PoCRA-IITB MoU II Updates

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IIT Bombay
16th September’19

MoU II - Objectives

A. Technical Refinement of GIS Water Balance Plugin and Automation
B. Development of Water Accounting Framework to guide planning and enable measurement of outcomes at project level
C. Implementation of framework through apps, guidelines
D. Support for DPR Assessment - operational support - ongoing process
E. Development of GIS based Dashboard
F. Video training material - released one video, one remaining - due on development of new MLP app
G. Collaboration with Agricultural universities
H. Dashboard Extension and Technical Support
I. Report on MoU II and several non-MoU tasks!

Phase I

Mahabhulekh data Analysis

Objective - Exploration of cadastral wise cropping data extraction from mahabhulekh data and Its use in water balance.

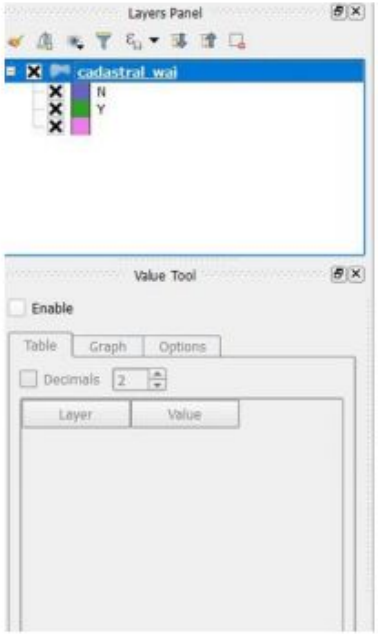
Taluka-wise count of villages and total count for district:-e.g Akola

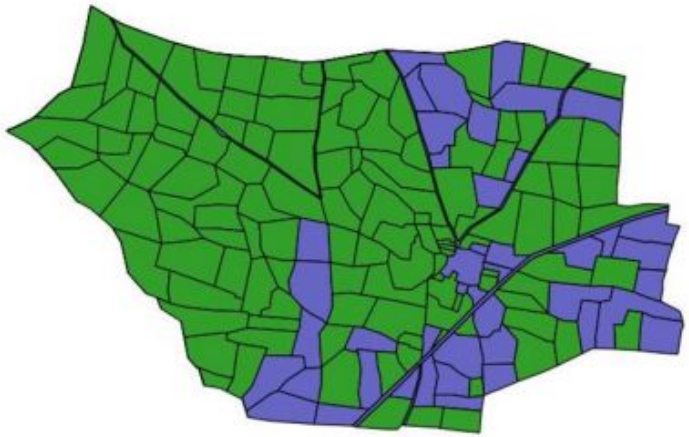
```
mhrorako_akt_gat_count.csv----6
mhrorako_tel_gat_count.csv----4
mhrorako_pat_gat_count.csv----3
mhrorako_bar_gat_count.csv----4
mhrorako_mur_gat_count.csv----2
mhrorako_bal_gat_count.csv----2
mhrorako_ako_gat_count.csv----19
Total Villages= 40
```

Mahabhulekh Village Count

```
akola_akot_gat_count.csv----180
akola_akola_gat_count.csv----199
akola_telhara_gat_count.csv----106
akola_murtijapur_gat_count.csv----162
akola_barshitakli_gat_count.csv----159
akola_balapur_gat_count.csv----103
akola_patur_gat_count.csv----96
Total Villages= 1005
```

Cadastral Village Count





Cropping data analysis for Wai, Washim

Discrepancies in the Mahabhulekh data

1. Missing Survey numbers in villages
2. Non-Standard formats for survey number representation
3. Number of villages covered is significantly less than known number of villages present in taluka (Village count given in folder of each district taluka-wise)
4. Some districts are missing (Hingoli,Parbhani,Washim)

Similar, taluka wise analysis for cadastral data is provided to cross-check the count of talukas, districts, gat_nos, etc. including missing data for mahabhulekh.

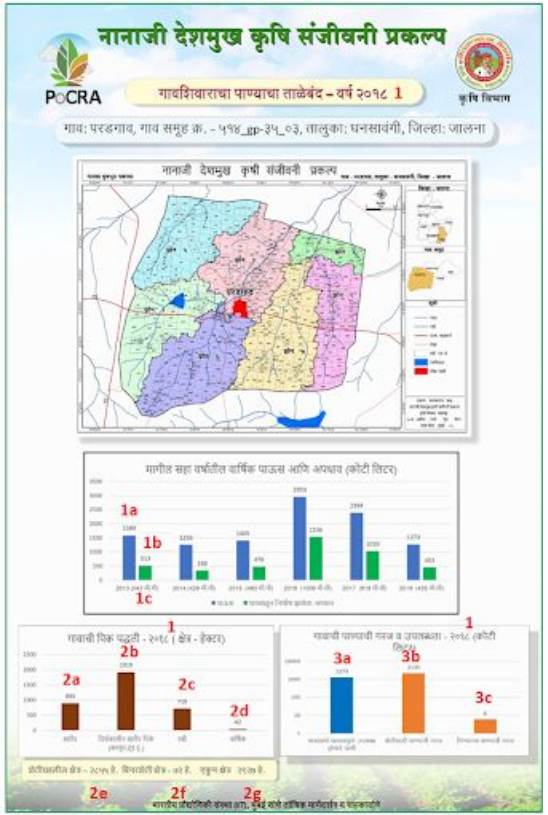
P.S. Wardha does not have location info in cadastral so its comparative data is missing in both sources.

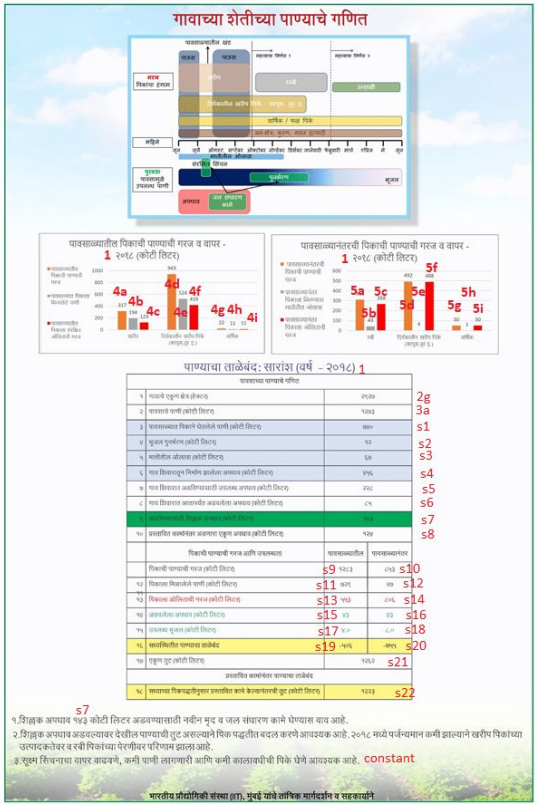
Village Level Water Balance Chart

Live Link :- [link]

Useful for community comprehension of water budget in villages

sample villages for live viewing: Ramgaon - 530060, Makner - 528454





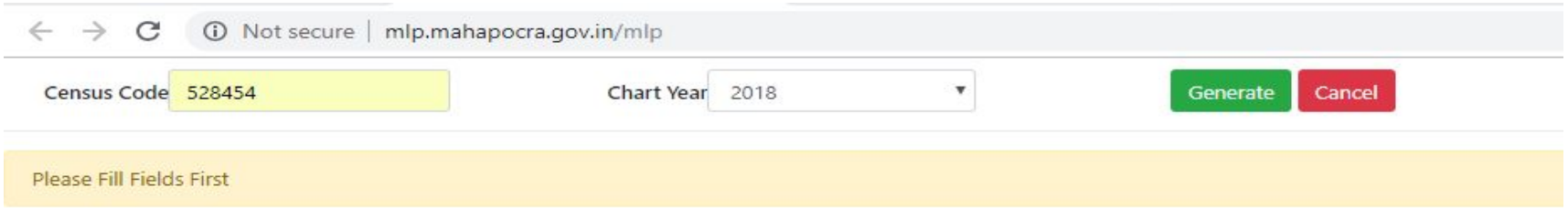
Visual Water Balance Charts

1. Delivered Backend queries and database for village level chart – output village-wise year-wise table with numbers (IITB)
2. Finalized Design of Front end display – printable pdf format in marathi for flex (Runtime)
3. Completed Front end automation for numeric entries in chart – graph formation, village name etc (Runtime)
4. Water Balance Queries also available in Postgress - last 6 years all scenarios (IITB)

Documents delivered: Procedure to prepare village chart, Database formulation

Schema and online chart generation

	census_code integer	village_name character varying(100)	chart_year integer	village_area_hectare numeric	rainfall_crorelitres numeric	runoff_crorelitres numeric	kharif_area_hectare numeric	longkharif_area_hectare numeric
1	530131	Pach Pimpal	2013	242.08	247.99	0	0	0
2	527026	Manegaon	2013	919.21	710.55	286.27	68.49	408.18
3	527027	Kothali	2013	684.25	528.93	221.92	57.99	333.42
4	527032	Salbardi	2013	365.50	282.53	105.46	28.42	157
5	527034	Hartale	2013	3541.04	2737.22	1157.80	520.79	1155.11



Charts available to download in pdf format

Water balance results for actual and MRSAC soil texture

Change in soil texture and depth leads to change in output of water balance.

To understand the variation of water balance components few samples from farms were collected and analyzed for texture analysis and actual depth at the site was observed.

Results for two farms from Pardgaon village is shown in the slides below.

Grid based comparison was made for soil shapefiles provided by NBSS&LUP and MRSAC.

Cotton Plot 328 Paradgaon

Cotton_328_2017				
	Test		MRSAC	
2017	Sandy_loam_0.5	Silty_loam_0.5	Clay_0.5	Clay_1.5
Rainfall_Monsoon_End	777	777	777	777
Runoff_Monsoon_End	229	230	376	268
AET_Monsoon_End	372	452	386	483
SoilMoisture_Monsoon_End	4	13	6	31
GW_Monsoon_End	172	83	11	0
Deficit_Monsoon_End	131	50	117	20
AET_Crop_End	413	497	425	539
SoilMoisture_Crop_End	4	9	6	11
Deficit_Crop_End	361	227	348	234
Cotton_328_2018				
Rainfall_Monsoon_End	436	436	436	436
Runoff_Monsoon_End	116	93	162	134
AET_Monsoon_End	253	292	260	301
SoilMoisture_Monsoon_End	4	9	6	1
GW_Monsoon_End	62	41	7	0
Deficit_Monsoon_End	283	244	275	235
AET_Crop_End	253	292	260	301
SoilMoisture_Crop_End	4	9	6	0
Deficit_Crop_End	525	485	517	476

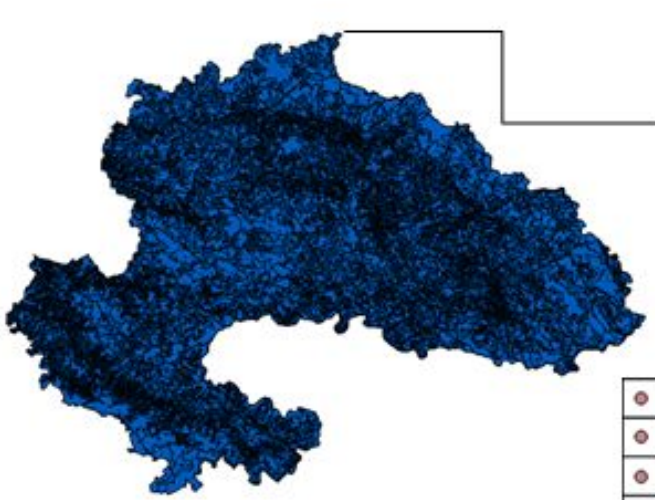
- According to MRSAC soil type at plot 328 is clay and its depth is categorized as very deep(more than 1m).
- Test result at above location texture to be sandy loam or silty loam and depth to be .5 m.
- Model results for two years 2017 and 2018 is given in the table for tested samples as well as MRSAC.
- Variation has been observed in terms of runoff, AET, GW and deficit values for different scenarios

Cotton Plot - 48

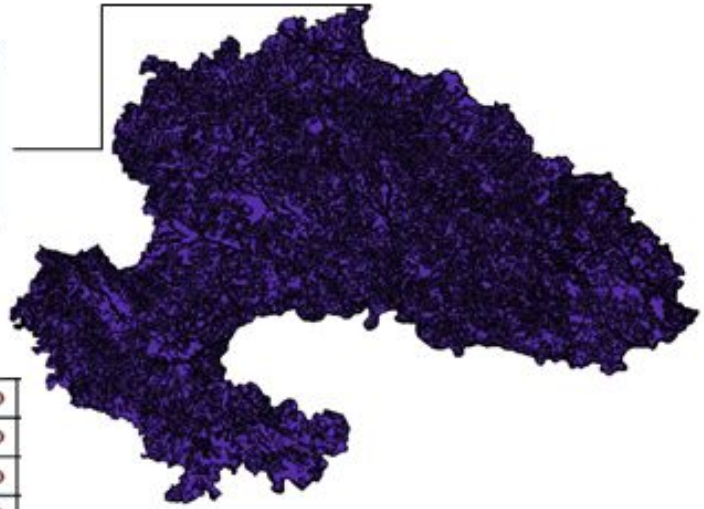
	Cotton_48_2017		
	MRSAC	Test	
	Gravely_clay_loam_0.5	Loamy_Sand_0.5	Sandy_loam_0.5
Rainfall_Monsoon_End	777	777	777
Runoff_Monsoon_End	431	229	287
AET_Monsoon_End	297	214	269
SoilMoisture_Monsoon_End	7	2	4
GW_Monsoon_End	45	347	223
Deficit_Monsoon_End	206	289	233
AET_Crop_End	333	239	298
SoilMoisture_Crop_End	7	1	4
Deficit_Crop_End	441	535	475
	Cotton_48_2018		
Rainfall_Monsoon_End	436	436	436
Runoff_Monsoon_End	199	138	156
AET_Monsoon_End	208	148	179
SoilMoisture_Monsoon_End	7	1	4
GW_Monsoon_End	21	149	96
Deficit_Monsoon_End	327	388	357
AET_Crop_End	208	148	179
SoilMoisture_Crop_End	7	1	4
Deficit_Crop_End	569	630	598

- According to MRSAC soil type at plot 48 is gravely clay loam and its depth is categorized as moderate(.25-.5m).
- Test result at above location texture to be sandy loam or silty loam and depth to be .5 m.
- Model results for two years 2017 and 2018 is given in the table for tested samples as well as MRSAC.
- Variation has been observed in terms of runoff, AET, GW and deficit values for different scenarios.

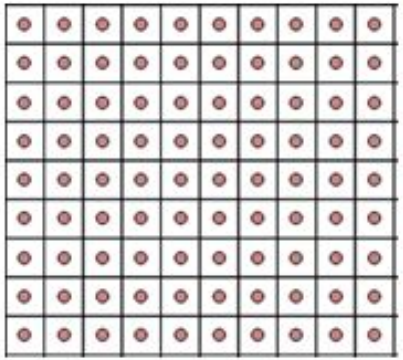
Comparative analysis of soils from MRSAC and NBSS&LUP



Attribute type at each location from both shapefile



Yavatmal_NBSSLUP_Shapefile
[9]



Yavatmal_MRSAC_Shapefile
[10]

Matrix with i,j values as attribute

Results of Soil Texture - Yavatmal

NBSSLUP Data	MRSAC Data													
	*	LS	C	HM	SL	SiL	GSCL	M	GCL	GC	CL	GL	SCL	WM	GSL
	i	0	1	0	0	0	0	0	0	1	0	0	0	0	0
	m	38	5461	118	113	96	823	6	2101	194	1099	15	54	274	634
	k	0	440	3	27	14	28	11	146	3	62	2	2	7	52
	h	0	16	0	13	0	7	0	41	2	56	5	1	0	23
	f	1	253	5	9	0	152	0	381	39	163	10	25	26	558

Maximum Value in Row

Maximum Value in Column

Maximum Value in both Row & Column

Sr.No	Short Form	Surface Texture
1	CL	Clay Loam
2	C	Clayey
3	GC	Gravelly Clay
4	GCL	Gravelly Clay Loam
5	GL	Gravelly Loam
6	GSCL	Gravelly Sandy Clay loam
7	GSL	Gravelly Sandy Loam
8	LS	Loamy Sand
9	SCL	Sandy Clay Loam
10	SL	Sandy Loam
11	SiL	Silty Loam
12	HM	Habitattion Mask
13	WM	Waterbody Mask
14	M	Mining

i	Sandy Clay
m	Clay
k	Silty Clay
h	Sandy Clay Loam
f	Clay Loam

21

Cont.

1. MRSAC soil maps are at 1:50000 scale which needs improvement
2. The actual soil have more silt content that clay content
3. Texture/depth validation of NBSSLUP data with MRSAC.
4. Possible Collaboration with NBSS & LUP.

