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Working Paper 3

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INTRODUCTION

The Kanakavati sandstone is spread across 4 blocks in Kachchh district of Gujarat and is the only dominant groundwater resource in coastal Kachchh areas. Around 5.43 lakh people in these 4 blocks – 3 lakh rural people and 2.43 lakh urban people depend on the shared aquifer for their water needs. (See Fig. 1). Industries in the region - thermal power projects, ports and other manufacturing industries and Special Economic Zones (SEZs) are also heavily dependent on groundwater making it economically significant.

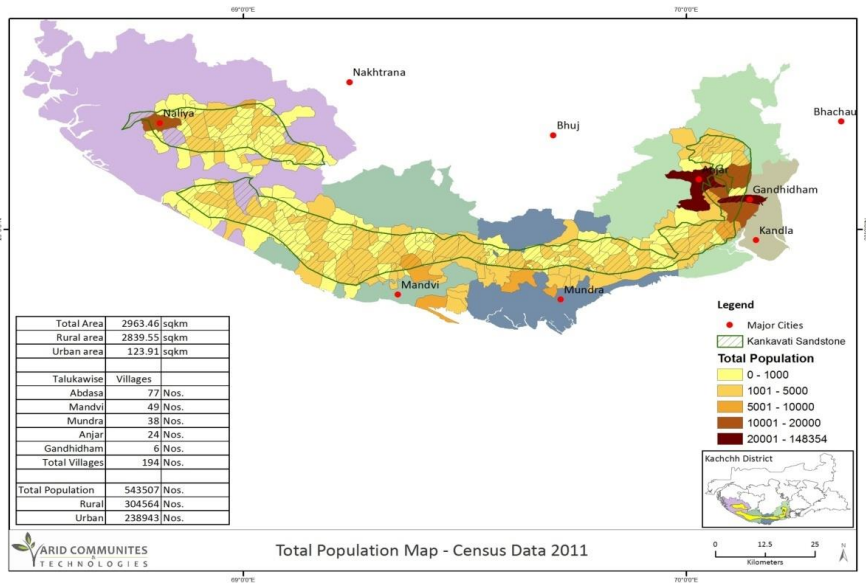


Fig. 1 Population Distribution on Kankavati Sandstone

Over time, there has been a severe stress on the aquifer which has affected both quantity and quality of water available. Three of the 4 blocks have been declared dark zones by the CGWB. The water has high TDS in all blocks, and over 50% of all villages in Abdasa block report saline ingress. The aquifer being shared between a variety of users and uses has led to competition and conflict between various groups.

Arid Communities and Technologies, (ACT) a Bhuj based organization has worked extensively in the Kanakavati Sandstone to demonstrate a science based, participatory approach to help manage the aquifer. The Participatory Groundwater Management (PGWM) Approach they implement espouses the following principles:

- Groundwater is a common pool resource.
- An aquifer-based understanding is necessary for groundwater management.
- Groundwater management must be understood across different uses.
- The units of groundwater management should be aquifers, watersheds and habitations.
- Groundwater management requires long term engagement.
- Management should catalyse community action.
- Groundwater management should integrate formal and peoples' knowledge.

ACT's work in the Kanakavati sandstone began with an understanding in 20 villages and has spread to all 4 blocks covering rural and urban areas. It offers a rich insight into principles for managing this shared aquifer.

KANKAVATI SANDSTONE

The first step in ACT's work was to understand the Kanakavati sandstone better.

