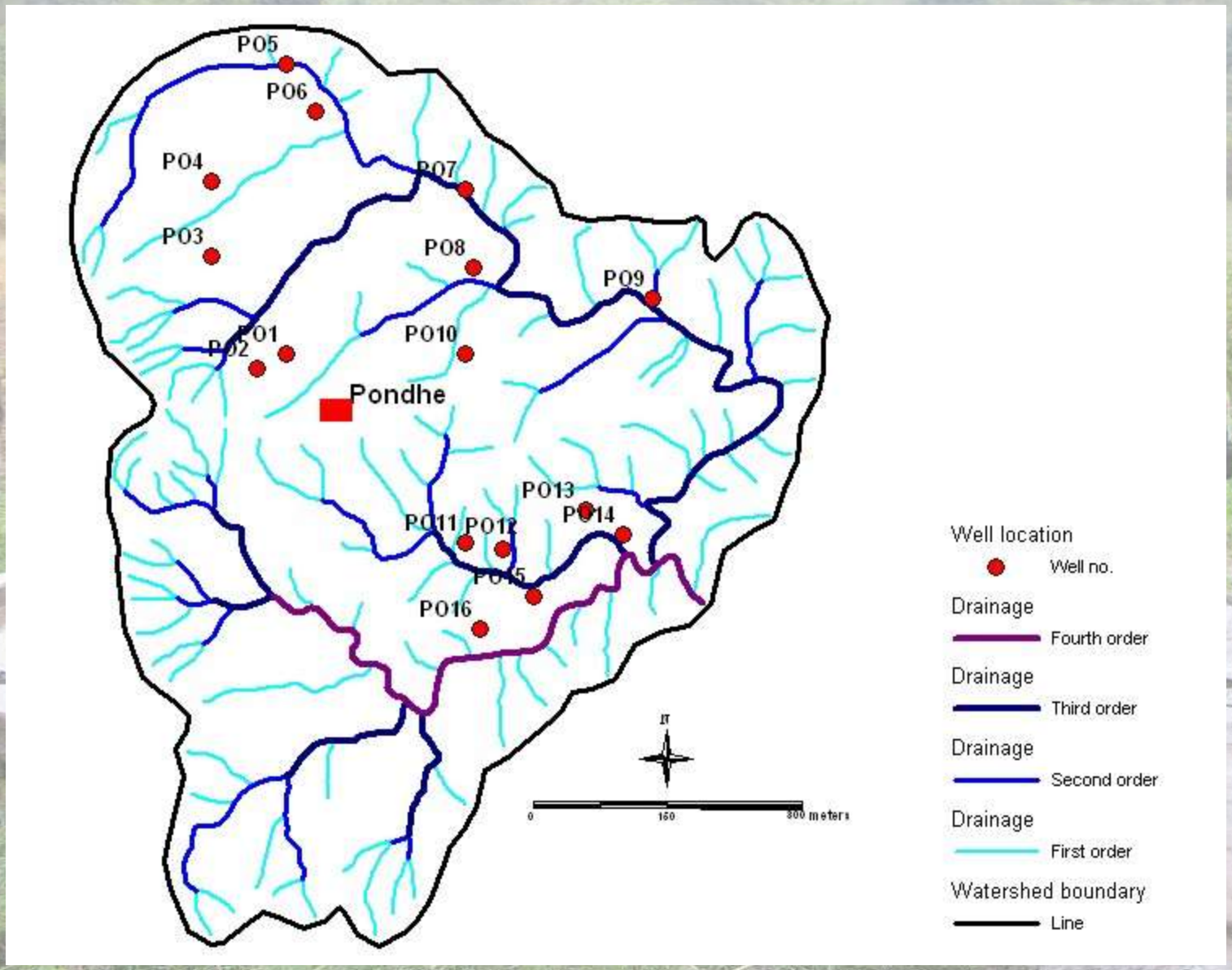
# ACWADAM's experience in Groundwater Management

# Pondhe

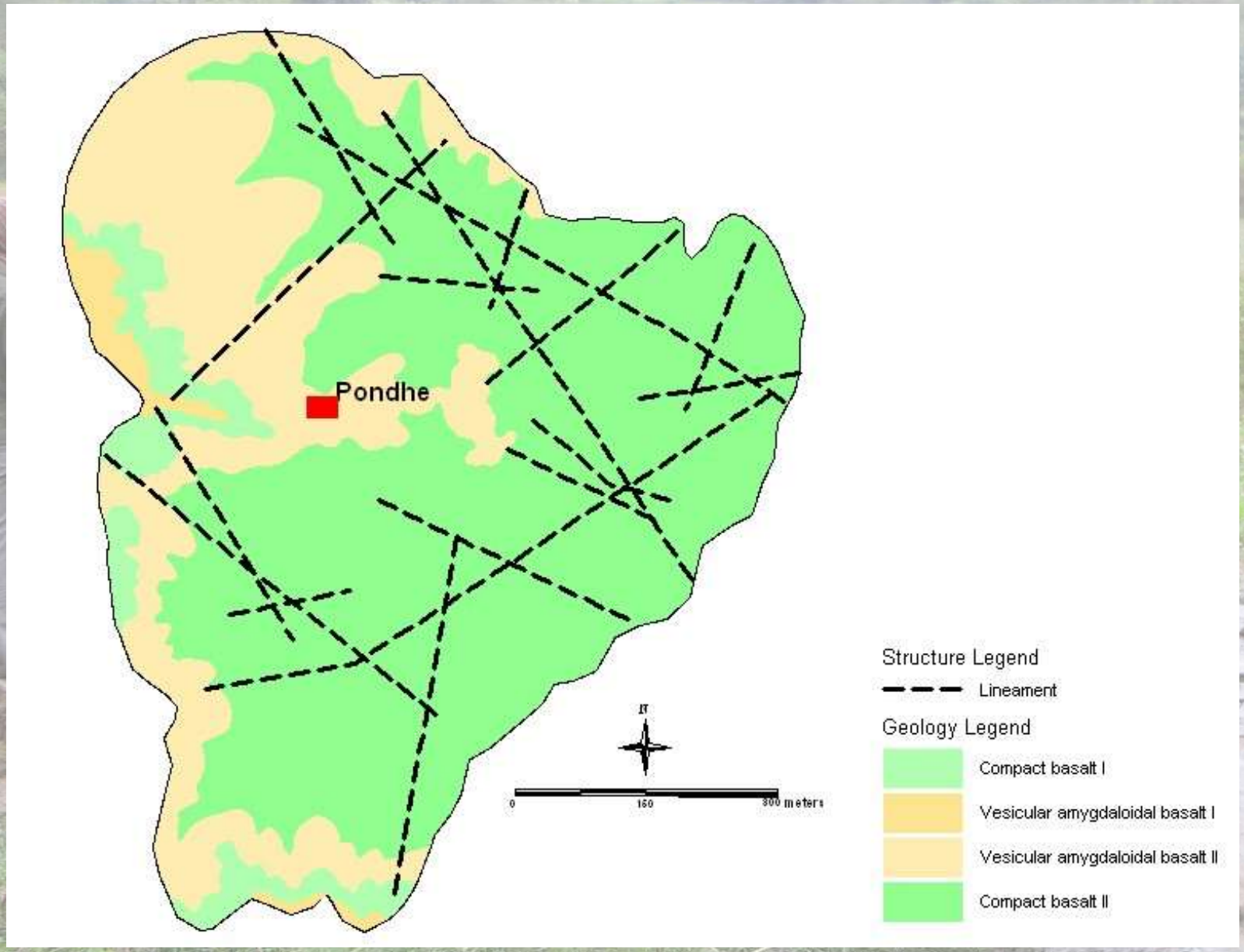
# Demographics and village area

- 140 households
- Population= 1000
- Watershed area= 1100 hectares
- Agricultural land= 850 hectares
- Rainfed agriculture
- Migration as agricultural labour to other villages.

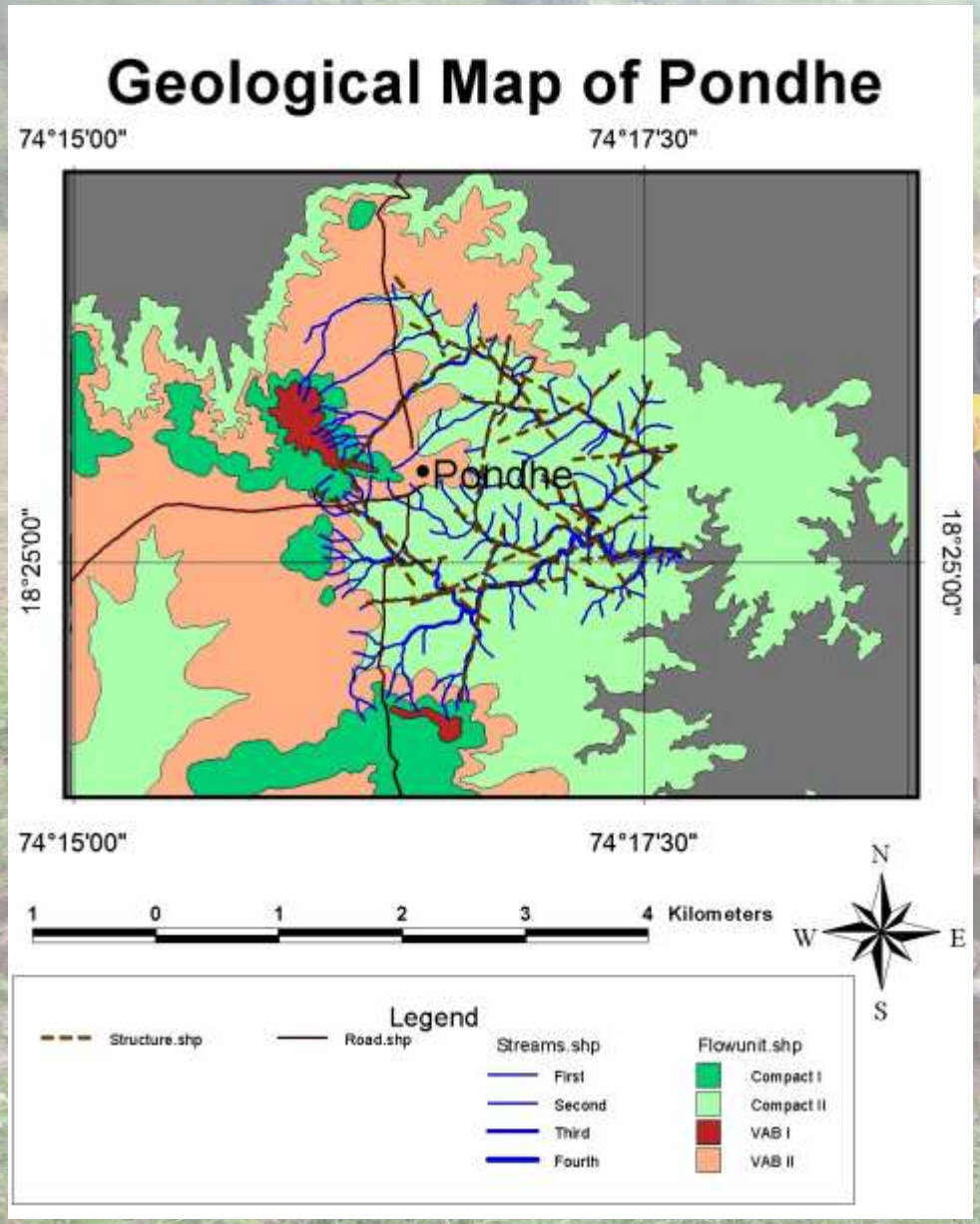
# Drainage and wells



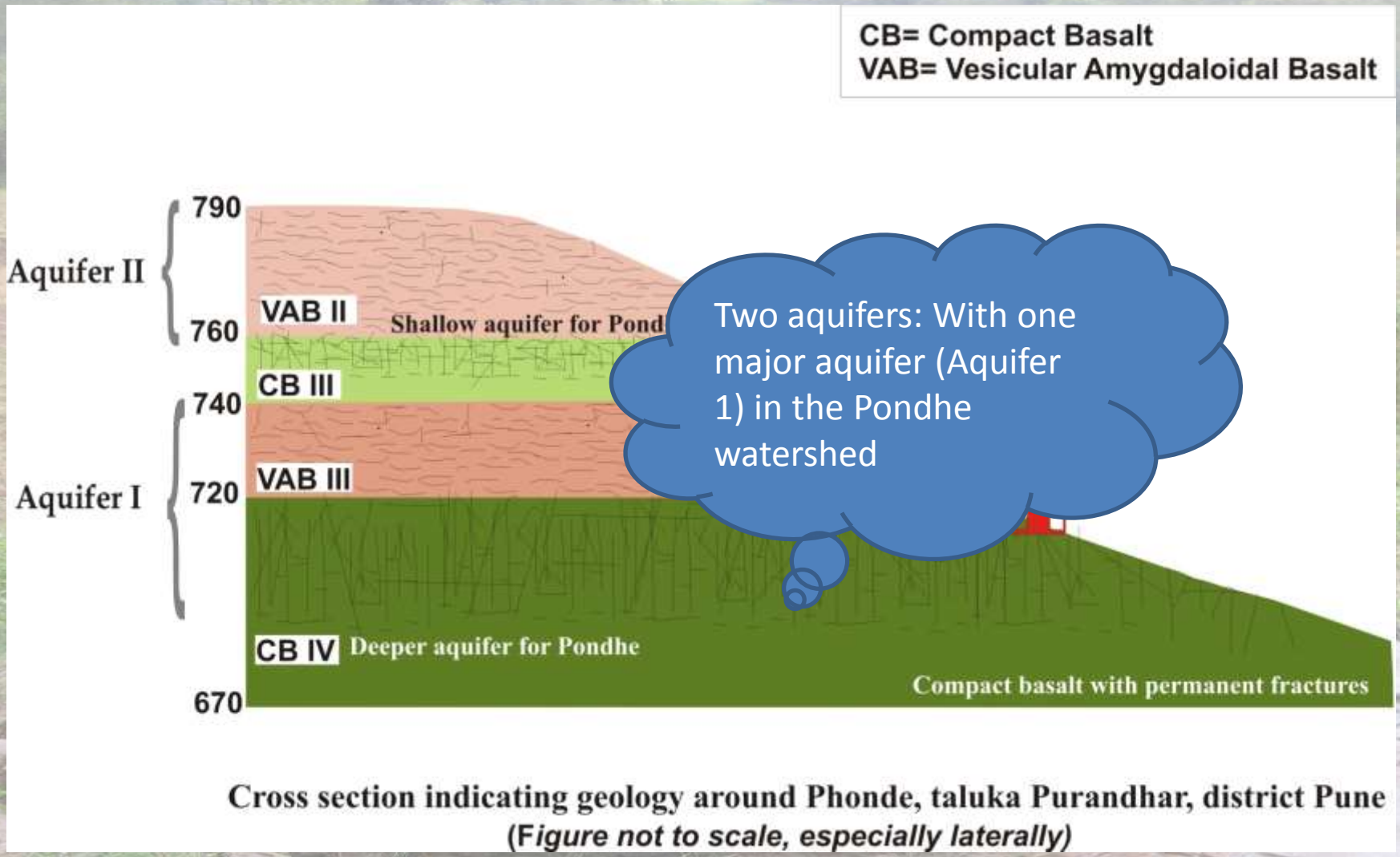
# Geology


Pondhe
N
0
150
300 meters
Structure Legend
Lineament
Geology Legend
Compact basalt I
Vesicular amygdaloidal basalt I
Vesicular amygdaloidal basalt II
Compact basalt II

# Geology and drainage

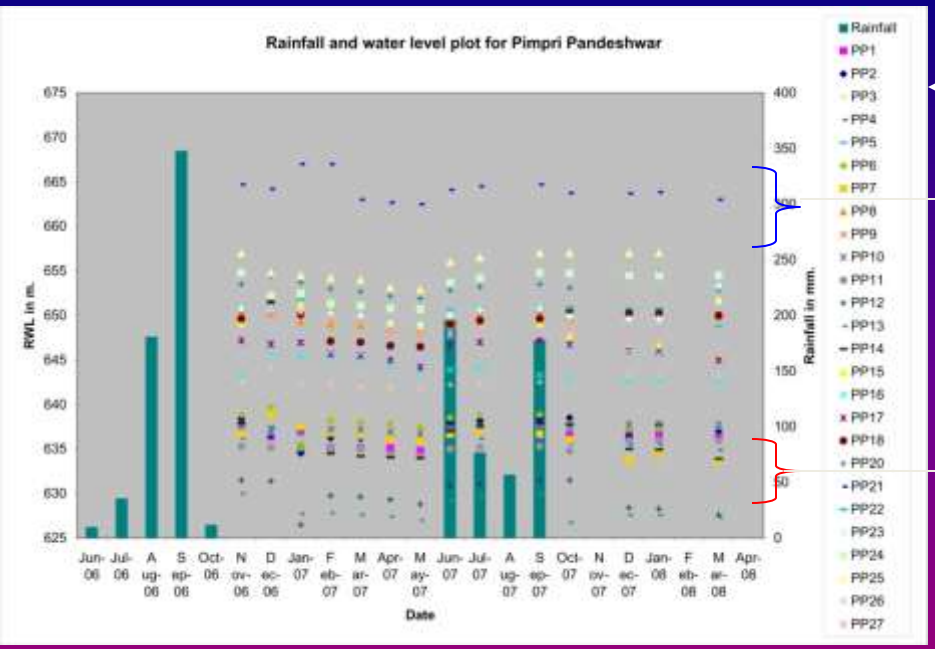



# Aquifer




**Cross section indicating geology around Phonde, taluka Purandhar, district Pune**
***(Figure not to scale, especially laterally)***

# RESULTS




## Well Hydrograph

Well no. 20, 21, 24 and 25 fall in a recharge zone.

