Design of watershed intervention for tackling drinking water problem – case study of Mograj habitation

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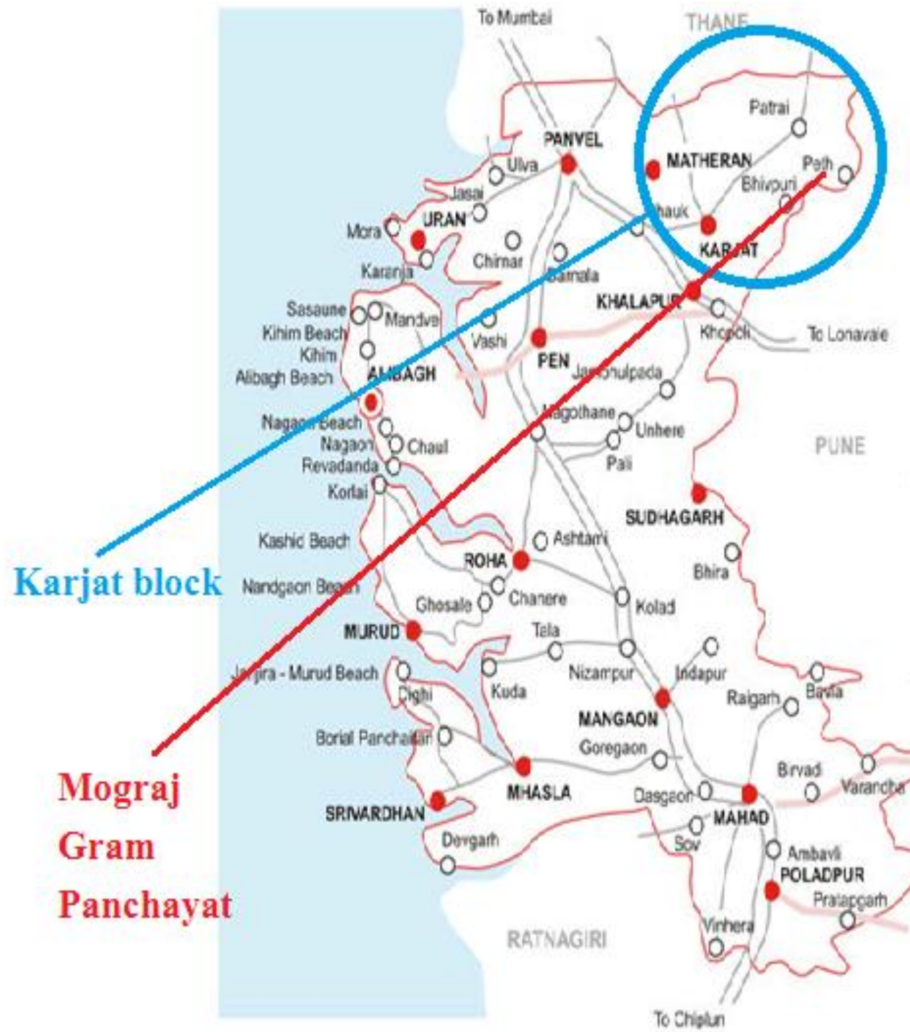
Overview

- Information about Mograj
- Understanding the needs (interactions with stakeholders)
- Understanding the watershed (gathering data from primary and secondary sources)
- Modelling the watershed, and proposing intervention based on analysis and simulations