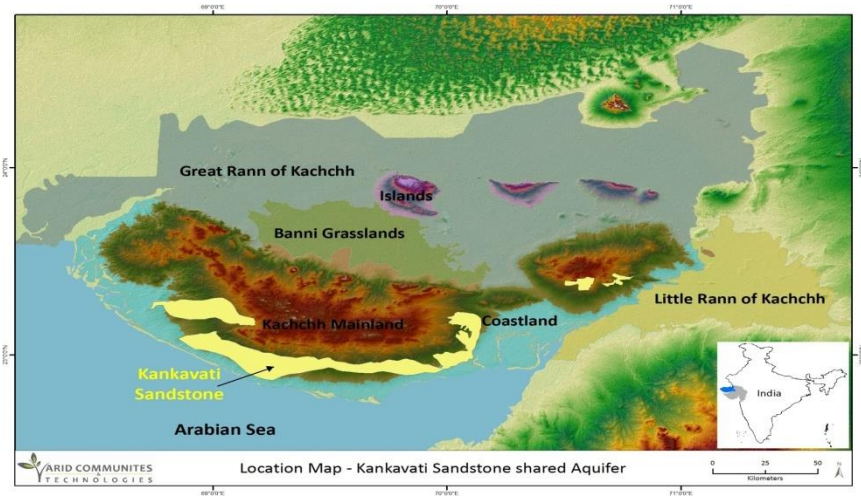


Fig 2. Location kankavati Sandstone

Kankavati sandstone represents the upper Tertiary formation of Geological timescale and is called the Manchar sandstone in Sind, Pakistan (See Fig. 2). The rocks of Kankavati Fm. belong to Pliocene age. Rocks of this formation overlay Khari Fm. of Miocene age. The litho-sequence represents a youngest Tertiary unit which is overlaid by coastal alluvium throughout its extension. Kankavati Fm. is exposed as a wide continuous belt of outcrops along the coastal plains of southwest, south and southeast of Kachchh Mainland region from Naliya in the west to Anjar in the east. A complete sequence is exposed in Kankavati River cliffs between the villages of Vinjhan and Sandhan. However, in the Mainland region i.e. south and south eastern parts, only upper most unit of the Kankavati is exposed. This has Deccan Trap as base (Biswas, 1993). Similarly, patchy outcrops are seen occurring in the Wagad highland area. The Kankavati Fm. is dominantly arenaceous in composition with intercalations of clay stone, shale, siltstone, marlites and calcareous sandstone as sub-ordinate constituents. The Kankavati Fm. attains its maximum thickness of 320 m in its type section that gradually decrease towards east. The complete sequence indicates its deposition in a regressive sea phase and under littoral to flood plain environment (Biswas, 1993).

Being highly porous and permeable, the Kankavati sandstone forms an ideal aquifer. Its unique inter-boundary, inter-watershed spread makes managing it a complex exercise involving multiple stakeholders. Improper and insufficient data, a lack of knowledge on aquifer characteristics, and a complete disconnect from the community further exacerbate the issues of management. Added to this is the problem of over-extraction by multiple stakeholders that was already discussed.

THE PGWM APPROACH - SPREAD

To tackle the problems of declining water tables and degradation of water quality, ACT implemented the PGWM approach as one of the resource centers supported by Arghyam to understand aquifer characteristics and work with the stakeholders to create decision support tools. This work which began in 20 villages of Abadasa Block has now spread across 4 Blocks through multiple collaborations:

- Kankavati Sandstone aquifer management in coastal blocks of Kachchh district, in collaboration with communities, Community Based Organizations, Kachchh Fruit Fodder and Forest Development Trust (KFFFDT), Infrastructure Leasing and Finance Services IL&FS), PARAB, Gujarat Institute of Desert Ecology (GUIDE) and Vivekanand Research and Training Institute (VRTI) .
- Aquifer mapping and management in Rapar area by training team members and volunteers of Samerth project areas.

- Mapping aquifer in two Rural Water Supply Scheme (RWSS) areas of the *Kachchh Jalmani* Project in collaboration with WASMO and Gujarat Water Supply and Sewerage Board (GWSSB).
- Kutch District level water management planning in collaboration with Federation of Kutch Industries Association (FOKIA).
- Implementation of Participatory Ground Water Management activities in Bhuj town in collaboration with Bhuj Nagar Palika (BNP), Bhuj Area Development Authority (BHADA) and Jalstrot Sneh Samvardhan Samiti (JSSS).

ELEMENTS OF THE PGWM APPROACH

Across the various partnerships, ACT has followed the following steps to ensure participatory, scientific groundwater management that reflect the PGWM principles outlined above.