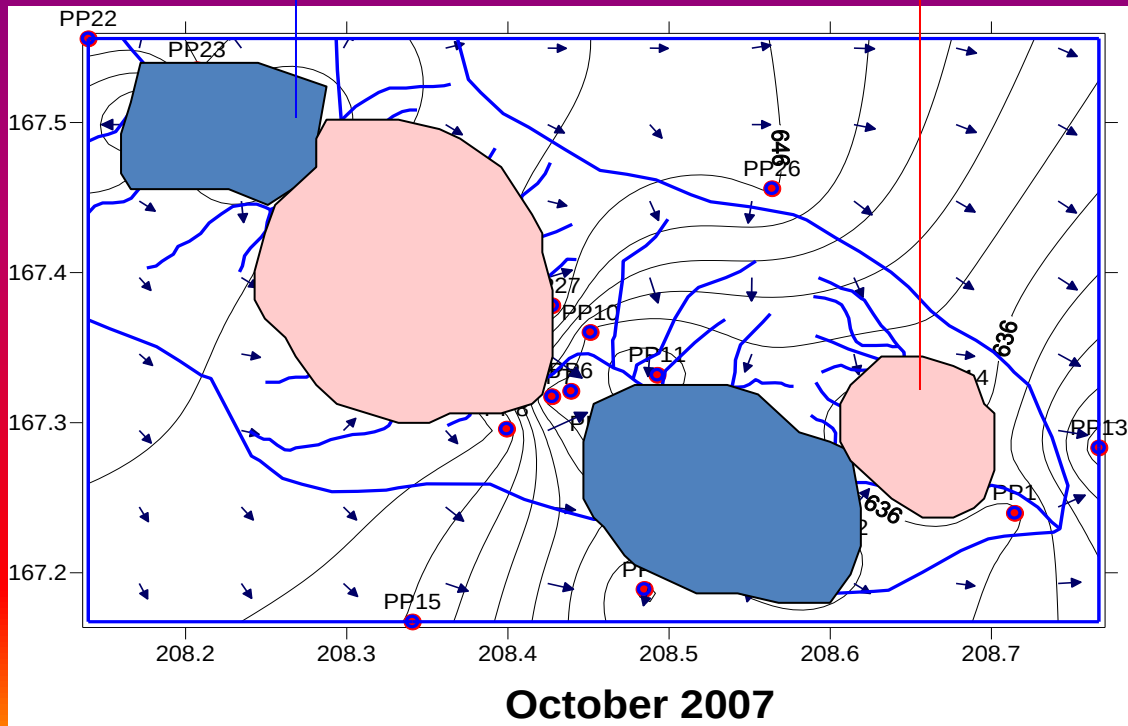
Well no. 12 and 14 fall in a discharge zone.

Recharge zone

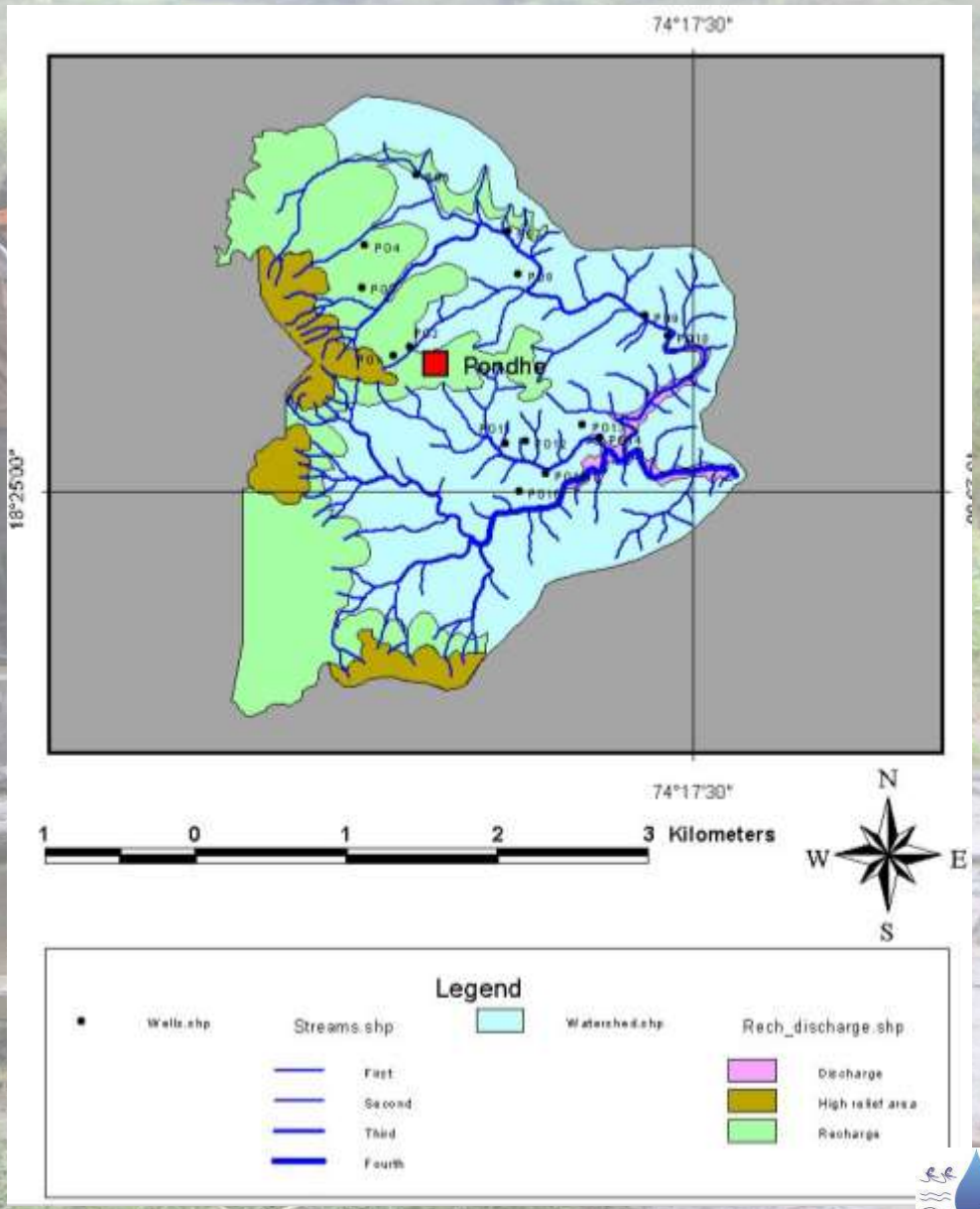
Discharge zone

Understanding aquifers using water level data – hydrographs and water table contour maps.

Water table contour map



# Treatment map



# Aquifer characters

- Aquifer not overexploited as against most aquifers in the region.
- Aquifer transmissivity is low (1 to 50 $m^2$/day), but specific yield is about 0.001 to 0.05 (not too low for Deccan basalts).
- There are some 50 odd large diameter dug wells in Pondhe.
- NO BORE WELLS.

# Redistributed demand..annual

- During an average rainfall year (350 mm)
  - Water allocation per family = 5000 $m^3$
  - Each family can irrigate 1 ha only
  - T his means the requirement is 5000 $m^3$ per hectare

- For 140 families, the irrigated area works out to 140 ha.
- Hence, the total requirement, mainly for protective (kharif) irrigation and rabi irrigation is 700000 $m^3$
- This means an average of about 64 mm from the Pondhe aquifer (… well within the estimates based on hydrogeology.)
- This also implies that a minimum of 64 mm of rainfall must recharge the Pondhe aquifer each year.

# Pondhe water users' association

- All irrigation in the watershed will be through formal water user groups
- Entirely on groundwater (dug wells)
  - Some 25 groups are planned to cover the whole village.
  - 35 out of the total 73 private wells will be "user group" wells under this programme.
  - Each well will be tested.
- Some 14 groups are already registered.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# Milestones

- Gramsabha of 15 Aug 06 passed a resolution that included many novel ideas (like no irrigation outside the well user association, no deep bore wells for irrigation etc.)
- Registration of groups with standard by-laws.
- GSDA has recognised the Pondhe process as a standard for its aquifer management programme.
- GSDA has recognised Pondhe as underexploited from a dark-grey watershed (scale issue) on the basis of ACWADAM's study.

# GRAM SABHA RESOLUTION

- GW use will be only through a community based system.
- Electrification related to water-use will also be through a community based system.
- WLs in all wells in Pondhe will be maintained throughout the year, i.e. no well should run dry.
- Using the minimum possible HP required to pump groundwater from the WUG well(s).
- No digging of any new wells in our area, at least for the next 10 years. Deepening of existing wells and new wells will exclusively be done for the WUG, under the supervision and advice of GGP and other technical partners.
- NOT TO DRILL bore wells for irrigation in Pondhe watershed.
- The cropping pattern and irrigation will be decided on the basis of the annual rainfall and availability of water resources
- Each family in Pondhe watershed will get a water share equivalent to irrigating at least 2.5 acres of crop.
- Only those families who agree to all the rules and regulations of this WUG will be allowed to enter in sale and purchase of land in Pondhe.
- Repairs and O & M costs - will also be shared equally by the member families of the WUA.
- Well-recharge systems will also be developed on an equitable basis

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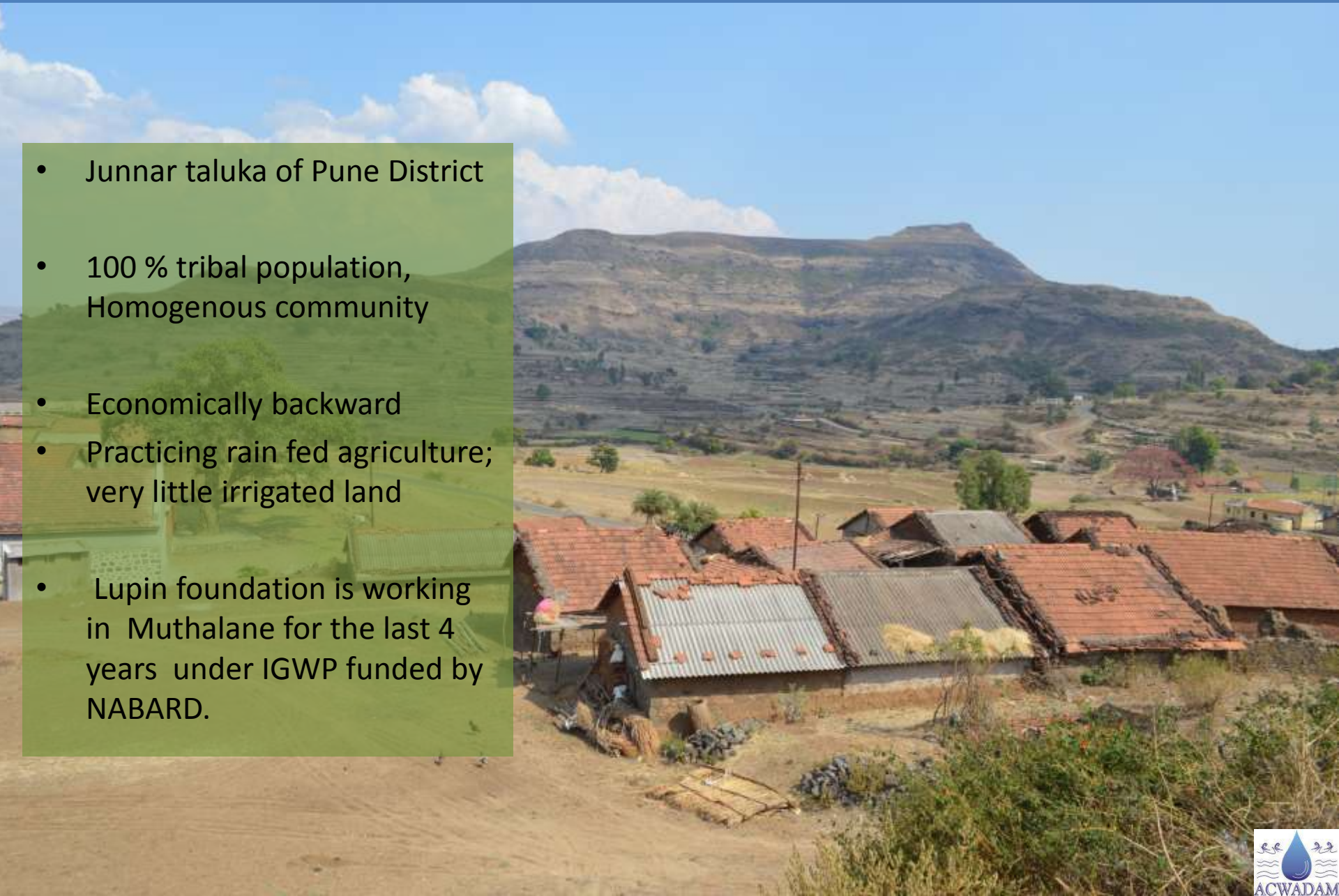
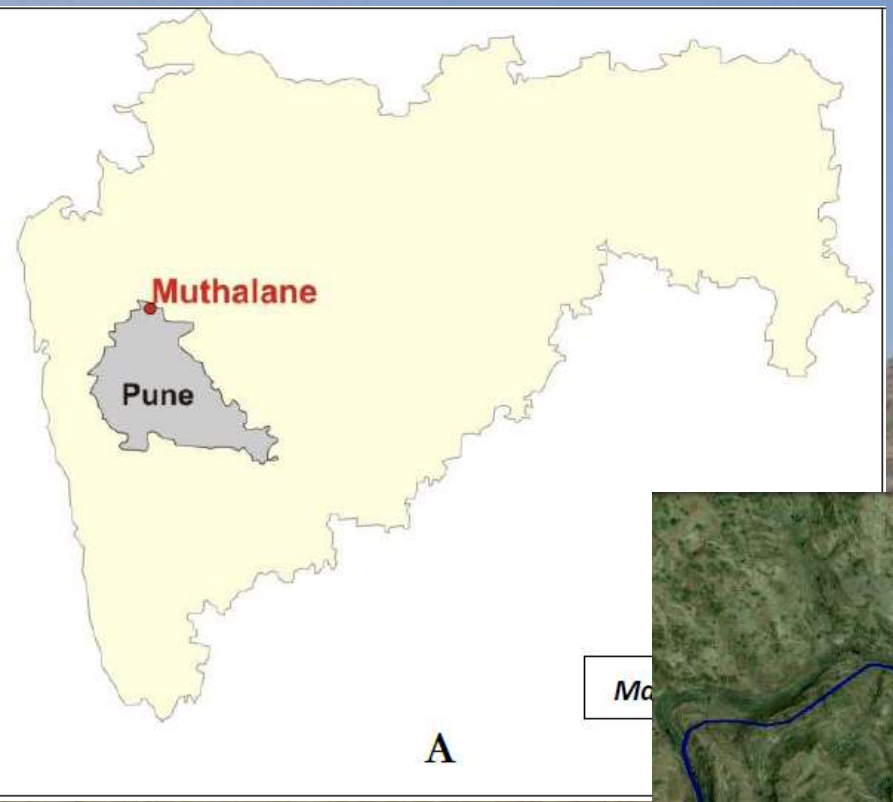
# Muthalane