Outcomes:

5. Guided MoU between PoCRA,GoM and NBSS&LUP,Nagpur
6. Mapping of soil resources on 1:10000 scale

- **work on integration with refined soil dataset will be done in MoU III**
- **Soil data collection app - link**

Phase II

Design and Demo - Soil App

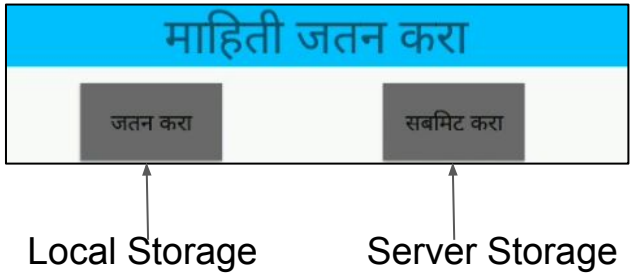
district_name character varying(100)	taluka_name character varying(100)	village_name character varying(100)	farmer_name character varying(100)	contact_no character varying(100)	gat_no characte
अमरावती	अकोला	अगासखेड	Swapnil	7709405270	54

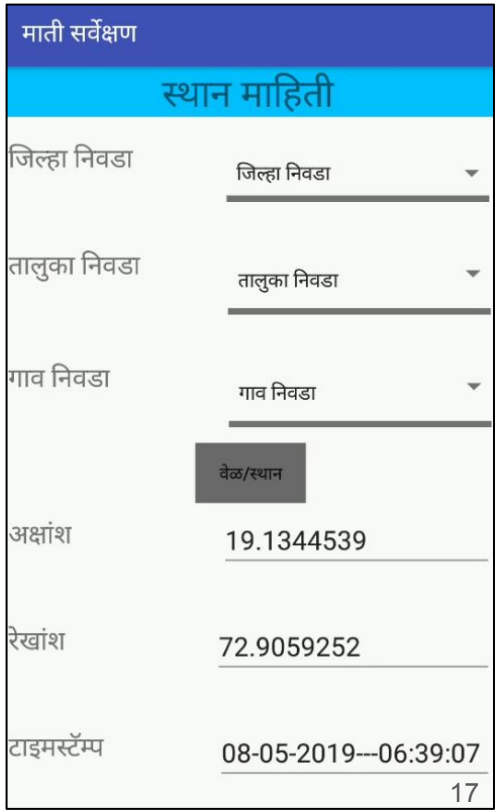
Attributes Collected:

1. **Location Information**
   a. District
   b. Taluka
   c. Village
   d. Latitude
   e. Longitude
   f. Timestamp
2. **Farmer Information**
   a. Farmer Name
   b. Farmer Contact Number
3. **Farm Information**
   a. Gat Number
   b. Crop Name
   c. Land Use
   d. Soil Type
   e. Soil Depth

Utility Features:

1. Click based Location and Timestamp
2. Local Input Storage
3. Input Storage at Server Database
4. Marathi Language

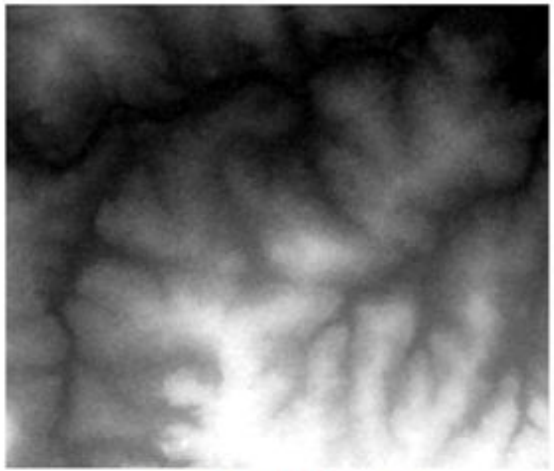


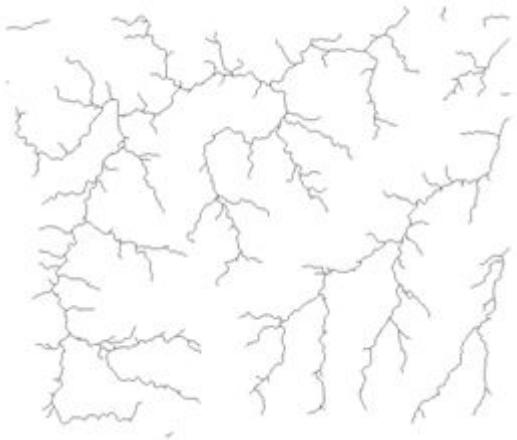


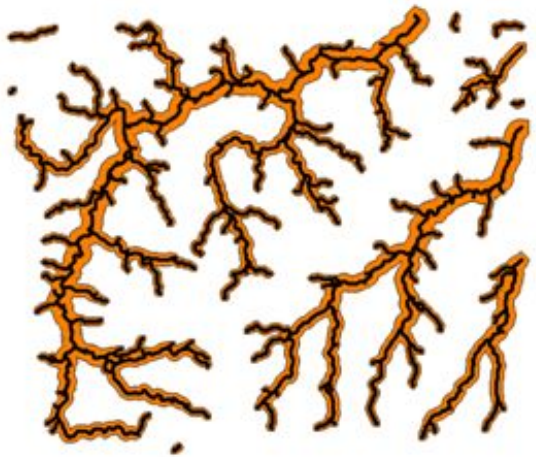
Simple Soil Classification based on SM

Paradgaon	Year-2014	Crop Soyabean			
depth	0.01	0.25	0.5	1	1.5
Soil type	Very Shal	Shallow (10 to 25cr	tely deep (25 to 50 c	Deep (50-100 cm)	Very deep (>100 cm)
Sandy Loam	215	135	103	103	103
Gravelly Sandy Loam	217	138	105	104	103
Gravelly Sandy Clay Loam	202	124	103	105	105
Sandy Clay Loam	214	135	106	105	105
Loamy	194	115	104	107	107
Loamy Sand	233	162	117	108	107
Gravelly Loam	192	114	104	108	108
Sandy Clay	205	126	108	109	108
Gravelly Silty Clay	190	111	106	110	110
Clayey	198	118	107	110	110
Gravelly Clay	196	118	108	111	111
Gravelly Clay Loam	197	119	109	112	112
Clay Loam	198	120	109	112	112
Silty Clay	194	116	109	113	113
Silty Loam	173	103	109	115	115
Gravelly Silty Loam	177	106	109	116	116
Silty Clay Loam	187	111	111	117	116
Sandy	233	180	137	124	124

What is stream proximity?



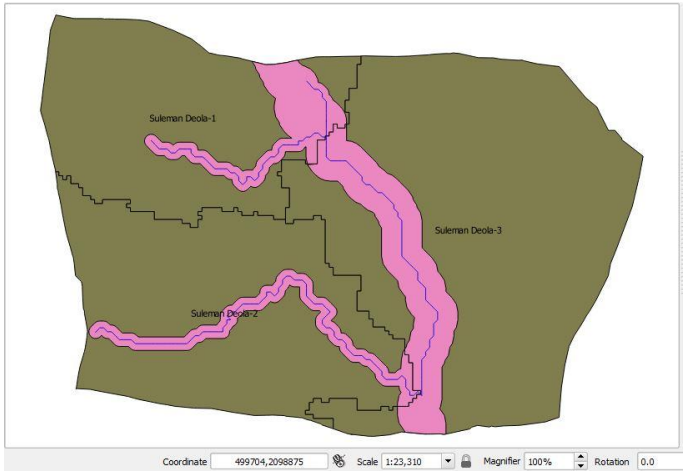


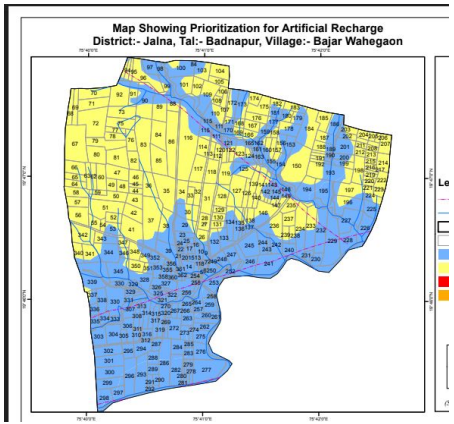


API - input (stream order, width) output - map (automated)

Inclusion of stream proximity - automated

- Variation of GW Recharge Priority map from GSDA
- Considered for zoning but not accepted.
- To be used in beneficiary selection, M&E, Farm Pond water accounting and GW recharge plans

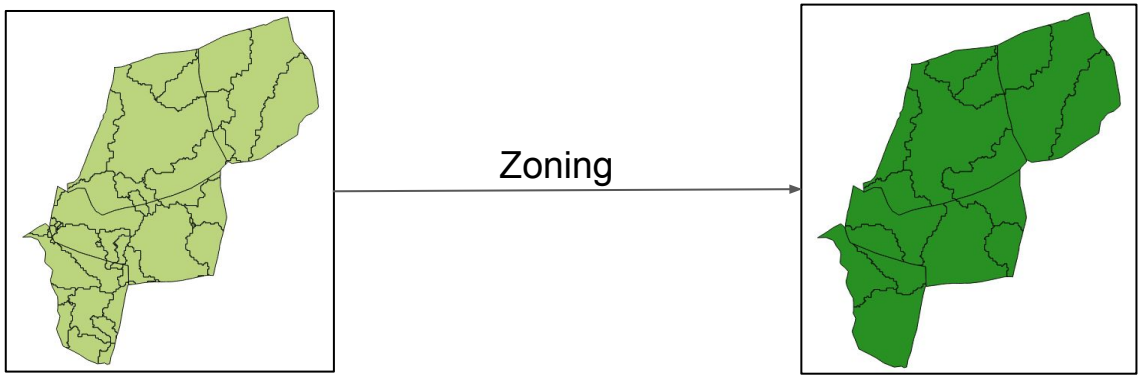




Zoning Overview - (Extension of Phase I Work)

What is Zoning?

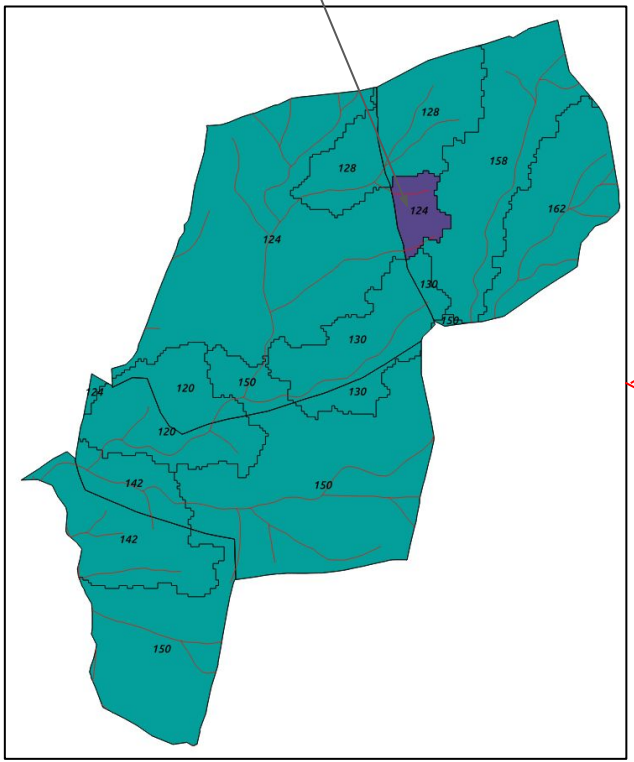
- How to **capture spatial variations** like Soil, Land-Use, GW-availability, SM-availability, socio-economic makeup,etc?
- Each zone shows similar properties distinguished from other zones.



Cluster Layer Intersected with Watershed

Final Zoning Applied Layer

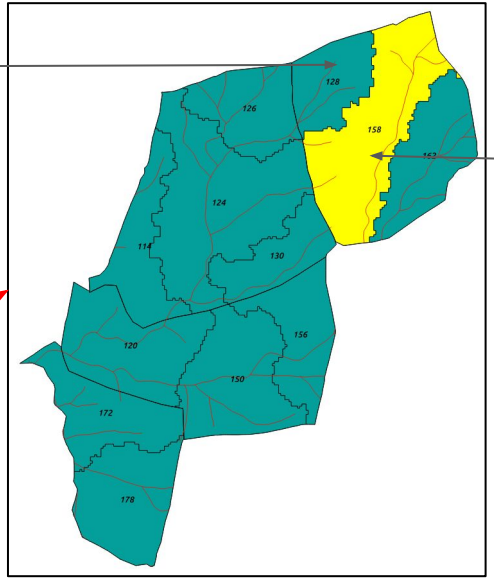
Small Zone to be merged



Watershed and Cluster Layer

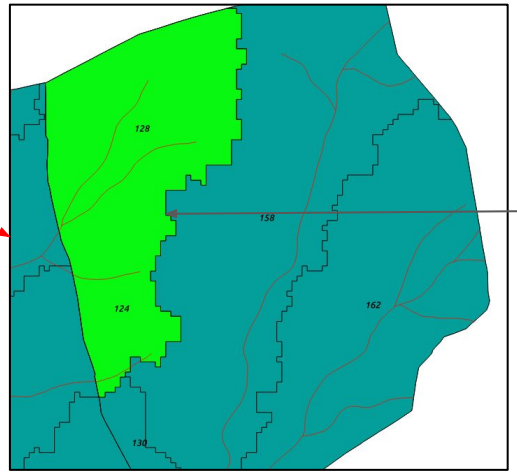
Expected Zone to merge with

Incorrect Merge



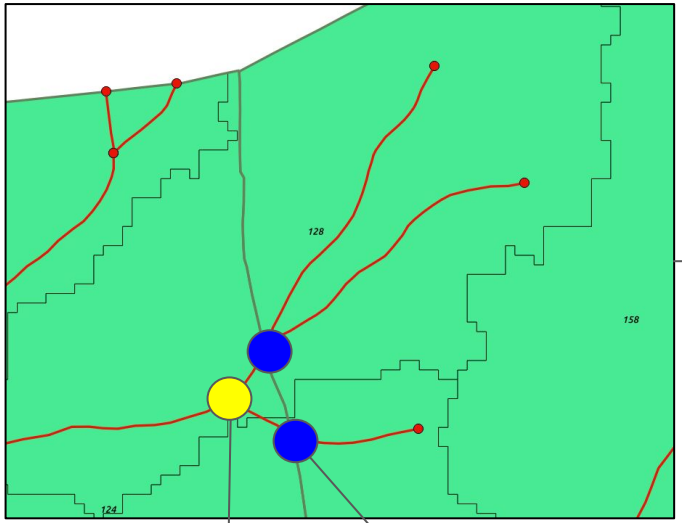
Merged in Larger area

Desired Merge

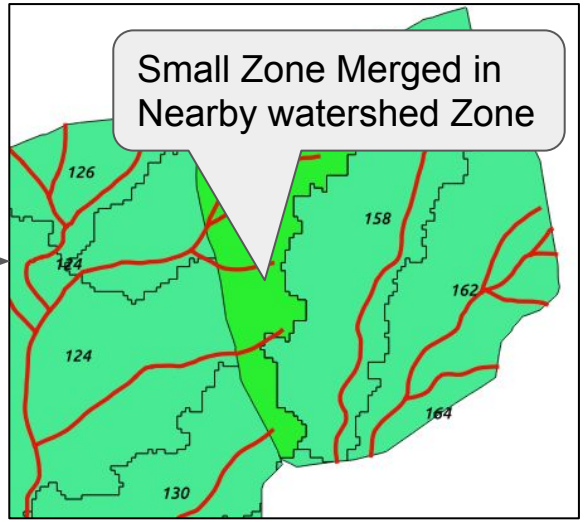


Desired Merged

Merging Logic



Correctly Merged



Zoning Approach

Objective:

- Add attribute between two adjacent zones for merging

Approach:

- Merge the small size zones based on **nearest drain point** instead of merging to a adjacent larger area zone
- The modified approach expects us to find the drain point for each adjacent zone w.r.t. the smaller size zone.
- Then, we find the distance between the drain point of smaller zone and the meeting point of the two drain points.
- The zone having **least distance** is the zone to be merged with.

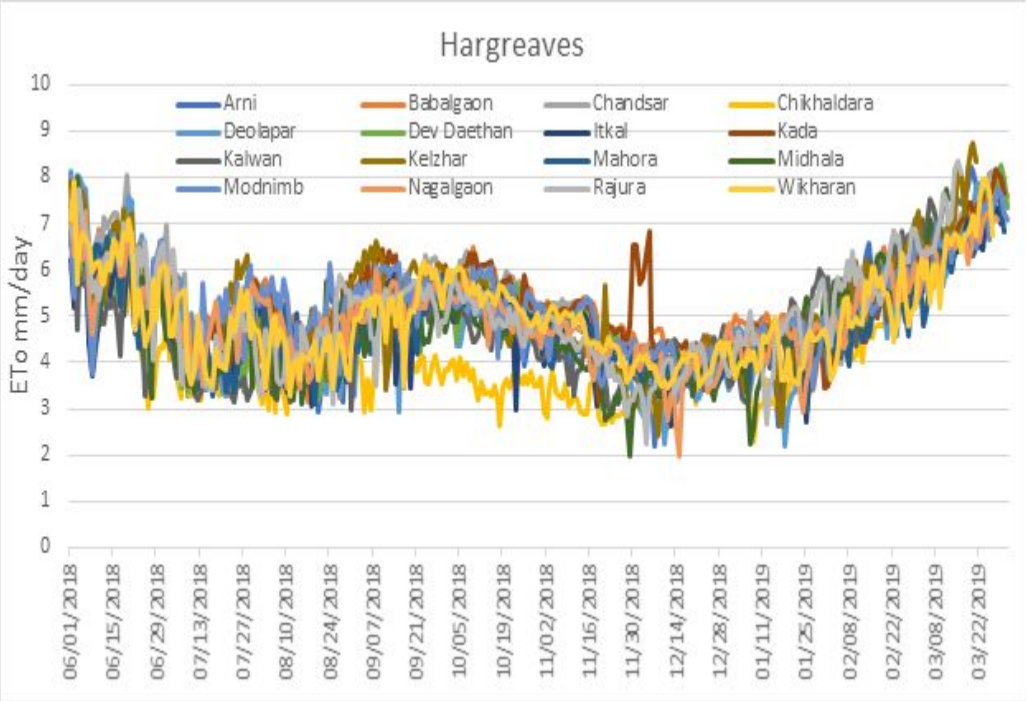
ET0 computation using daily weather parameters

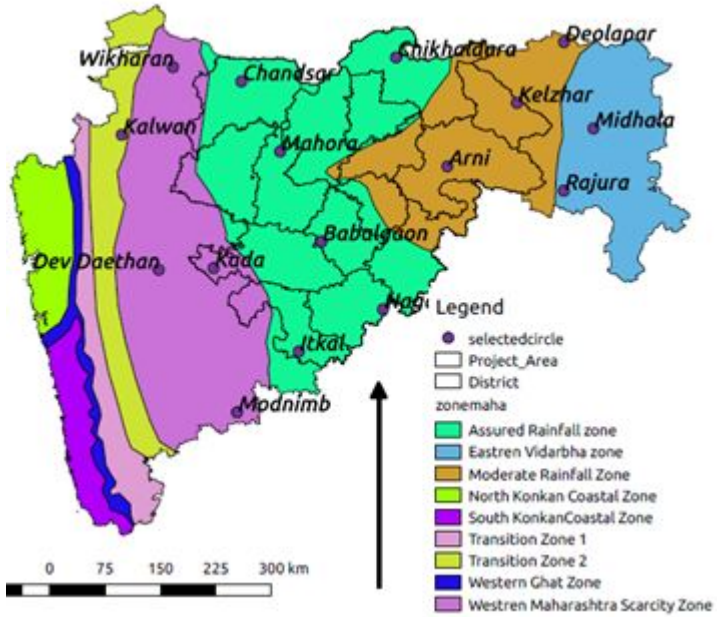
Hargreaves and Samani method is used for computation of daily ETo based upon literature, data available and suggestions made by SAU's.