Mograj, Karjat block, Raigad district, Maharashtra

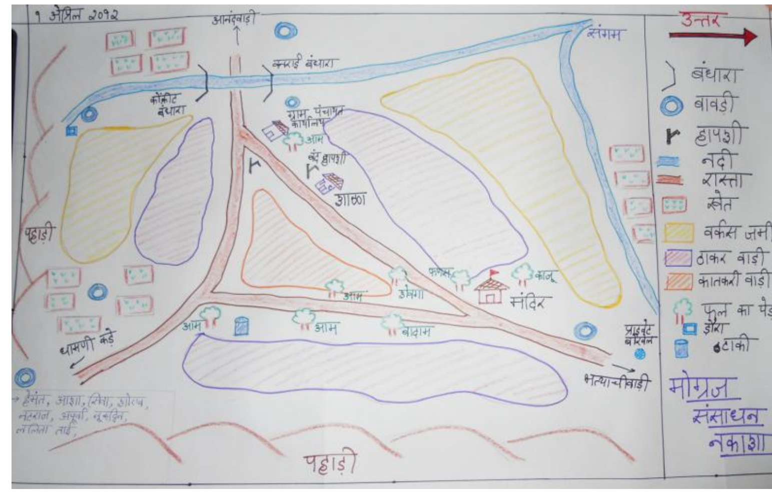


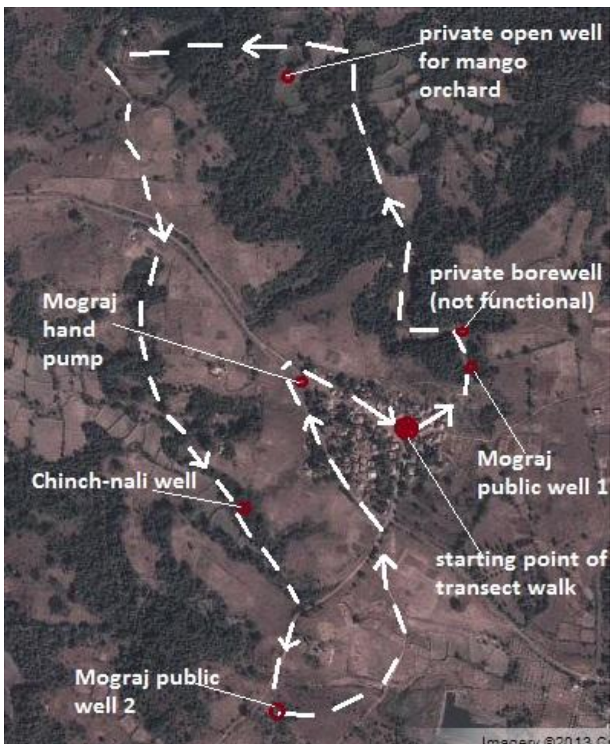
About Mograj

- Small and poor tribal hamlet (75 households) situated in the foothills of the Western Ghats
- Rainfed region – subsistence farming (paddy, *varai*, *nagli*)
- High rainfall (over 2500 mm), high runoff zone, underlain by basalt
- Drinking water problem in dry season (March to June) every year, like many other hamlets in the region

Understanding the needs (interactions with stakeholders)

- Participatory Rural Appraisal, interviews, discussions
- Secondary data - Census, National Rural Drinking Water Programme portal, Google Maps etc.





Understanding the needs - Drinking water scenario

Water source	Type	Ownership	Distance	Depth	Water availability
Public Well 1	Open Dug well	Public	100 m	10 ft	Till January
Public Well 2	Open Dug well	Public	500 m	25 ft	Till 1st week April
Hand pump 1	Bore	Public	Non functioning	-	-
Hand pump 2	Bore	Public	50 m	100 ft	Till April
Chinch-nalichi well	Open Dug Well	Public	750 m	20 ft	Till April
Farm house well	Open Dug Well	Private	1 km	20 ft	12 months
Purshottam Patil's Well	Open Dug Well	Private	1.6 km	25 ft	12 months
Anandwadi well	Open Dug well	Public	2 km	25 ft	12 months
Chaudharwadi well	Open Dug well	Public	2.5 km	-	12 months
Private bore well	Bore	Private	Not in use presently	100 ft	-