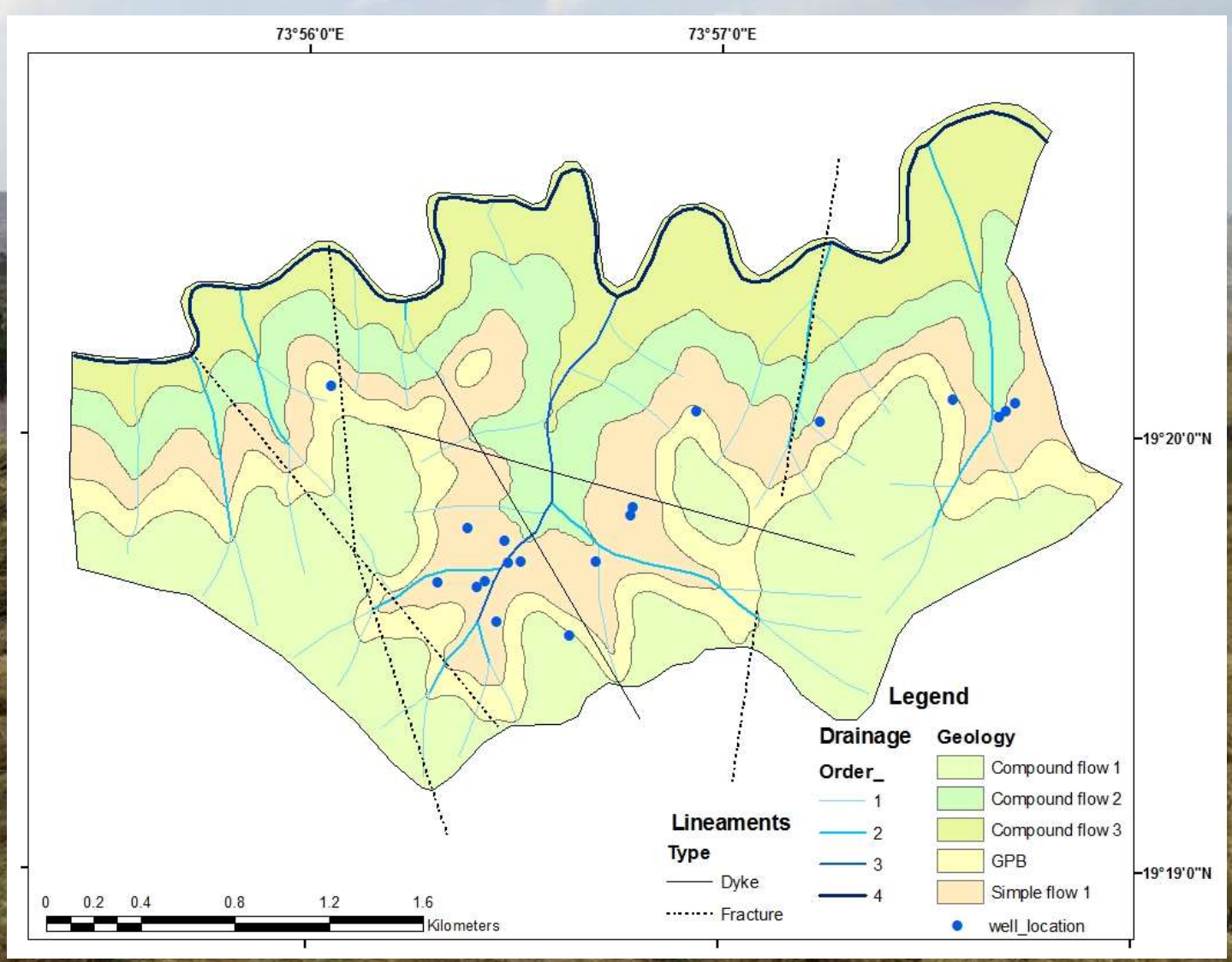


- Junnar taluka of Pune District
- 100 % tribal population, Homogenous community
- Economically backward
- Practicing rain fed agriculture; very little irrigated land
- Lupin foundation is working in Muthalane for the last 4 years under IGWP funded by NABARD.


Muthalane
Pune
A


19 wells in the village
© 2012 Google
Image © 2012 GeoEye
1/2009
2007
19°19'56.08" N 73°56'46.12" E elev 950 m

# Geology of Muthalane



# MUTHALANE

Area: 900 Ha

Highest point 1150 m.

Population : 1270

Lowest point 760 m.

Agricultural land : 201 Ha

Irrigated land : 7 Ha

Rainfall : 900 mm.

## Hydrogeological data

- Geological mapping
- Water level data on monthly basis.
- Water quality analysis
- Weather data
- Experimental bore hole drilling (November 2012)
- Pumping tests

## Socio-economic data

- Socio-economic survey
  Exposure visit- Waghad dam
- Promotion of SRI
- Promotion of micro irrigation

**Resource understanding**

**Community participation**

# Participatory GW Management

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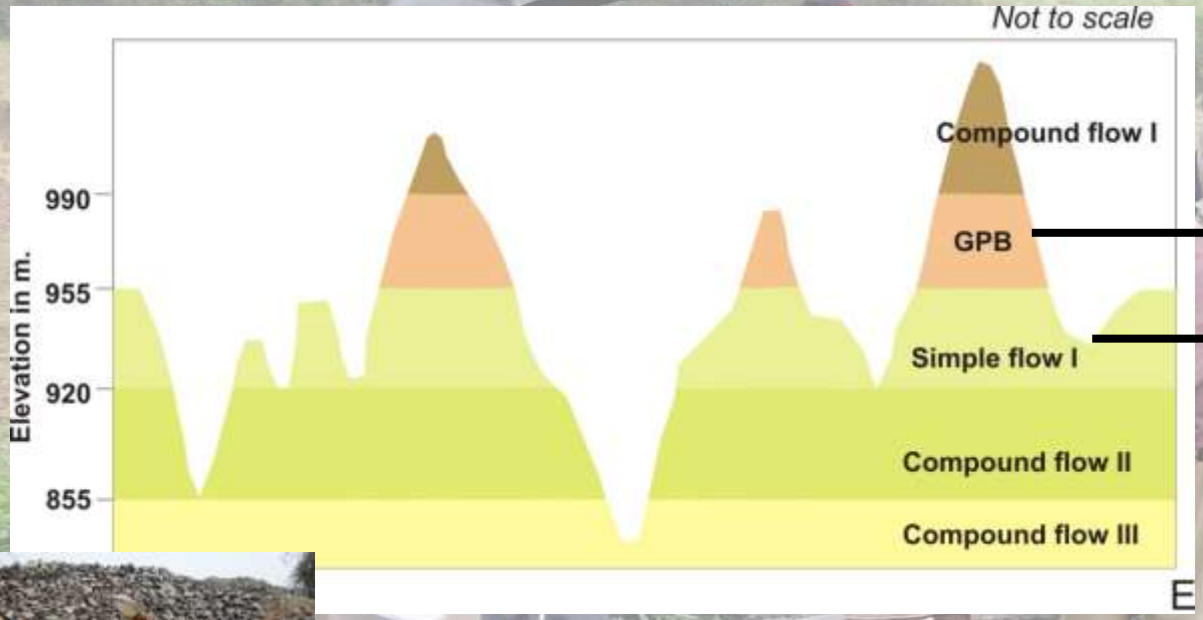
# Muthalane Aquifers



# Well groups in Muthalane

| | Group | No. of members | Total area (ha) | Proposed action |
|---|---|---|---|---|
| 1 | Daryamata Community well group | 14 | 14.59 | New well |
| 2 | Bhamkai Community well group | 11 | 4.41 | New well |
| 3 | Baradinath Community well group | 11 | 10.59 | New well |
| 4 | Jagdamba Community well group | 15 | 13.94 | New well |
| 5 | Sanjivani Community well group | 11 | 5.49 | New well |
| 6 | Mahalaxmi Community well group | 7 | 11.1 | Surface water use |
| 7 | Dhavalbaba Community well group | 12 | 6.29 | Well repair |
| 8 | Santoshimata Community well group | 14 | 21.04 | Well repair |
| 9 | Samarth Community well group | 13 | 4.82 | Well repair |
| 10 | Adarsh Community well group | 16 | 8.07 | Well repair |
| 11 | Bhimai Community well group | 16 | 8.63 | New well |
| 12 | Jagruti Community well group | 11 | 5.87 | Well repair |
| | Total | 151 | 114.84 | |

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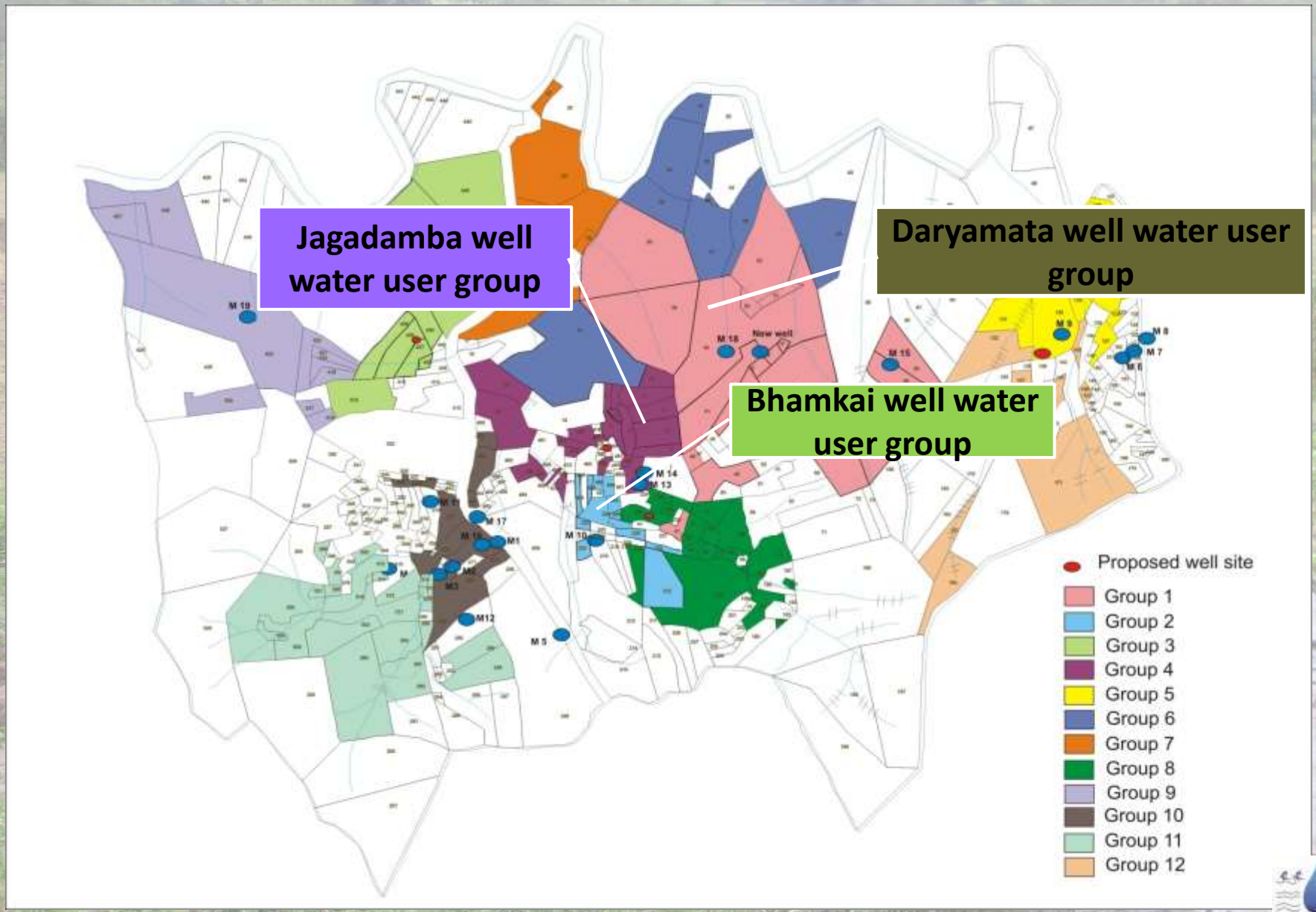
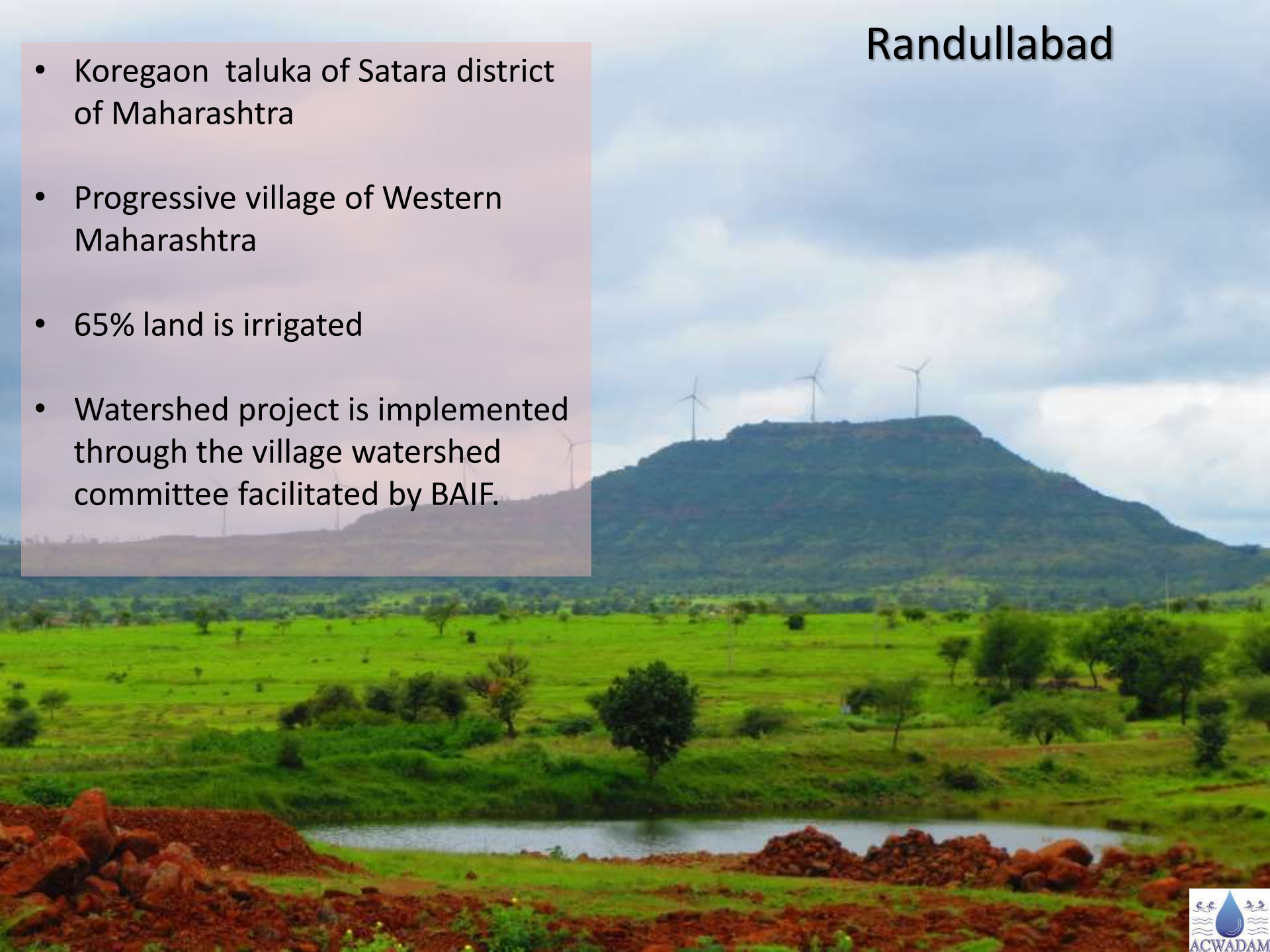
# MUTHALANE: GROUNDWATER USER GROUPS