ETo = $0.0023^{*}(T\ \text{mean} + 17.28)^{*}(T\ \text{max} - T\ \text{min})^{0.5}{*}\text{Ra}{*}0.408$

$$R_a = \frac{24\ (60)}{\pi} G_{sc}\, d_r\, [\omega_s\ \sin(\varphi)\ \sin(\delta) + \cos(\varphi)\ \cos(\delta) \sin(\omega_s)]$$

ETo using Hargreaves Samani Method





B, C, D - Water Accounting Framework and Outcome Measurement

Deliveries

1. Water Allocation and Crop Hierarchy Framework

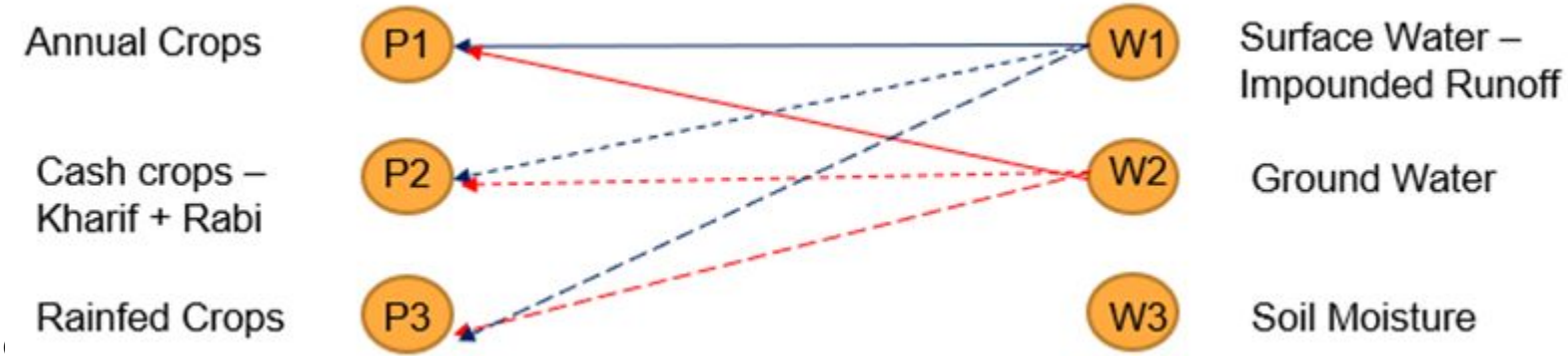
   Crop - Risk and Returns

   Budyko - Overall water balance indices

2. Water Productivity measurement framework
3. Beneficiary prioritization guidelines

Crop hierarchy and Water Allocation framework

- Measuring compulsory load (P1) and discretionary load (P2,P3) in the village
- Measuring Water availability – W1- surface storage, W2 - GW recharge and W3 - soil moisture
- Strategizing intervention planning to convert P2 load to P1, P3 load to P2 or P1 to more area



- Preparing norms to limit no. of proposed farm ponds, wells
- Measuring how much additional land can be brought under P1 crops without damaging P3 crops
- This can be converted into an handheld planning analysis app

Crop hierarchy

- Based on economic returns and risk and crop water requirement

Crop	Average modal wholesale market rate in Partur / Jalna APMC	Std dev of modal price distribution	Mean of daily price spread	Mean price spread as % of mean price	Crop water requirement (mm)	Output (Rs. Per cu.m.)
Cotton	Rs. 4367	16%	Rs. 1108	25%	700-800	Rs. 10
Tur	Rs. 3894	7%	Rs. 477	12%	575-625	Rs. 7.5
Soyabean	Rs. 3227	8%	Rs. 315	9%	350-400	Rs. 14
Wheat	Rs. 1670	14%	Rs. 171	10%	500-525	Rs. 9
Jowar	Rs. 1674.90	20%	Rs. 233	14%	400-450	Rs. 5
Sweetlime	Rs. 3125	21%	Rs. 1875	60%	1600-1800	Rs. 38

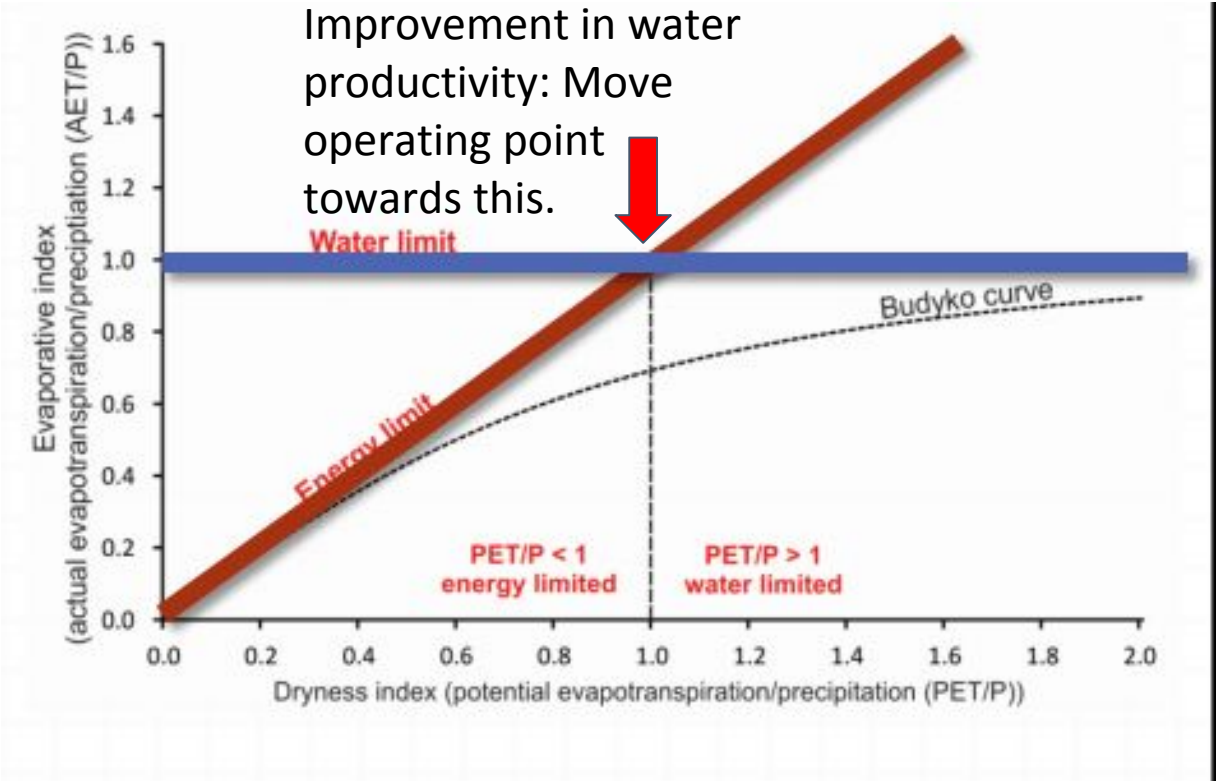
- Downscaling of economic vulnerability/ viability by preparing such tables at each taluka/ cluster.
- Maximizing output per unit of water
- Crop hierarchy needs to be studied and developed based on risks, returns and input costs.

Measuring watershed yields: Budyko curve

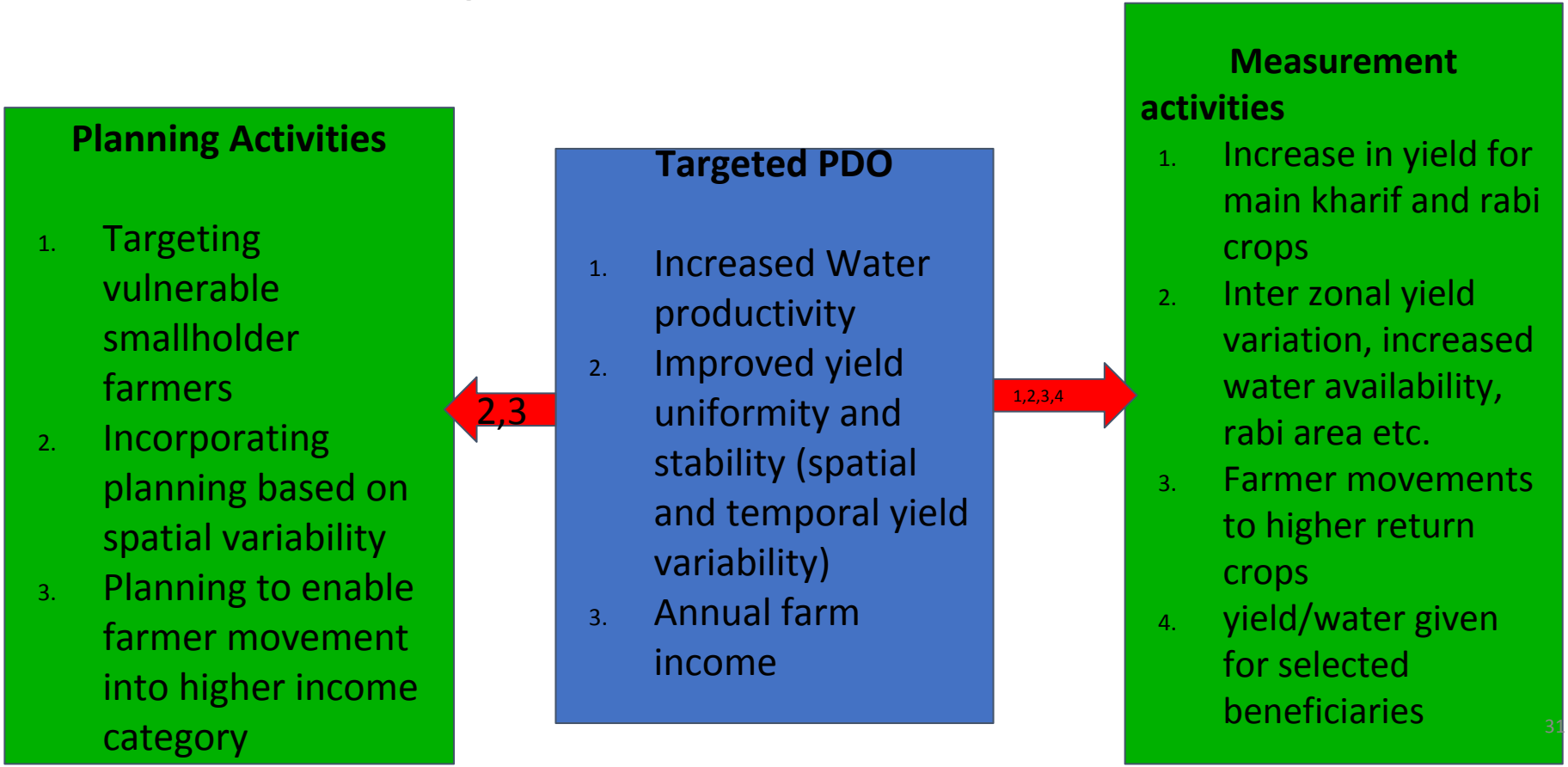
Indicator: Improved Water utilisation

1. AET/Effective Rainfall: Indicates the extent of rainfall being useful to crops with optimal value at 1
2. AET/PET - indicates the extent of water requirement fulfilled and an indicator of yield (optimal value at 1)

We plot village operating point based on water allocations to various crops from water budget based planning framework.



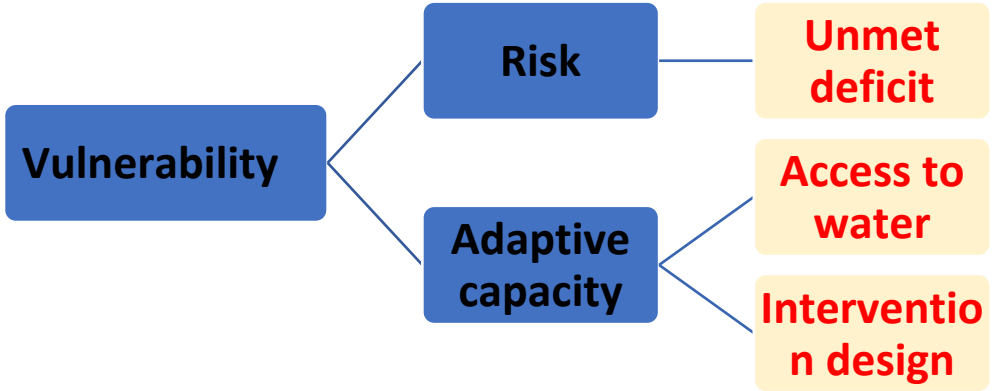
Target Project Development Objectives by streamlining Planning and Measurement Framework



B1-B2 Framework design for plan analysis and indices measurement

- Computation of crop hierarchy and water accounting framework with its linkages to village level planning and beneficiary selection.
- Measurement framework for water productivity indices and methodology for measurement of critical project outcomes.
- 'Budyko curve' used to develop indicators and at village and cluster level.

Vulnerability = Risk – Adaptive Capacity



To understand the vulnerability, risk of the farmer we need to first understand the different crops, their hierarchy, how a farmer allocates water to these crops and then their access to water.

Crop level Indices through Farmer Survey

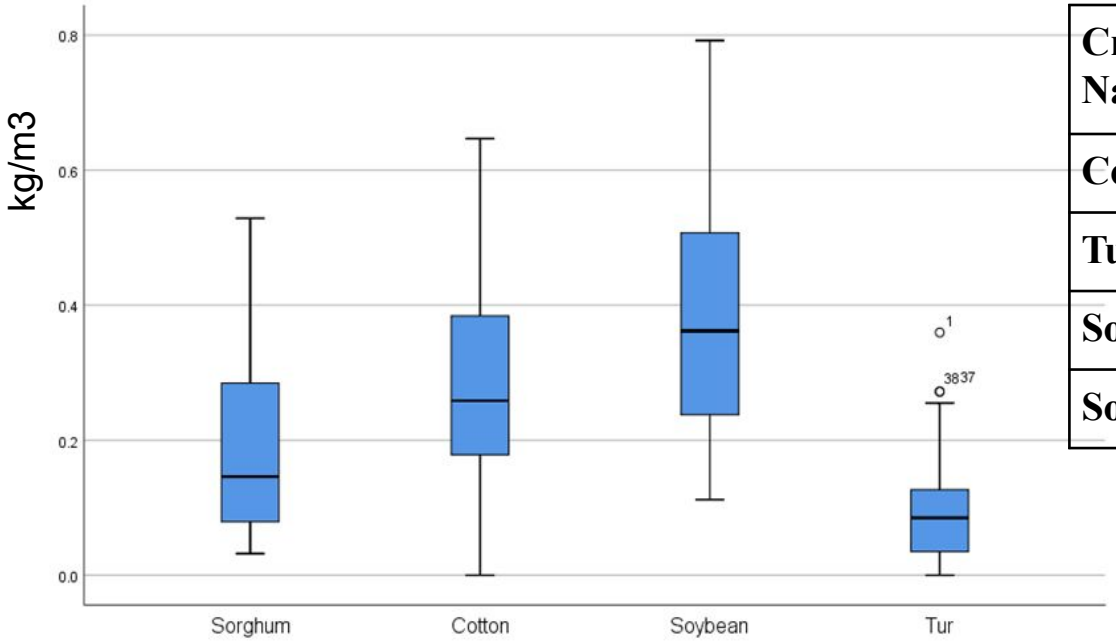
Water productivity (kg/m3)	Economic productivity (Rs/m3)	CV for yield
Yield * Area (AET+Water Allocation)	Yield * Area* Selling Price per unit (AET+Water Allocation)	Std. Dev of yield Average Yield

-Conducted at Village level for 3 main P2 and P3 kharif crops. (soybean/cotton/tur/moong/udid)

- Conducted for sample farmers to gauge spatial yield variability

-To be conducted at baseline, midline and endline for longitudinal farmers and once for varying farmers

Water Productivity



Crop Name	WP Range	WP Mean	WP std dev	Sample size
Cotton	0.00-0.98	0.35	0.13	142
Tur	0.00-0.91	0.36	0.20	101
Sorghum	0.03-0.53	0.21	0.13	56
Soybean	0.00-0.80	0.36	0.17	85

Source: Field visit to Yelda & Mamdapur, Beed, Wabgaon, Wardha, Yewati, Jalgaon, Tadmugli, Latur

1. Longitudinal Farmers: improvement in WP for one common crop will be monitored for 3 years
2. Variable Farmers: will be used to determine WP mean for primary crops in village

Calculated CV - Spatial & Temporal Variability of yield

Crop Name	Tadmugli	Wabgaon	Yewati	Yelda	Mamdapur
cotton	0.92	1.85	0.99	0.89	0.89
gram	0.84	2.87	-	0.87	0.87
maize	0.68	-	1.48	1.23	1.23
rabi_onion	-	-	1.64	1.23	1.23
rabi_wheat	-	2.01	0.78	1.1	1.1
sorghum	1.2	-	-	0.98	0.98
soybean	1.63	1.85	-	1.35	1.35
Sugarcane	-	1.66	-	1.2	1.2
tur	1.30	2.09	0.46	1.18	1.18
Udid	-	-	-	1.22	1.22

Year- 2018

Crop name	CV 2018	CV 2017	Number
cotton	0.97	0.52	63
gram	0.61	0.43	22
maize	1.54	1.41	51
rabi_onion	0.66	3.79	11
rabi_wheat	0.70	0.43	25
sorghum	0.79	0.68	14
soybean	0.99	0.36	52
Sugarcane	1.61	0.51	3
tur	2.23	2.89	58

CV difference over mid term and end term can be used to evaluate the yield variability spatially and temporally.

