Project on Climate Resilient Agriculture

PoCRA Team

IIT Bombay

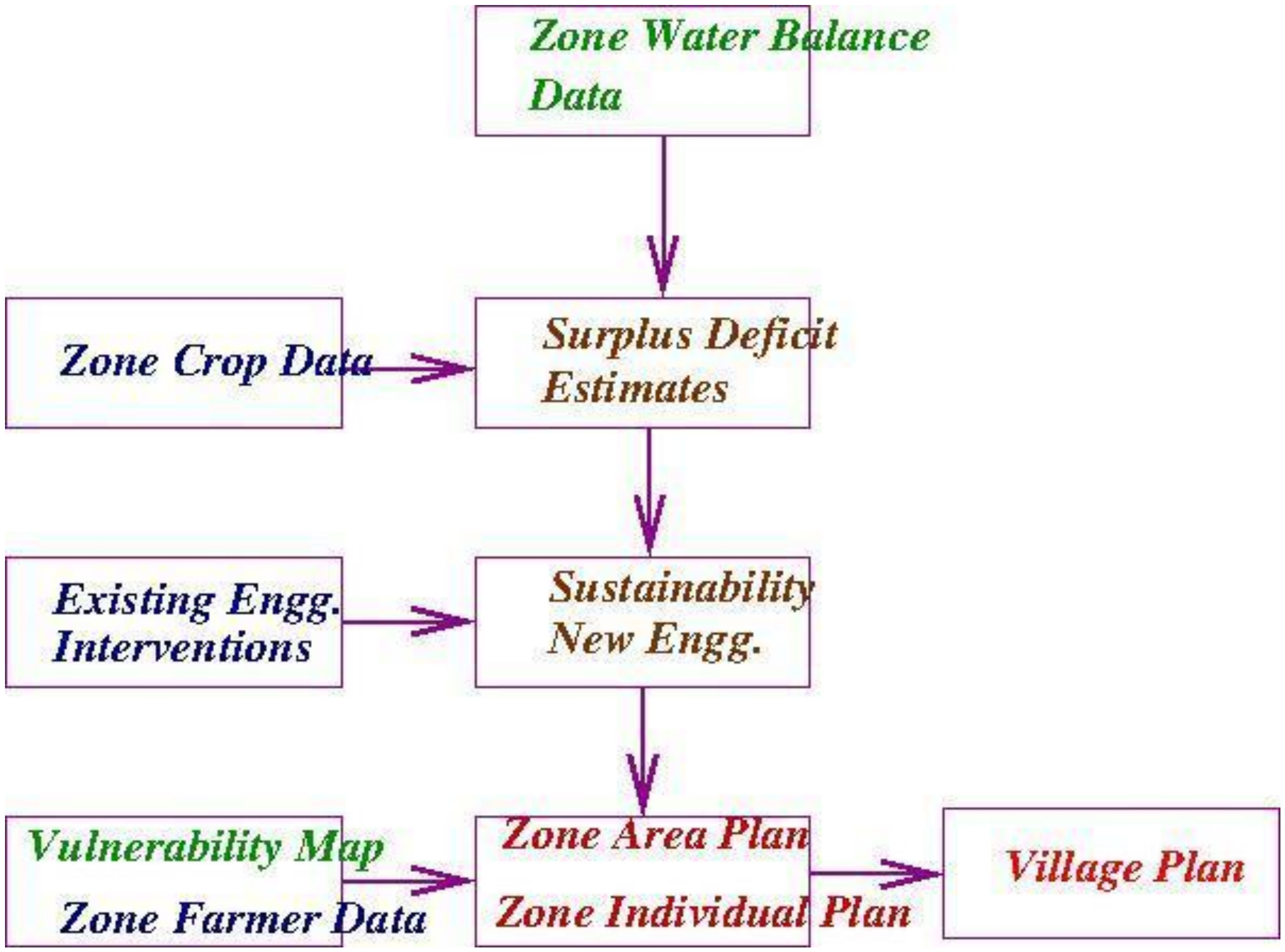
MoU - I

1. Water balance objectives
2. Overall Framework
3. Point Level Model
4. Measuring Vulnerability
5. GIS tool for Spatial Water Balance
6. Zone level water budget and planning
7. Future Scope: MoU II

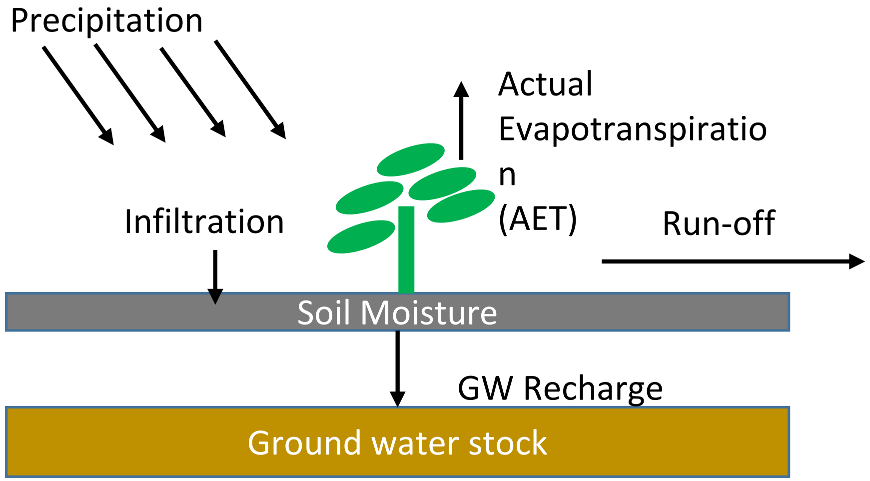
Water Balance Focus Areas

- Kharif dry spell planning:
  - Identification of farmers most vulnerable in dry spells *where*
  - Quantification of monsoon protective irrigation required
  - Computation of run-off and **monsoon deficit** *how much*
- Post monsoon planning:
  - Quantification of soil moisture and ground water available for post-monsoon crops (long Kharif, Rabi, annual crops) *supply*
  - Current post-monsoon crop water requirement *demand*
  - **Post monsoon deficit**
- Guidance on structures based on above
  - Planning at zone (100-250ha) level, using principles of watershed
- Advisory on cropping pattern and land use (MoU-II)

Basic Outline of Water-balance enabled planning framework



Basis for the water budget framework – Simple hydrological cycle: **Farm Level Model**

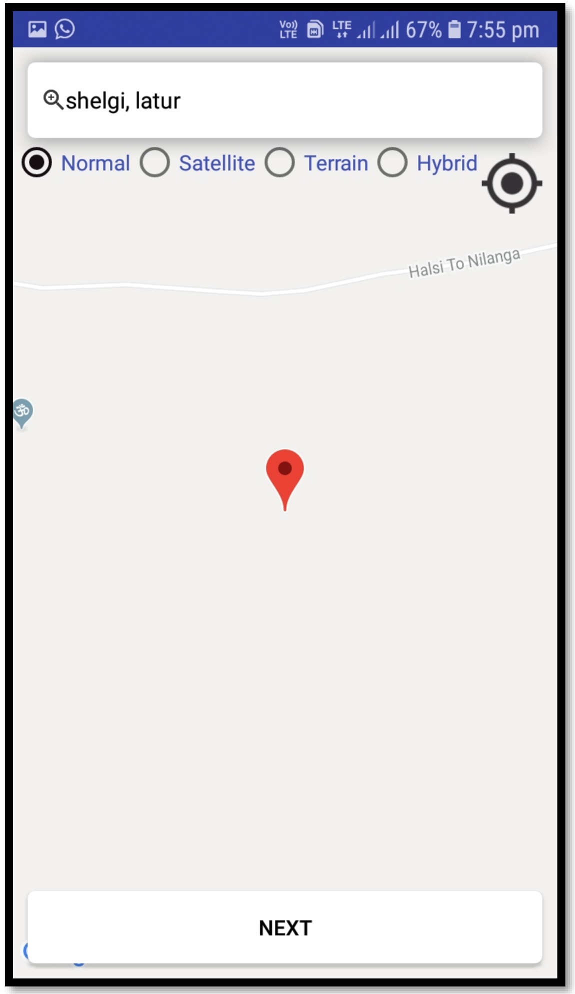


Model Validated against SWAT and field observations

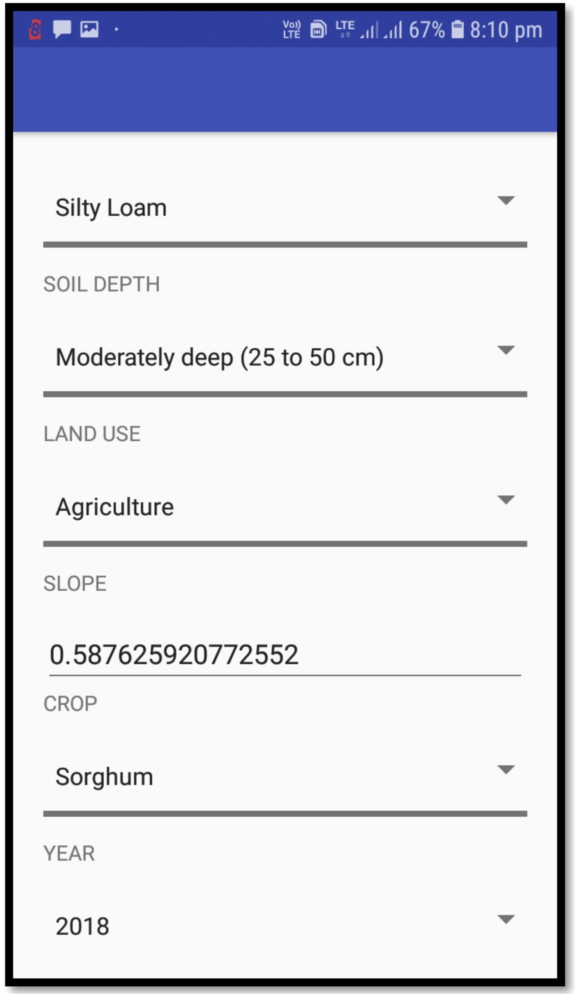
Component	Method (Reference)	Data source
Rainfall	Input	Maharain.gov.in
run-off, infiltration	SWAT method based on SCS-Curve number adjusted for slope	SWAT theory
Potential crop ET (PET)	Modified Penman method	ET0: WALMI, Kc: FAO
Actual crop ET (AET)	FAO methodology	Soil properties: FC, WP, Crop root depth
GW recharge	SWAT methodology	Soil conductivity