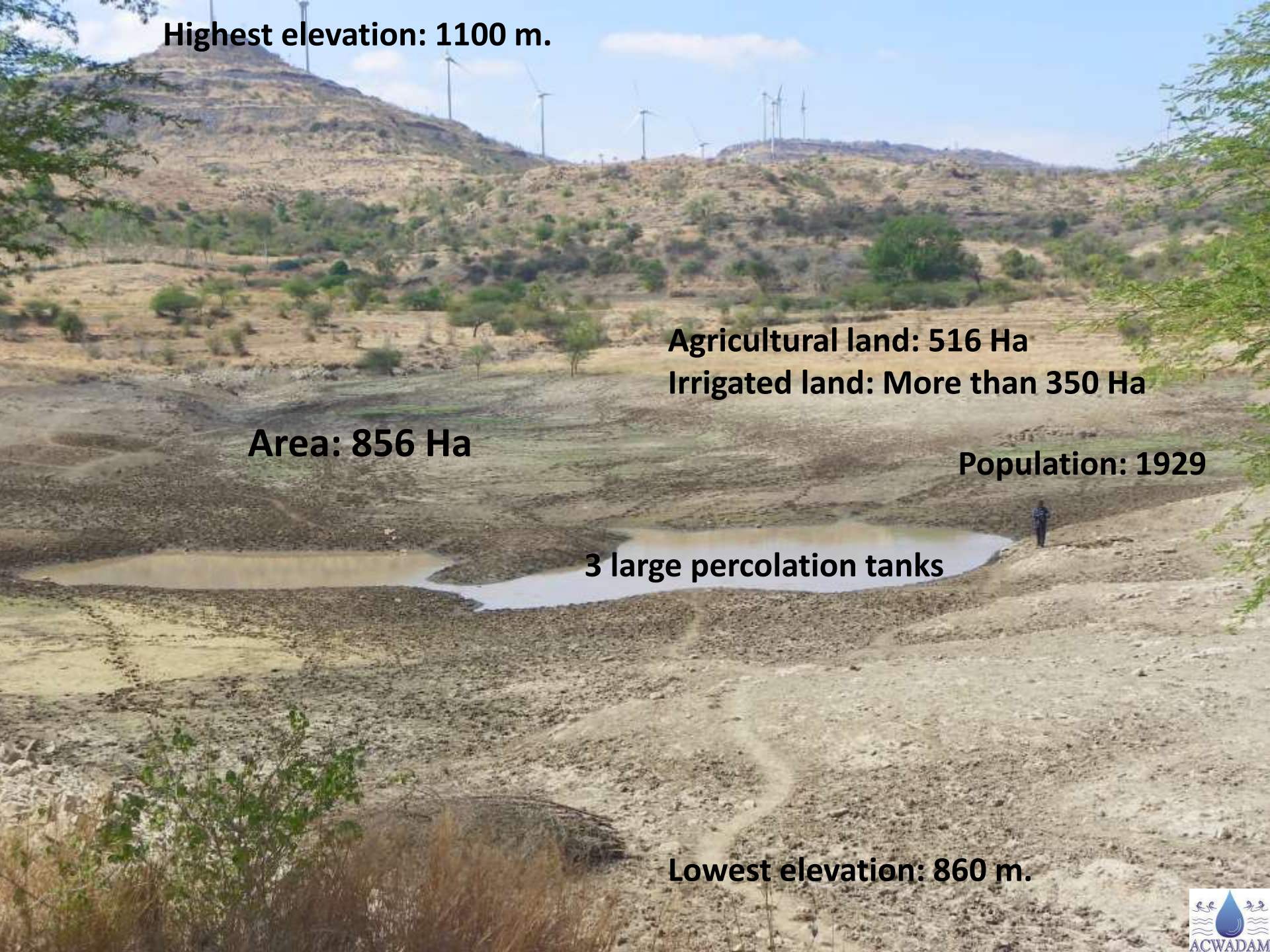


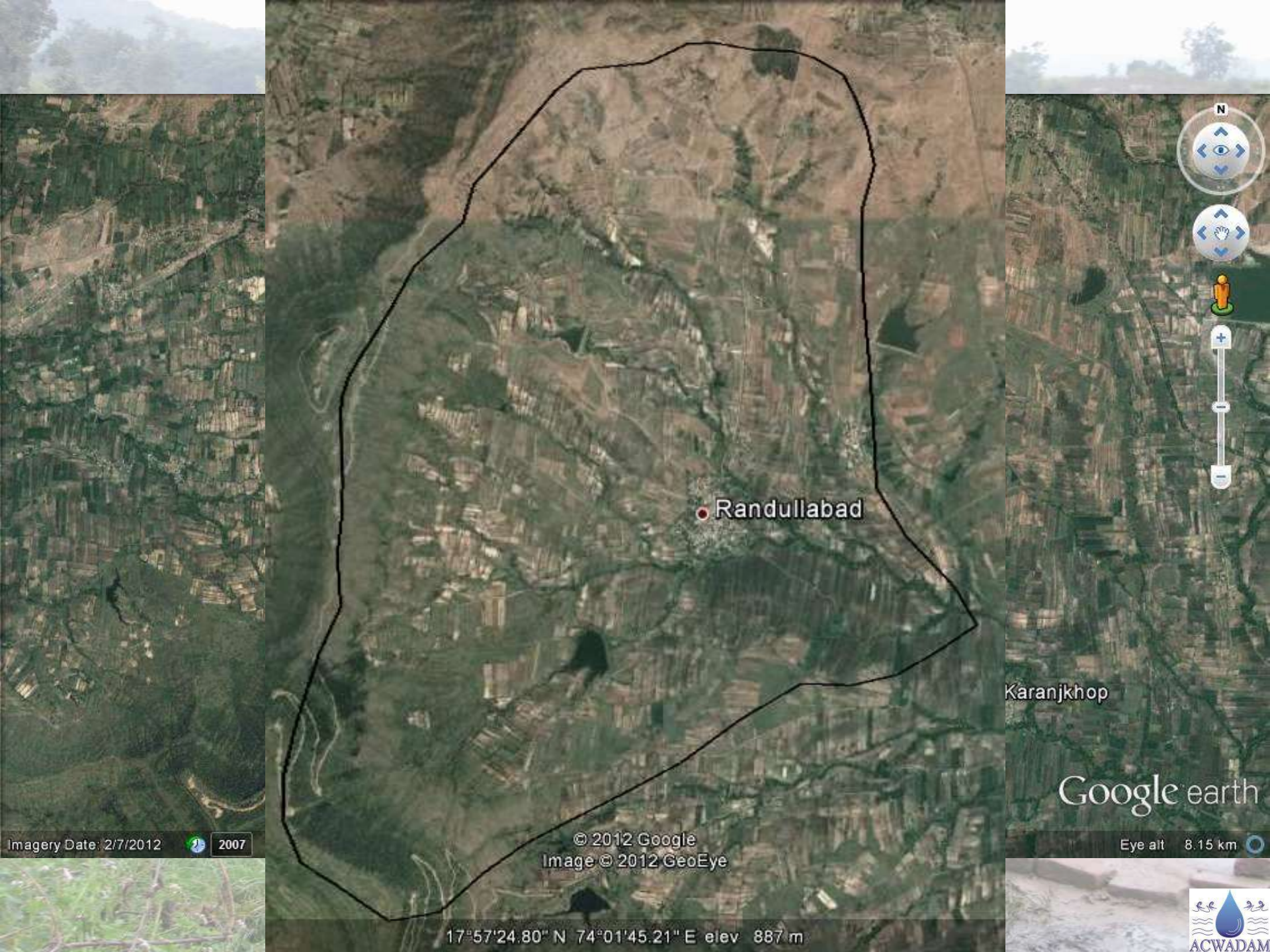
Outcomes:

# Randullabad

- Koregaon  taluka of Satara district of Maharashtra
- Progressive village of Western Maharashtra
- 65% land is irrigated
- Watershed project is implemented through the village watershed committee facilitated by BAIF.




Highest elevation: 1100 m.
Agricultural land: 516 Ha
Irrigated land: More than 350 Ha
Area: 856 Ha
Population: 1929
3 large percolation tanks
Lowest elevation: 860 m.


Randullabad
Karanjkhop
Imagery Date: 2/7/2012
2007
© 2012 Google
Image © 2012 GeoEye
17°57'24.80" N 74°01'45.21" E elev 887 m
Google earth
Eye alt 8.15 km
N
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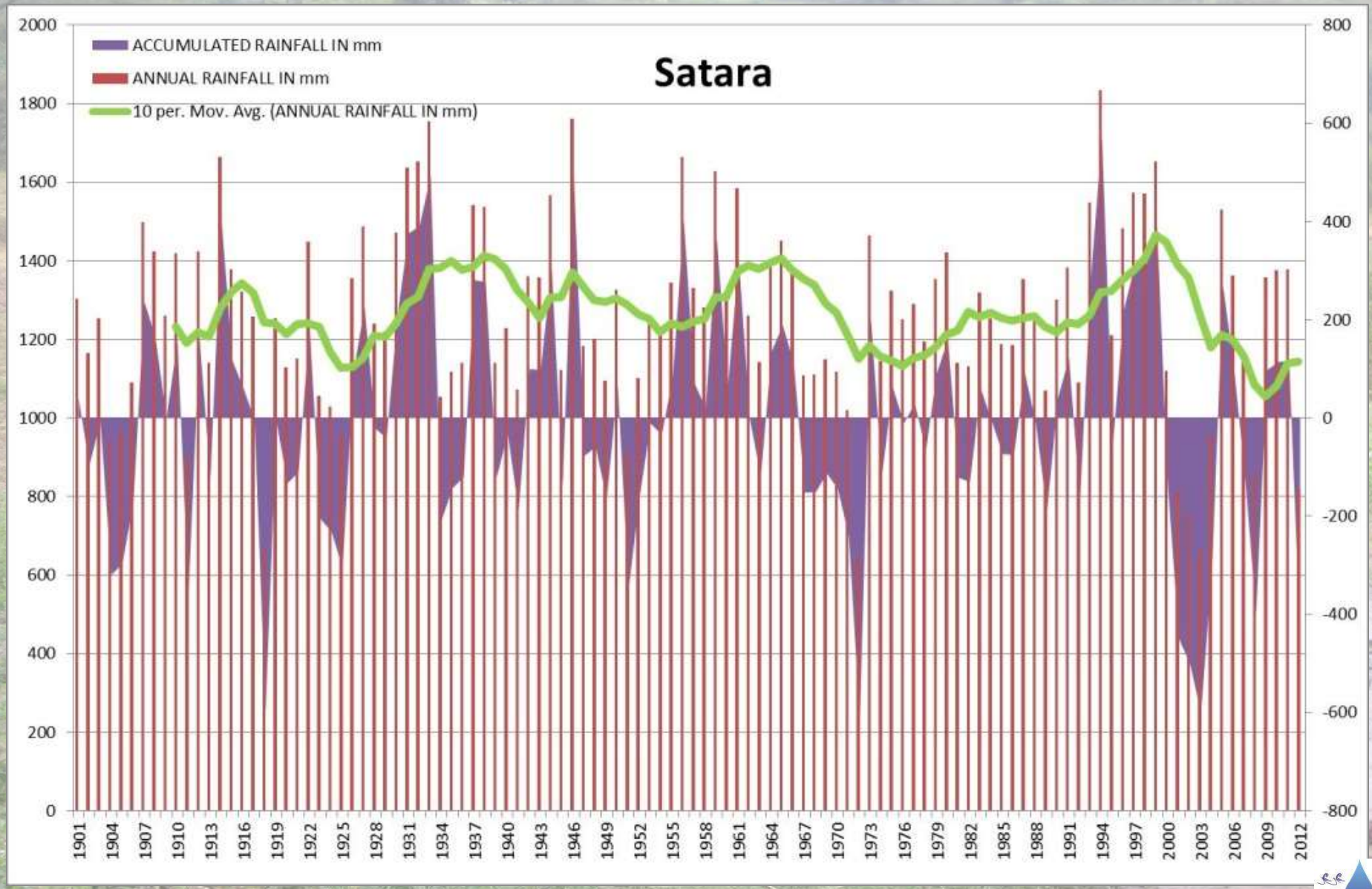
# Rainfall pattern

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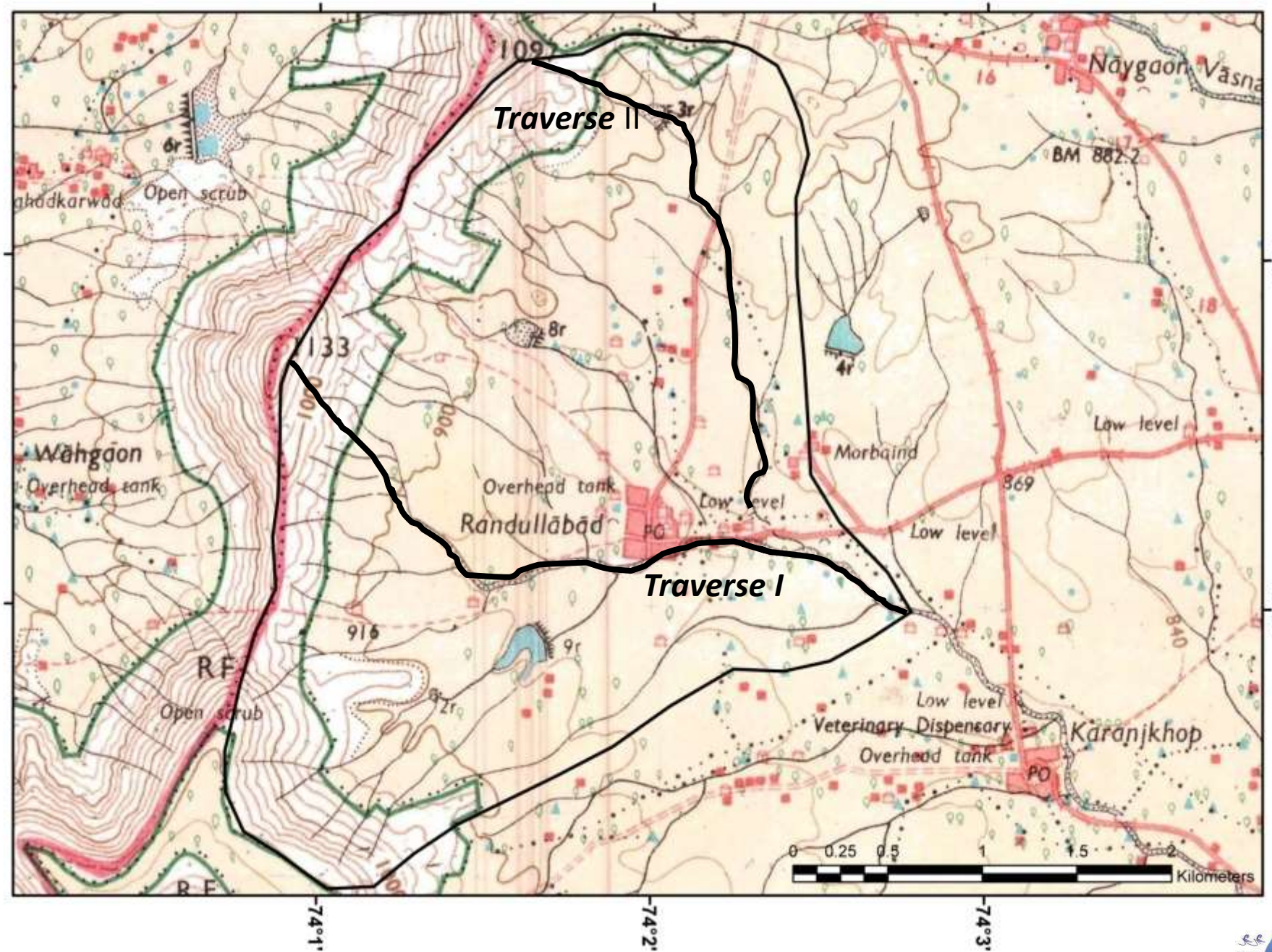
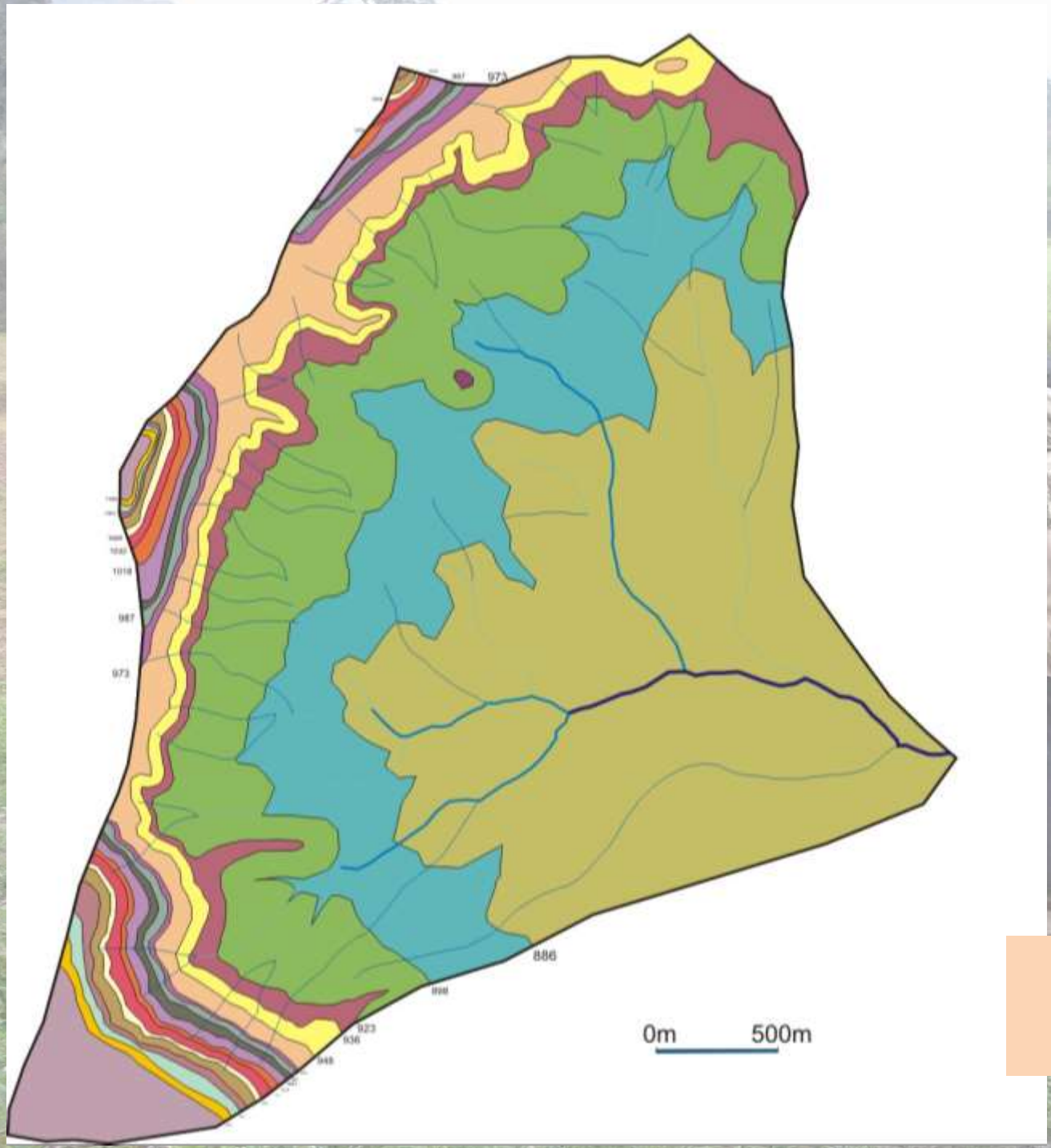
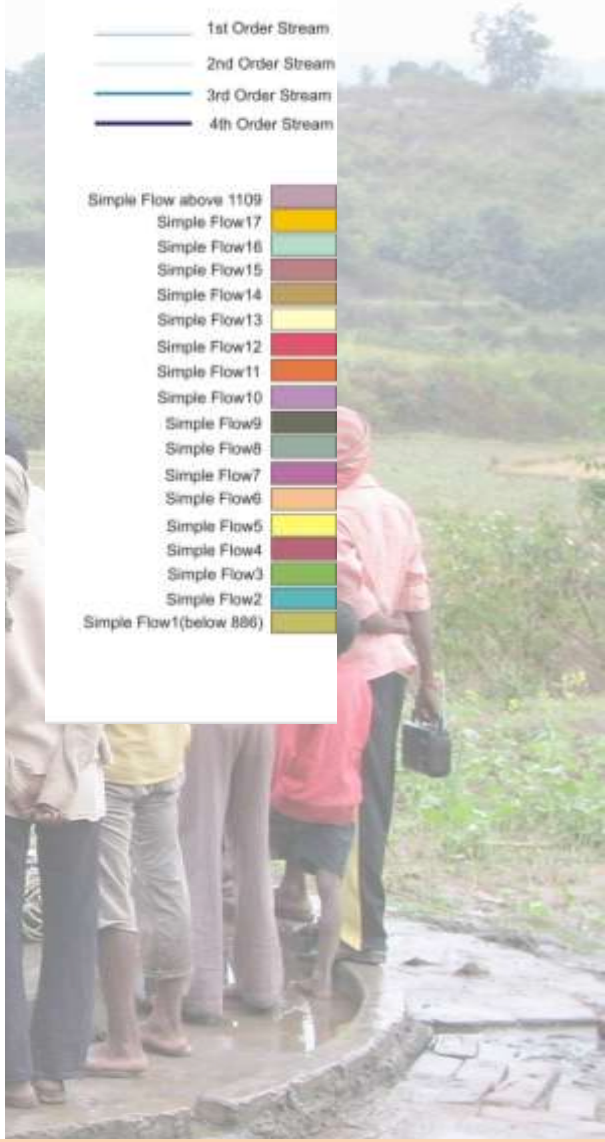