- **Capacity building:** The first step to understanding the aquifer better is to create of professionals and partnerships that can help in data collection and aquifer characterization. Several institutional partnerships were established for aquifer mapping and generation of baseline data creation process. For e.g. ACT worked with organizations such as Sahjeevan, VRTI, KFFFDT to support them in planning and implementation of their projects such as the "Pani Thiye Panjo" work. PhD and M.Sc. students of M. S. University and Kachchh University also support data collection. To help map the aquifer at a micro-scale, a cadre of young professionals were trained in hydrogeology. These professionals have become the backbone of knowledge on the Kanakavati sandstone and have formed their own organization –the Naliya Parabs (See Fig. 3).

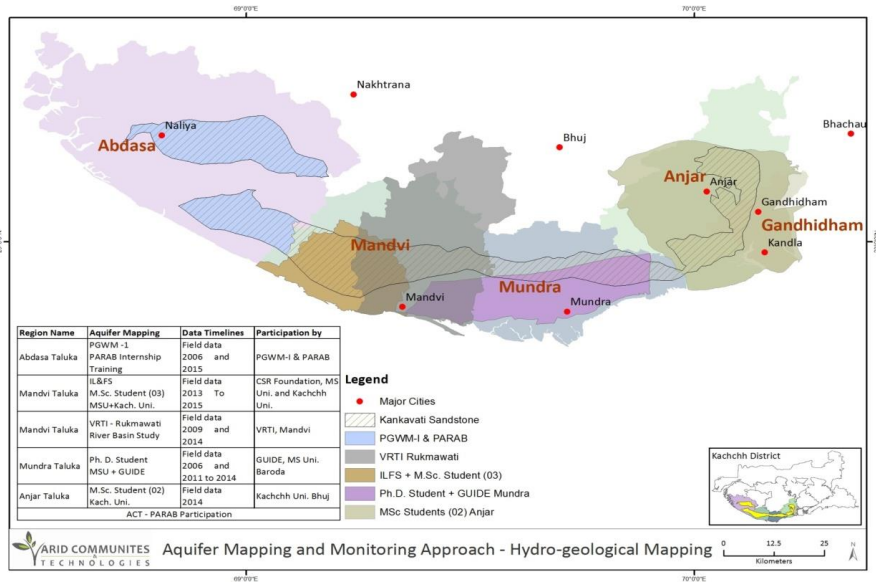


Fig. 3 Aquifer Mapping and Data Generation Process - Collaborations

- **Data collection:** The trained cadre of para-hydrogeologists and local partners generate baseline information. A groundwater monitoring network has now been established (See Fig. 4). A monitoring network of 1190 observation wells on entire aquifer has been put in place in the pre monsoon season of 2015.
- **Analysis and intervention design:** Based on the data collected, preliminary analysis on water quality and water level is produced in addition to regional level information such as water resources, watersheds etc. (See Fig. 5). The results are discussed with various experts including rural experts, and local CBOs, and village groundwater management committees. This helps in the creation of the detailed decision support tools for groundwater management.

- **Working through partnerships:** As indicated earlier, the work on Kanakavati sandstone involves multiple partnerships between different stakeholders like government organizations (WASMO, GWSSB, CGWB, GWRDC etc.), non-government organizations (Samerth, KFFFDT, VRTI etc) and CBOs (FPO, PARAB, JSSS etc). These partnerships transcend institutional linkages and the rural-urban divide.