Farm level App

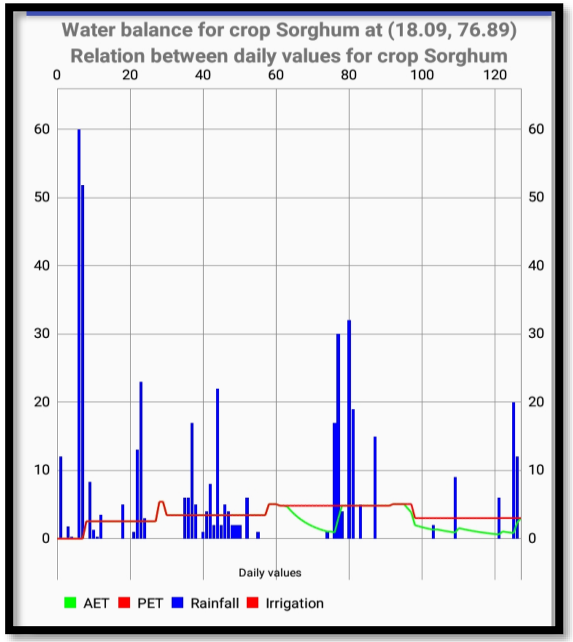
Farm Location



Inputs



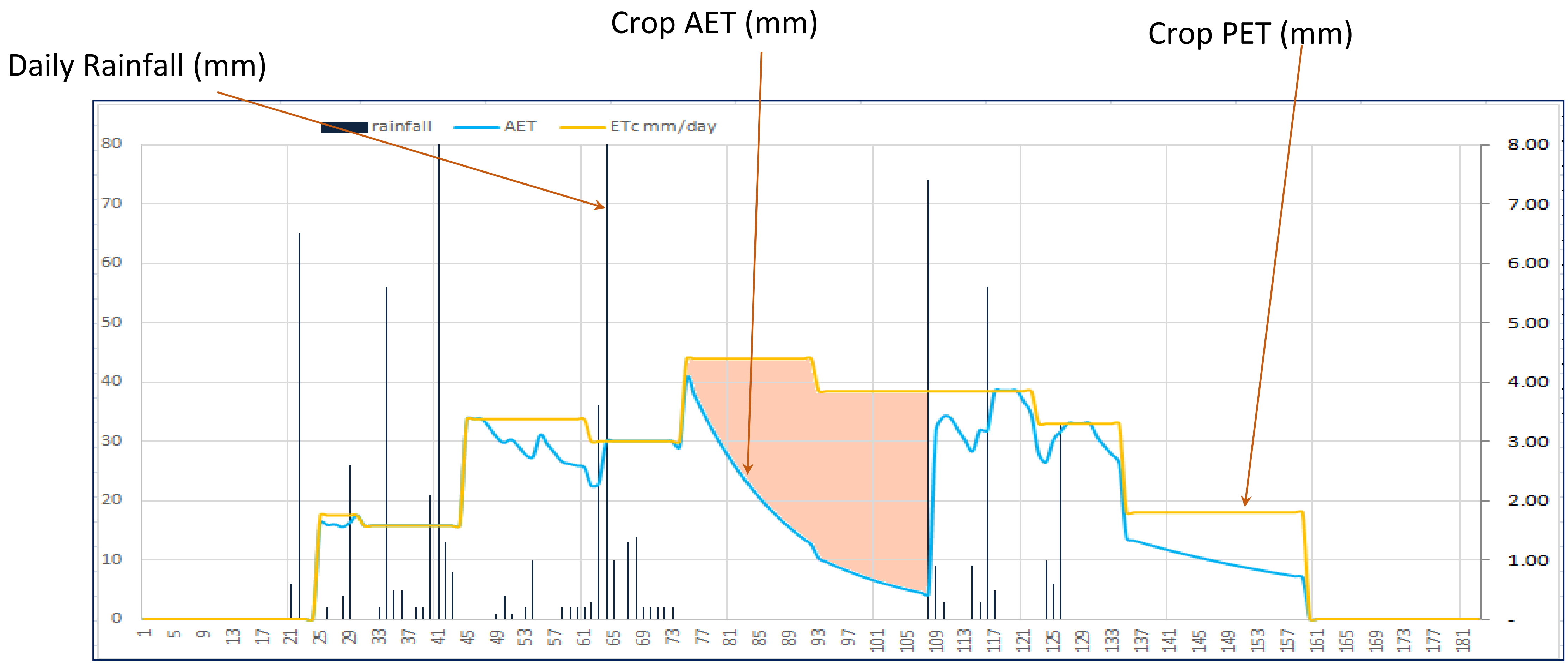
Outputs



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

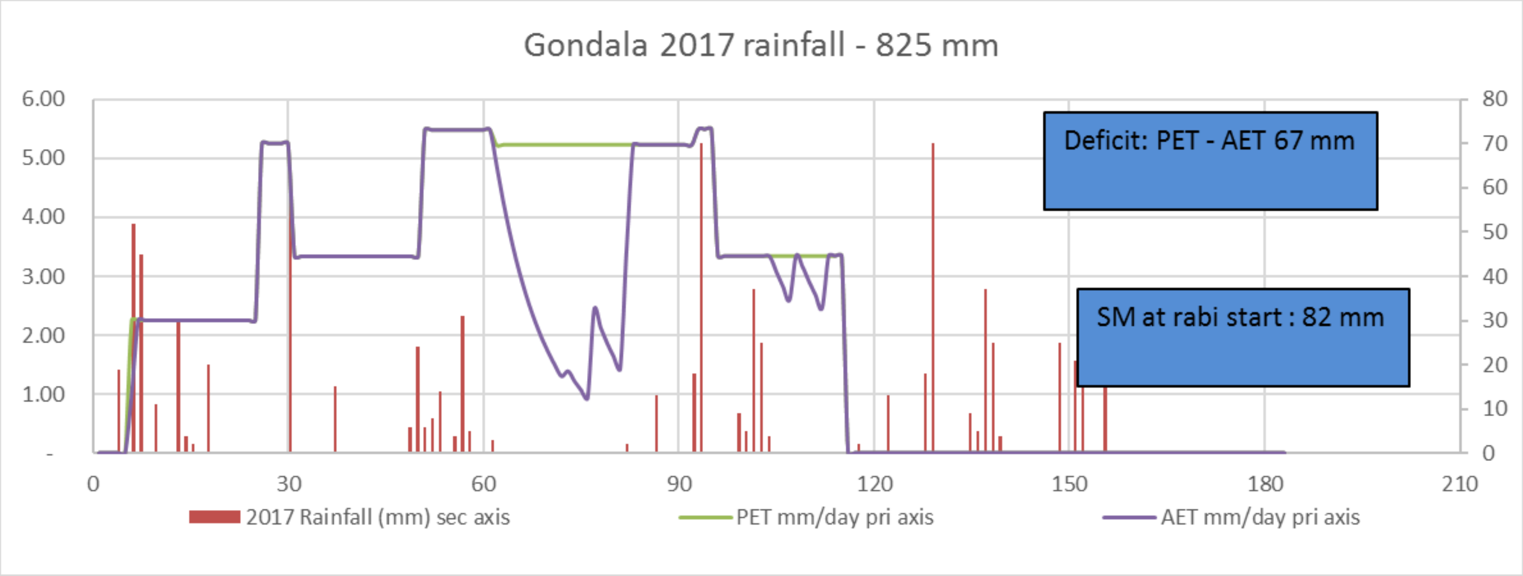
- This will be useful for Agricultural Assistants, Field Level staff and Farmers

Measuring vulnerability: dry spells, soil moisture deficit



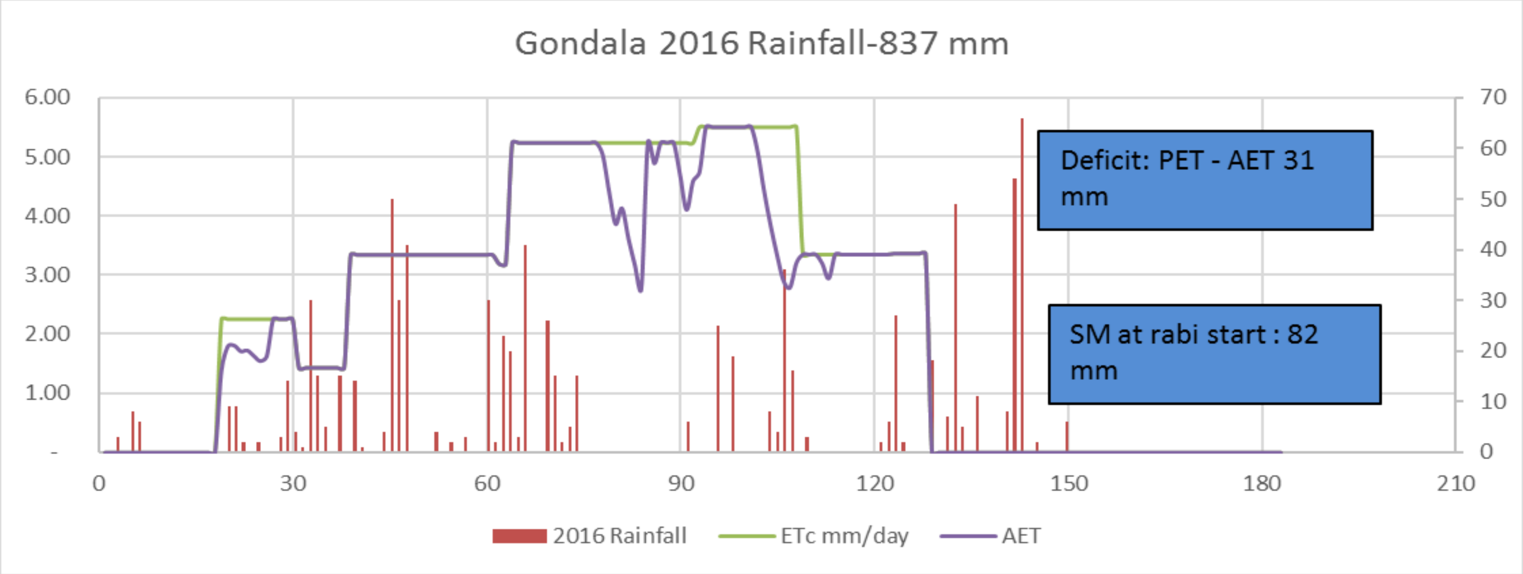
Sinnar, Nashik (2017)