Traverse II
Traverse I
Wāngaon
Overhead tank
Randullābād
PG
Overhead tank
Low level
Morbaind
369
Low level
Low level
Naygaon Vasna
BM 882.2
Low level
Veterinary Dispensary
Overhead tank
PO
Karanjkhop
Open scrub
Open scrub
RF
RF
916
840
109
133
100
96
16
17
18
3r
6r
8r
4r
9r
8r
2r
0 0.25 0.5 1 1.5 2
Kilometers
74°1'
74°2'
74°3'
17°58'
17°57'

**Study of rock types, fractures, weathering type and well section.**



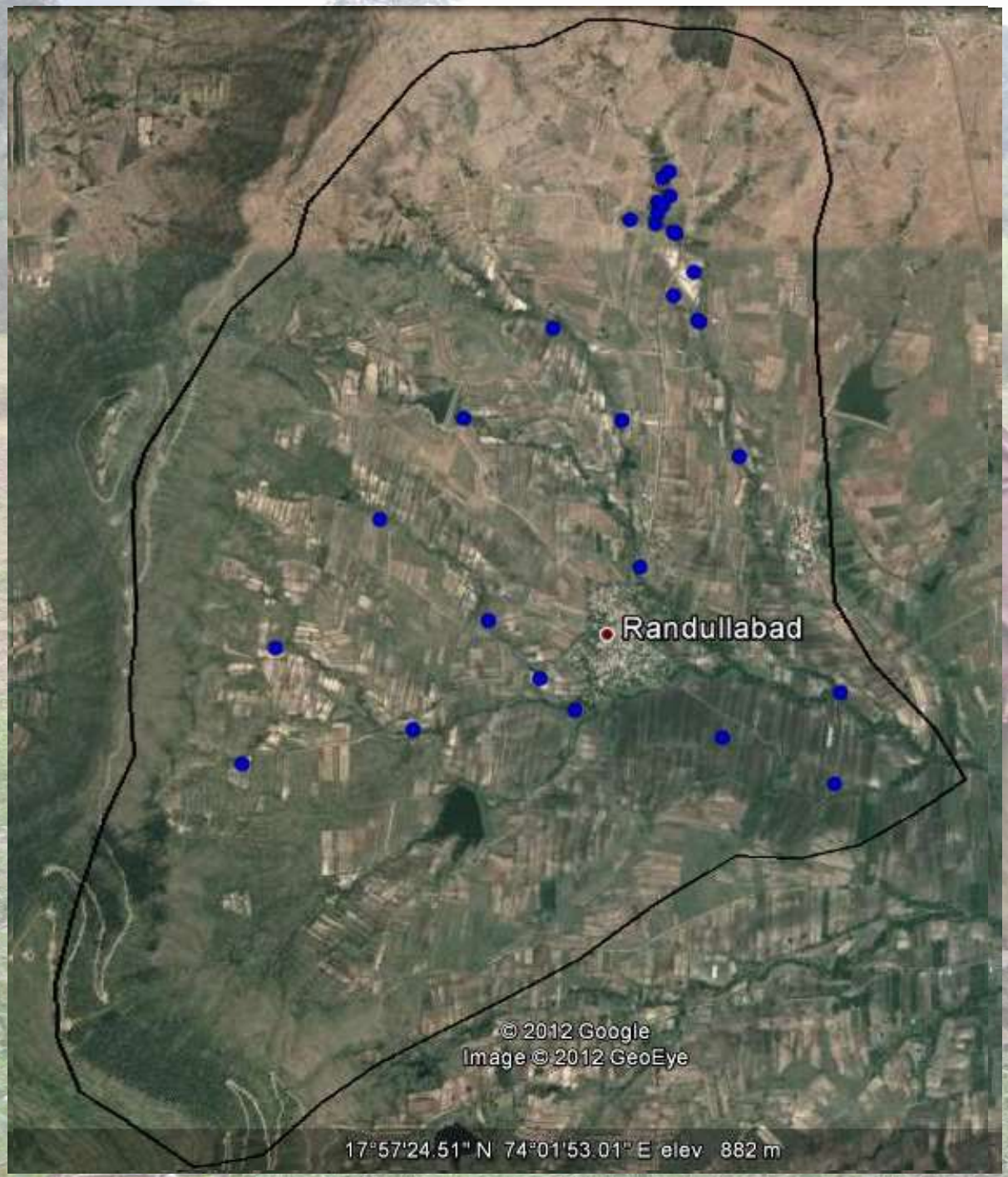
# Geological map of Randullabad village

# Monitoring network

Preparation of well inventory and collecting water level data for 29 wells every month.

Conducting pump tests on 10 wells to understand the aquifer characteristics.

Water quality analysis of 12 different sources – twice every year.




**There are 167 wells in Randullabad.**

**ACWADAM was monitoring 29 wells on monthly basis.**

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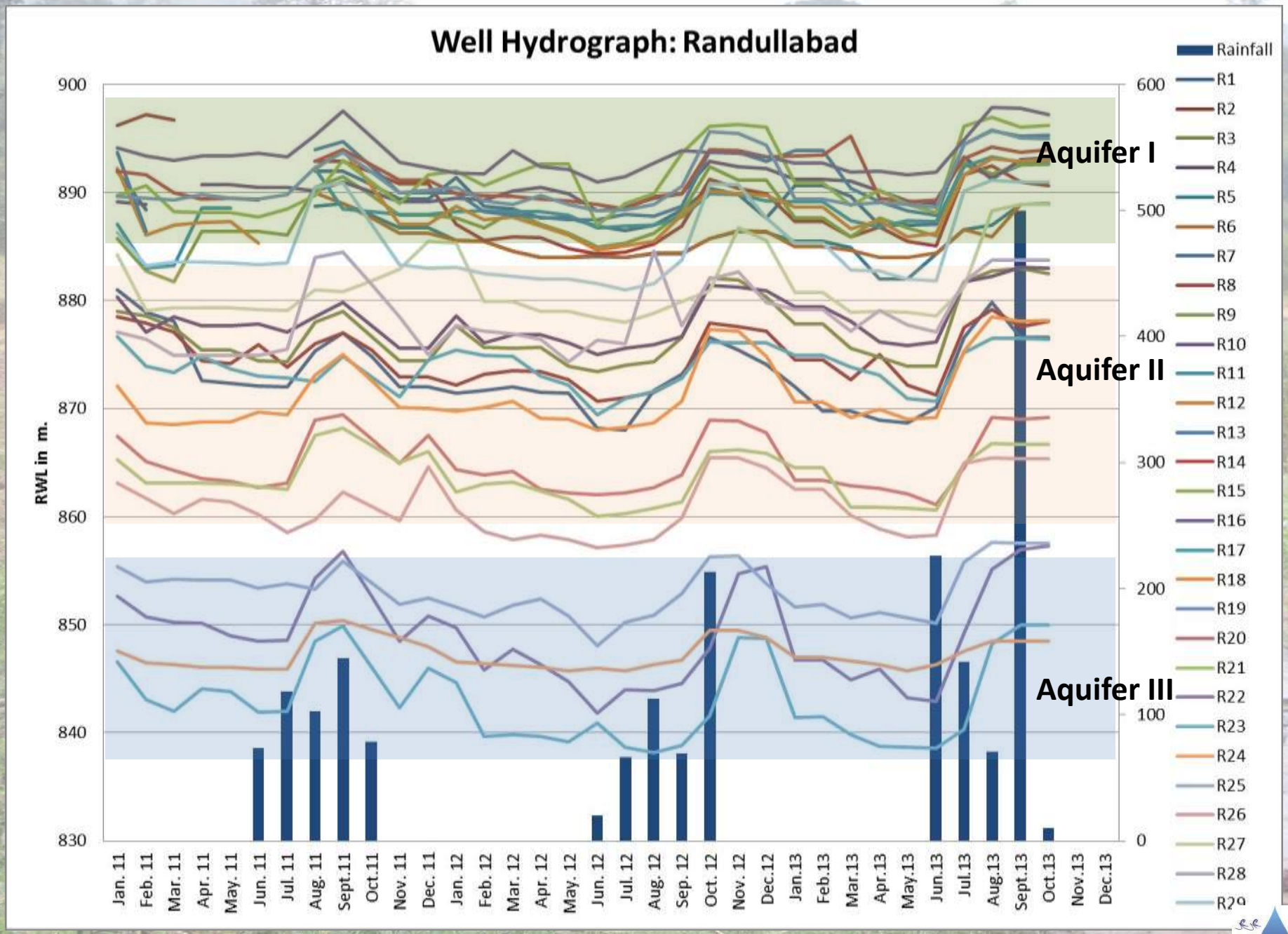
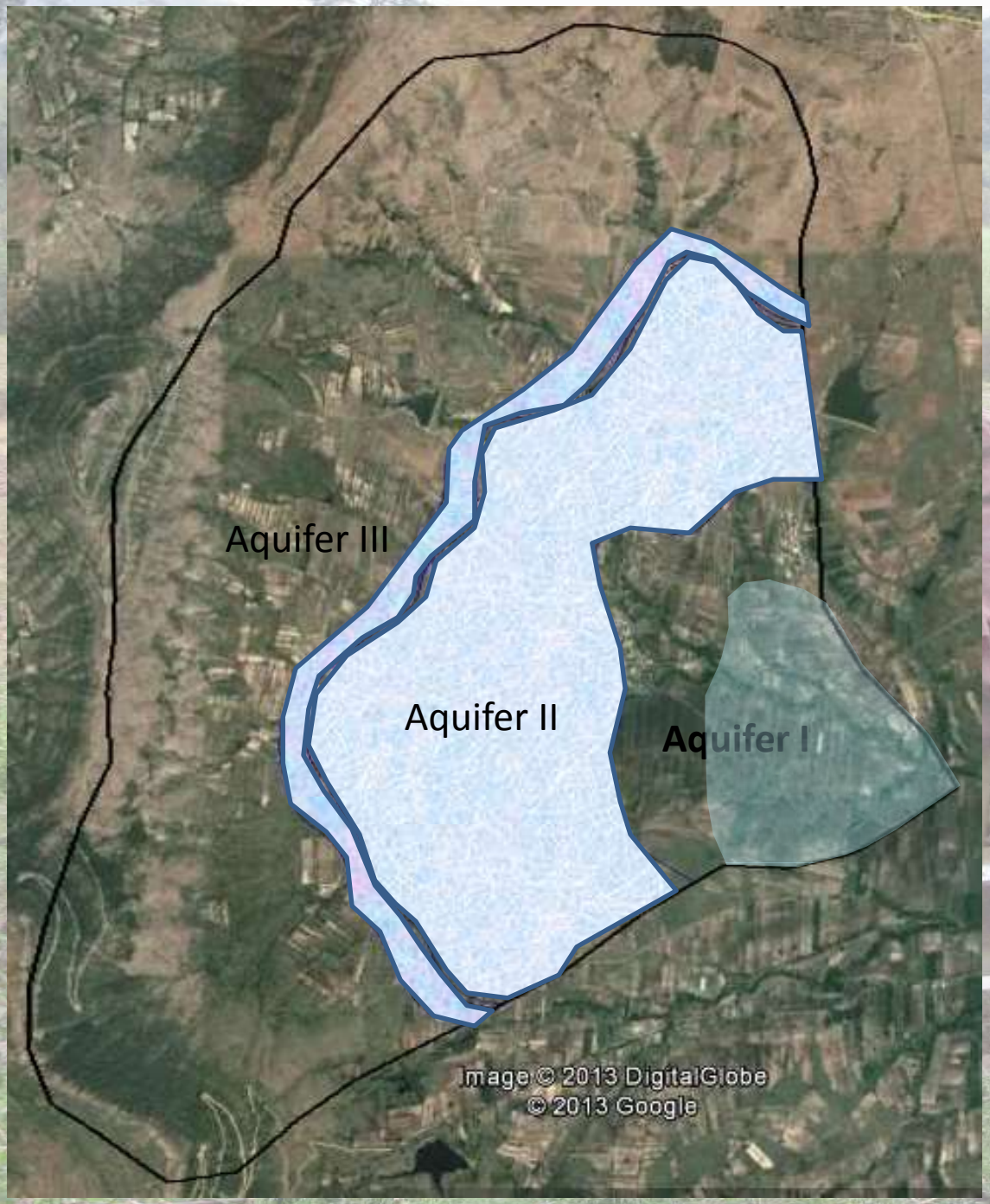
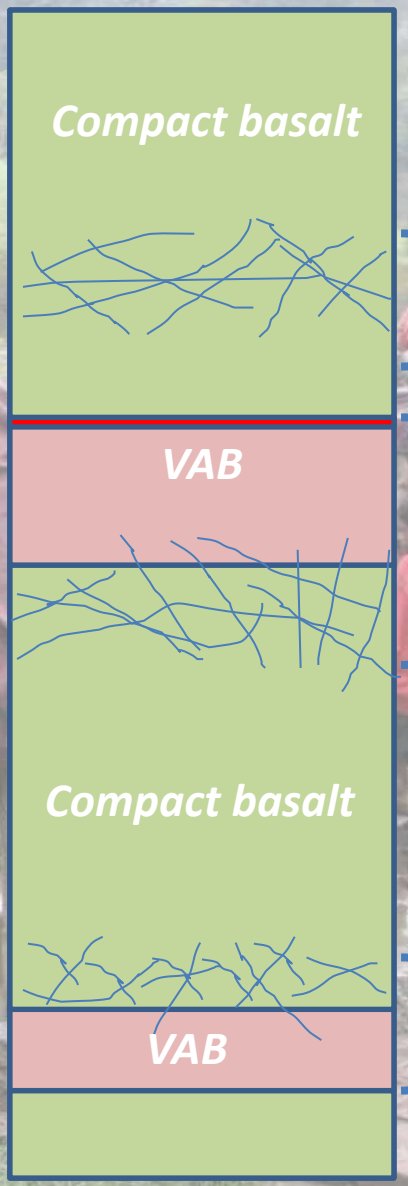