Source: Field visit to Yelda & Mamdapur, Beed, Wabgaon, Wardha, Yewati, Jalgaon, Tadmugli, Latur

Beneficiary Prioritization- Questions (As a part of D)

Id	Category	Questions
1	Land Area	**1A)** Is the land area available more than the reference value of the land area in the village
2	Stream proximity	**2A)** Is there a stream within 100 m from your farm?
3	Household size	**3A)** Is your household size more than 4?
4	No. of salaried members	**4A)** Is there a salaried member in your immediate family?
5	Biophysical vulnerability	**5A)** This parameter will be precomputed for all the cadastral numbers in the village for a reference crop soybean.
6	Water Assets	**6A)** Do you have a well / borewell / farm pond or any other irrigation source on your land? **6B)** Is the well/ borewell/ farm pond functioning? **6C)** Does any one of your water source have water available for irrigation after the month of January?

Beneficiary Prioritization- Questions

Id	Category	Questions
7	Cropping pattern	**7A)** Do you cultivate an annual crop? **7B)** Do you cultivate a rabbi crop? **7C)** Do you provide irrigation to your kharif crop?
8	Migration	**8A)** Do you migrate for more than 3 months in the year?
9	Labour work	**9A)** Do you engage in labour work in the village for more than 3 months?
10	Allied business	**10A)** Do any of your immediate family members engage in any allied business?

Beneficiary Prioritization- Formulae

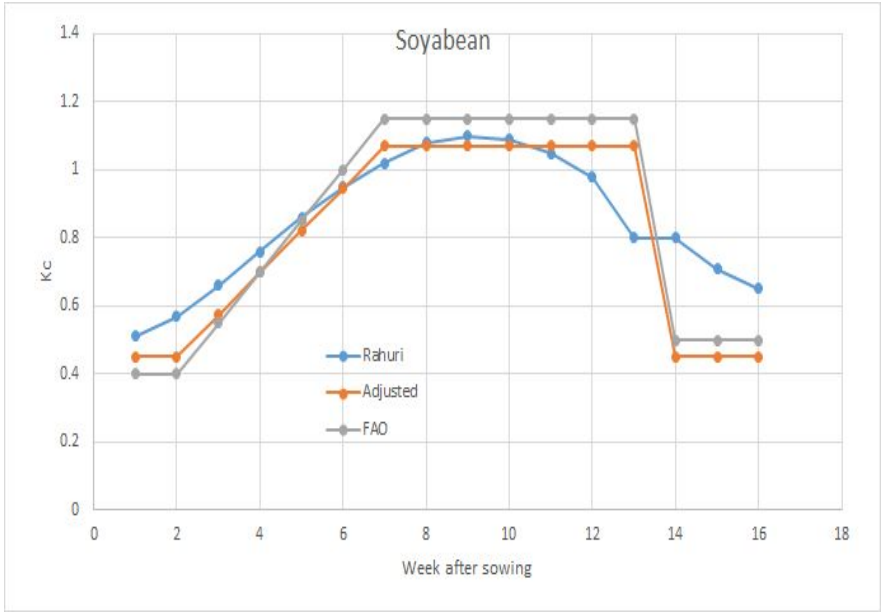
Category	Benefit	Elimination criteria	Prioritization formula	Relevance
Demand side benefits	Horticulture	6A+6B	1A+2A+3A+4A+5A+6C+7A+7B+7C+8A+9A+10A	The elimination criteria considered eliminates farmers without a water source and further prioritizes farmers with water for longer durations. The prioritization formula is in accordance with the demand side benefits.
Supply side benefits	Well	1A+6A	2A+3A+4A+5A+7B+8A+9A+10A	Wells should be provided to farmers without any existing source of irrigation. Source of irrigation should include borewells or well.

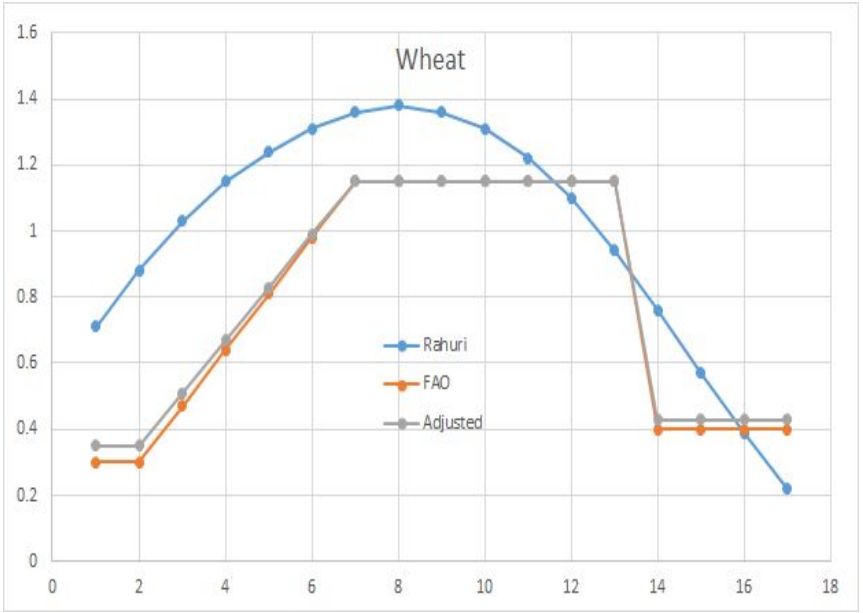
Horticulture- ranking (Village - Wabgaon, Wardha)

Farmer Name	Index	Priority rank
Suman Lokhande	8	1
Haribhau Umbre	8	1
Pramod Bale	7	2
Kalpana Lokhande	7	2
Bharat Shidulkar	7	2
Lilabai Rajurkar	6	3
Haridas Hande	6	3
Dhananjay Didphay	6	3
Vandu Khusate	5	4
Dilip Lotkar	5	4
Ramesh Debade	5	4
Mangesh thote	4	5
Ujjwala Narayane	3	6

Phase III

Incorporation of PET for Drip/Sprinkler - Kc Modification





Findings:

- Substantial difference between regionally reported Kc values and FAO.
- Modified Kc valued easily integrable in current system.

Cont.

Regionalization of Kc was tried using FAO methodology for year 2018.

However, long term weather data should be used.

Results were compared with Kc values of Rahuri university.

There is significant difference of Kc values adjusted and obtained from rahuri.

For time being FAO values are used.

Experiment for improvement in Kc is proposed with agriculture universities.

Modelling irrigated AET example - drip/sprinkler

Farmer name	Baban Dane	
Village	Chapadgaon	
Taluka	Ghansawangi	
District	Jalna	
Soil Type	clay loam	
	Irrigated	rainfed
Rainfall (input)	577.0	397.0
Runoff	167.4	102.2
Infiltration	409.6	294.8
SM	0.0	0.0
GW recharge	0.0	0.0
AET	409.6	294.8
PET (input)	811.0	811.0
Deficit	401.4	516.3
Irrigation	180	

* All values are in mm

yield: 4.5 q/acre

Farmer name	Kasubai Jadhav	
Village	Tongaon	
Taluka	Aurangabad	
District	Aurangabad	
	Irrigated	rainfed
Rainfall (input)	475	475
Runoff	152.2	132.6
Infiltration	322.8	342.4
SM	30.1	30
GW recharge	18.2	6.8
AET	375.8	305.6
PET (input)	555.8	555.8
Deficit	180	250.2
Total Irrigation	112.5	
Total Effective Irrigation (90% efficiency)	101	

yield: 4 q/acre

Irrigation water for drip is added to soil moisture with 90% efficiency.

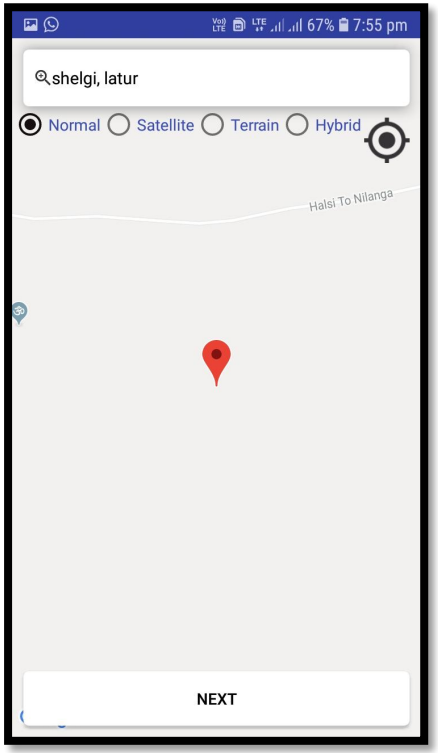
Irrigation water for sprinkler is added to rainfall

Simulation is done in farm level app

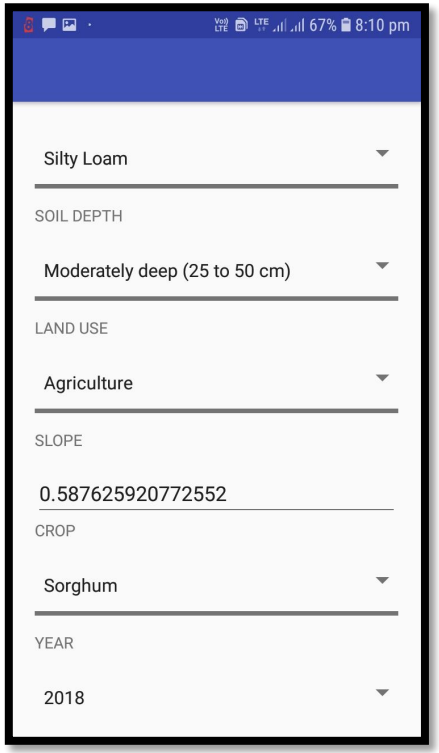
Methodology transferred to M&E agency for computation of water productivity

Farm level App

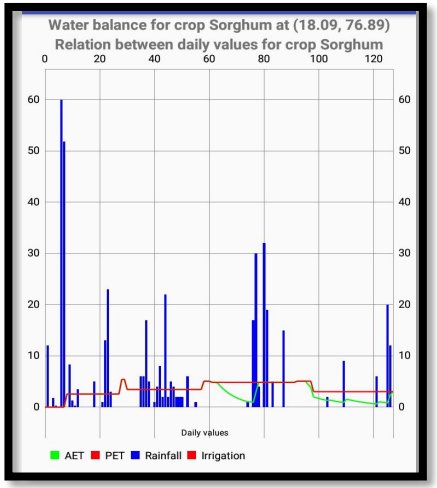
Farm Location

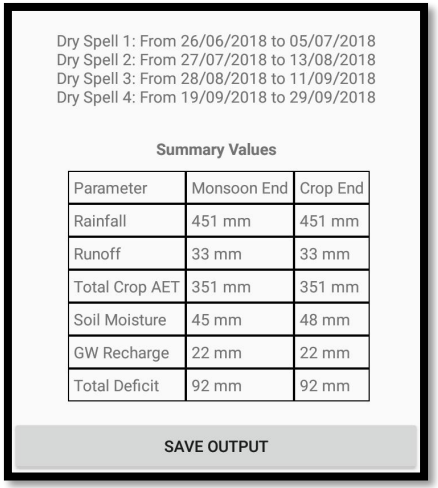


Inputs



Outputs





Parameter	Monsoon End	Crop End
Rainfall	451 mm	451 mm
Runoff	33 mm	33 mm
Total Crop AET	351 mm	351 mm
Soil Moisture	45 mm	48 mm
GW Recharge	22 mm	22 mm
Total Deficit	92 mm	92 mm

- **This will be useful for Agricultural Assistants, Field Level staff and Farmers**

Extensions proposed in Farm level App

1. Computation of water productivity
2. Computation of economic productivity
3. Addition of Contingencies scenarios, generation of triggers based upon the algorithms, extension through FFS coordinator and cluster assistant.

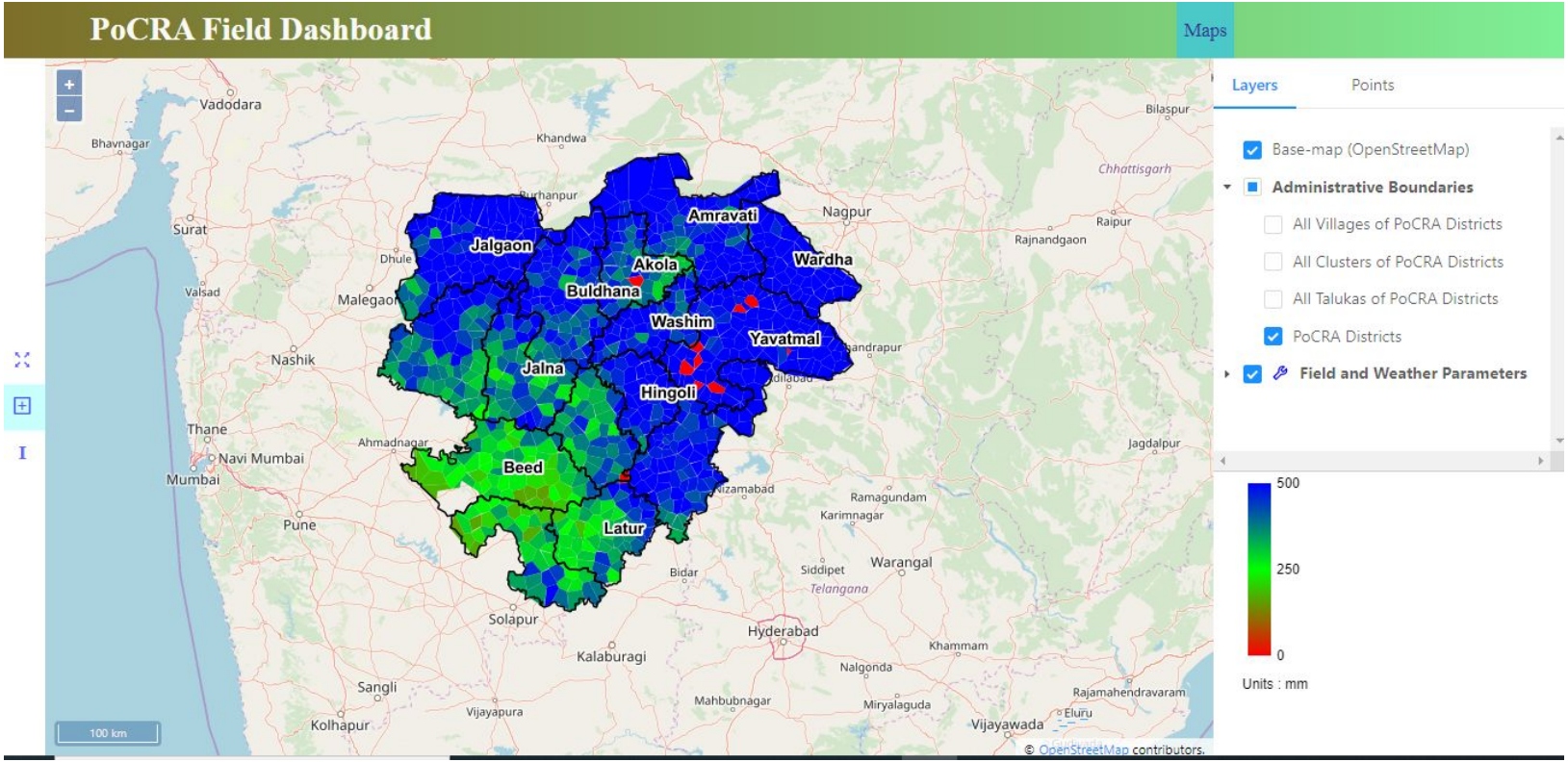
- Download link: https://www.cse.iitb.ac.in/~pocra/Android_app/app-debug.apk

Previous (Phase II) dashboard delivery:

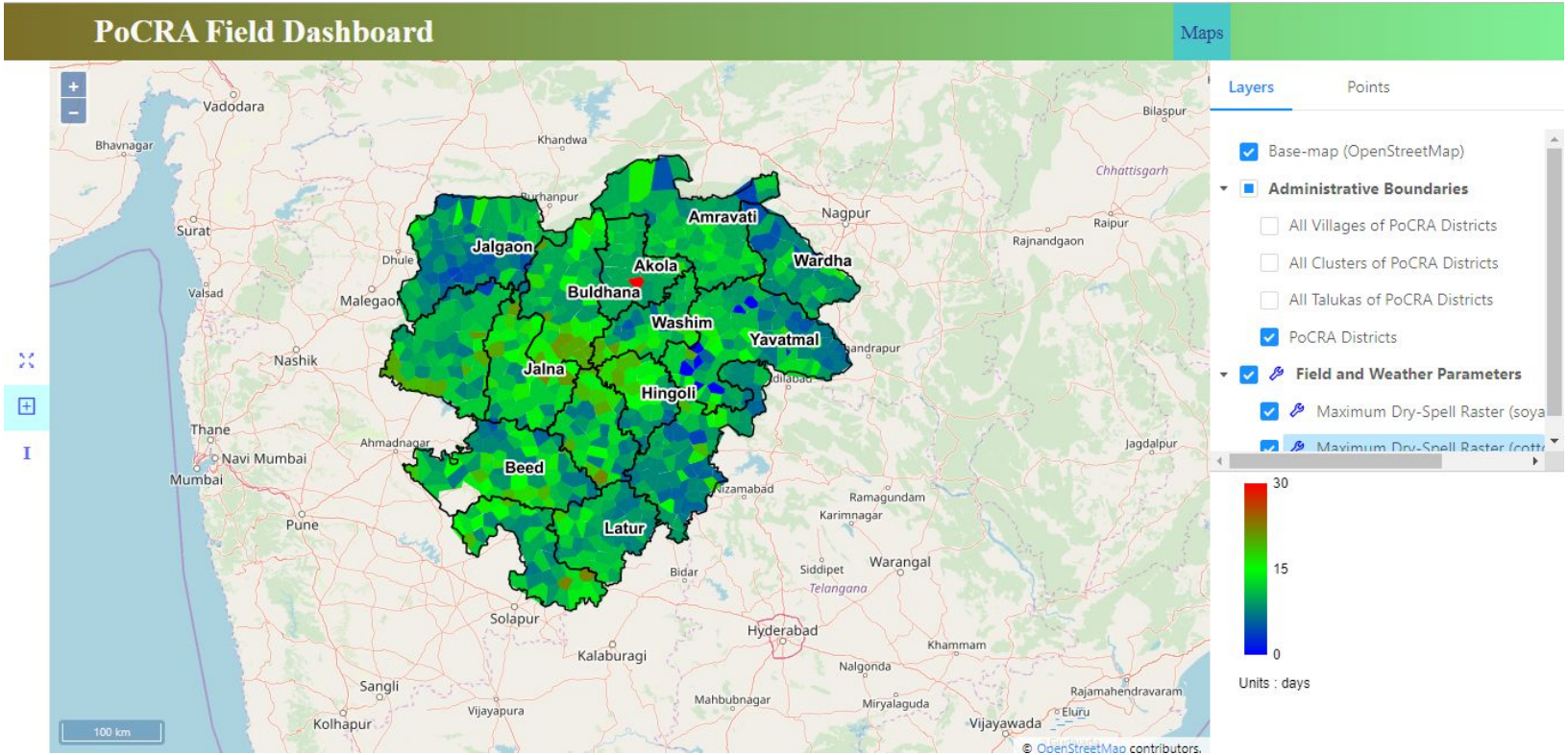
- **Form of delivery:** Demonstration on the Development VM
- **Deliverables:**
  - a web-mapping application
  - an estimation process running behind the web-mapping application
- **Features:**
  - Visualization of rainfall and crop-wise water component rasters
  - Spatially aggregated values of these parameters per administrative region
- **Major addition expected for Phase III:** Porting and Dynamic ET_0 computation (done)

Dashboard current live link: link

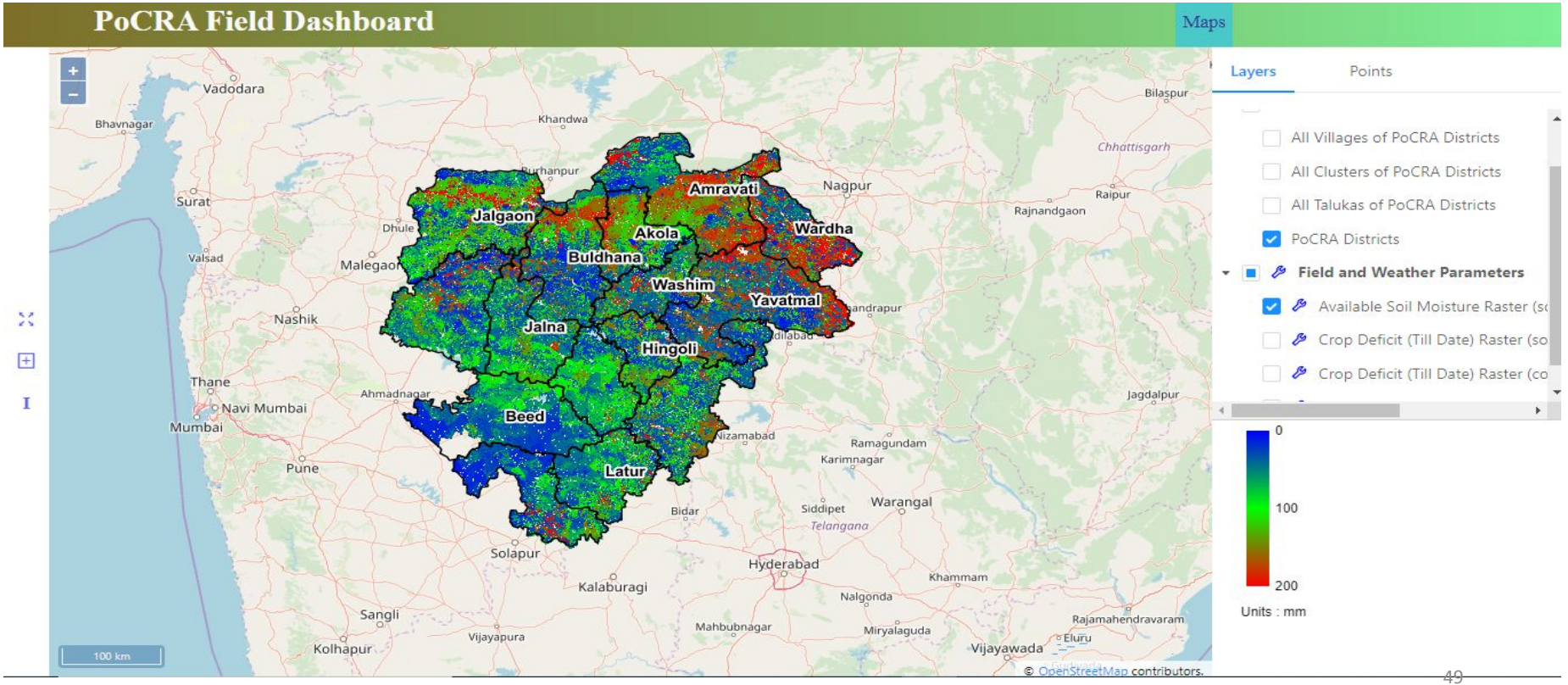
Total Rainfall Map upto 31st August



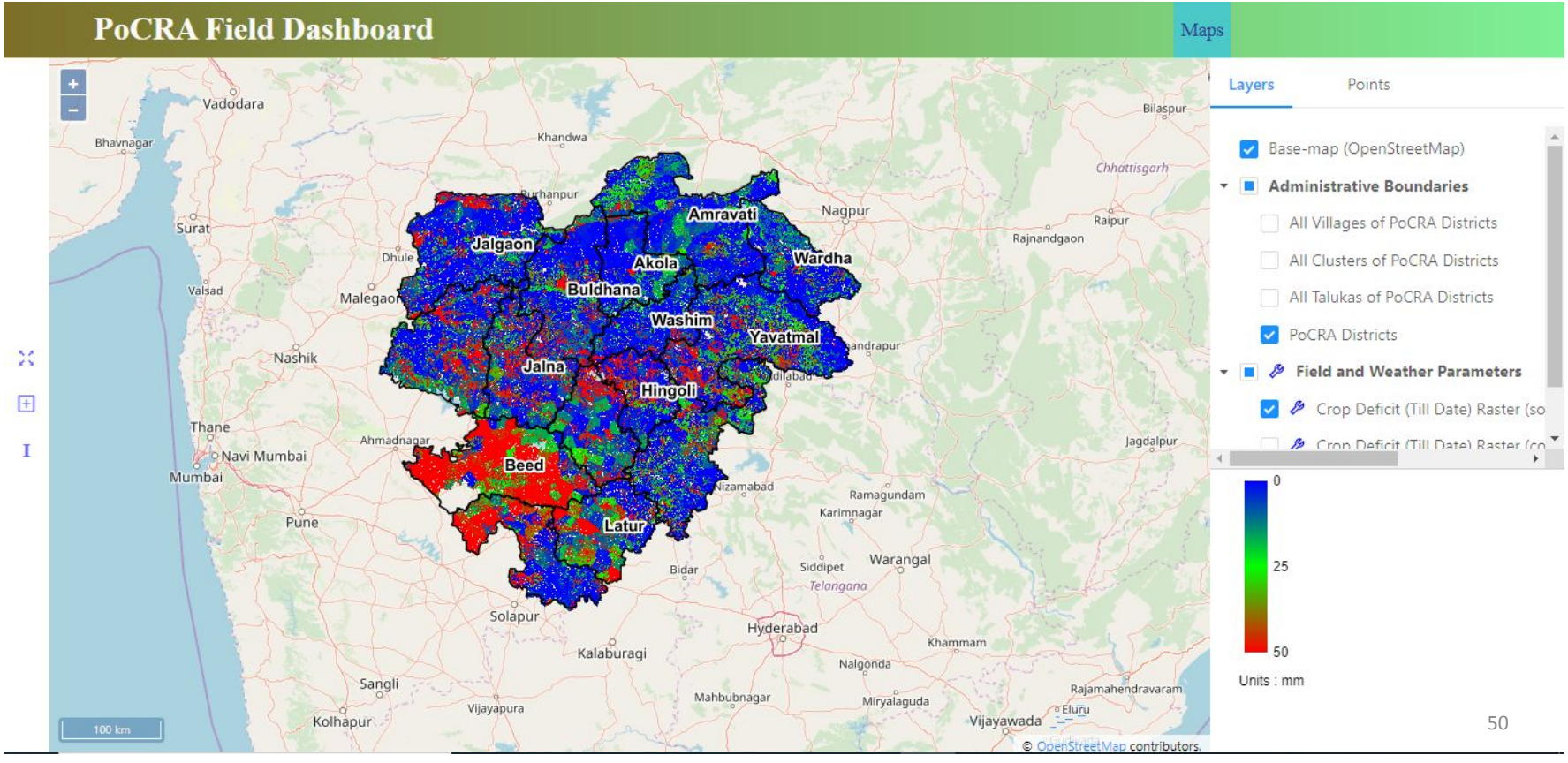
Maximum Dry Spell upto 31st Aug



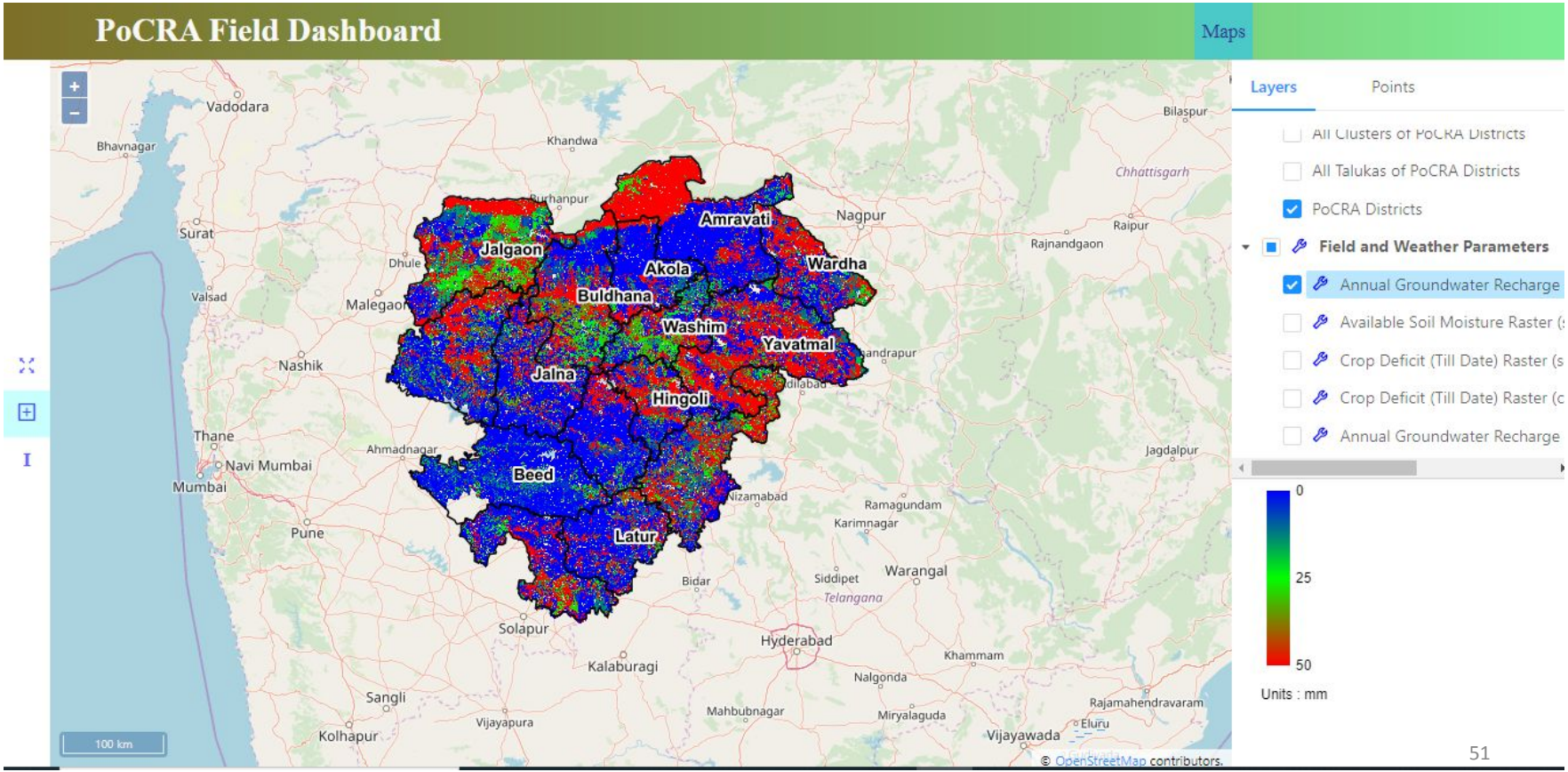
Soil Moisture till 31st Aug (soybean)



Crop deficit map upto 31st Aug - soybean (sowing - 50 mm threshold)

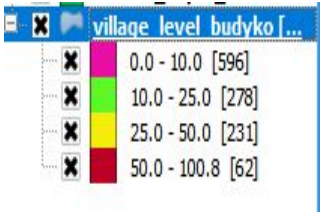


GW Recharge upto 31st Aug (soybean)

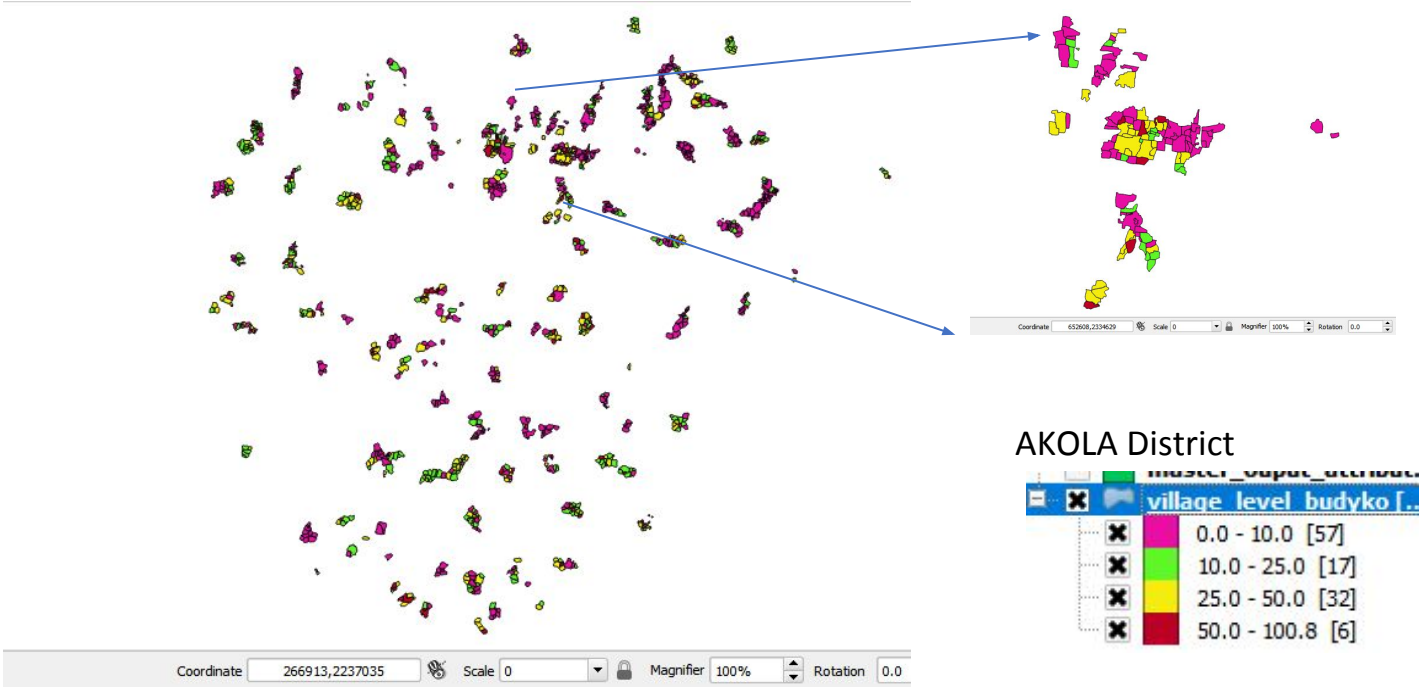


Project status indicators - MLP water Budget data

Storage Capacity Actual – Project Area

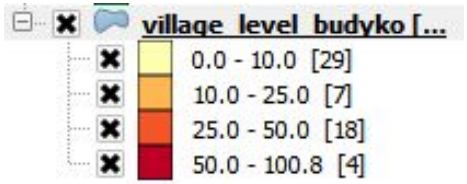


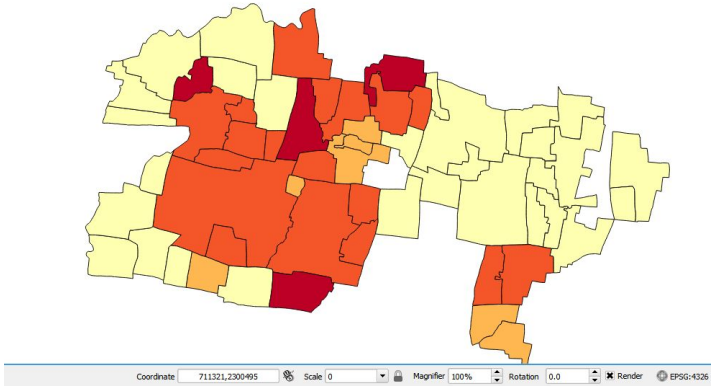
Feature count is there in square bracket – total 1167 villages