Kharif dry spell impact



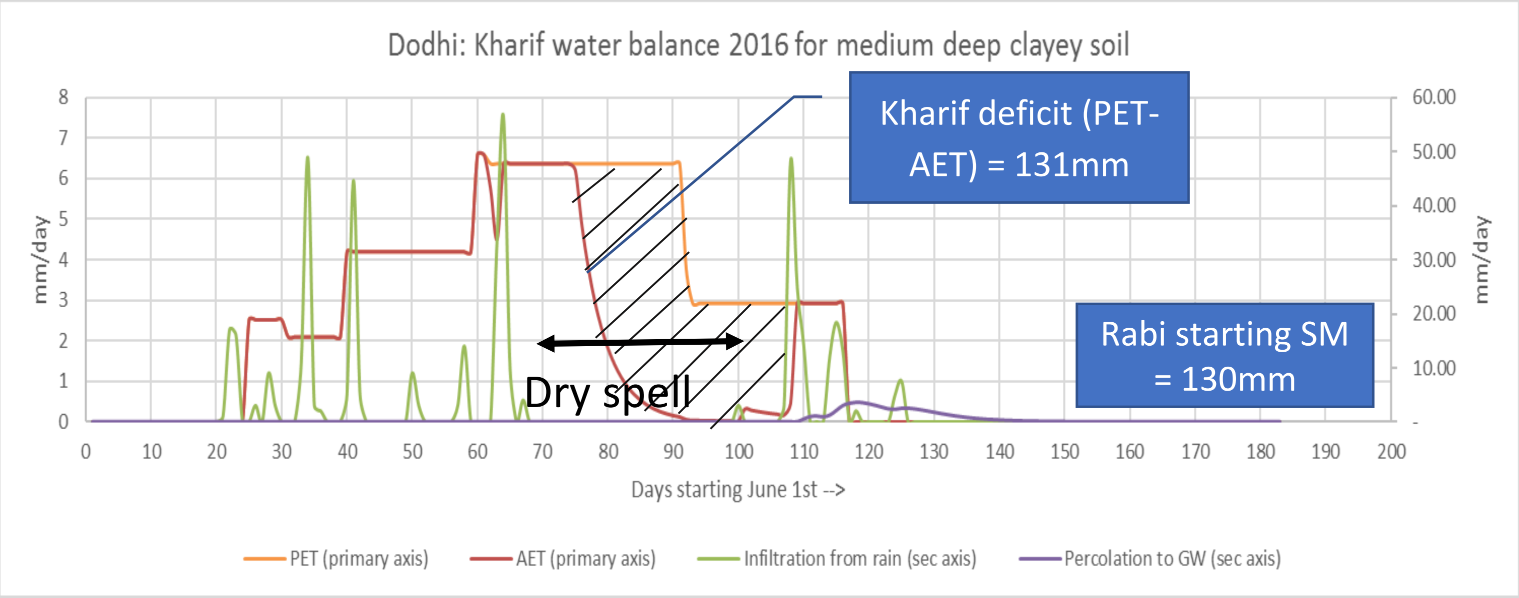
Components (mm)	Year 2017
Rainfall	825.00
Runoff	251.50
Soil Moistur	82.60
GW Rechar	113.83
AET	377.11

Crop: Soyabean

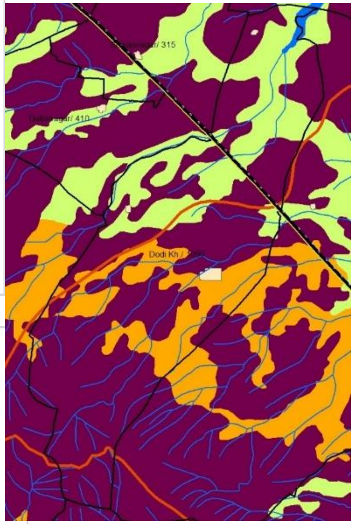


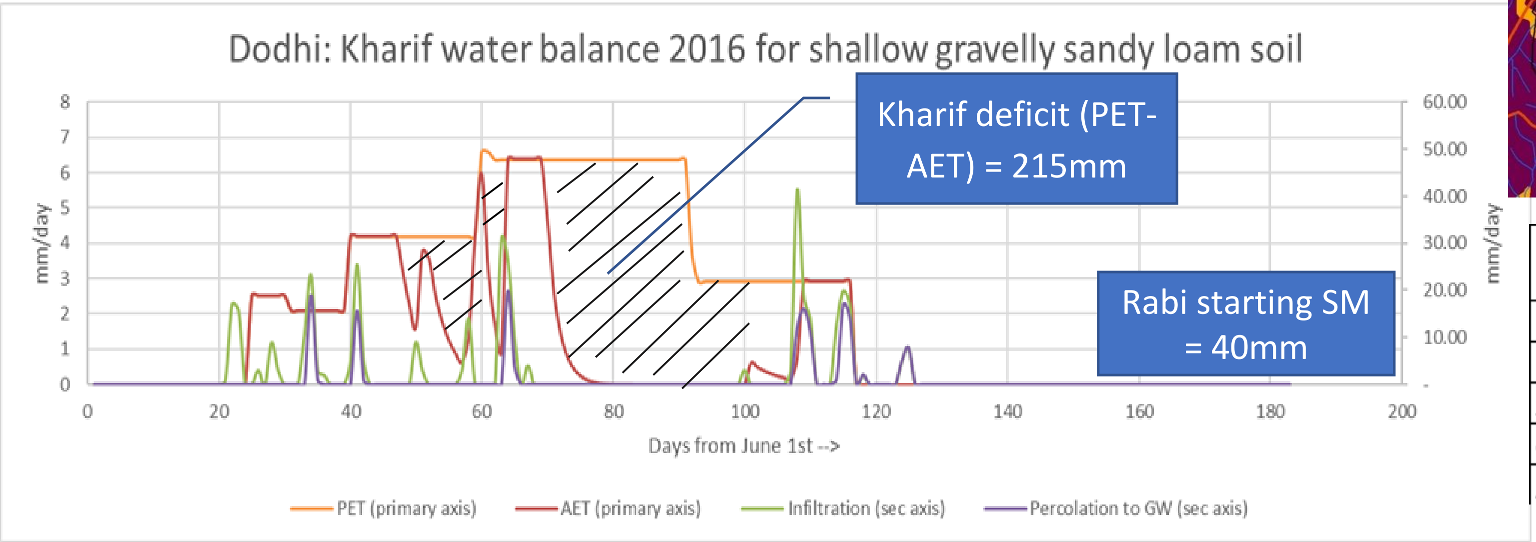
Components (mm)	Year 2016
Rainfall	837.00
Runoff	273.00
Soil Moistur	82.60
GW Rechar	84.40
AET	397.02

Kharif dry spells and soil type – spatial variability



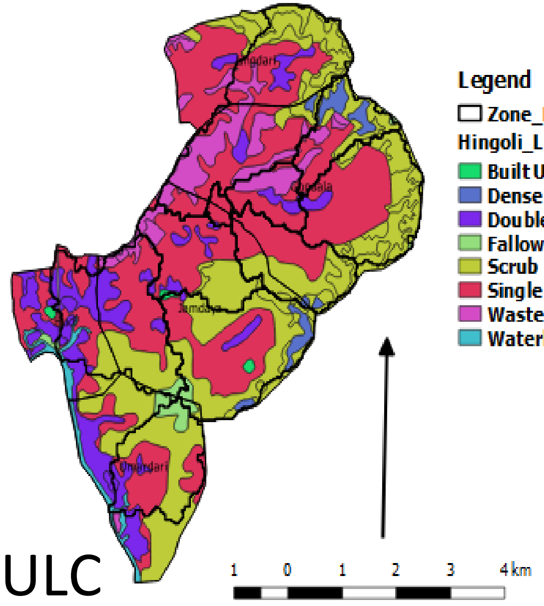
Components (mm)	Medium deep clayey soil
Rainfall	563.00
Runoff	109.98
Soil Moisture	130.00
GW recharge	57.50
AET	265.52



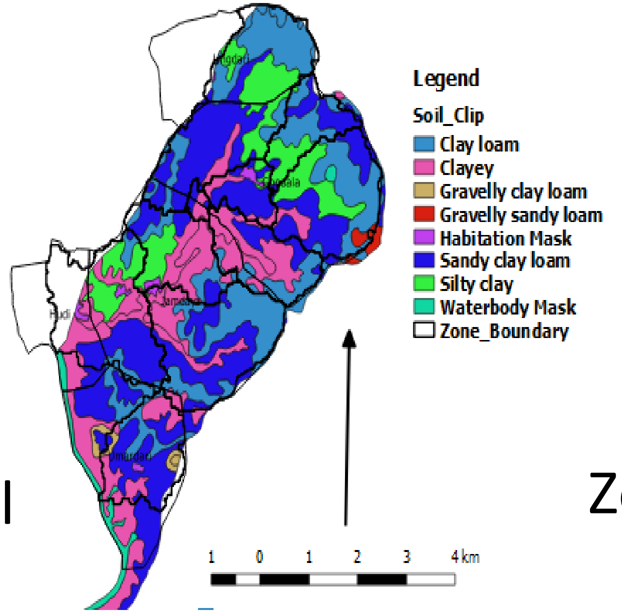


Components (mm)	Shallow sandy
Rainfall	563.00
Runoff	195.43
Soil Moisture	40.00
GW recharge	145.84
AET	181.73

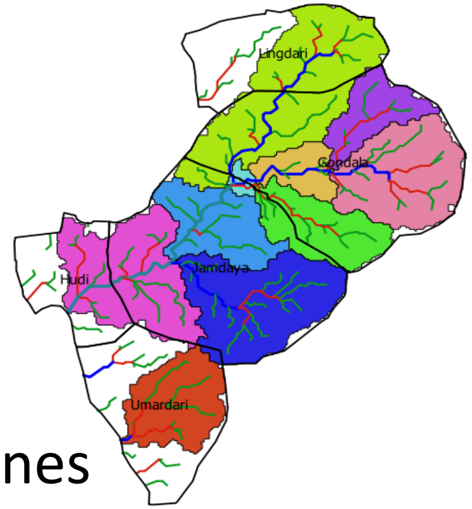
Spatial GIS Model: Sample Gondala cluster inputs