Well Hydrograph: Randullabad
RWL in m.
900
890
880
870
860
850
840
830
600
500
400
300
200
100
0
Aquifer I
Aquifer II
Aquifer III
Jan. 11
Feb. 11
Mar. 11
Apr. 11
May. 11
Jun. 11
Jul. 11
Aug. 11
Sept.11
Oct.11
Nov. 11
Dec. 11
Jan. 12
Feb. 12
Mar. 12
Apr. 12
May. 12
Jun. 12
Jul. 12
Aug. 12
Sep. 12
Oct. 12
Nov. 12
Dec.12
Jan.13
Feb.13
Mar.13
Apr.13
May.13
Jun.13
Jul.13
Aug.13
Sept.13
Oct.13
Nov.13
Dec.13
Rainfall
R1
R2
R3
R4
R5
R6
R7
R8
R9
R10
R11
R12
R13
R14
R15
R16
R17
R18
R19
R20
R21
R22
R23
R24
R25
R26
R27
R28
R29



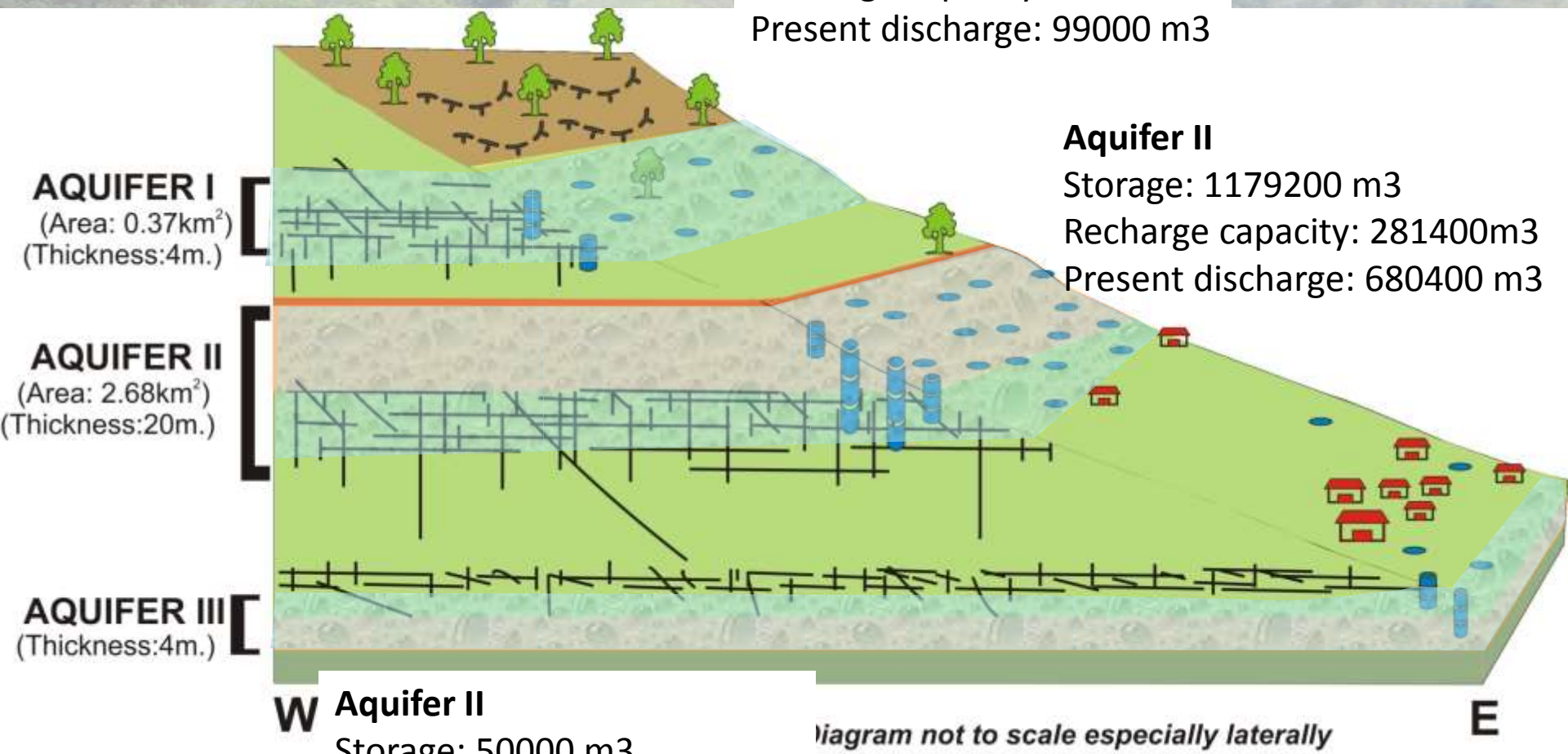

Thickness-5m.

Thickness-20m.

Thickness-5m.

**Aquifer I**
Storage: 67200 m3
Recharge capacity: 60480m3
Present discharge: 99000 m3

**Aquifer II**
Storage: 1179200 m3
Recharge capacity: 281400m3
Present discharge: 680400 m3




**Aquifer II**
Storage: 50000 m3
Recharge capacity: 50000m3
Present discharge: 94500 m3

# Aquifer properties

| | Aquifer area | Thickness | Sp. Yield | Aquifer storage |
|---|---|---|---|---|
| | $km^2$ | | | (m3) |
| **Aquifer I** | 0.56 | 6 | 0.02 | 67200 |
| **Aquifer II** | 2.68 | 8 (VAB) + 12 (CB) | 0.05 (VAB) & 0.01 (CB) | 1179200 |
| **Aquifer III** | 0.5 | 5 | 0.02 | 50000 |

**Aquifer storage= aquifer area * Thickness * Specific yield**

# Recharge to aquifer

| | Aquifer area | Sp. Yield | WL fluctuation | Aquifer recharge | Aquifer recharge |
|---|---|---|---|---|---|
| | $km^2$ | | (m) | (m3) | (mm) |
| Aquifer I | 0.56 | 0.02 | 4.6 | 51520 | 92 |
| | | | | | |
| Aquifer II | 2.68 | 0.05 (VAB) & 0.01 (CB) | 5.1 | 410040 | 153 |
| | | | | | |
| Aquifer III | 0.5 | 0.02 | 7.6 | 76000 | 152 |
| | | | | | |

**Aquifer recharge= aquifer area * Specific yield * WL fluctuation** ***(June to October)***

# Discharge from aquifer

| | Actual no. of wells | Aquifer area | Specific yield | WL fluctuations | | Abstraction from aquifer |
|---|---|---|---|---|---|---|
| | | $km^2$ | | m | | $m^3$ |
| Aquifer I | 30 | 0.56 | 0.02 | 4.9 | 54880 | 98 |
| | | | | | | |
| Aquifer II | 100 | 2.68 | 0.05 &0.01 | 6.7 | 538680 | 201 |
| | | | | | | |
| Aquifer III | 35 | 0.5 | 0.02 | 4 | 40000 | 80 |

**Specific yield method**

**Aquifer discharge= aquifer area * Thickness * WL fluctuation *(Nov. to May)***

**By pumping method**

**(Total pumping hours * discharge)-(15% return flow)**

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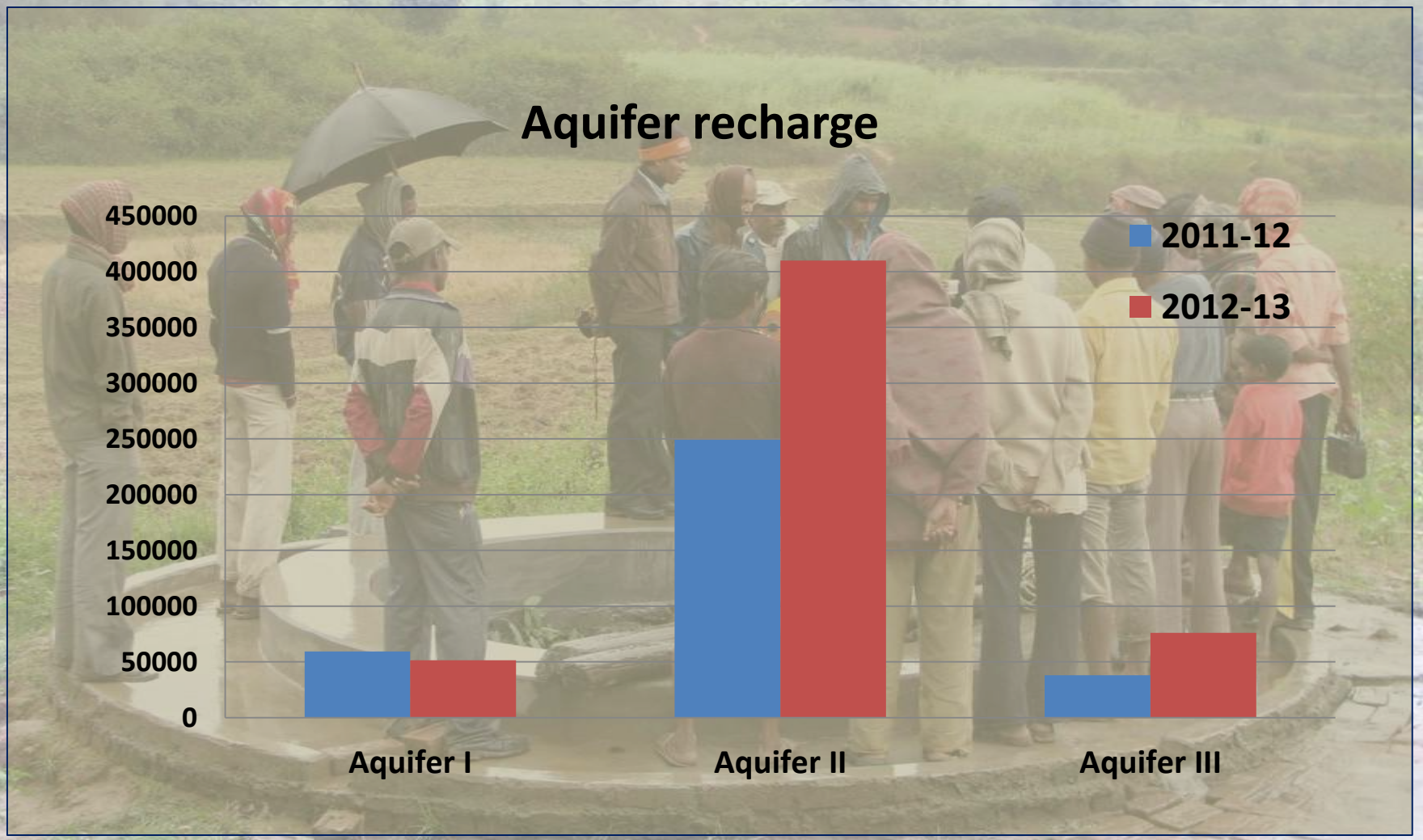
# Recharge : A comparison of two years




**Rainfall in 2011: 518 mm and Rainfall in 2012: 480 mm.**

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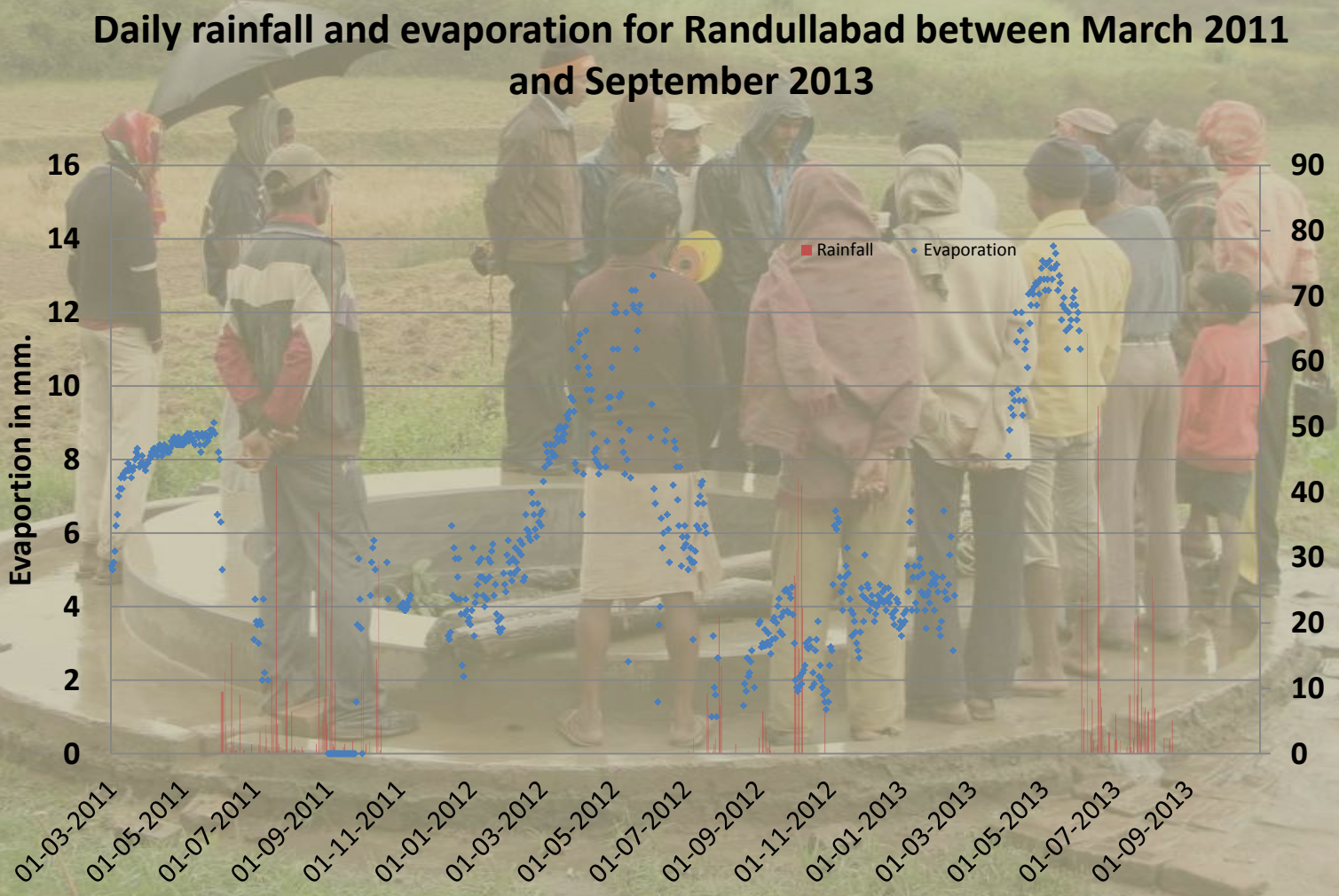
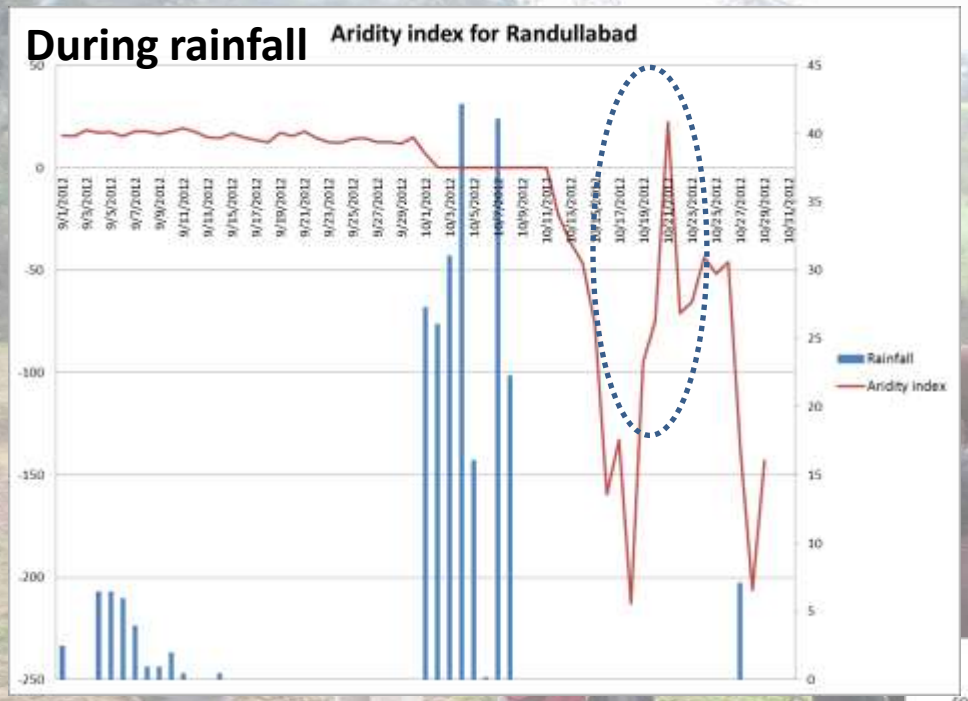
# Weather data