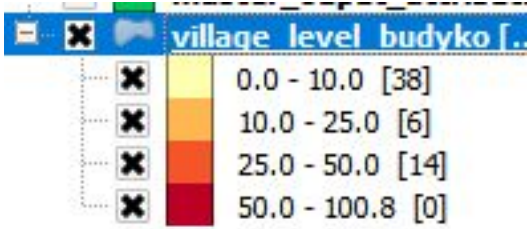
AKOLA District

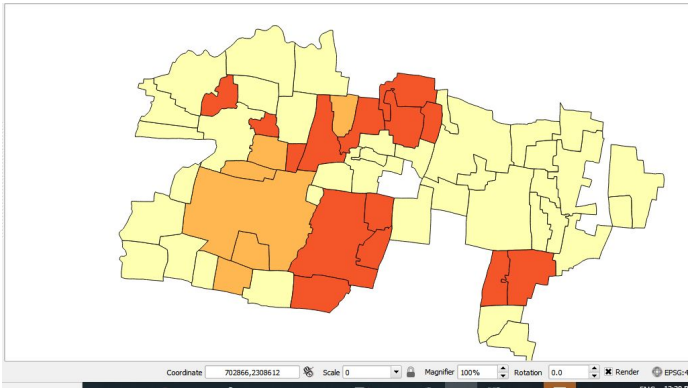
Storage Capacity Actual in mm– Aloka Taluka



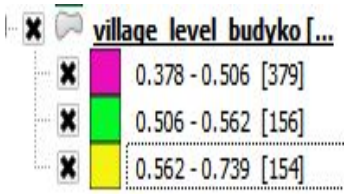


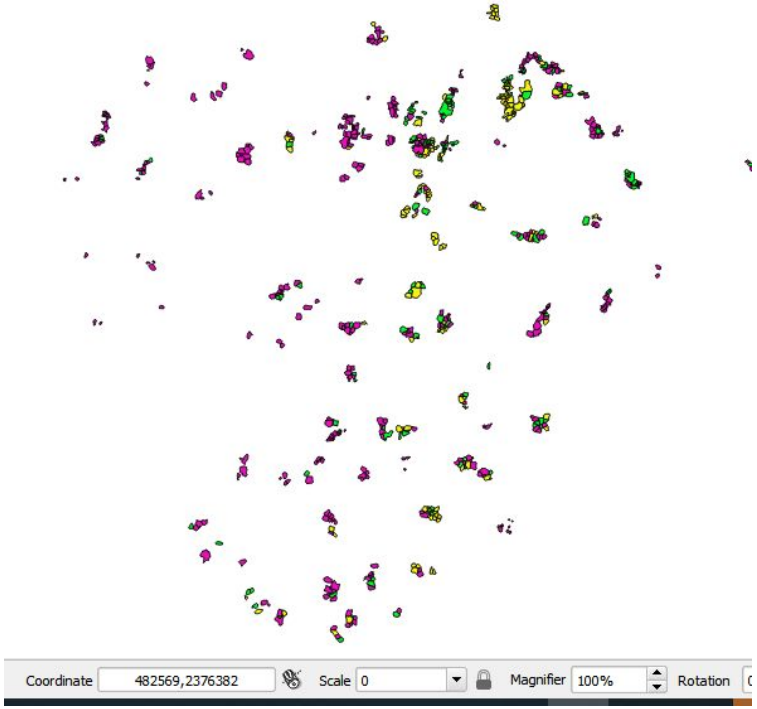
Area Treatment Actual in mm



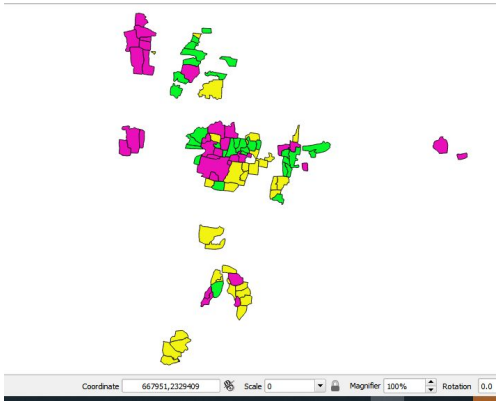


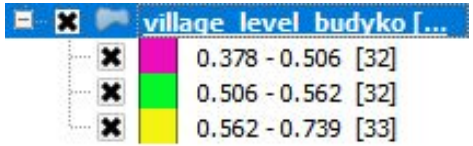
Rainfed AET/PET



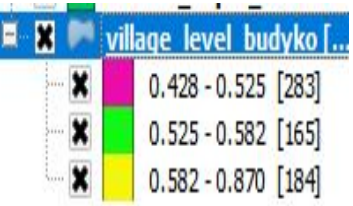


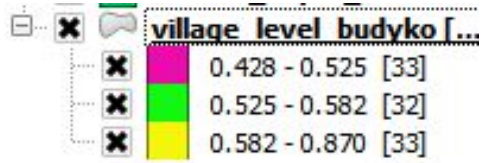
Akola District



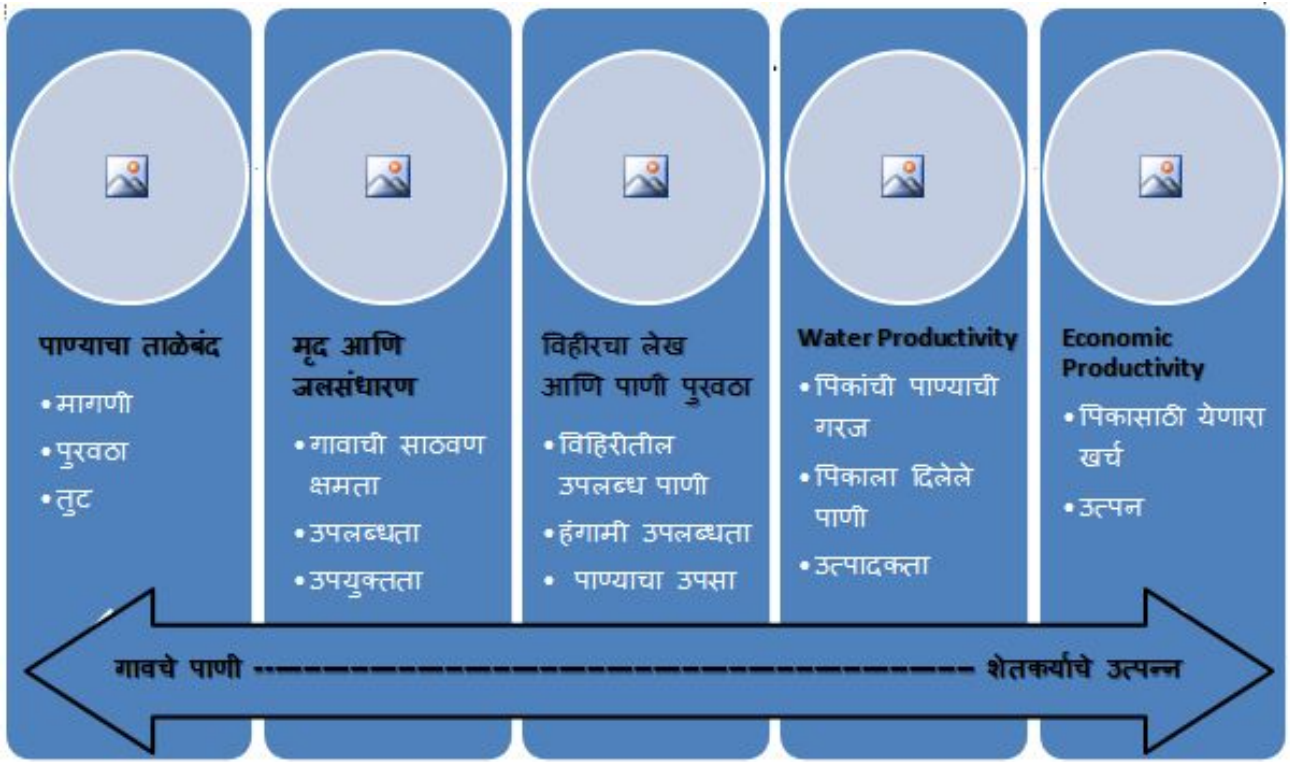


Irrigated AET/PET



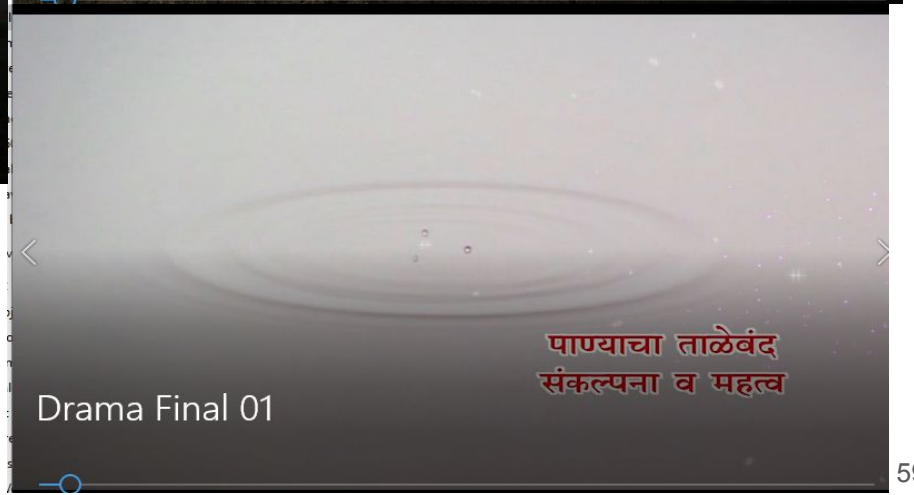


Extension with Agricultural universities - RAWE



Sr. No.	College Name	Number of PoCRA Villages	Number of Students
1	College of Agriculture ,Badnapur Dist. Jalna	1	5
2	College of Agriculture ,Kharpudi Dist. Jalna	5	40
3	College of Agriculture ,Khandala Dist. Aurangabad	3	20
4	College of Agriculture ,Pathari Dist. Aurangabad	2	15
5	College of Agriculture, Kanchanwadi Dist. Aurangabad	2	20
		Total	105

Water Balance Concept Video



Field Visit Details

1. Yelda and Mamdapur, Beed - December 2018
2. Yevati, Jalgaon - February 2019
3. Wabgaon, Wardha - February 2019
4. Tadmugli, Latur - February 2019
5. Chapadgaon, Jalna - March 2019
6. Dahigaon, Amravati - April 2019
7. Rohi Pimpalgaon, Chikala, Ijali, Nanded - June 2019
8. Akoli, Bhidi, Ganeshpur, Wardha 19th-20th July 2019
9. Suleman Deola, Wangi, Beed - June 2019 (was visited twice - 2 month field stay by CTARA students)
10. Discussion with SAU's, Parbhani - 24th-25th April

Identified concerns and solutions

1. Well Access is a key point resulting in GSDA MoU for integration with GW recharge plan
2. Selection of beneficiaries is important - scope to utilize vulnerability maps, stream proximity and beneficiary prioritization guidelines
3. Water Budgeting to be revised for Command Area Villages
4. Provision of approved DPR in Gram Panchayat necessary for accountability
5. Improvement in Community Comprehension of Water Budget required - to be done by engaging Krushi Mitra and other functionaries to explain village maps and water budgets in schools

Observations and inputs through Field Visit

1. Canal Details should be available with krushi sahayak in village/ currently no details are available with him or at GP office. Water Balance for command area villages - MoU-III
2. Displaying Village maps in schools and engaging Krushi sahayak to explain it to school children.
3. Setting up raingauge in village and engaging school children in measurement with the help of krushi mitras
4. Formal provisions can be made for community wells - examples seen on field
5. Documentation of community wells/other sharing arrangements in village
6. Improved formats need to be designed for community farm ponds, community wells highlighting proposed water management

Recommendations for GSDA on Wahegaon Cluster

1. Augmentation of groundwater recharge in drinking water wells should always be recommended
2. Access to groundwater during kharif dry spells and rabi and how is the problem to be addressed.
3. An average of 4.5 TCM per well and 1 hour of pumping in May was noted. It was also noted that 45% of wells went dry. This indicates that a small number of production wells seem to be functioning. We need to check if these are in stream-proximity areas or in the GW recharge prioritization map of GSDA?
4. Well inventory data to be attached with recharge plan.

Cont.

5. No yield tests were performed. We suggest that a pumping and recovery test be performed in at least two wells, one in stream proximity and another away, in every cluster.
6. Soil type of Wahegaon is largely clayey and wells actually rise much slower with the peak level in November. This is not indicated in their report. In fact, the absence of soil texture and depth is not considered but only the WTF method is used. This can be unreliable since the data of the observation well also indicates the large variance in WTF.
7. An over-extraction of 243 TCM for the total area of 2443 H. indicates a drop of 10mm per year. Assuming a Sy of 0.016 gives us the stated number of 0.65m per year. This needs careful analysis and validation since such a large drop should have been mentioned by farmers with an increasing trend in wells going dry. Our conjecture on this is that the aquifer beyond the phreatic aquifer has poor specific yield and is largely unexploitable. In other words, over-extraction causes wells to dry earlier rather than the average water table to fall.
8. In the upcoming recharge plans, wherever new wells are possible, preference should be given to community wells with augmented recharge structures. GSDA should come up with norms and guidelines for such arrangements.

Opportunity for innovations and collaboration.

On the whole, there is now a unique opportunity for GSDA, IITB and other agencies:

- Technical matters, models, cross validation etc.
- Community interventions - documentation and design
- Exploring new ways of enabling a community to manage its GW resources.