LULC

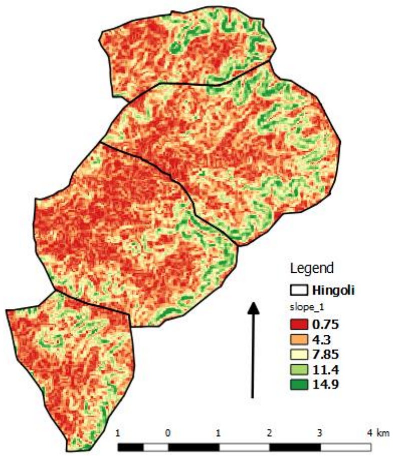


Soil



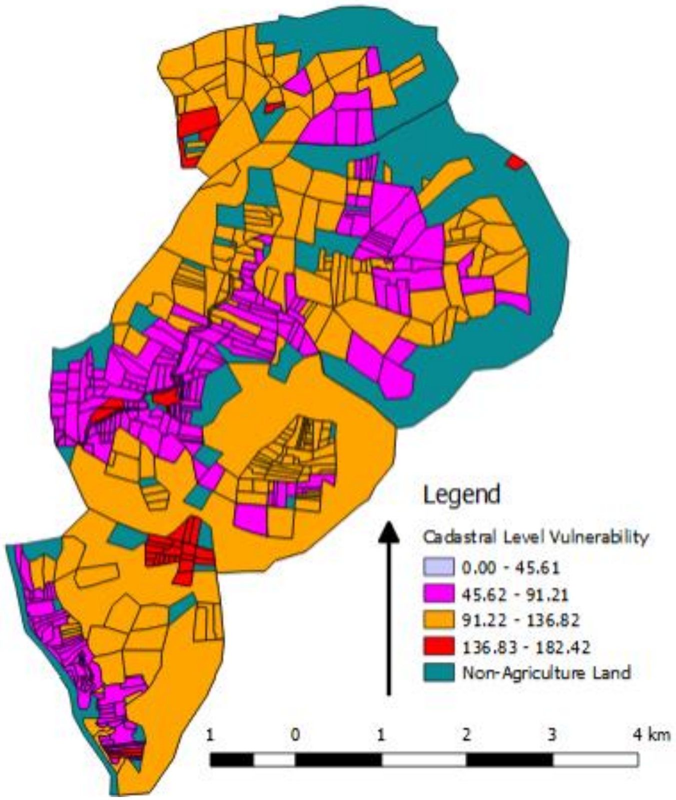
Zones

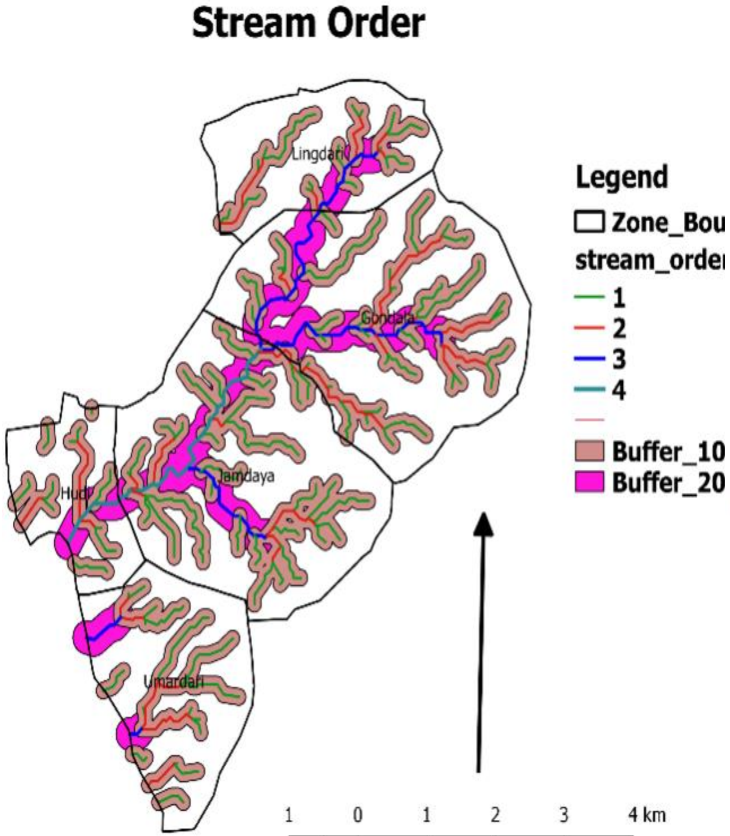
Cadestral

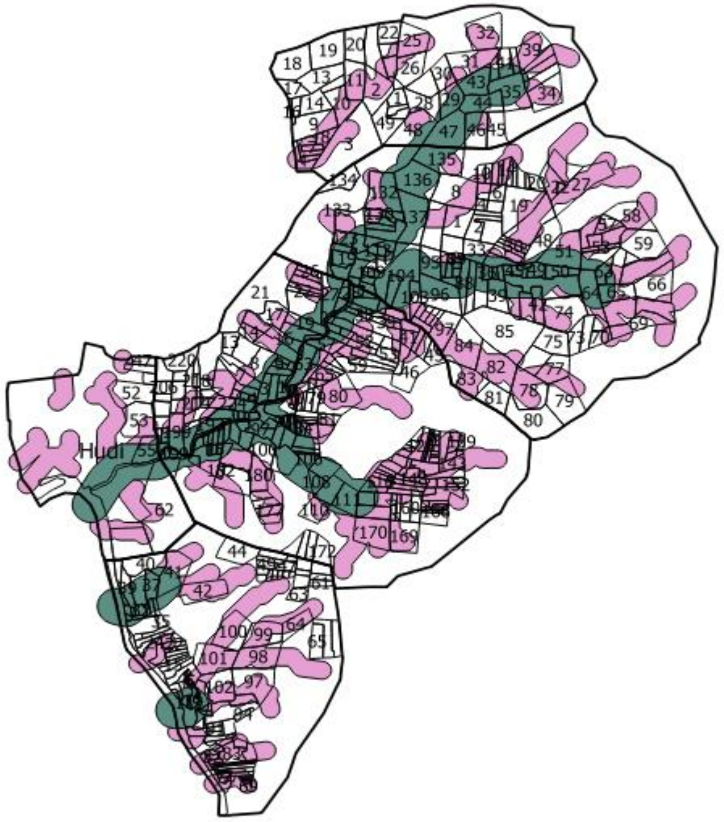


Slope

Outputs: Monsoon Farm Level Vulnerability map and Stream proximity map







Overall Usage Methodology: Inputs an Outputs

Front End

Input Data required from field

- Collection of zonal cropping data
- Existing structures and capacity
- Human and animal population

WB Kit for microplanning

- Zonal monsoon end water balance for major crop types in village

Back End

Water balance app on tablet

Output in PDF format

Output for Zone

-Monsoon balance: monsoon stress and available supply

Monsoon security Index

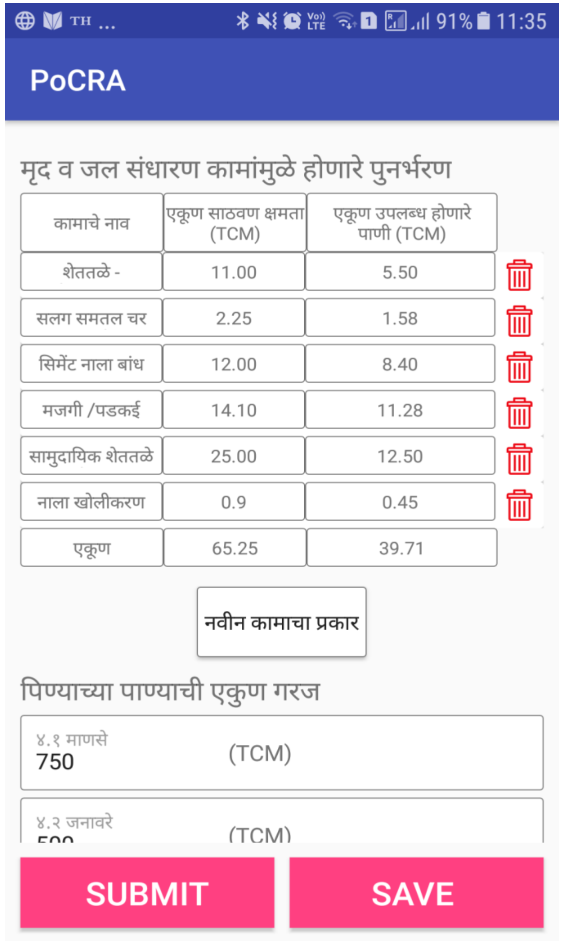
- Post-monsoon balance: irrigation requirement vs. supply of soil moisture and GW

Post-monsoon security index

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

Sample Water Budget Output Table in PDF format

Wadhvi village - 473mm -2017 Rainfall		Zone 1	Zone 2	Zone 3	Village
	Zone Area in hectare	423	60	179	662
Monsoon Balance (TCM)	Monsoon protective irrigation req. (deficit)	435.2	32.9	150.1	618.2
	Storage Available for Crops In Monsoon	34.0	5.1	122.7	161.9
	GW Available for Crops in Monsoon	4.7	0.2	1.2	6.2
	Monsoon Balance: Current Supply - Demand	-396.5	-27.6	-26.1	-446.7
	Monsoon Protective Irrigation Index	0.09	0.16	0.83	0.27
Post Monsoon Balance (TCM)	Rabi Total Water Requirement	162.5	11.5	230.6	404.6
	Drinking Water Requirement	0.0	0.0	39.4	39.4
	Water Available from Soil Moisture	35.9	2.6	35.7	74.2
	Water Available from GW	18.9	0.9	4.9	24.7
	Storage Available for Crops in Rabi Season	34.0	5.1	122.7	161.9
	Rabi Balance: GW supply+SM+structures-Rabi Demand-Drinking Water	-73.7	-2.9	-106.7	-183.3
	Post Monsoon Protective Irrigation Index	0.55	0.75	0.60	0.59
Design (TCM)	Water Available from Runoff	276.3	16.6	90.5	383.3
	Additional Water Available for Impounding	208.2	6.4	0	59.5

Note: Zone 3 has a large reservoir currently

Validation and Adaptation

- Model validation has been done against SWAT (Soil and Water Assessment Tool), the current industry standard
  - Current model is light-weight version of SWAT for ease of use
  - Output is consistent with SWAT output
- Field Level Validation has been done as follows -

Sr.no.	Component	Validation method
1	Input maps: Soil texture, Soil depth, Landuse, streams, Rainfall pattern	Field Observation and Matching with maps
2	Output: Runoff, streamflow in Rainfall events,GW stock and flow	Questions to farmers
3	Output: crop deficit, operating point/watering's given	Questions to farmers

Issues and Learnings

1. Soil texture mapping to AWC, soil bulk density, conductivity MRSAC soil texture name mapped to values using SPAW (USDA) refinement need for pocra region
2. Crop water requirement (PET) – currently ideal PET based on WALMI and FAO dataset (need following to better match field conditions)
   i. Need for operating point on yield watering curve for various main crops in PoCRA region
   ii. Kc values for micro irrigated crops
3. Crop Hierarchies and Water allocation– Information on irrigated and unirrigated crops, its economics for better coupling of water balance to cropping pattern and Intervention planning advisory

Work to be done in MoU II

- Refinement of water balance model and input datasets
- Design of framework for village plan analysis
  - Water accounting framework with linkages to village planning.
  - Measurement framework for water productivity indices.
- Integration of framework into app/dashboard and translating into planning guidelines
- Support in DPR assessment
- Dashboard for real time monitoring of various activities
- Video Traning.
- Research experiments with agriculture universities/institutes
  - Refinement of soil data sets.
  - Refinement of Kc values

Refinement of water balance model and input datasets

- Validation of existing soil datasets.
- Incorporation of daily climatic factors (temp, wind, humidity, temperature) in ET0 computation.
- Integration of improved crop ET values into the plugin.
- Incorporation of regional flows.
- Incorporation stream proximity into zones and its automation.
- Feasibility of mahabhulekh data integration