Outcome of needs assessment

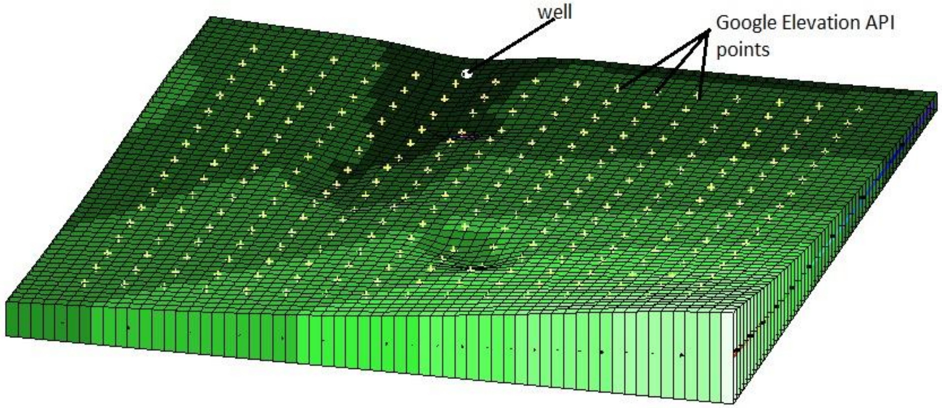
- Water availability (types of sources, distance to source, availability during dry seasons etc.)
- Water consumption (season-wise, source-wise)
- Functional / non-functional schemes
- Other on-going schemes

- *Varchi* well (public well 2) was chosen for watershed treatment
  - Most land in watershed was fallow, less chances of land conflicts
  - Slope suitable for watershed treatment
  - Almost whole village depends on this well during dry season
  - Well is not too far from the village, access path is not difficult

Understanding the watershed - Preliminary survey of the watershed

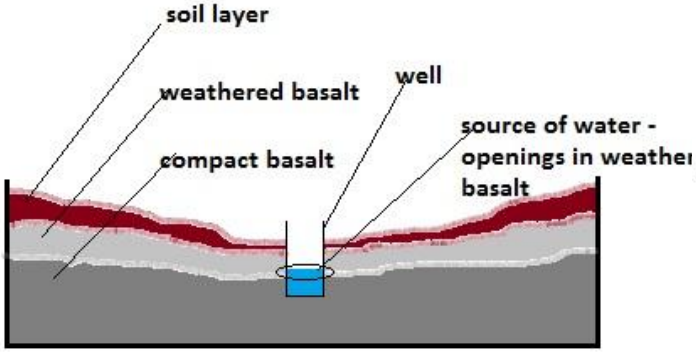
- Identifying boundary conditions
  - Traversing the watershed boundary (delineation of rough boundary with the help of GPS)
  - Noting down streams, small hillocks, paddy fields etc.
  - Getting key information from villagers about water logging, flows in the stream at different times etc.