Other services and Support

1. Support to runtime IT team - explaining backend data structure, queries, testing of app, features etc.
2. Support to run plugin for pocra villages
3. GSDA note on recommendations
4. Redevelopment of plugin for new real time weather dataset, coding for reallocation of rainfall circles, dynamic ET0, matching with old dataset before 2018

Phase IV pending Items

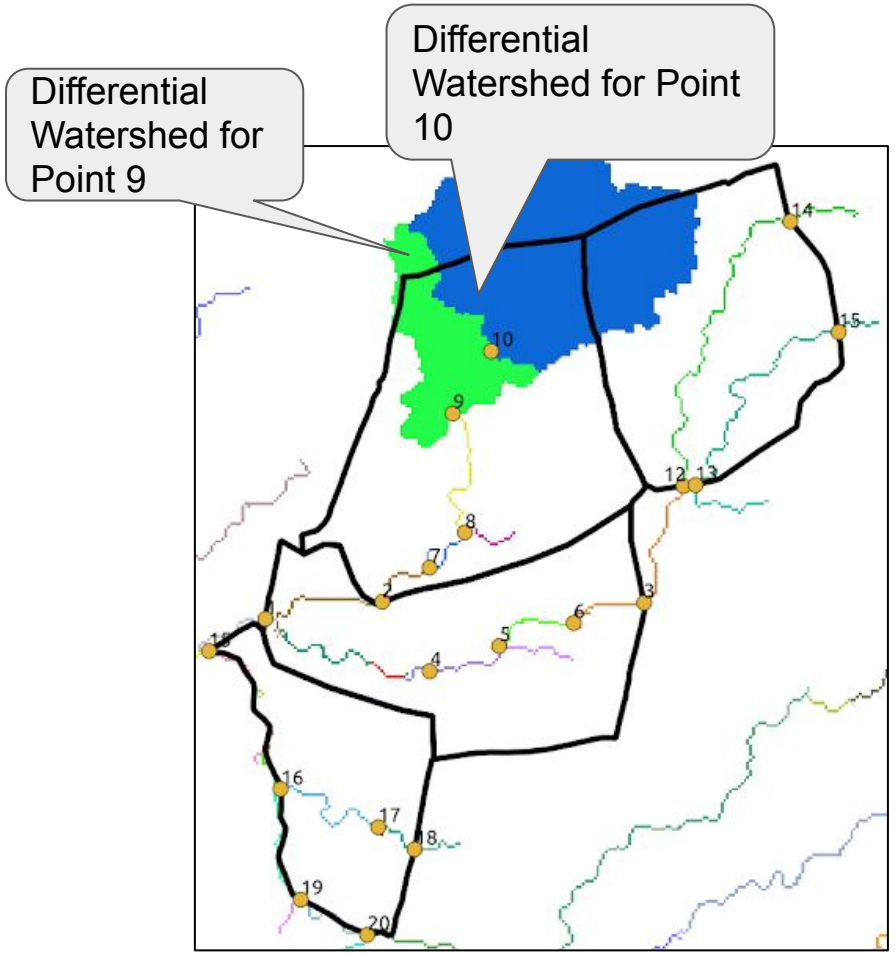
1. Delivery of Dashboard version with scope for querying
2. Delivery of automated water balance plugin - will all new changes (dynamic ET0, skymet rainfall circles, data dumping to cloud DB)

   Validation and Porting

3. 1 Video on new MLP app
4. Surface and GW accounting Framework - Now and in MoU-III
5. Overall report on work done in MoU II

Differential Watershed

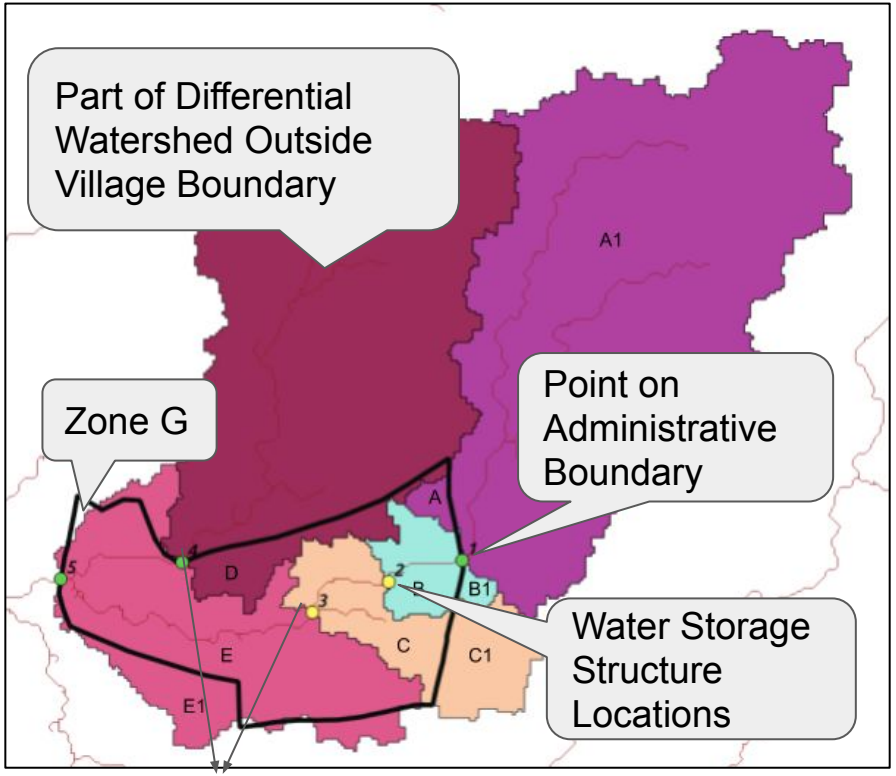
1. Watershed of a point *p* is the surface area from which runoff resulting from rainfall is collected and drained through *p.*
2. The differential watershed of a point *p* vis a vis *q,r,...* which drain into it, is that part of the watershed, which is the new water accumulating at that point, which may be the subset of the actual watershed of the point.



Differential Watershed For Point 9 and 10

Visualization of Steps - Step 6

Allocate zones to differential watershed areas.



Differential Watershed Restricted to Village Boundary

Flow of Water

Point No.	Contributing Inner Zones	Contributing Outer Zones	Label
1	A	A1	+1
2	B	B1	0
3	C	C1	0
4	D	D1	+1
5	E	E1	-1

Order of Processing: 1-2-3-4-5

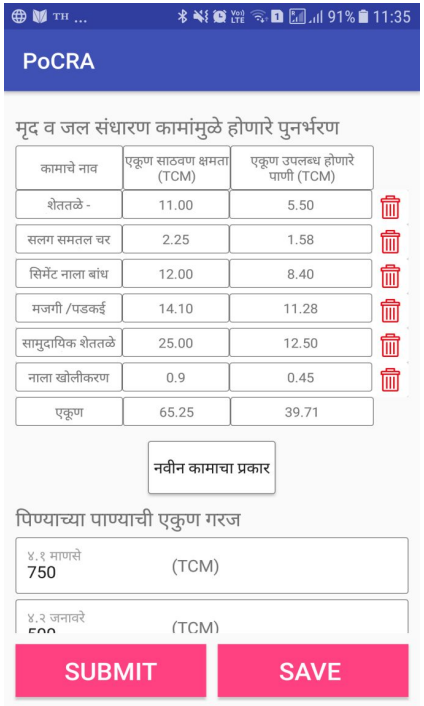
Thank You !

Backup

In the Field: PoCRA App Interface

Cropping Pattern

Existing Storage Structures



Drinking Water Requirement

App available for downloading on google play store.

Can be used on Tablet as well as Smartphones

Drip and Sprinkler Irrigation Modelling - Sample

Farmer: Baban Dane

Crop Area: 6 acre

sprinkler spacing: 20x40 foot

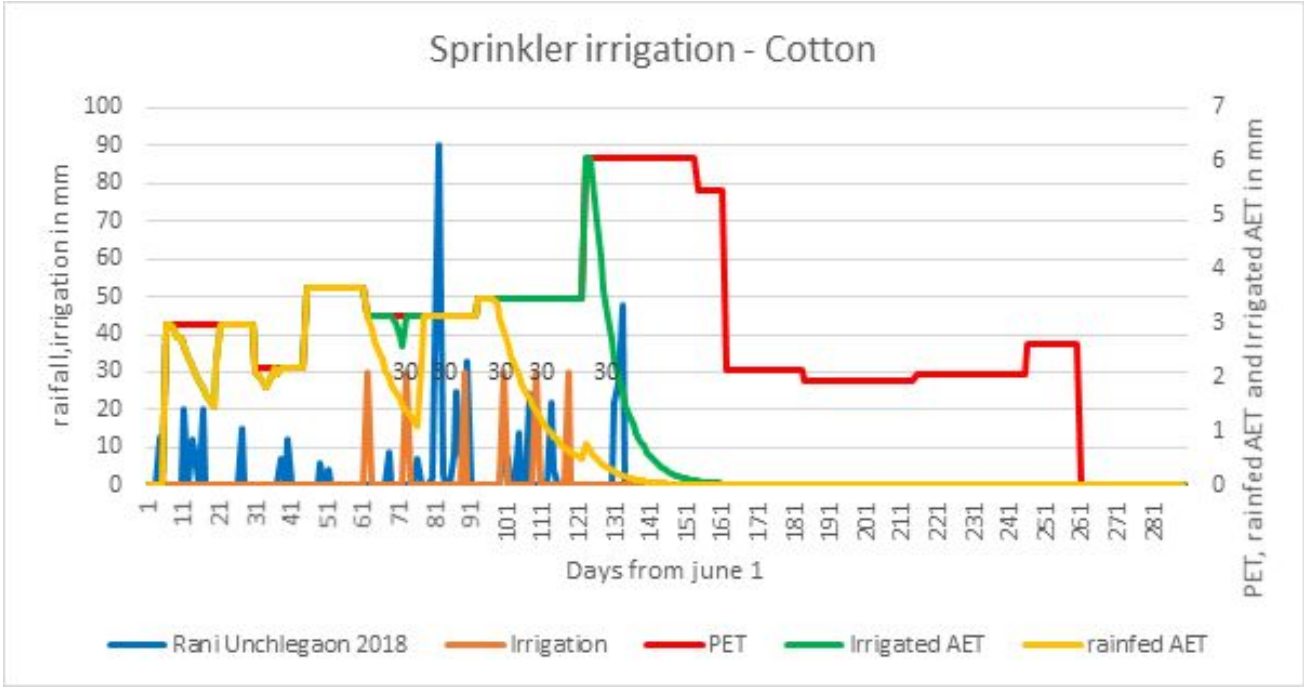
flow rate: 15 mm/hr

number of waterings: 6

irrigation time per patch: 2 hrs

water per irrigation: 30 mm

total irrigation: 180 mm



Baban Dane- Chapadgaon, Jalna

Drip Irrigation

Farmer: Kasubai Jadhav

crop area: 2 acre

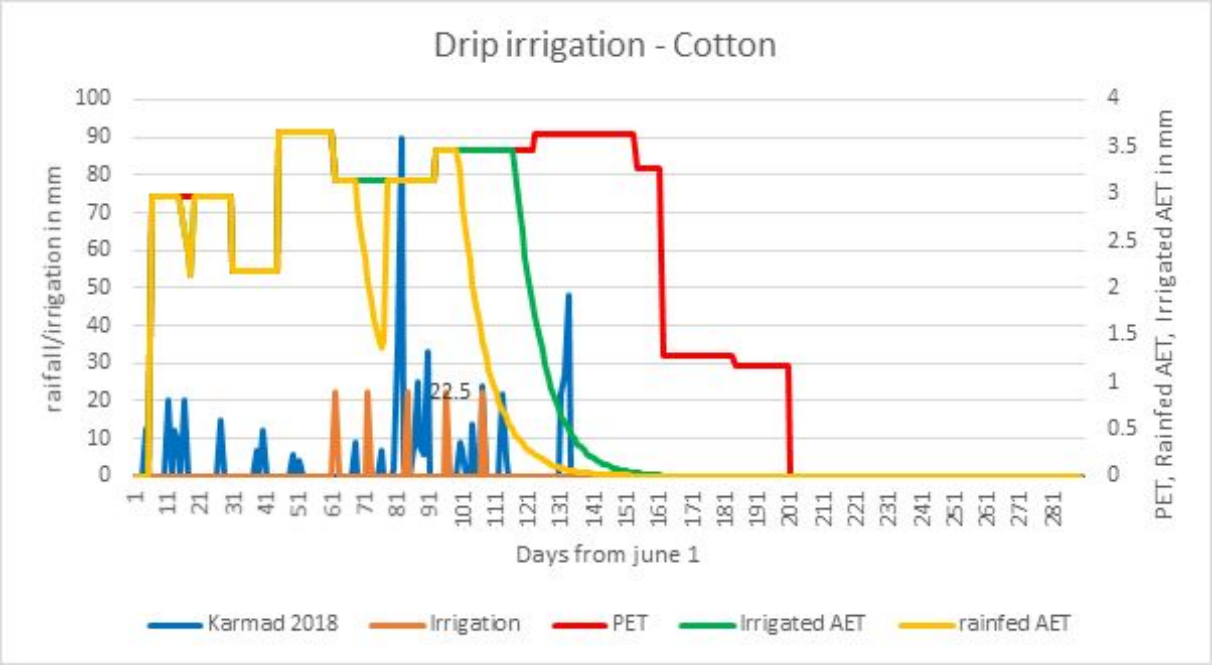
drip spacing: 0.5 x 1.6 m

drip flow rate: 6 LPH

number of waterings: 5

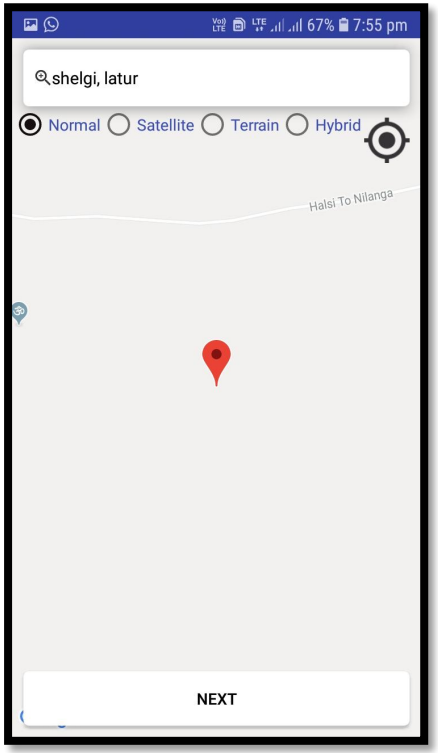
irrigation time: 3 hrs

irrigation water per day: 22.5 mm

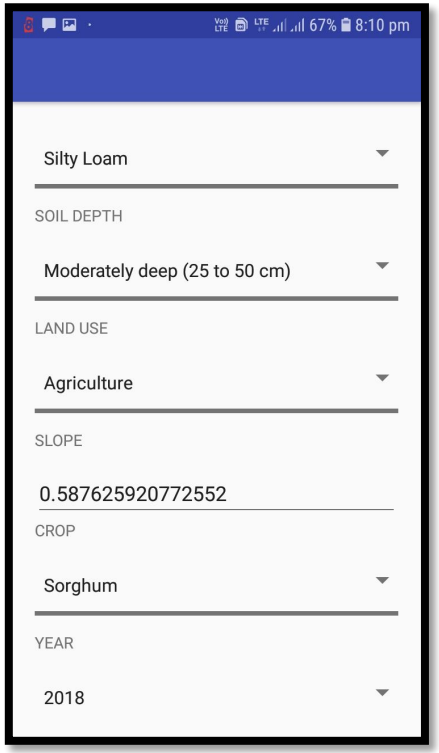


Farm level App

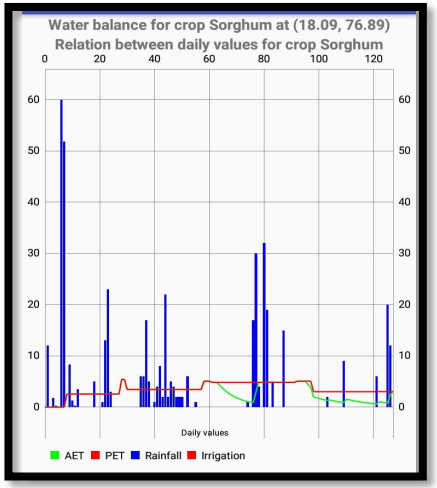
Farm Location

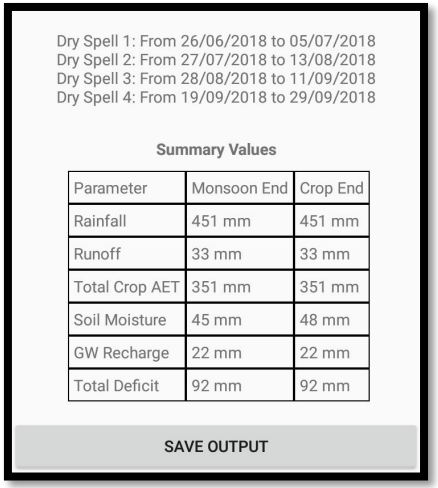


Inputs



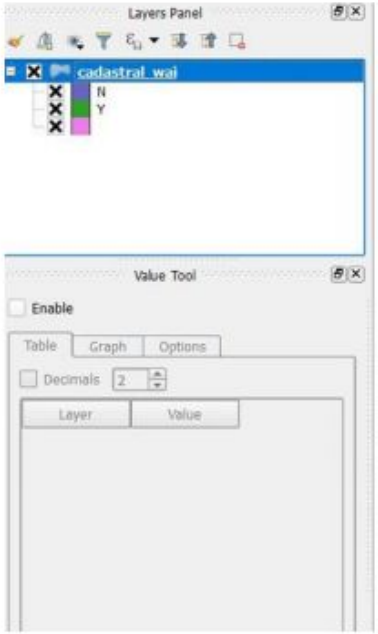
Outputs

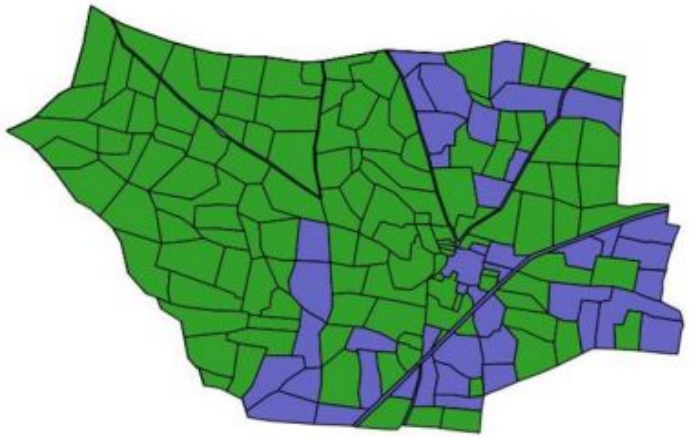




Parameter	Monsoon End	Crop End
Rainfall	451 mm	451 mm
Runoff	33 mm	33 mm
Total Crop AET	351 mm	351 mm
Soil Moisture	45 mm	48 mm
GW Recharge	22 mm	22 mm
Total Deficit	92 mm	92 mm

- This will be useful for Agricultural Assistants, Field Level staff and Farmers
- Download link: https://www.cse.iitb.ac.in/~pocra/Android_app/app-debug.apk