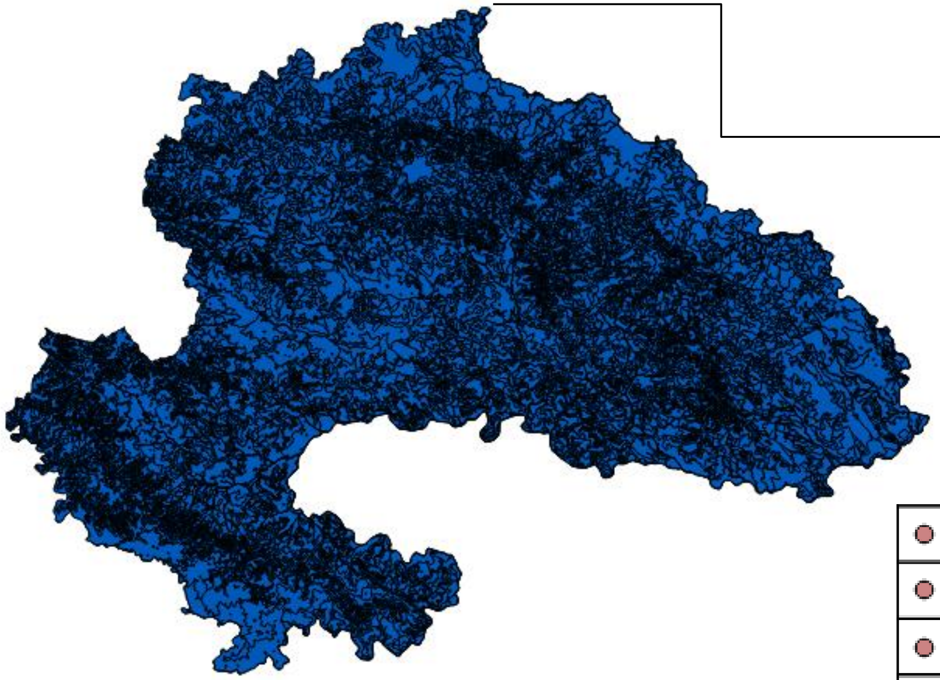
A1 Validation of existing soil datasets

Water balance results for actual and MRSAC soil texture and Operating Point

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
Soil Moisture_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
Soil Moisture_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
Soil Moisture_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
Soil Moisture_Crop_End	4	9	6	0

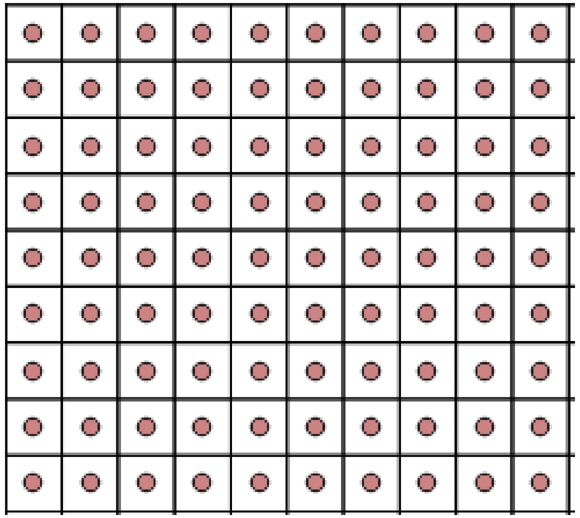
- According to MRSAC soil type at plot 328 is clay and its depth is categorized as very deep(more than 1m).
- Test result at above location texture to be sandy loam or silty loam and depth to be .5 m.
- Model results for two years 2017 and 2018 is given in the table for tested samples as well as MRSAC.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

Problem Statement & Approach

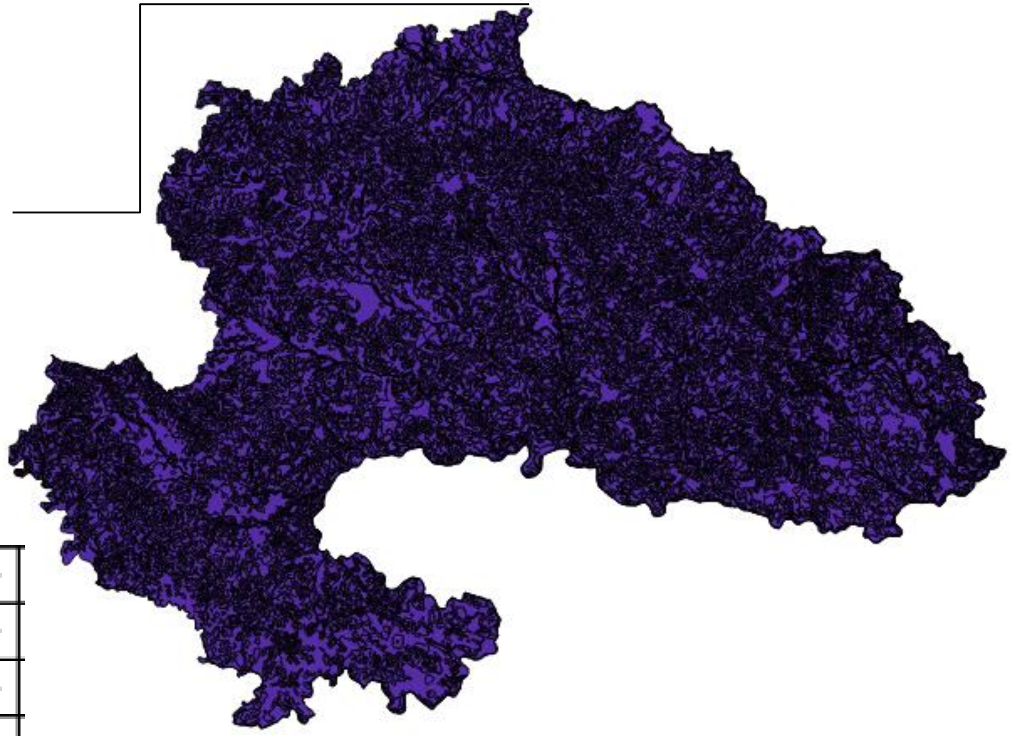


Yavatmal_NBSSLUP_Shapefile [9]

Attribute type at each location from both shapefile



Matrix with i,j values as attribute



Yavatmal_MRSAC_Shapefile [10]

A2 and A3 – Better estimation of ET and PET for Non agricultural lands, Micro irrigated lands

- Primary Approach – Prepare a framework and set of field experiments to compute Kc values for the Important crops like soyabean, cotton, tur, moong etc. and work with SAU's.

- Secondary Approach – Use of Satellite products available and weather parameters for better computation of PET, ET and water productivity.

- Water productivity measures the annual increase in water productivity at sub district level (taluka); it is expressed as a ratio of agricultural production (in kg) over evapotranspiration (in m3). It is measured from Year 3 onwards and for kharif season only. It is expressed as percentage change relative to a baseline value of **0.23 kg per cubic meter**.

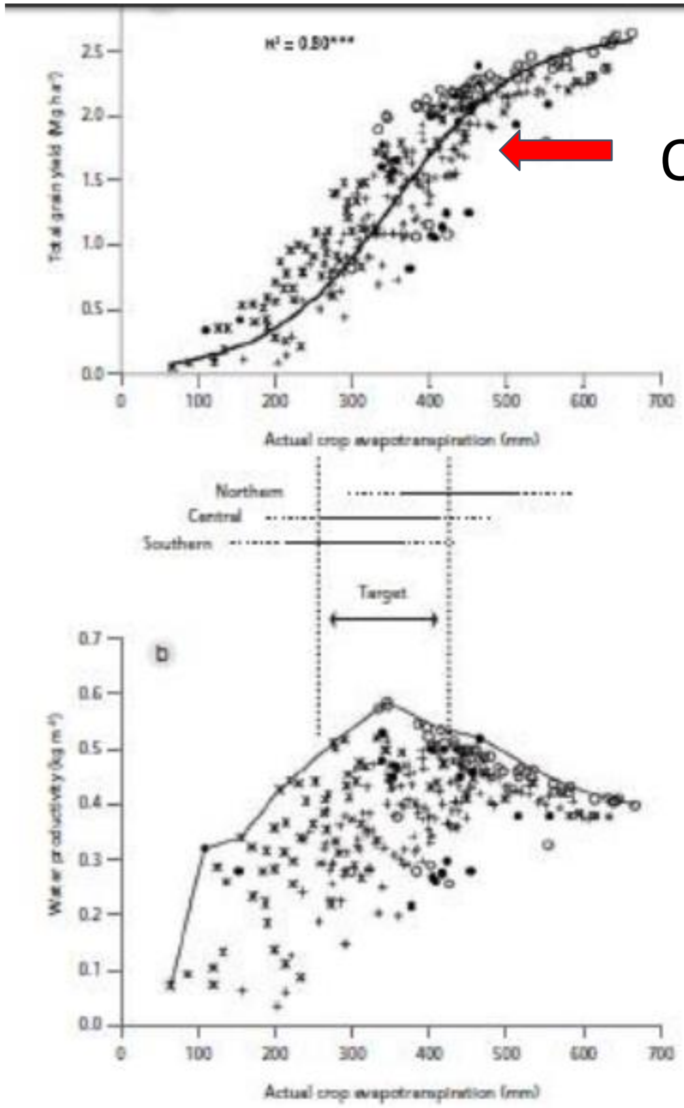
Tracking water productivity: Yield Watering Curve

1. The operating point on yield watering curve for each of main P1, P2 and P3 crops in village will be measured and its movement towards optimum point will be tracked temporally.
2. The water allocation regime based on planning framework will be utilized for this.

$$\frac{\text{Yield * Area}}{\text{(AET+Water Allocation)}} \quad \text{(kg/cum)}$$

If Yield watering curves for main crops in PoCRA region are available from Agricultural universities

1. **enable tracking wrt optimum point**
2. **Enable measurement of water given to crops**

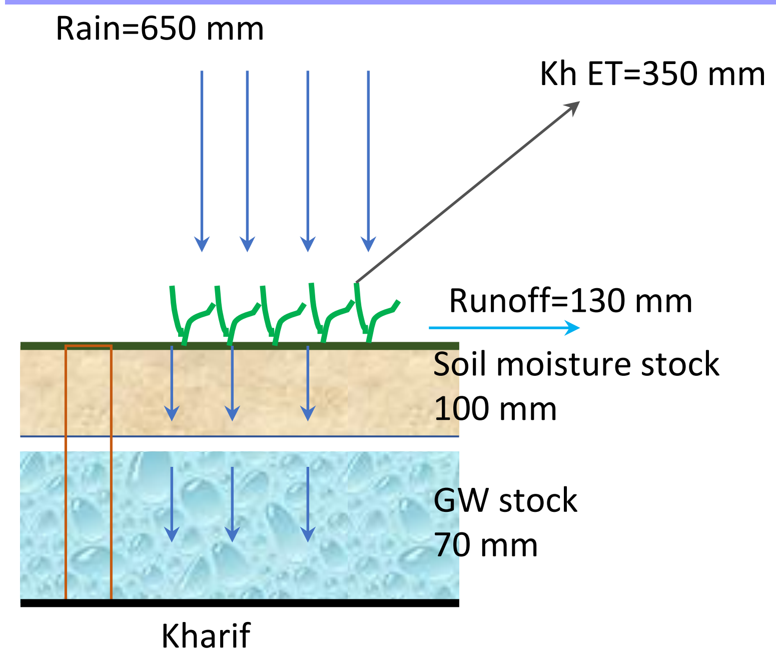


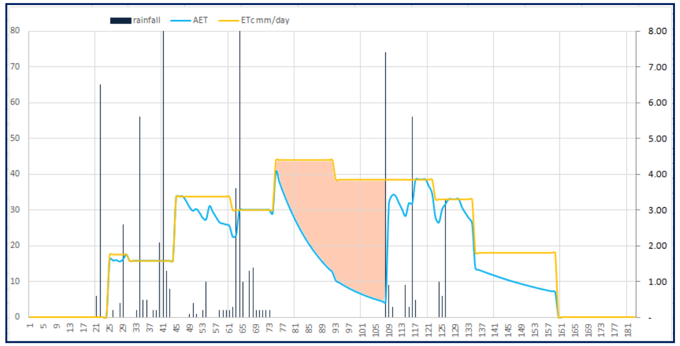
Optimum point

Source: FAO

A4 Incorporation of Groundwater Flows

PoCRA soil moisture balance model





The current PoCRA model is based on the point level daily soil moisture balance model