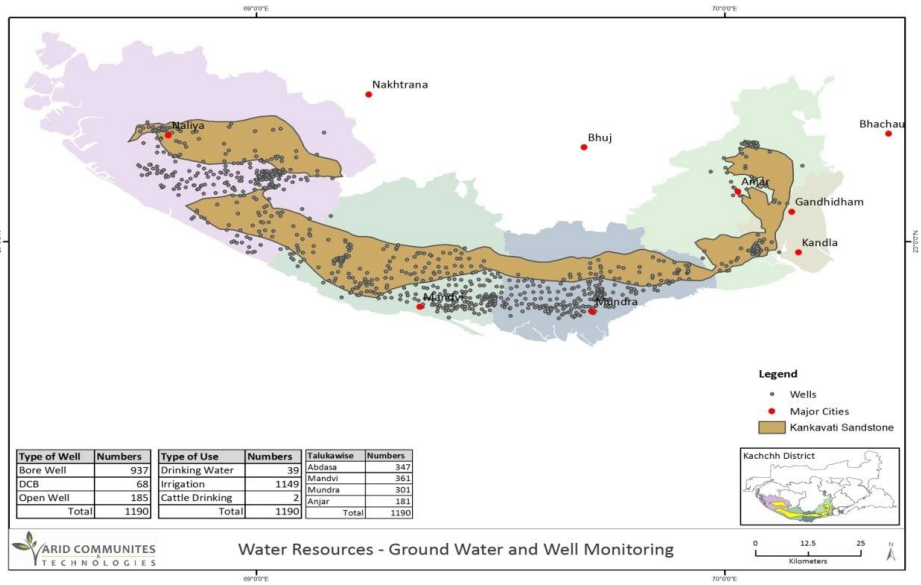
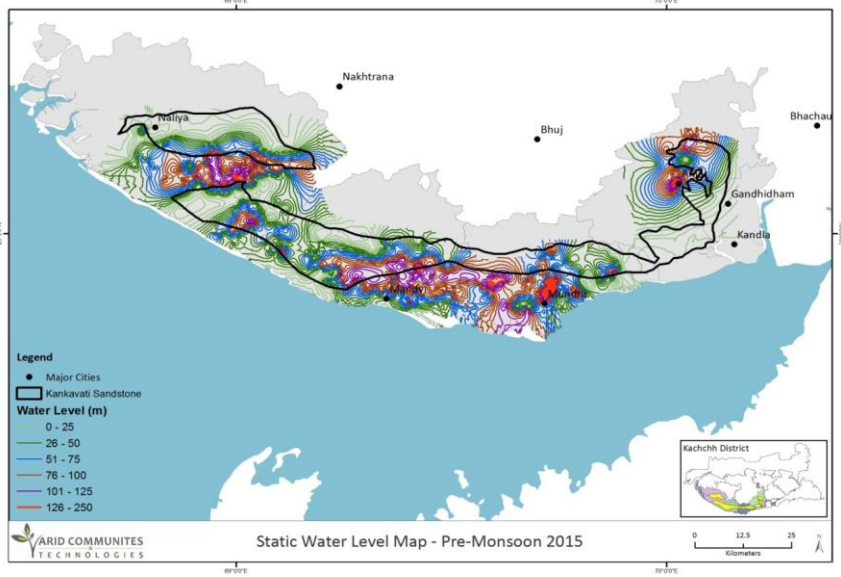


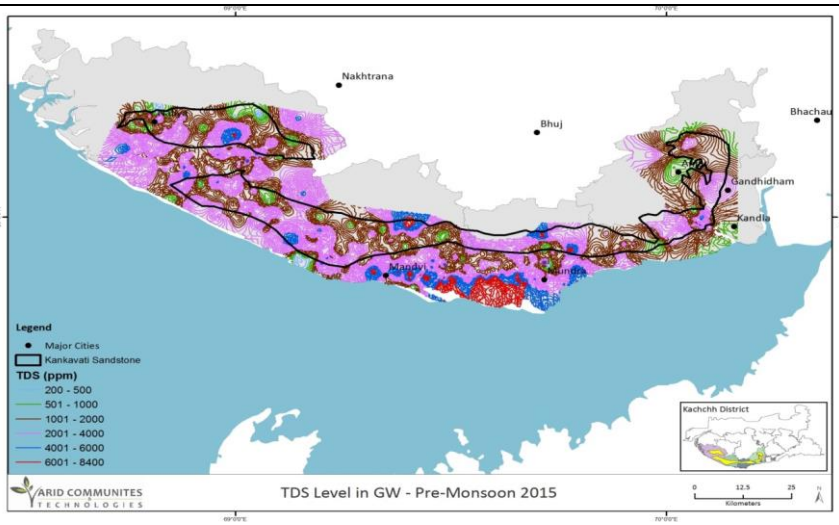
Fig. 4 Monitoring Network on Kankavati Sandstone