Understanding the watershed – data collection and surveys

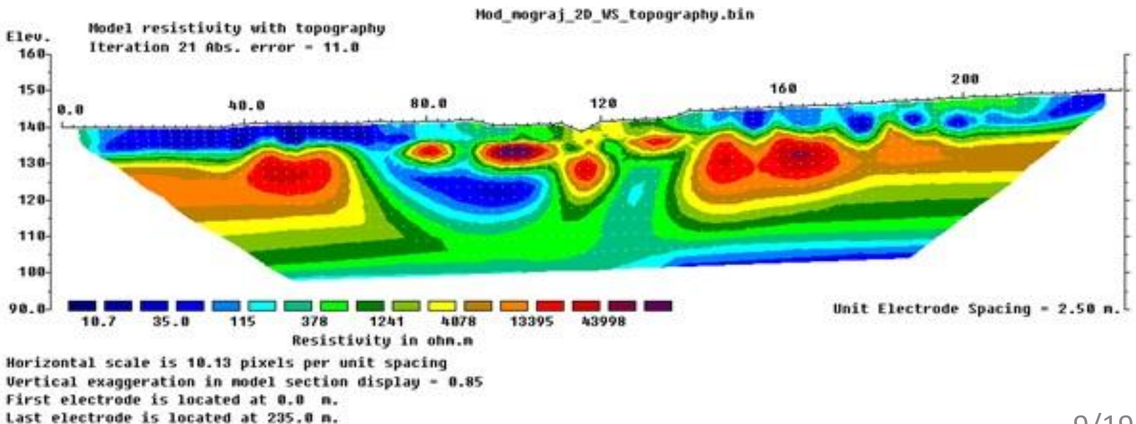


Terrain data

Soil data



Geological data

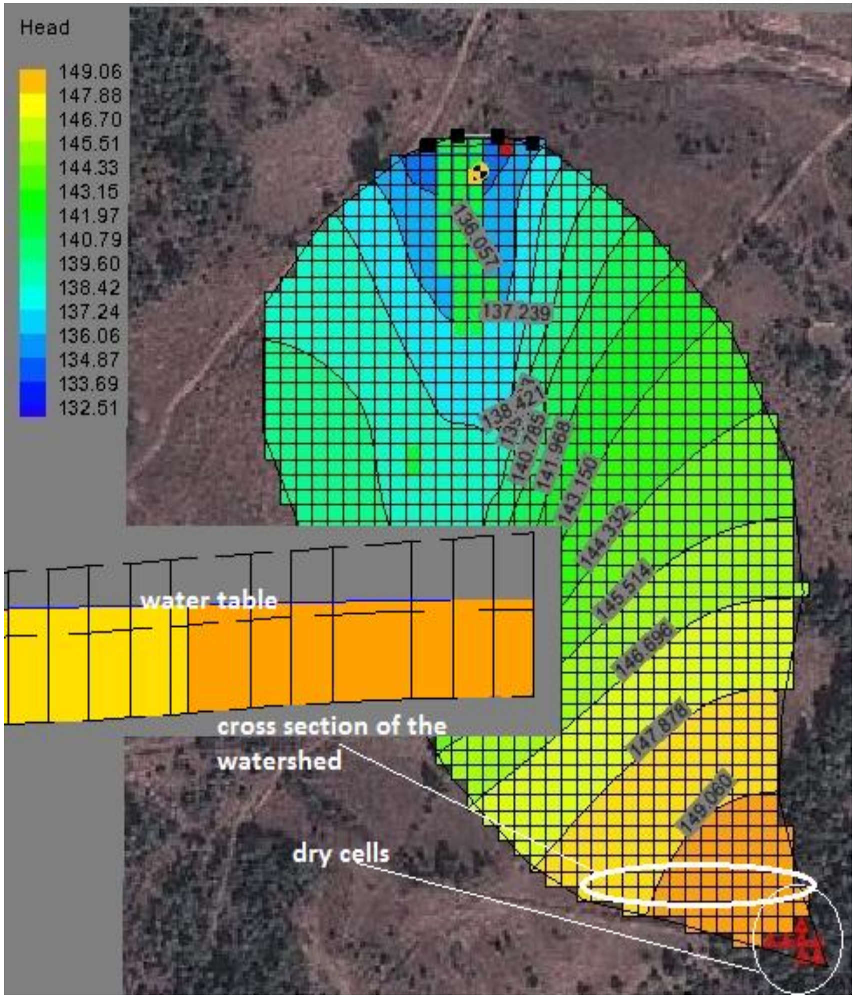


Outcome of studying the watershed

- Presence of thick conductive layer in the upper catchments, hence contour trenches to hold rainwater for longer period after monsoon seemed to be the best option
- Very thin soil layer around the stream, hence less chances of recharging the aquifer through check dam in the stream
- MODFLOW (groundwater modeling software) to be used to model the watershed and simulate contour trenches to see their impact on *varchi* well