Which takes daily rainfall as input and gives
1. point/farm level soil moisture
2. Crop AET
3. Surface runoff generated at farm level and
4. Vertical groundwater recharge at farm level

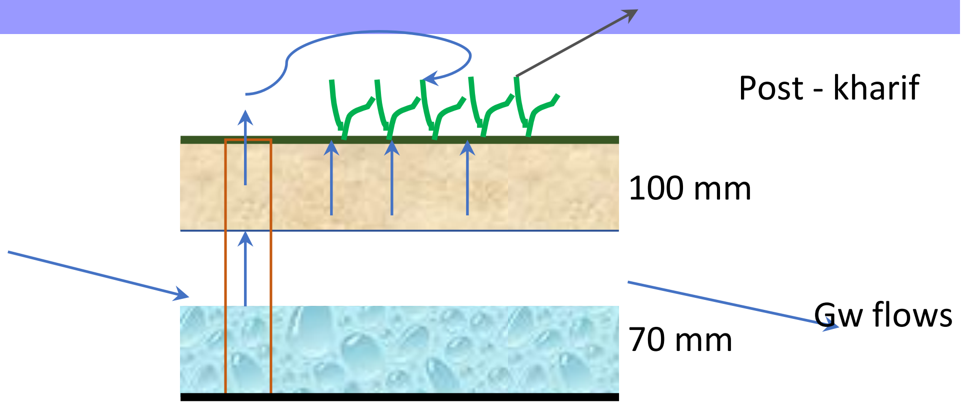
From this daily balance, all these quantities are Aggregated for the whole season

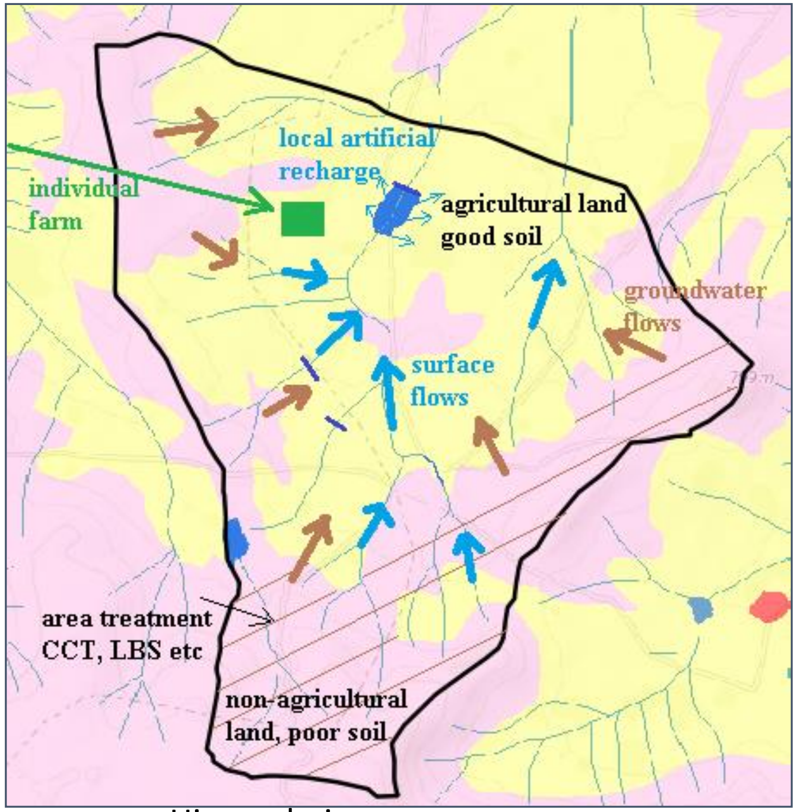
At the same time, all the quantities are Aggregated spatially for the zones

This is very important to determine crop water stress/deficit during kharif season and identify the vulnerable regions in the village

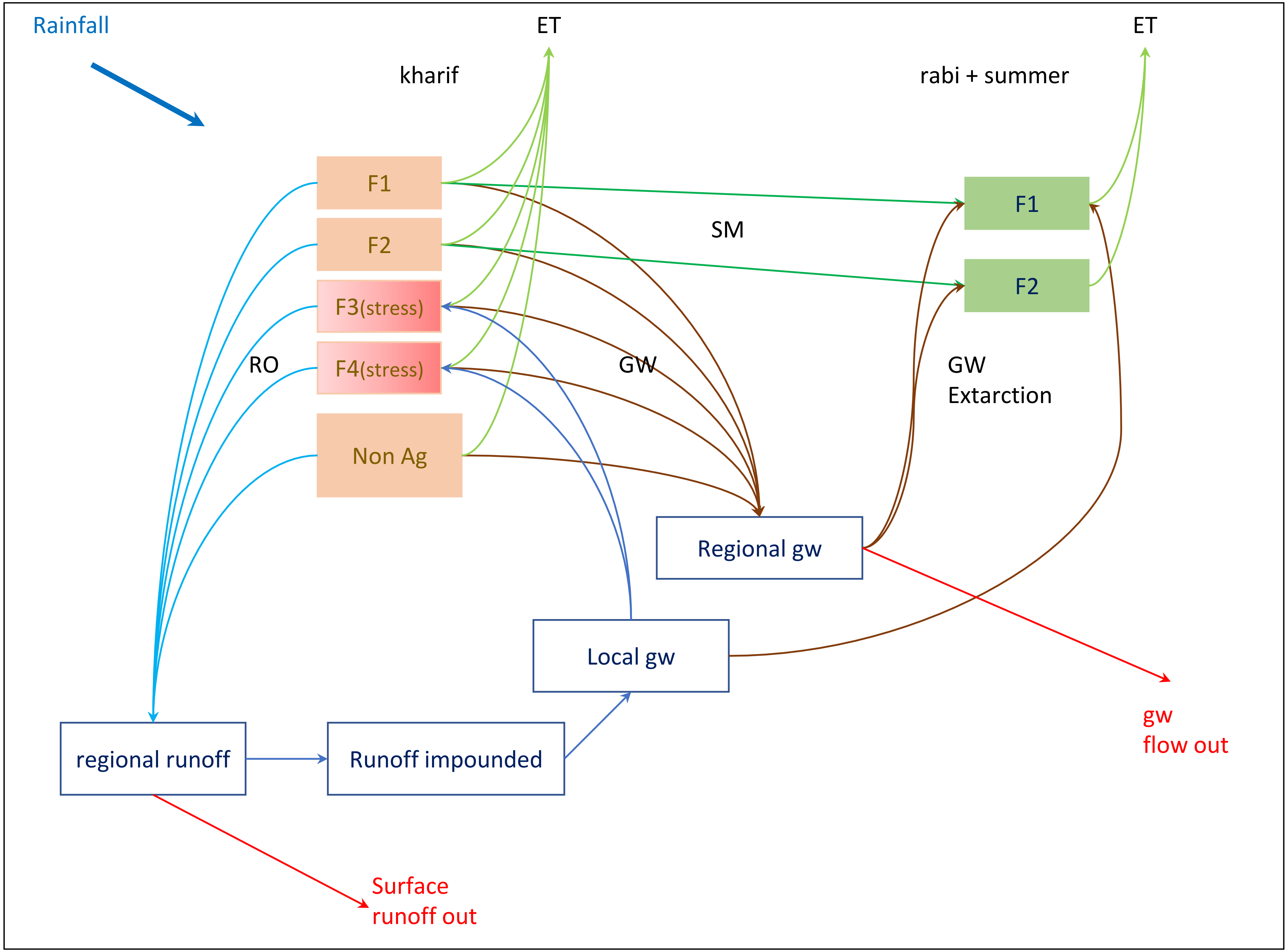
Need for estimating regional flows

- During kharif, soil moisture is the key determinant of the farm level crop security
- But post – kharif crop water security depends on –
  - Surface runoff impounded which increases gw locally
  - Groundwater / sub-surface flows
  - Baseflows
- Which are all regional flows. All flow from the recharge area to discharge area (high gradient to low gradient)
- These flows together with impounding structures determine access to water in rabi and summer seasons





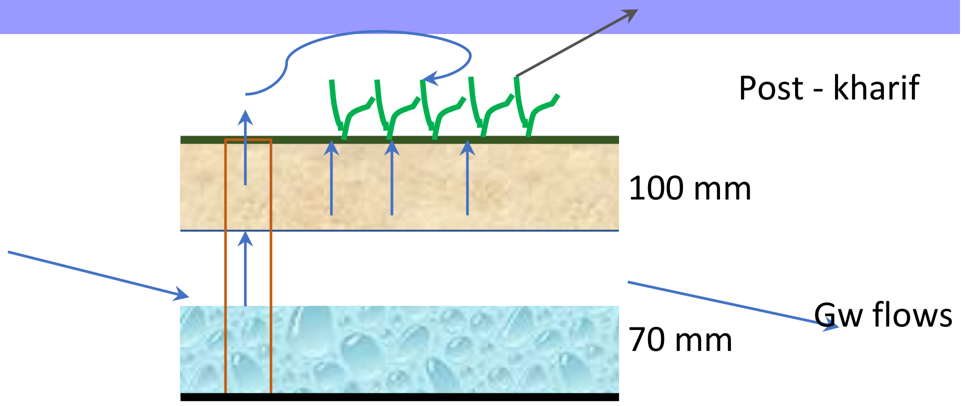
Hiware bajar map



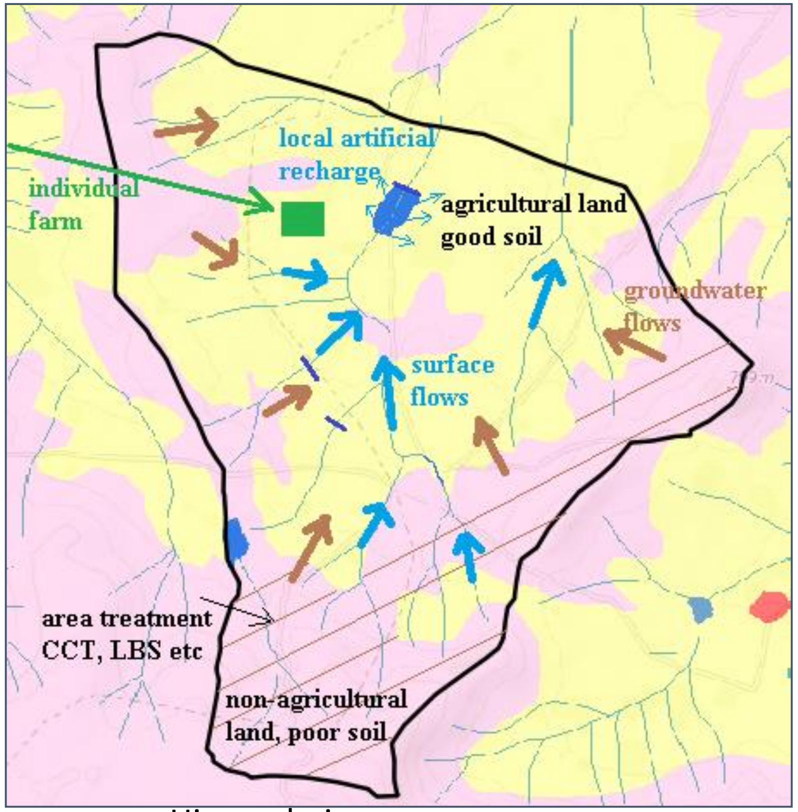
Rainfall
ET
kharif
ET
rabi + summer
F1
F2
F3(stress)
F4(stress)
Non Ag
F1
F2
SM
RO
GW
GW
Extarction
Regional gw
Local gw
regional runoff
Runoff impounded
gw
flow out
Surface
runoff out