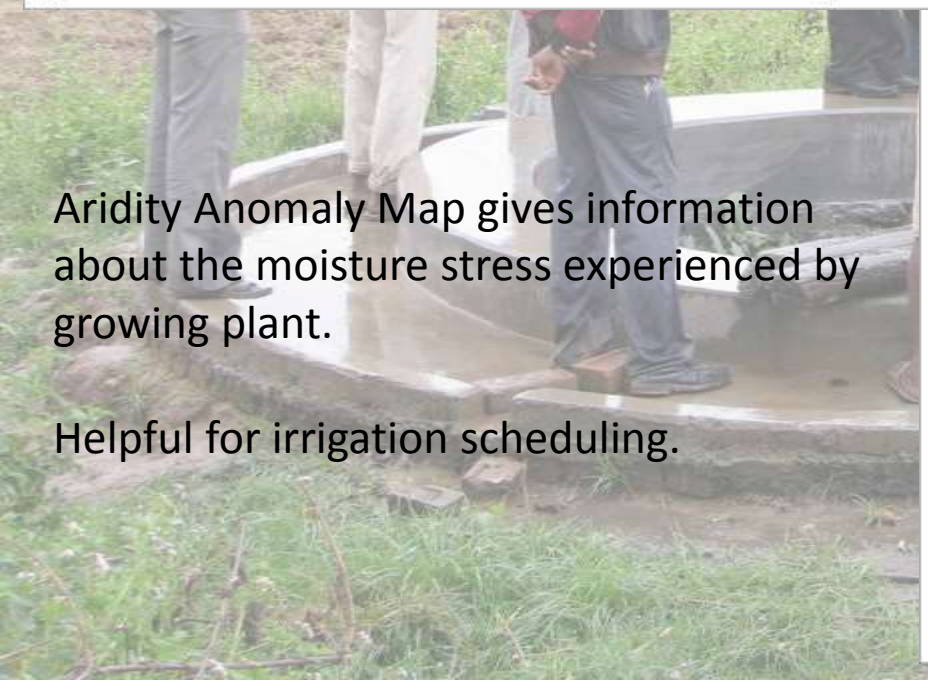


# Aridity Index

**During rainfall**

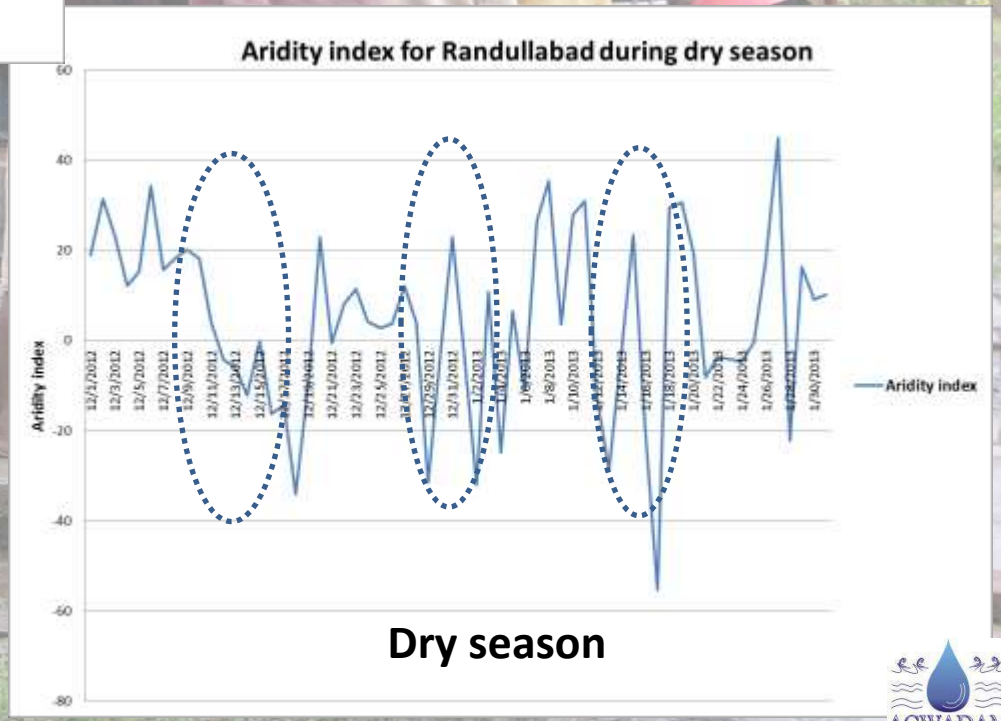



Aridity index = ((PE-AE)/PE) *100



Aridity Anomaly Map gives information about the moisture stress experienced by growing plant.

Helpful for irrigation scheduling.

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# Crop Evapotranspiration

| Crop | ETc (initial stage) | ETc(mid stage) | ETc (maturity stage) | Season |
|---|---|---|---|---|
| Potato | 0 mm/day | 3.65 mm/day | 2.27 mm/day | Kharif |
| Beans | 1.42 mm/day | 3.75 mm/day | 1.27 mm/day | Kharif |
| Sorghum | 0.68 mm/day | 4.48 mm/day | 3.63 mm/day | Rabi |
| Wheat | 1.37 mm/day | 4.91 mm/day | 2.69 mm/day | Rabi |
| Gram | 0 mm/day | 4.27 mm/day | 2.31 mm/day | Rabi |

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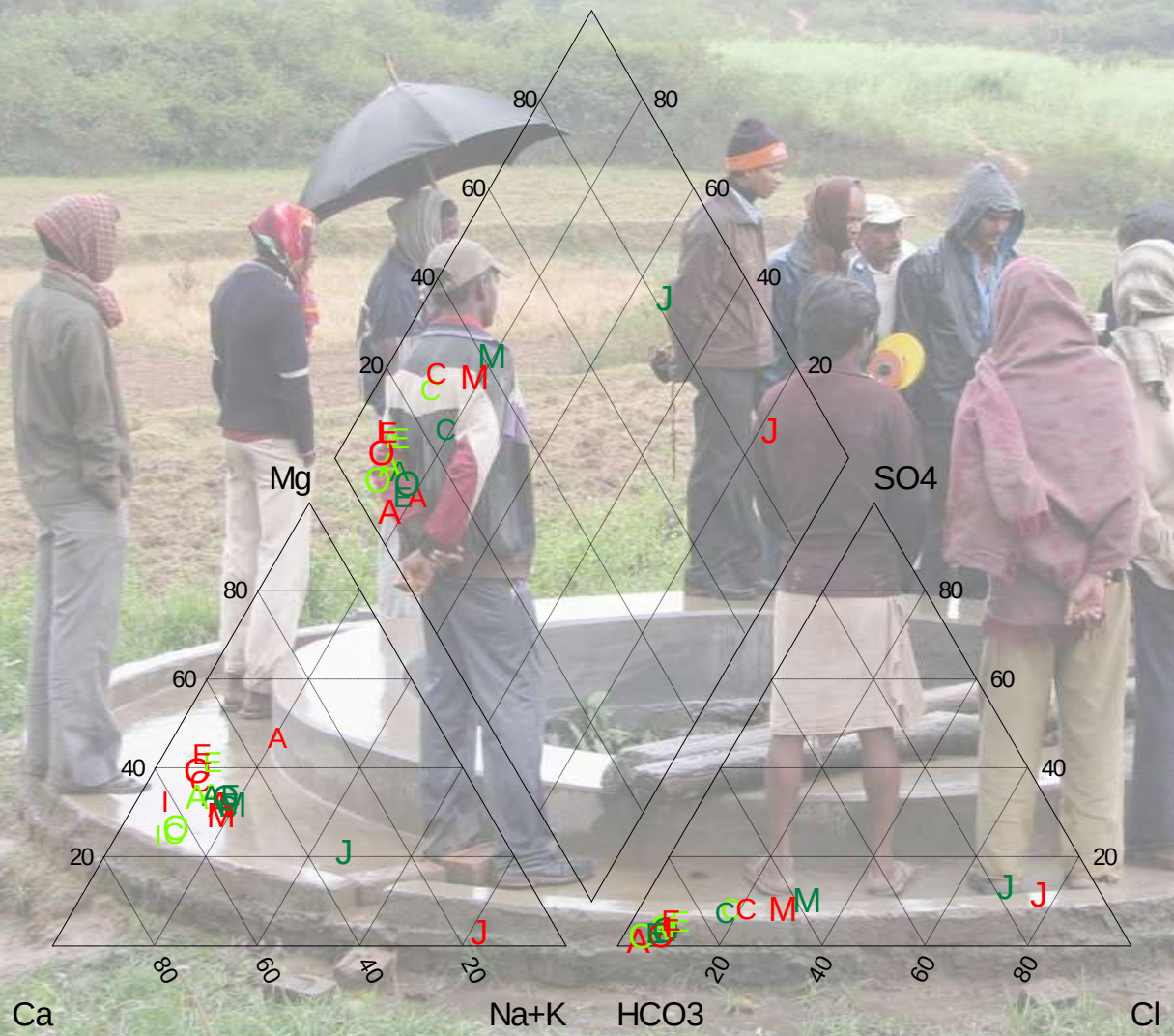
# Piper Plot for Randullabad for 3 seasons




Legend

- E W25_Dec 11
- E W25_May 12
- E W25_Dec 12
- O W21_May 12
- O W21_Dec 12
- C DW well_Dec 11
- C DW Well_May 12
- C DW well_Dec 12
- A W15_Dec 11
- A W15_May 12
- O W21_Dec 11
- J HP1_May 12
- J HP1_Dec 12
- I W23_Dec11
- I W23_May 12
- A W1_May 12
- A W1_Dec 12
- M HP3_May 12
- M HP3_Dec 12
- A W1_Dec 11

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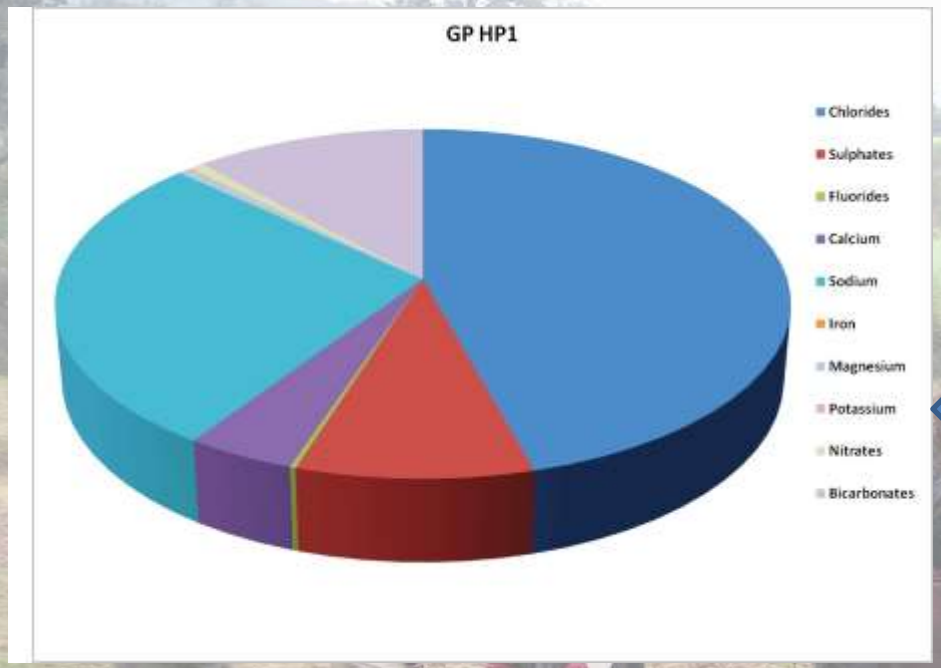
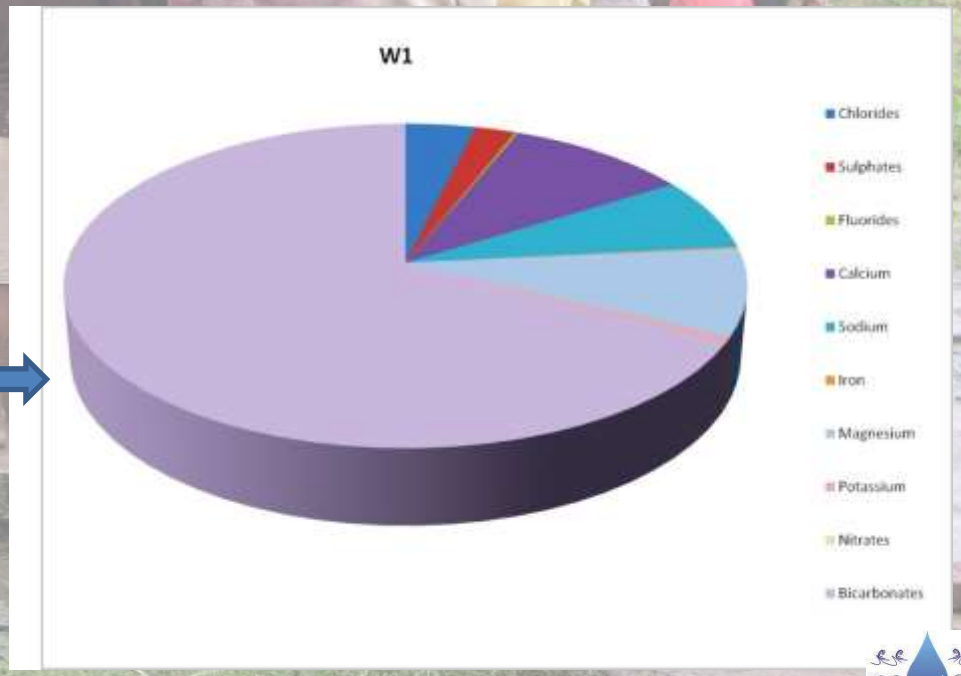
# GW Quality as indicator to delineate aquifers




**Hand pump- 210 FT (65m) deep**

**Dug wells- Up to 120 FT (40m) deep**

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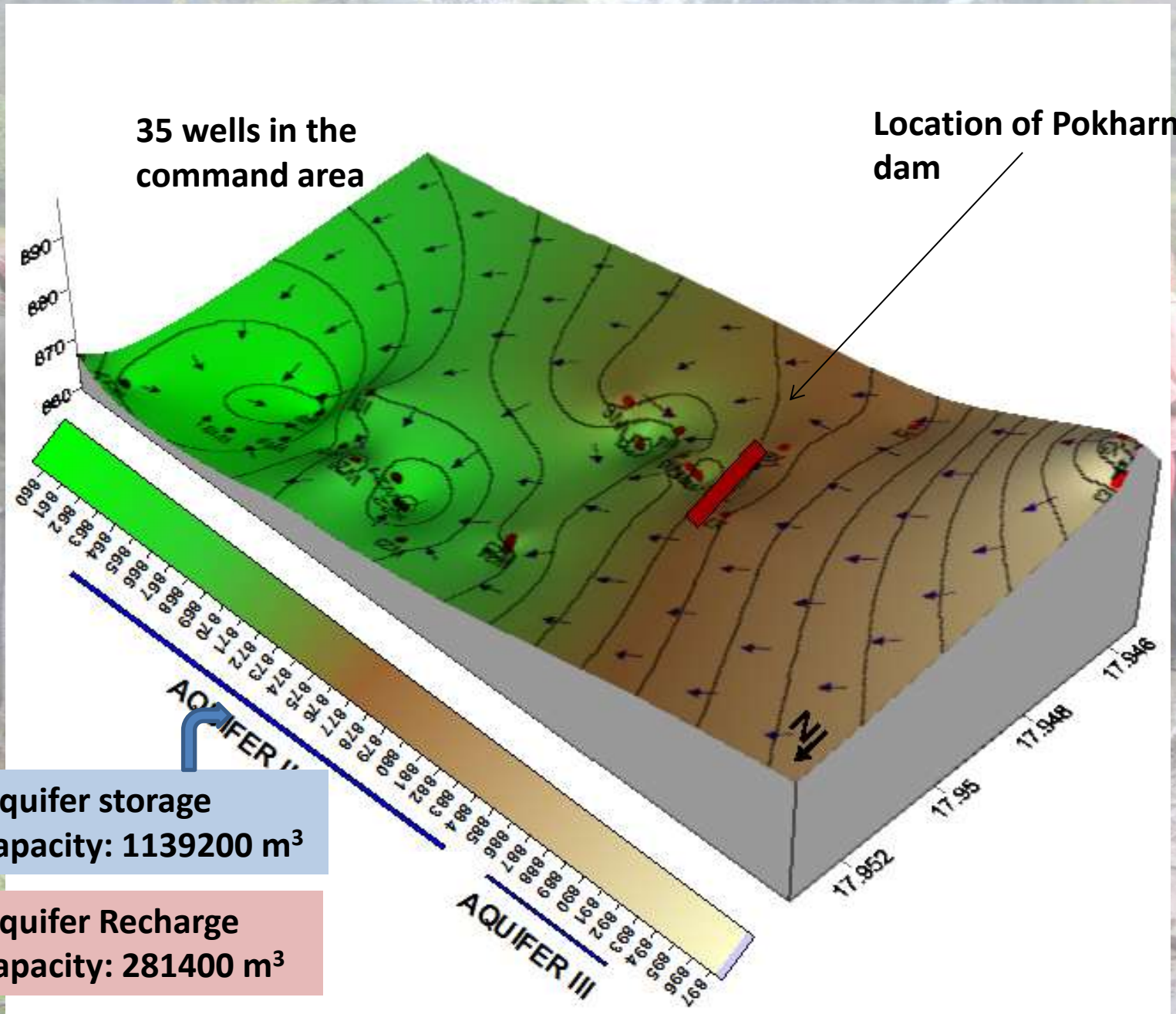
# ACWADAMs Recommendations: Reviving the percolation tank