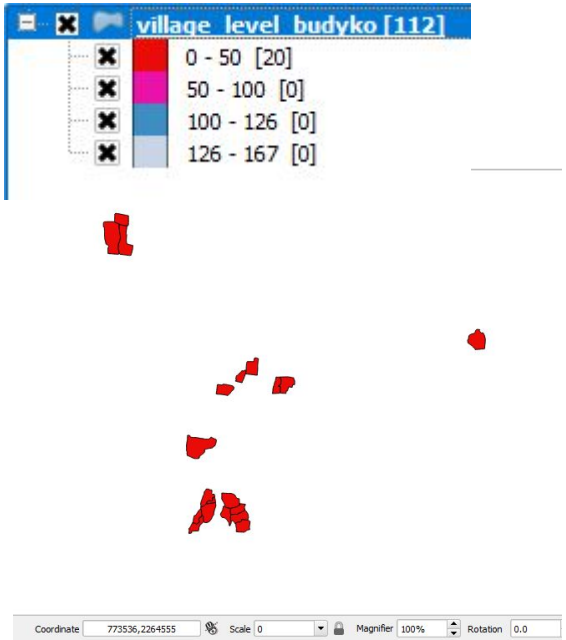


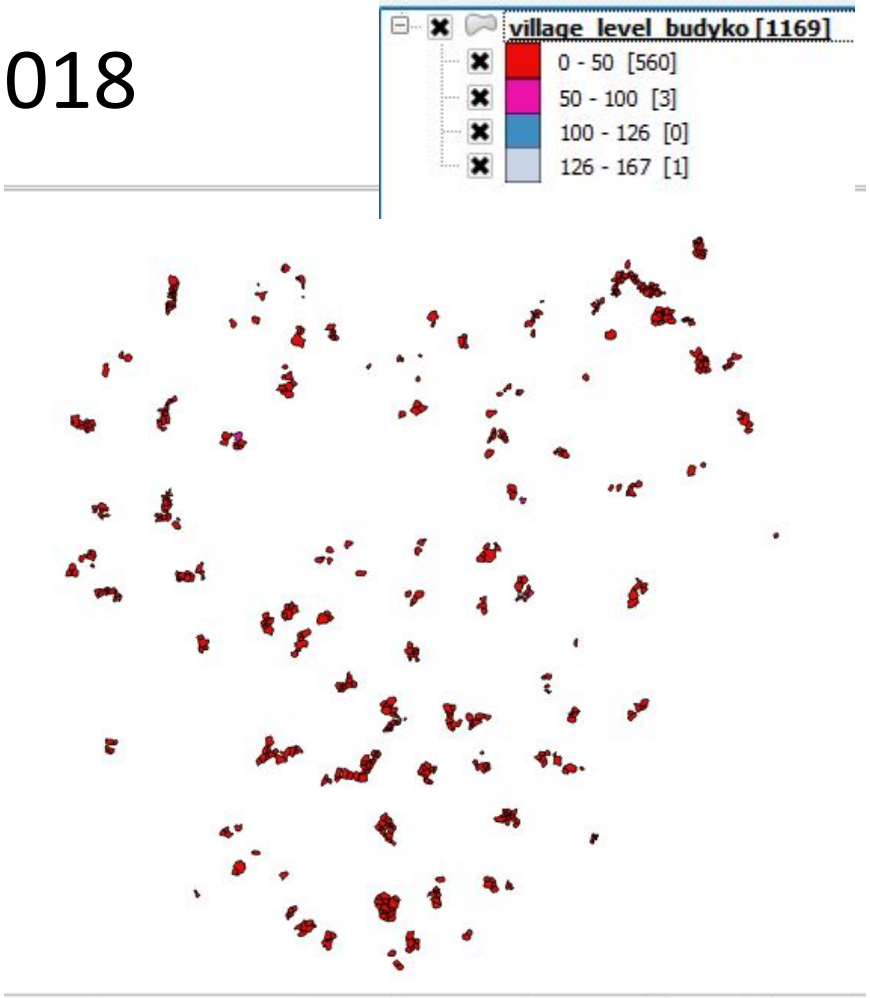


Cropping data analysis for Wai, Washim

Total supply / P1 PET 2018

Akola district





Daily vs Aggregate water balance model

	JSA water balance computation	PoCRA Water Balance computation
1	The Strange's table provides the run-off in terms of percentage of the monsoon rainfall for Good, Average and Bad catchments. These are gross estimates.	Runoff is computed based upon SCS curve number methodology which is calibrated with SWAT, an international standard.
2	Aggregate rainfall model.	Daily time-step. Sensitive to dry spells and peak rainfall events.
3	It does not take soil conditions or land-use into account	It takes location specific soil and LU properties. Makes the computation of field capacity, wilting point, run-off, recharge more accurate. This helps, e.g., in selection of farm-ponds, interventions.
4	It does not give kharif water stress. Protective irrigation is assumed to be 10 percent of crop water requirement.	It gives crop-specific kharif water stress based upon the rainfall pattern and need for protective irrigation.
5	It does not split infiltration into soil moisture (SM) and groundwater (GW) recharge values.	It gives the soil moisture and groundwater available . Knowing SM helps in knowing protective irrigation requirements. Knowing GW helps in deciding if wells will be useful.
6	It does not give any vulnerability maps.	It gives the vulnerability maps for the identification of vulnerable farmers.
7	It works at village level.	It allows for zone-wise analysis for better targeting.

Limitations of both PoCRA and JSA: do not account for sub surface ground water flows. Model output quality limited by quality of input data being used (eg - rainfall, soil texture etc)

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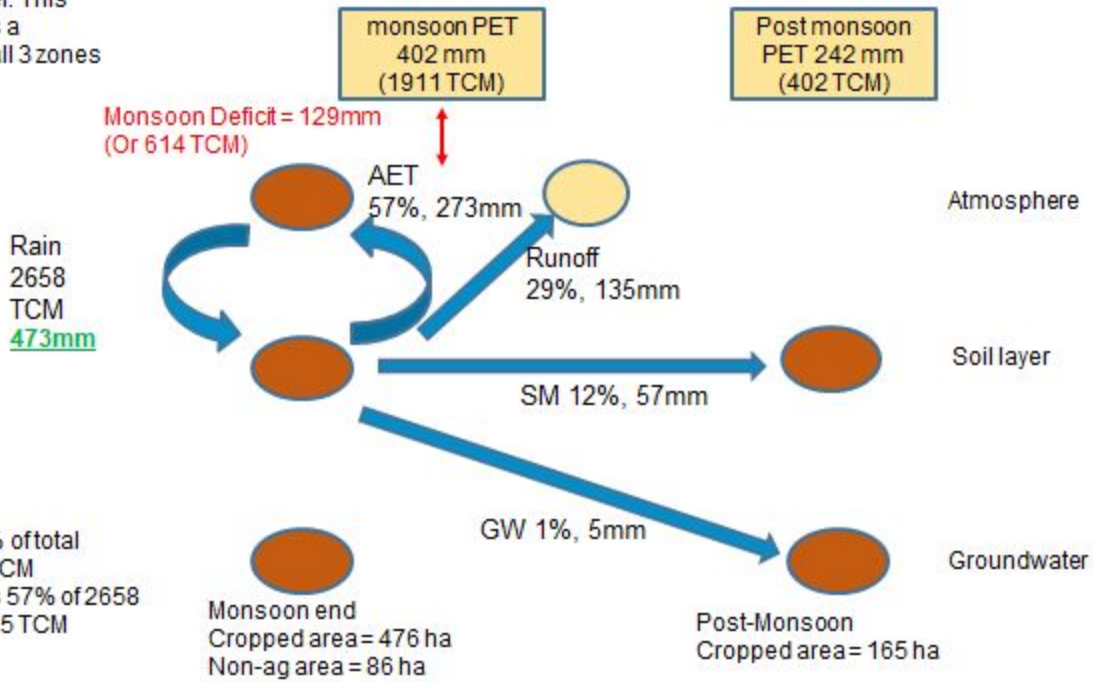
Wadhvi 2017 POCRA village level water balance

Note: POCRA balance is done at zone level. This village balance is a consolidation of all 3 zones



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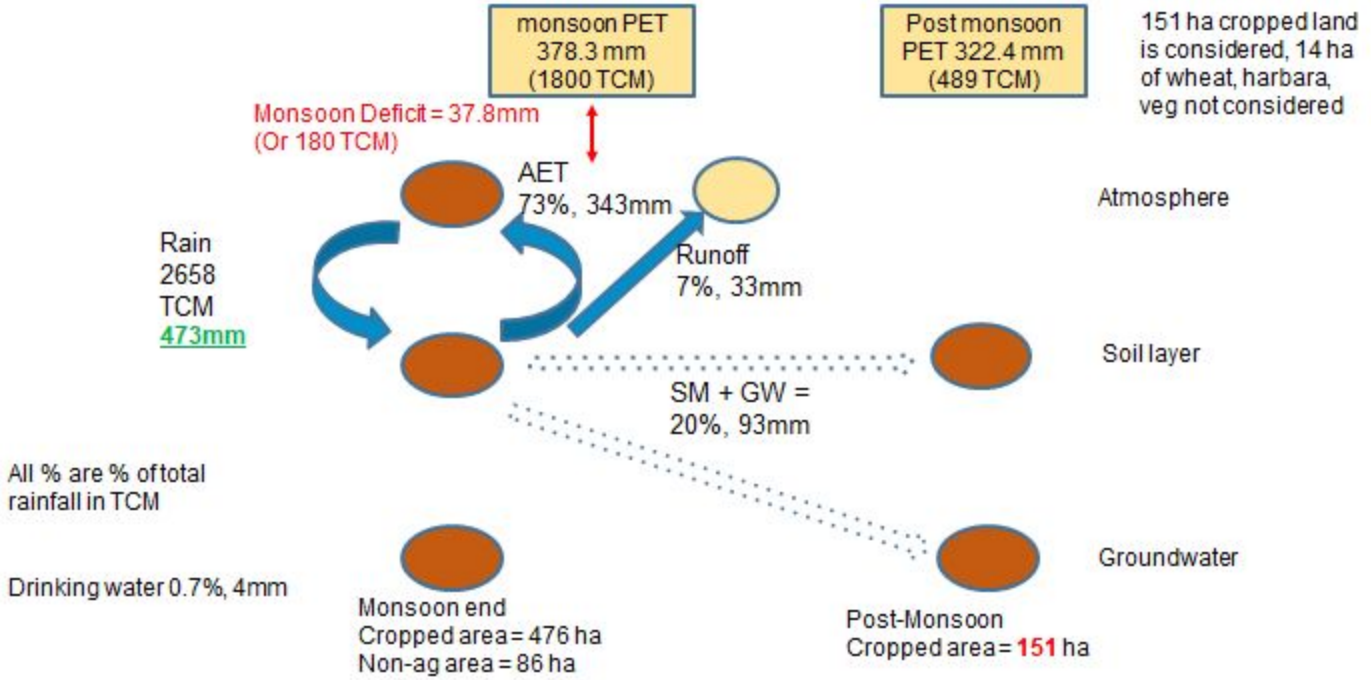
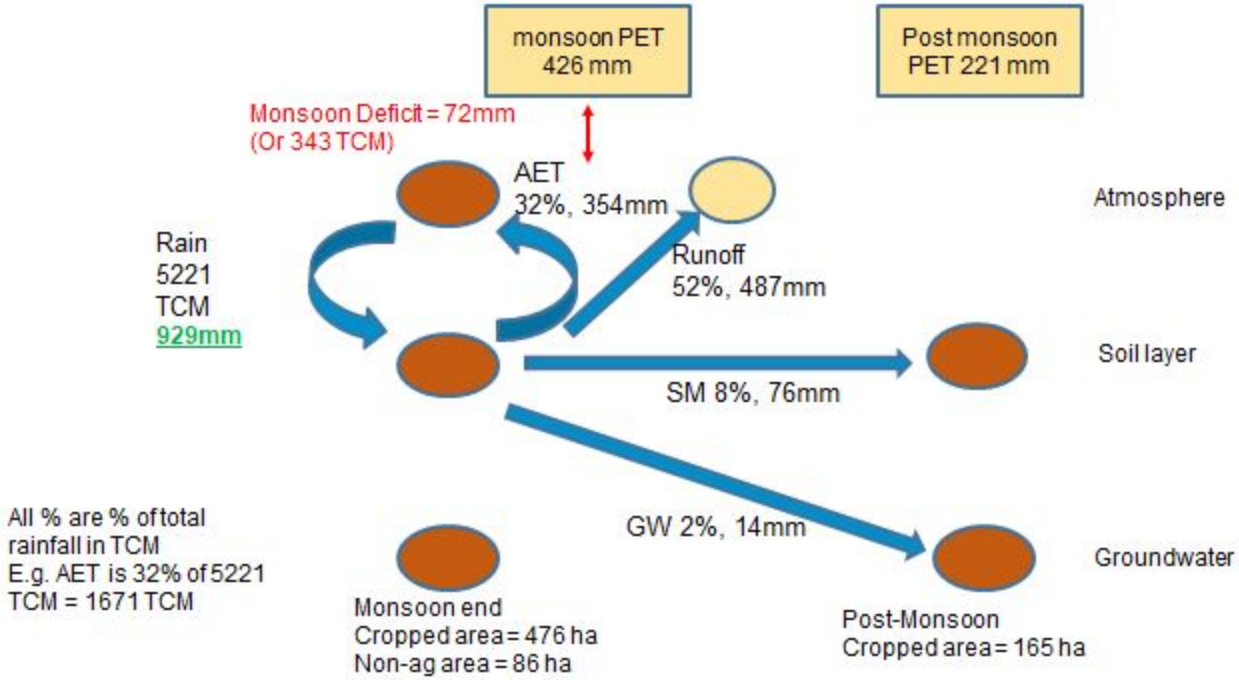
Wadhvi 2017 JYS village level water balance



Wadhvi 2016 POCRA village level water balance



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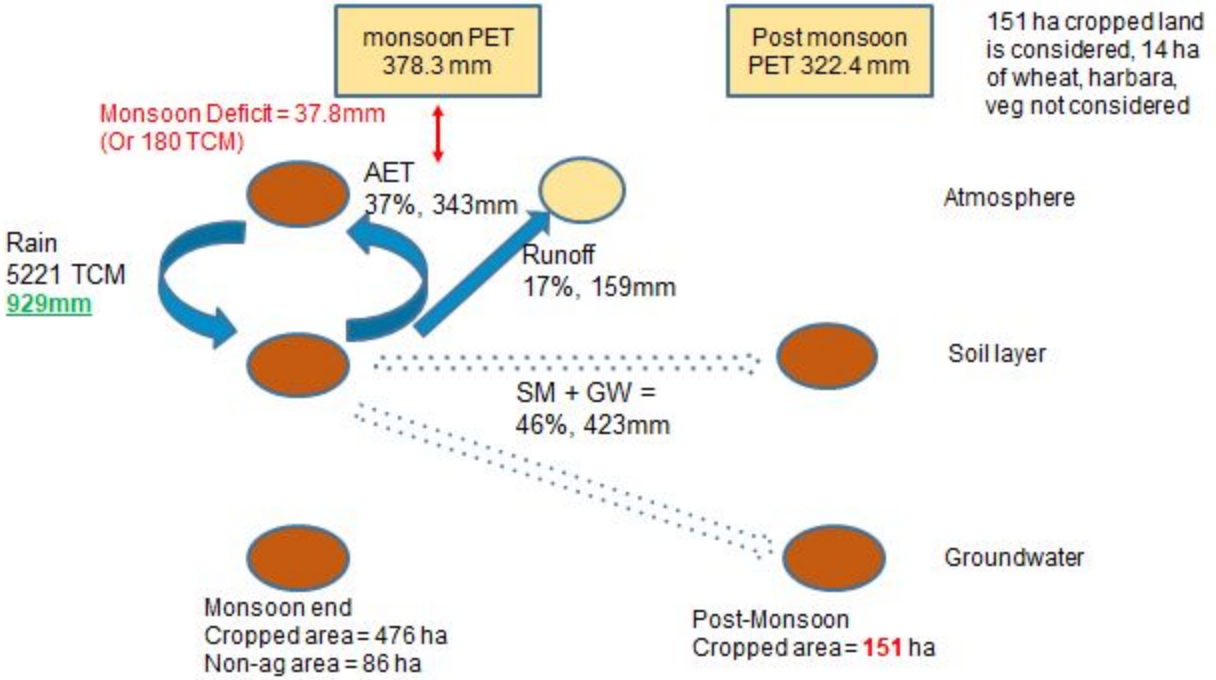
Wadhvi 2016 JYS village level water balance



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Rainfall – 473 mm	JYS	PoCRA
Runoff generated	**7% or 186 TCM** (as per aggregate rainfall using Strange's table)	**29% or 771 TCM** (as per daily rainfall events using SCS CN methodology and soil properties)
Current storage available for use	203 TCM	203 TCM
Kharif water demand	1800 TCM (full K + 1/2LK)	1911 TCM (full K)+ (LK PET upto monsoon end)
Kharif deficit	**180 TCM** (10% of demand)	**614 TCM** (as per soil and crop type calculation)
GW Recharge Soil Moisture	532 TCM or 93mm total	GW Recharge: 5mm or 27 TCM Soil Moisture: 57mm
Water available for rabi	527 TCM (assumes all SM+GW to be available for Rabi since separate values not known. Current storage-PI available for Rabi)	261 TCM (⅔ of GW+ ½ of current storage+SM available in Rabi area) (note this is reduced because most water is in soil moisture which is a local stock)
Rabi + summer water demand	487 TCM (322 mm)	402 TCM (242 mm over 165 ha)
Rabi water use index (supply /	**1.08**	**0.6**

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Influence of Surflag and Tcon on Fraction of runoff released