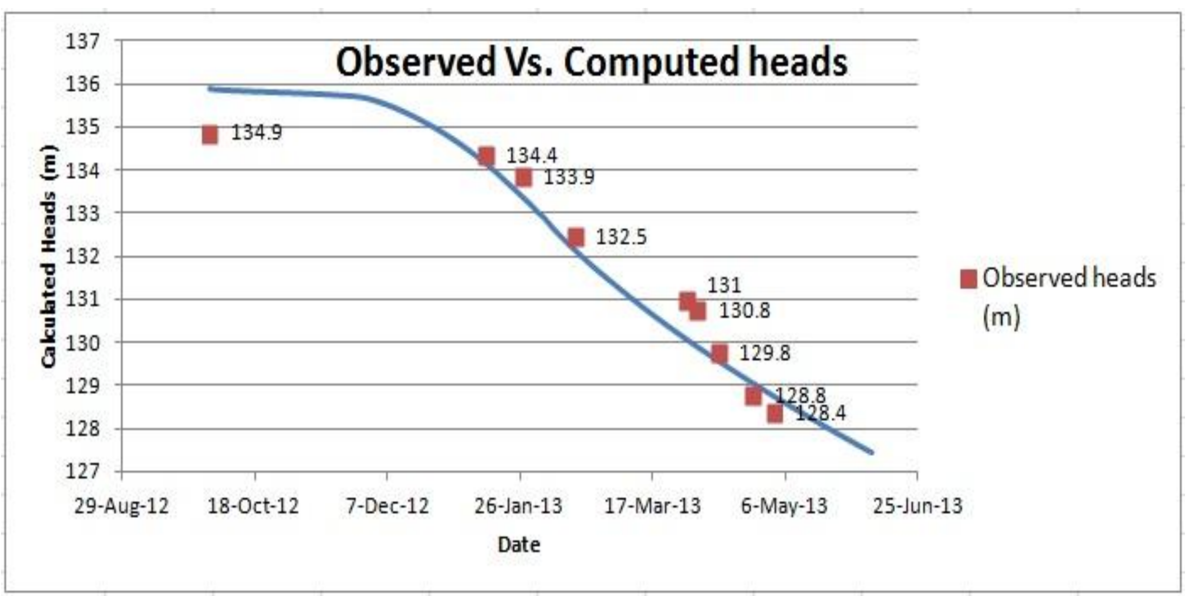
Steady state simulation (model calibration)

- Model was run in steady state with constant head boundary condition to simulate the monsoon season
- Model was caliberated through multiple iterations so as to match the on-field conditions by adjusting parameters
- Simulation results showed that most of the top layer in the upper catchment area remains dry just after the monsoon season