- **Feeding back information to community and government:** The decision support tools that are designed with stakeholders are fed back into the communities for implementation. Farmer producer companies have shown interest in understanding and implementing this work to secure critical irrigation for the crops. The work is also shared with wider stakeholders such as academic institutions - especially in Kachchh University and the Agriculture University. Sensitization on the approach is also carried out with government officials of Salinity Ingress and Prevention Circle (SIPC), Irrigation, and the Groundwater Department.
- **Scaling the PGWM Approach in Kanakavati Sandstone:** Given the shared aquifer nature of the Kanakavati sandstone, ACT has moved away from a village by village approach to a larger, aquifer-level approach. This is expected to help frame larger water management strategies for supply side management and decision making e.g. to prepare recharge plan, allocation etc. To manage this, villages have been aggregated into clusters. This clustering helps demand side management and embedding the PGWM principles through technological inputs, practice level interventions, drinking water source protections etc in local self governments.

  In order to understand the groundwater situation, design appropriate interventions and use the knowledge generated to provide evidence for work in other areas about eight representative clusters (two in each block and 5 villages in each cluster) have been identified to demonstrate PGWM interventions (See Fig. 6)



A



B

Fig.5 Decision Making Tools for Aquifer Level Management Plan A. Static Water Levels and B. TDS Concentrations in GW of Kankavati Sandstone

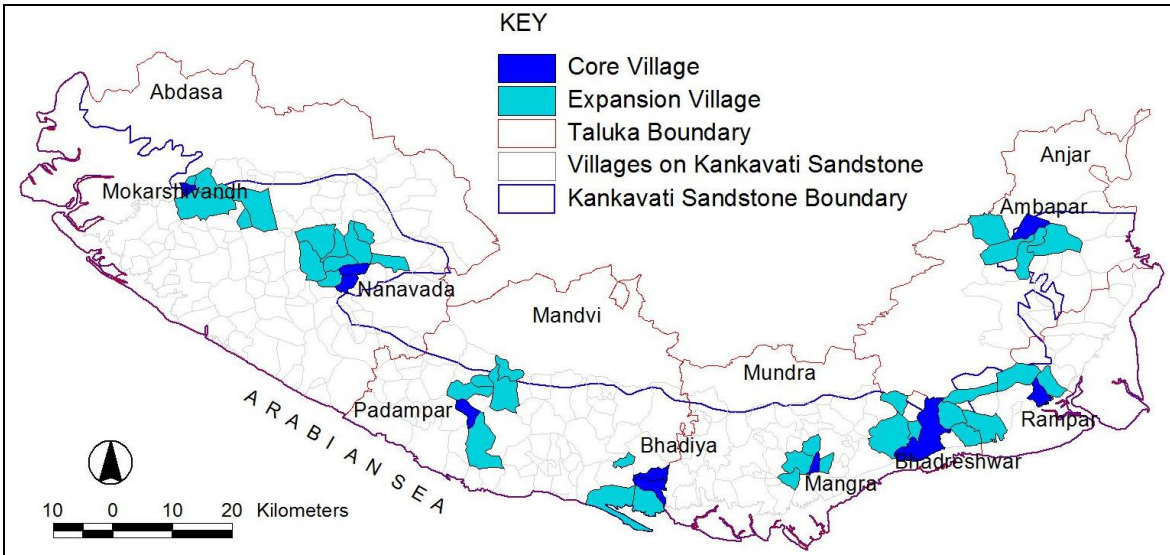


Fig. 6 PGWM Demonstration Clusters

WAY FORWARD AND RECOMMENDATIONS

The work has entailed departure from traditional approaches that have been adopted for water security in Kachchh in 3 significant ways. First, is to place emphasis on local solutions wherever possible for water security. Second is to not restrict treatment to areas affected by salinity but treat adjoining areas as well. Third, is to, wherever hyrdro-geologically relevant, convert surface storage structures like tanks to recharge structures. This helps in increasing underground storage and significantly reduces losses due to evaporation.