Need for estimating regional flows

- Thus, soil moisture is in-situ
- can be transferred from kharif to rabi on the same farm
- is not transferred from one farm to other

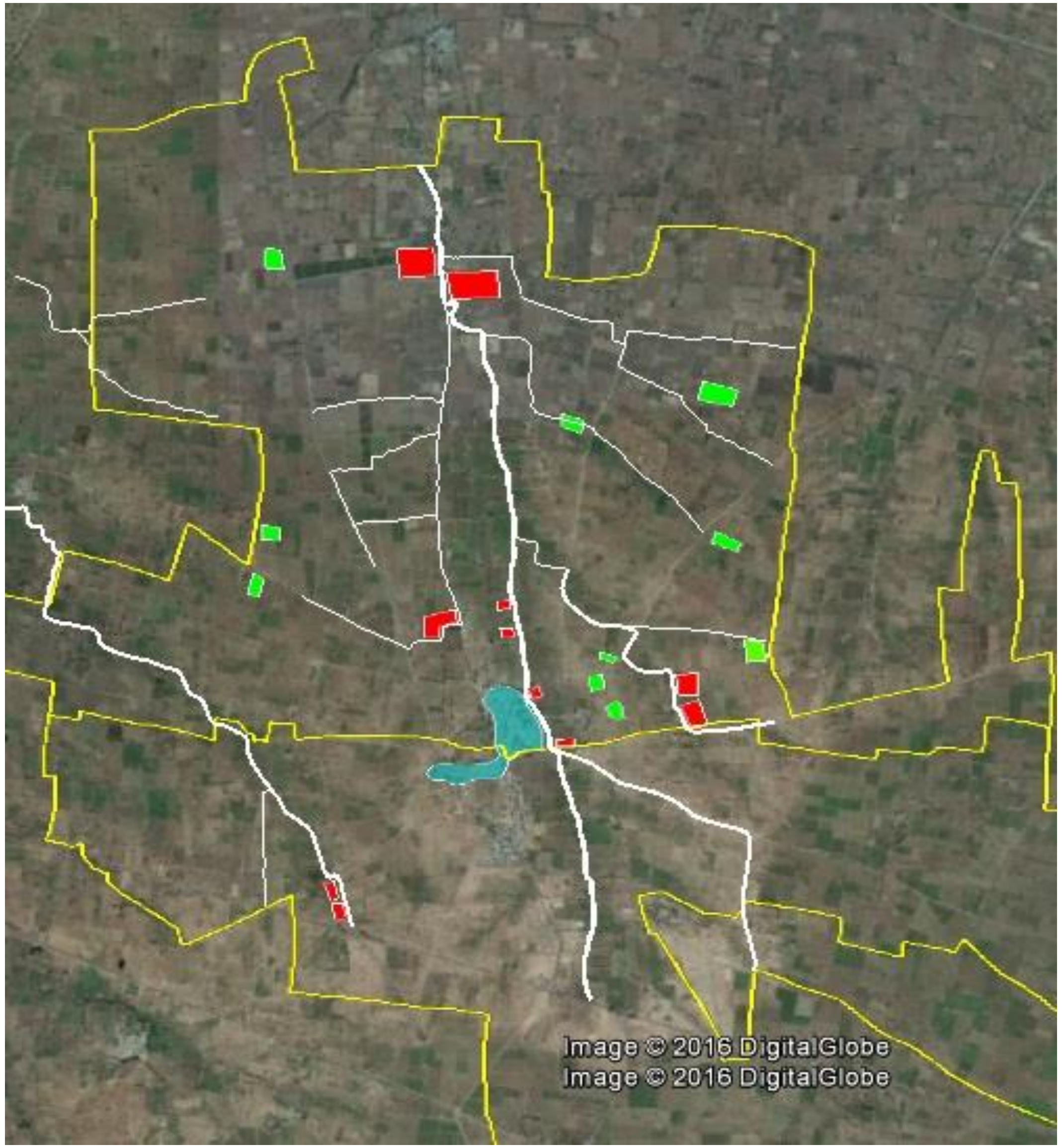


- Surface runoff and Groundwater flows are regional
- Recharge and runoff generated on one farm or on non-ag land during kharif are transferred to different farms in rabi (due to gradients and geological setup)
- **Thus, cannot be transferred from kharif to rabi on the same farm**



Hiware bajar map

Gw and surface flows towards stream proximity (pedgaon, parbhani)

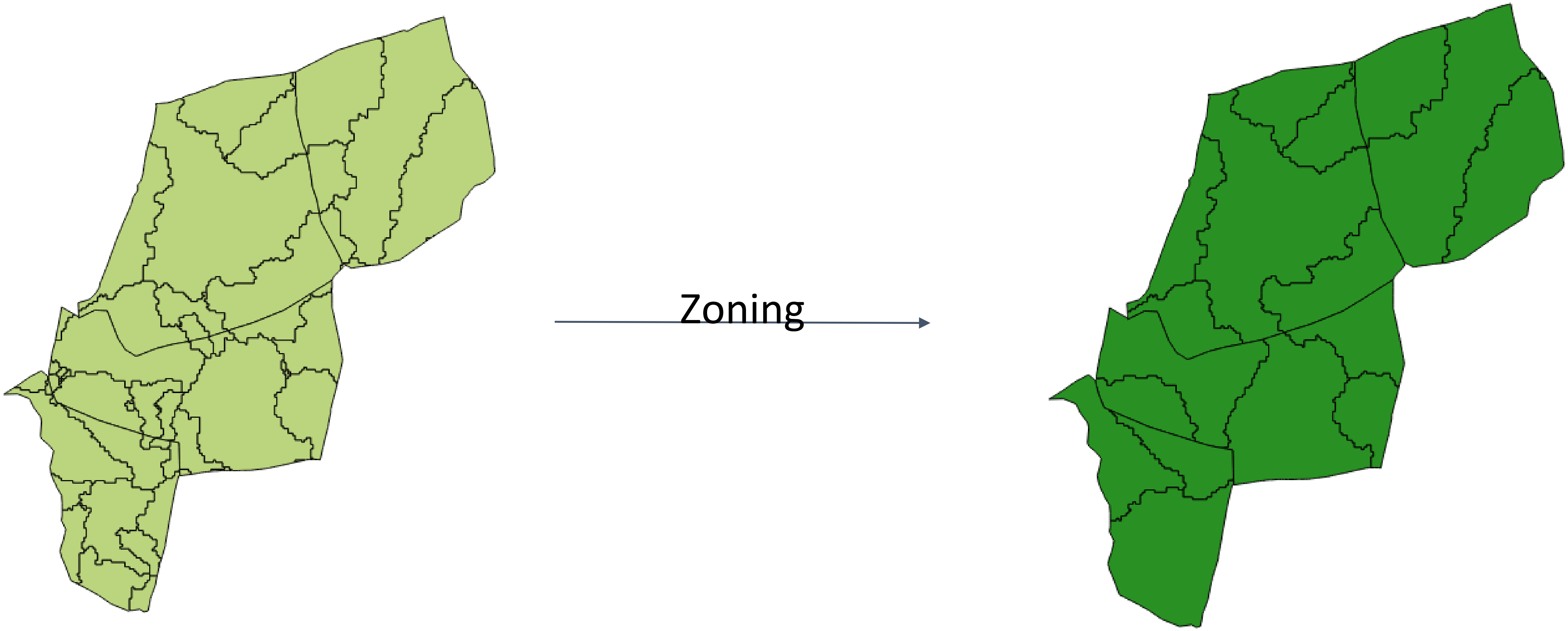


A5 Zoning Process

Steps of Zoning

1. Generate Stream and Watershed from DEM
2. Load Village and Watershed Layer
   a. Add zone_area attribute to watershed layer
   b. Apply Eliminate Sliver Polygons algorithm with appropriate threshold to watershed layer
3. Intersect Village and Cleaned Watershed Layer
4. Clip the Intersected layer to generate separate polygons for each village
   a. Update the zone_area attribute of each Clipped layer
5. Clean the separated polygons individually
   a. Use v.clean with appropriate threshold for each layer
6. Merge all the Cleaned Layers
   a. Update the zone_area attribute of the merged layer

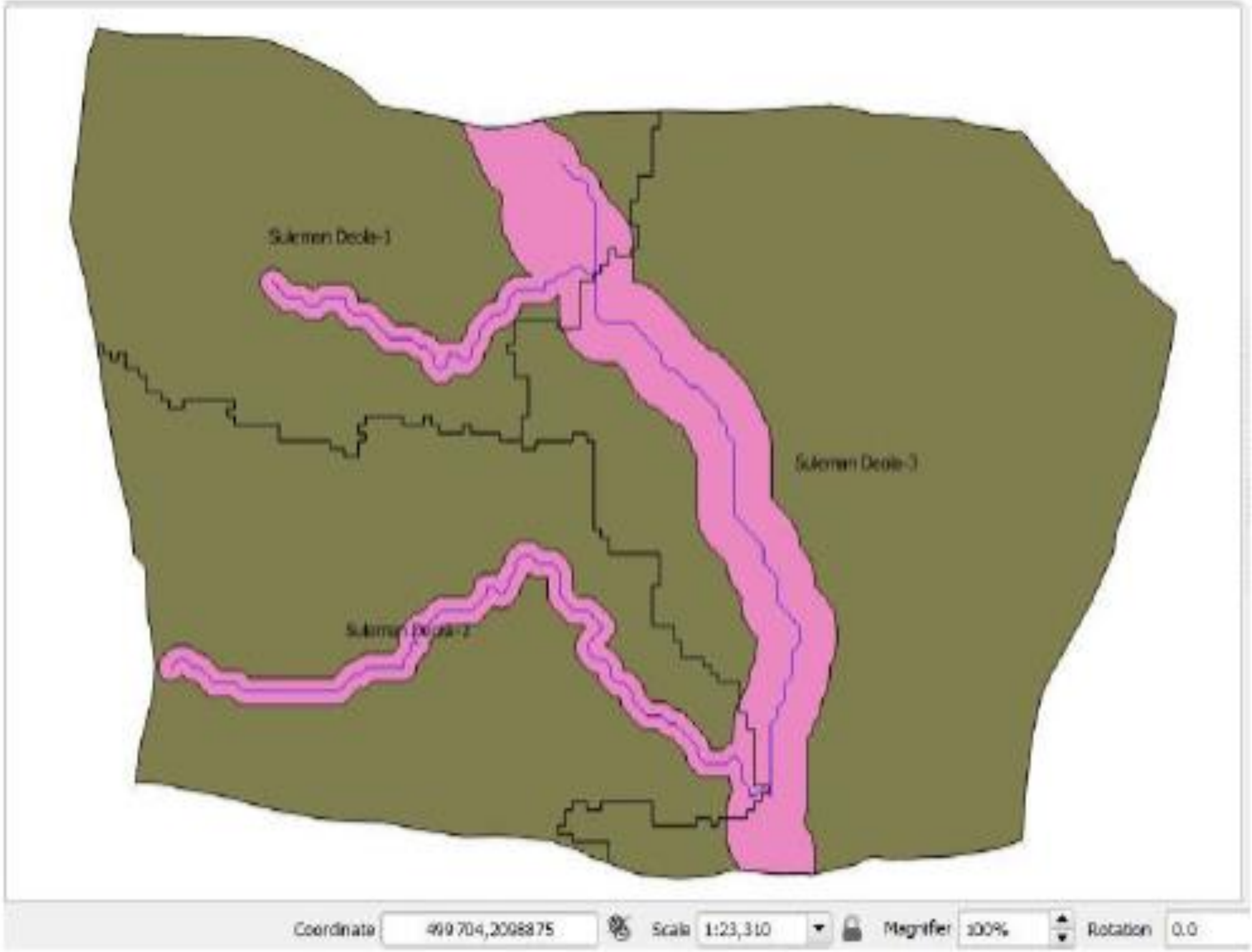
In short..