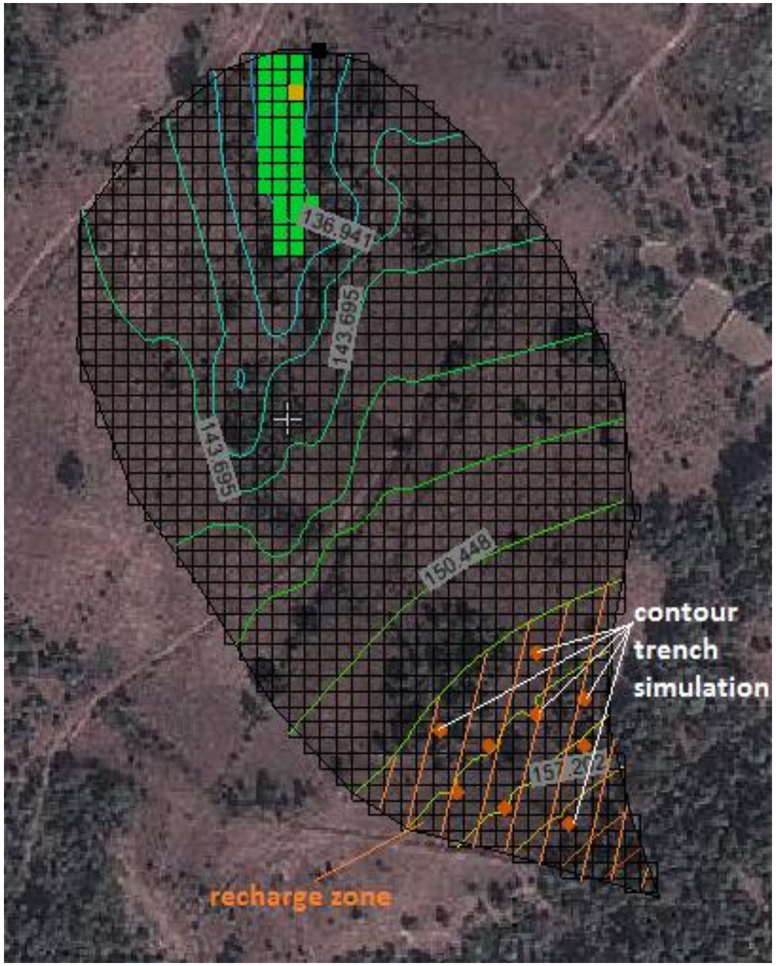
Transient state simulation (model validation)

- Model was run in transient state for **250 days (i.e. from 1st October to 8th June of next year)** to simulate the dry period (i.e. recharge rate = 0)
- Drain boundary condition used, heads allowed to fall as water flows out of the groundwater system from bottom face of the boundary cell, depending on the conductance
- Well withdrawal data and observed heads at well entered into the model



Conceptual model of contour trench

- Basic assumption – Contour trenches will be filled completely and continuously during steady state (due to heavy rainfall and fairly low conductivity of the soil)
- Thus, contour trenches can be modelled using constant head cells in the recharge zone
- Total no. of staggered trenches to be dug = approx. 200 (i.e. 200 cubic meters of excavation)



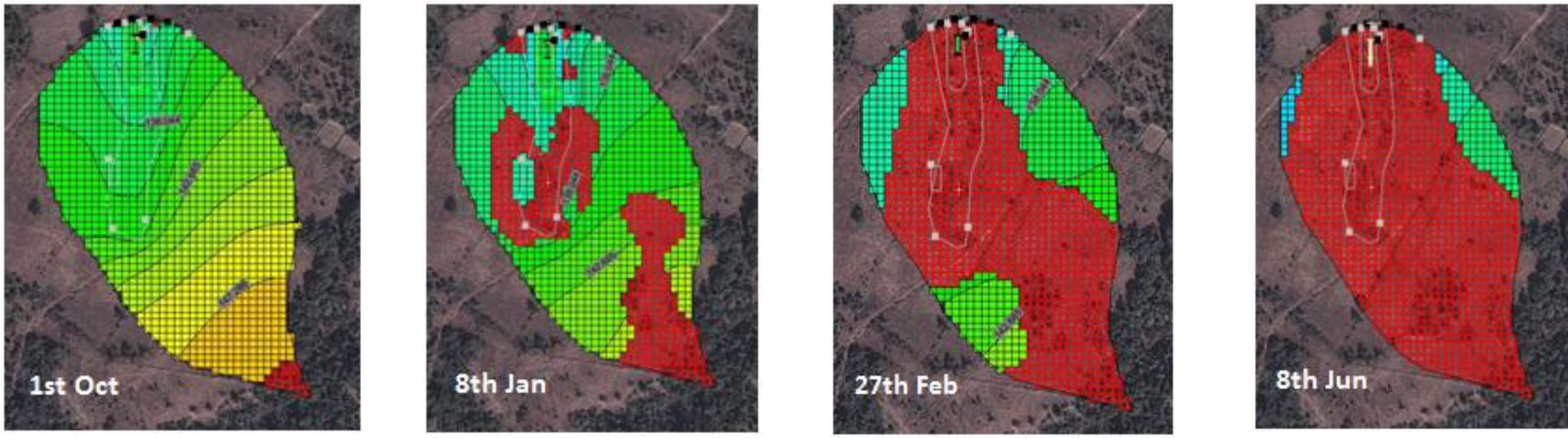
Transient state with contour trenches

- The model with contour trenches was run in steady state to get the heads at the end of monsoon season due to added recharge by contour trenches