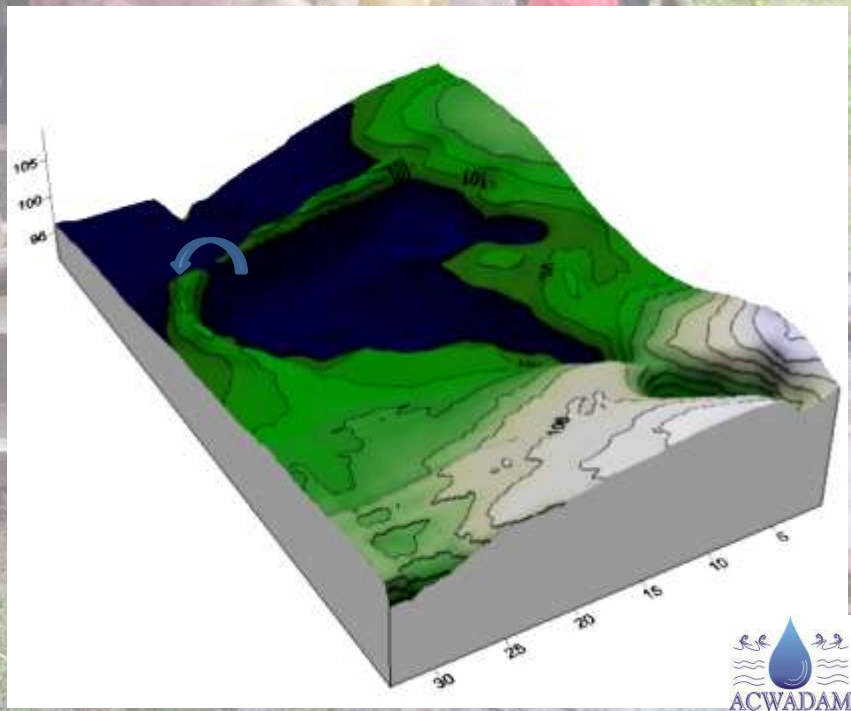


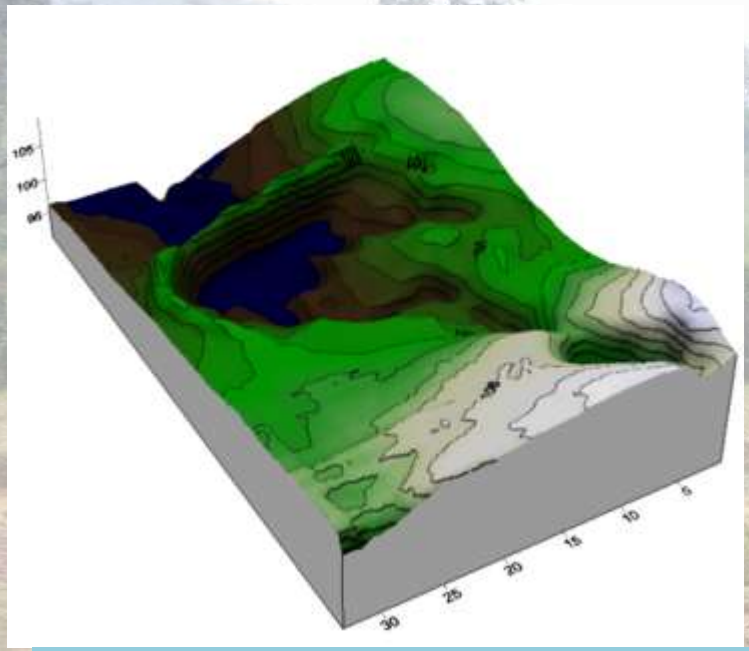

**Aquifer storage capacity: 1139200 $m^3$**

**Aquifer Recharge capacity: 281400 $m^3$**

# Critical problems

- Percolation tank has not been desilted for last 40 years and therefore, almost 78439 cum of silt is deposited in the tank.
- A thin layer of clay is deposited at the base which is acting as a confining layer and not allowing water to percolate down, defeating the recharge purpose.
- Dam wall is in need of immediate repairs and maintenance. At one location, the dam wall has become weak and may breach after heavy rainfall.

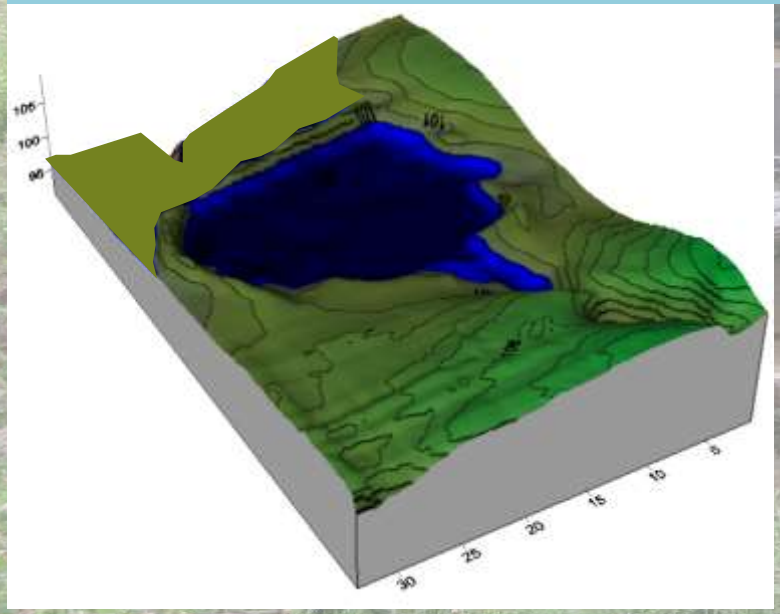




## Present situation

| Water column in Dam | Water storage | Potential percolation |
|---|---|---|
| 1 m | 11650 $m^3$ | 1398 $m^3$ |
| 2 m | 32500 $m^3$ | 3900 $m^3$ |
| 3 m | 64500 $m^3$ | 7740 $m^3$ |
| 4 m | 117000 $m^3$ | 14040 $m^3$ |
| 5 m | Leakage | Leakage |

In basalt ,12% of the storage will be percolated. This will have some impact on the actual recharge to the aquifer.



## After De-siliting

| Water column in Dam | Water storage | Potential percolation |
|---|---|---|
| 1 m | 18750 $m^3$ | 9000 $m^3$ |
| 2 m | 44600 $m^3$ | 21408 $m^3$ |
| 3 m | 78450 $m^3$ | 37656 $m^3$ |
| 4 m | 124700 $m^3$ | 59856 $m^3$ |
| 5 m | 200750 $m^3$ | 96360 $m^3$ |

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| Protocols | Aquifer 1 | Aquifer 2 | Aquifer 3 |
|---|---|---|---|
| **Hydrogeology in Watershed Programmes** | NECESSARY | ESSENTIAL | DESIRED, but not NECESSARY |
| **Recharge area protection (Forest cover & community lands)** | NECESSARY | ESSENTIAL | DESIRED, but not NECESSARY |
| **Pump capacity regulation** | NECESSARY | NECESSARY | NECESSARY |
| **Regulation of distance between wells (Drinking well protection)** | DESIRED, but not NECESSARY | DESIRED, but not NECESSARY | NECESSARY |
| **Depth Regulation (wrt drinking well)** | DESIRED, but not NECESSARY | NECESSARY | NECESSARY |
| **Regulation of agricultural water requirement (crop water requirement)** | ESSENTIAL | NECESSARY | ESSENTIAL |
| **Groundwater sharing through community participation** | NECESSARY | NECESSARY | NECESSARY |
| **Drinking water quality monitoring** | DESIRED, but not NECESSARY | NECESSARY | NECESSARY |
| **Regulations to control overexploitation** | NECESSARY | NECESSARY | NECESSARY |
| **Groundwater Monitoring to understand the GW availability** | NECESSARY | NECESSARY | NECESSARY |
| **Community sensitization and awareness generation for groundwater use** | NECESSARY | NECESSARY | NECESSARY |

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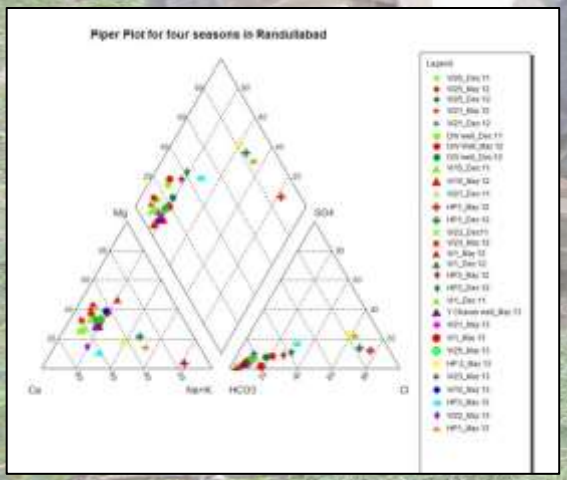
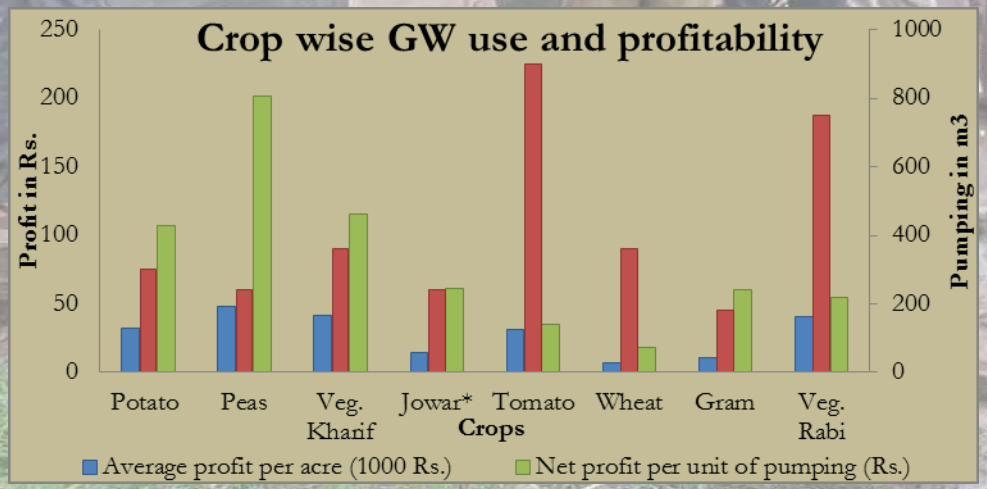
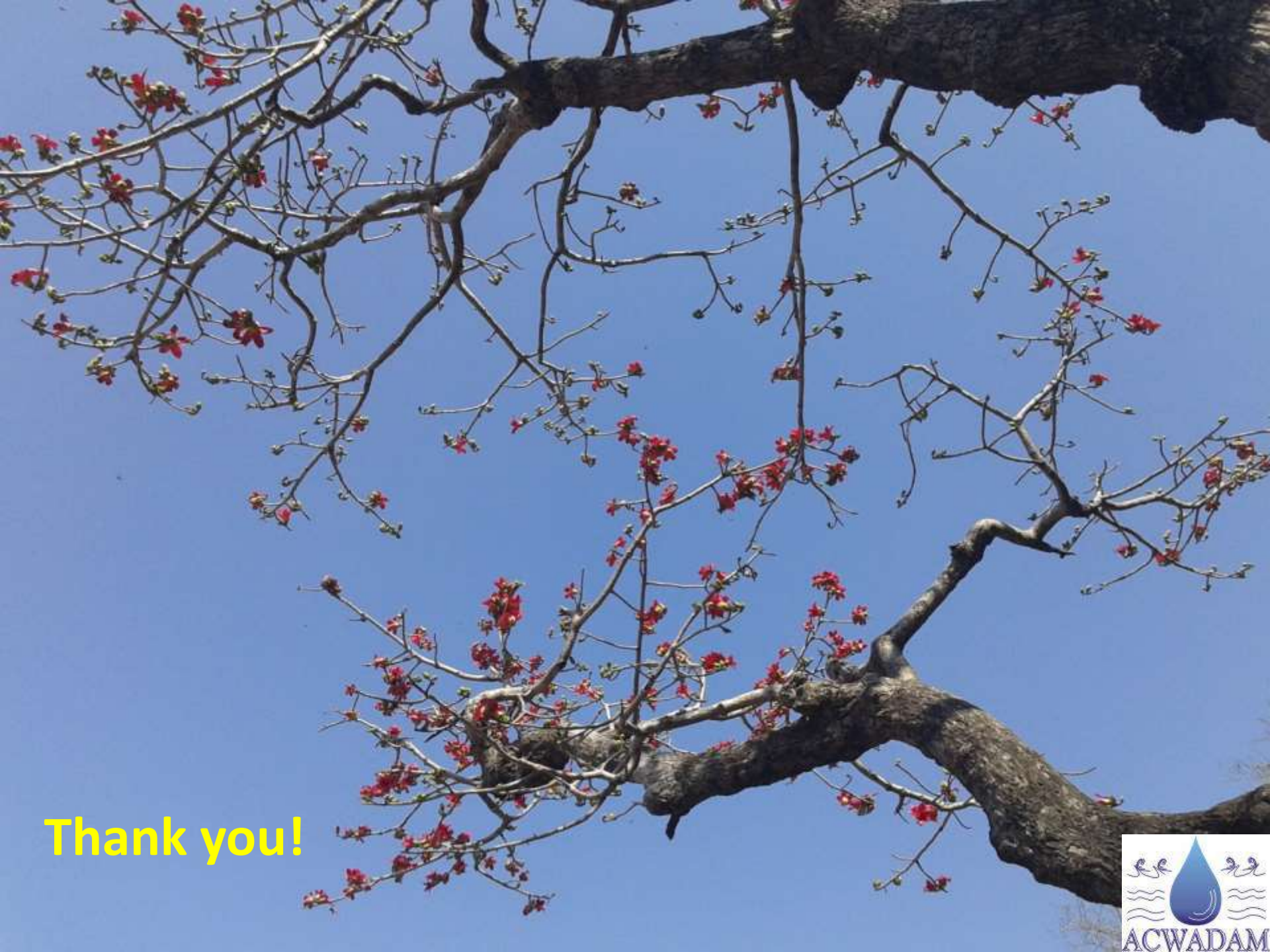
# Key impacts of PGWM

| Parameter | Impacts |
|---|---|
| Hydrogeology – data, information | Decision support in long-run; process of monitoring |
| Improved approach to recharge | Through input to WSD plan |
| Drinking water security | Depth and distance regulation; back-up sourcing |
| Sharing of resource | Various forms and at different scales and dimensions |
| Development of cadre | Varying degrees, but ingrained into the basic concept of PGWM… |
| Improvement in sustained availability of water | Drinking water availability and/or irrigation water availability improved |
| Sensitization & awareness | Exposure visits, trainings, knowledge building |
| Input to advocacy | Various levels – from adjoining villages, other organisations working in these areas and State/Centre |

**Water quality**





Thank you!
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