- Rainfall (mm)
- Volume in MAR structure (m³)
- Cumulative recharge (m³)
- Cumulative inflow (m³)
- Cumulative evaporation (m³)
- Cumulative spill (m³)

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**Legend:**
- Orange: Rainfall (mm)
- Green: Volume in MAR structure (m³)
- Blue: Cumulative recharge (m³)
- Red: Cumulative inflow (m³)
- Yellow: Cumulative evaporation (m³)
- Black: Cumulative spill (m³)
- Dashed black: Sill Level
Monitoring groundwater levels

Simply measuring and wooden float
Monitoring groundwater levels

Installation of depth sensor
Measuring rainfall
Measuring rainfall

Simple raingauge; <$5
Measuring weather

Automatic weather station
Checkdam monitoring and recharge analysis
MyWell

Crowdsourcing rainfall, groundwater levels, checkdam levels and water quality data to support VGCs; Android version 2;
Historical readings for 1 month, 3 month, or year long intervals

Compare today’s readings with the trends over the last 2 years
Storing and sharing groundwater data

Farmer using MyWell
Enabling technology needs to help people to work together for sustainable groundwater futures

For managing and sustaining groundwater, we need information on four aspects:

1. Groundwater Levels
2. Rainfall
3. Water quality
4. Checkdam water level

If we have the above information, we can understand what is happening in terms of groundwater use and recharge.

It is important to remember that we are solving the problem that was created by people and any good solution needs to involve them.

Any use of technology should work with people; not remove them from the scene and alienate them.

Also, technology can be used for training and capacity building → e-Learning through short video; online platform for specific self-paced learning etc.
Conclusions

Ø Complex problems often require simple solutions. This is very much true for groundwater management.

Ø The participatory, village level monitoring approach developed in MARVI can empower local community and help develop their own groundwater management dialogue and strategies.

Ø Communication about what is happening, what can be done and how it can be done is the key with a common pool and invisible resource such as groundwater.

Ø We need to develop and simplify groundwater science that can be used by farmers and implemented by government agencies.
Conclusions

• BJ can collect highly reliable information for groundwater level, rainfall and recharge estimation with simple technology.

• BJ collected data can be used for communicating village scale groundwater balance analysis and modelling.

• Villagers can find their solutions if they are supported and nurtured.
MARVI Publications

Available for download at http://www.marvi.org.in/books
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