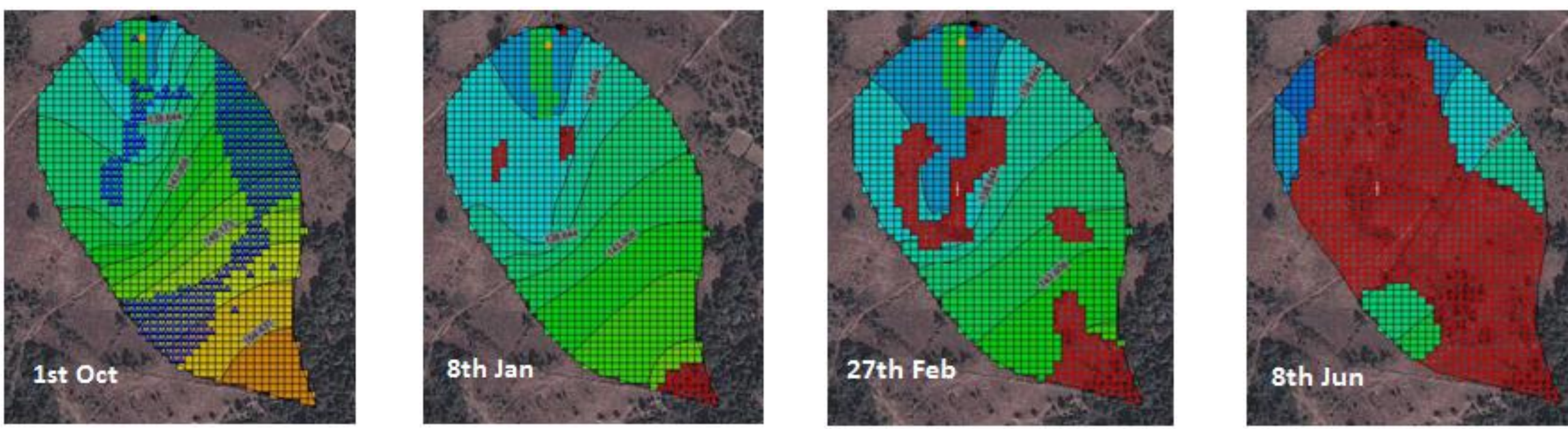
- These heads were set as initial heads of the transient state and the constant head condition for contour trenches was removed

- Heads at different times and storage (flow budgets) were compared for knowing the impact of contour trenches