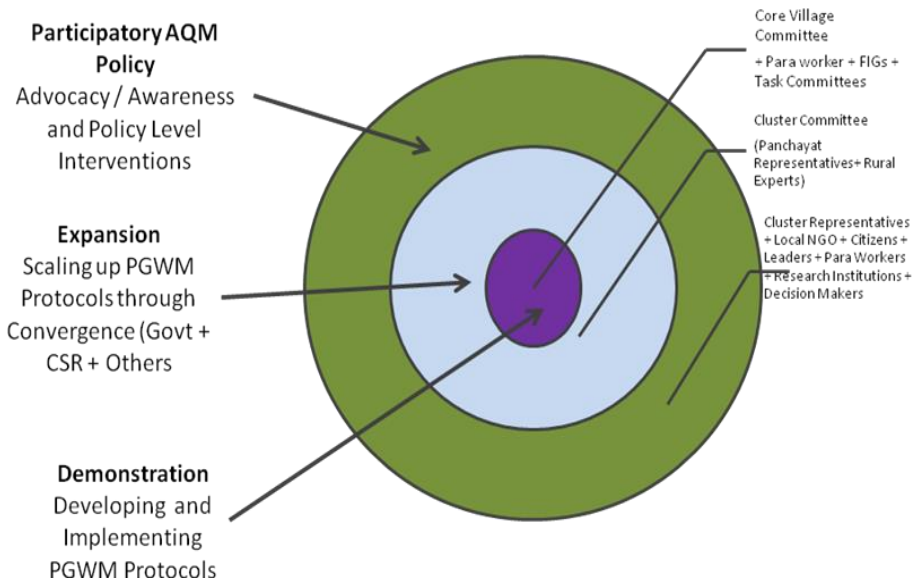


Fig. 7 Groundwater and Aquifer Management at Various scale

The PGWM Approach holds tremendous promise for collective, science-based aquifer management in the Kanakavati sandstone. Based on the work done so far, it is possible to create aquifer-lever management protocols (see Fig. 7).

An aquifer-level solution is only possible if government and non-government agencies collaborate. Some possible actors and collaborations are outlined below.

- **CGWB** is the premiere organisation for both data collection and trainings on hydrogeology in the country. An aquifer level approach in the Kanakavati sandstone can be facilitated through joint data collection. To do this, joint trainings could be undertaken to build a cadre of around 40 para hydrogeologists – 10 per block for data collection, monitoring, water budgeting and water allocation planning over 2 years. The data collected can serve as advisories to district based on sound data and approach for management of groundwater.
- **WASMO** is an unique organisation in Gujarat set up to promote drinking water security and community level water management. A collaboration with WASMO is already underway in the *Kachchh Jalmani* project. This could be expanded to the 5 blocks of Kachchh. It would also be highly beneficial if the scope of *Kachchh Jalamani* is enhanced to include development and implementation of source protection guidelines in its work area.
- **GWSSB** has the mandate of regulating water supply, incorporating source protection guidelines for individuals has shown great promise in working areas. These could be incorporated within GWSSB as well to prevent exploitation of groundwater, especially around the critical influence zone of the source. GWSSB can also play a pivotal role in promoting simple but effective solutions such as rain water harvesting across urban and rural through special schemes.

- **The Irrigation department** can use the water balance exercise in the command area to assess the irrigation potential and can use this exercise to create management plans as is being done in North Gujarat.
- **The ZP (DDO)** should consider designing projects for water security based on an understanding of aquifers and participation. It is possible to incorporate elements of the PGWM Approach outlined above into the Integrated Watershed Management Plan process. Civil society and communities have also successfully used MGNREGA to provide employment to local people and ensure aquifer based groundwater management. At the same time, it could help align agriculture research and extension work to focus on demand management.
- Several Industries have been established in the Kanakavati sandstone that rely heavily on groundwater availability for functioning. These industries are investing in groundwater management as a part of their work on Corporate Social Responsibility. It would be ideal if they invest in data collection and aquifer management as a part of their business strategy for sustaining their production.

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