Comparing heads at different times

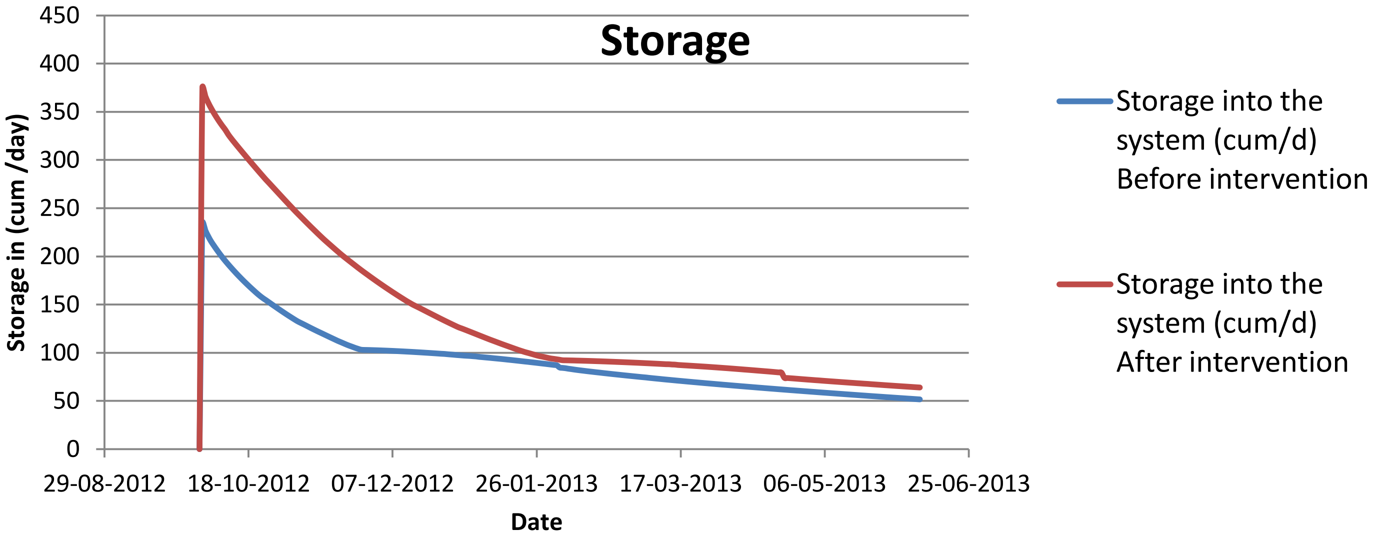


Transient state – without intervention



Transient state – with intervention

Observations

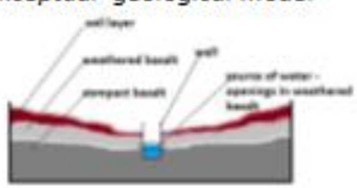
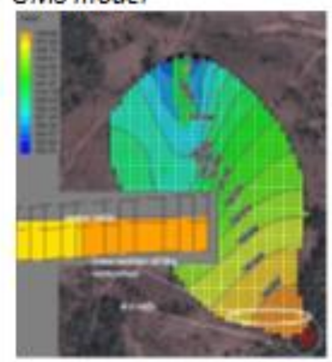
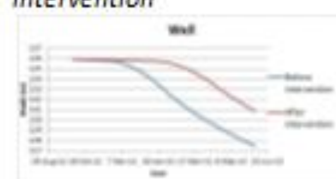


Conclusions

- Basic planning practices i.e. collecting primary and secondary data through community interaction, field observations, detailed surveys and modelling for outcome prediction were successfully followed for solving drinking water problem in Mograj

- The model and simulations showed that contour trenches can be effective in raising the water level in the *varchi* well during the dry season

- Thick layer of soil in the upper catchment, and the fact that this layer remains dry after monsoon season were key indicators for choosing contour trenches as the solution

Step 1 -> Understanding the needs and site identification	**Step 2 -> Aquifer characteristics – soil properties, rock properties, layer data**	**Step 3 -> Modelling parameters – boundary conditions, stress periods**	**Step 4 -> Model simulation, calibration and predictions**
Datasets - PRA, Transect Walk, Resource maps, census data, scheme data, discussions with people	Datasets - Rapid geological surveys, trial pits, soil data, soil permeability tests	Datasets – Fetching Google satellite elevation data, doing key topographic surveys, preparing contour maps in GIS, representing watershed in GMS	Tools – MODFLOW, Groundwater Modelling and Simulation Software (GMS)
Meetings with people  *Resource map* 	*Conceptual geological model*  *Trial pit, permeability test*  	*HTML App for fetching elevations from Google APIs*  *3D terrain for delineating watershed boundaries* 	*GMS model*  *Predicting impacts of intervention* 

Thank you

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  - Kunda tai, Sushma tai
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