Intersected Layer

Merged Layer

New Zoning Approach



- Variation in Surface and ground water availability in stream proximity and non proximity will be taken into account

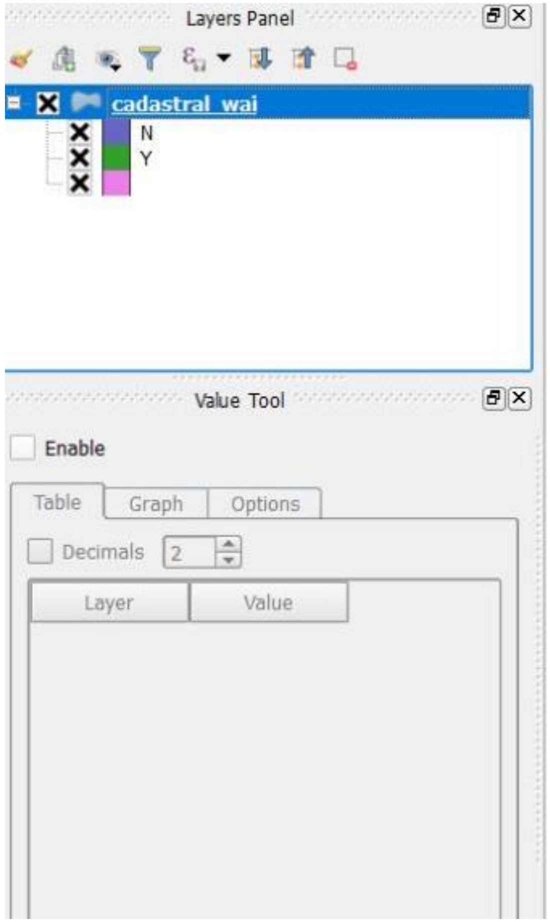
A6 Analysis of Cropping Data

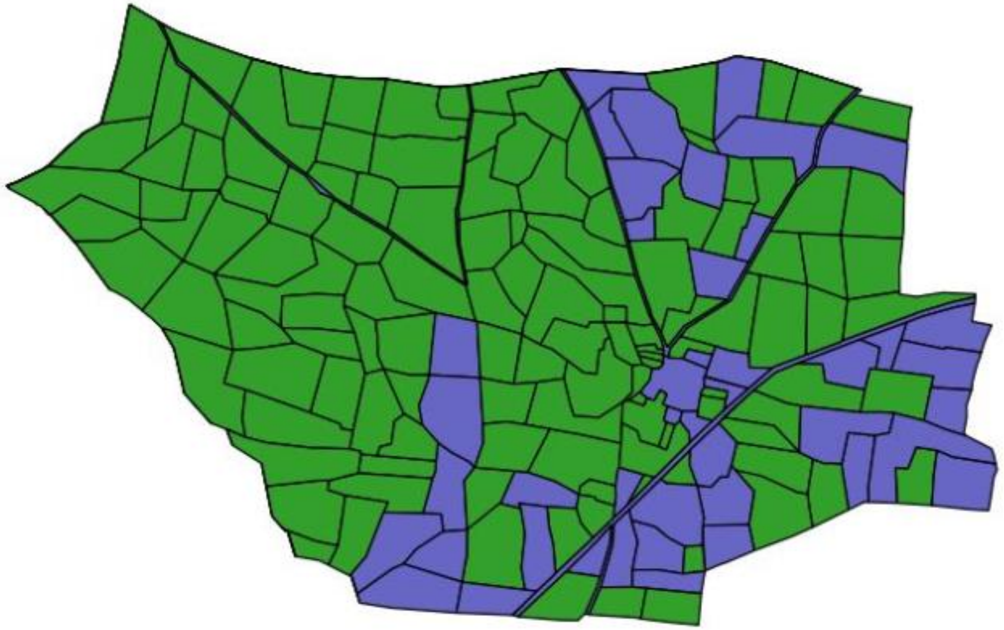
Analysis of Cropping Data

- Objective:
  - Data is as collected by Mahabhulekh and objective is to analyse its comparability with cadastral Maps; i.e. ratio of surveys in cadastral are also present in Mahabhulekh cropping data.
- Method:
  - Removing of duplicacy from cropping data as for multiple owners in same surve/subsurvey_no, there were duplicacy for crop1...crop n for all khatas(owners).
  - Single entry for tuple (survey no + survey area + crop + crop area) is kept.
  - Extracting numeric first part of survey nos (as cadastral maps only has numeric only survey nos) for each entry
  - Comparing survey list obtained from above step with cadastral maps

★ Output Analysis and comments:

District	Village	Gat present/ Total survey nos	Total survey nos extracted from cropping data	Comments
Washim	Wai	142/202	175	Nearly 60 % surveys matched with cadastral
Washim	Isafpur	27/30	62	Cropping data has more survey nos than total gat in cadastral
Akola	Akhatwada	189/194	174	Mora data matched (189>174) as few polygons having same survey no
Akola	Moradi	298/307	292	Mora data matched(298>292) as few polygons having same survey no





Cropping data analysis for Wai, Washim

B-D Design, integration of Planning framework

Target Project Development Objectives by streamlining Planning and Measurement Framework

Planning Activities

1. Targeting vulnerable smallholder farmers
2. Incorporating planning based on spatial variability
3. Planning to enable farmer movement into higher income category

2,3

Targeted PDO

1. Increased Water productivity
2. Improved yield uniformity and stability (spatial and temporal yield variability)
3. Annual farm income

1,2,3,4

Measurement activities

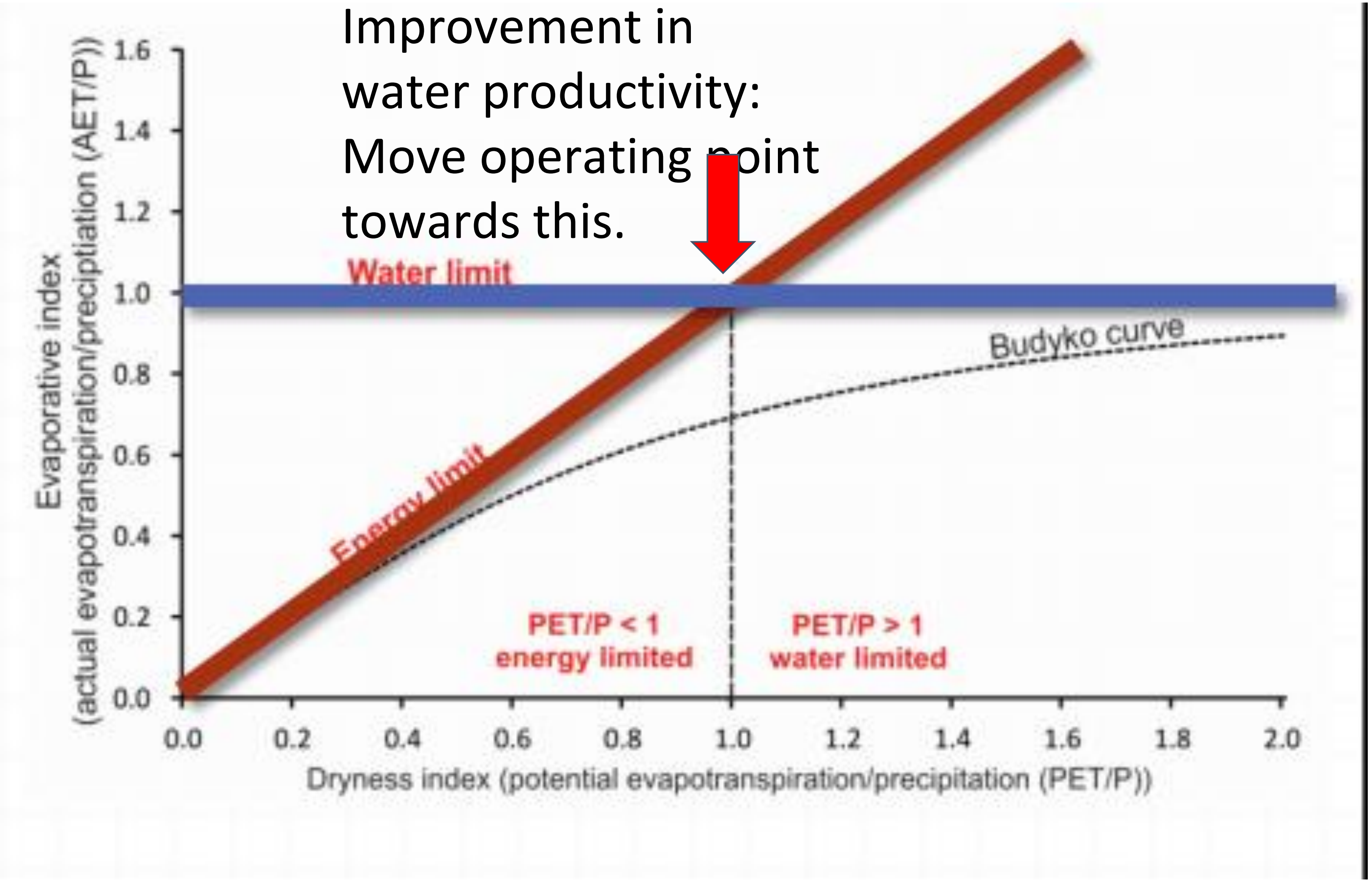
1. Increase in yield for main kharif and rabi crops
2. Inter zonal yield variation, increased water availability, rabi area etc.
3. Farmer movements to higher return crops
4. yield/water given for selected beneficiaries

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)

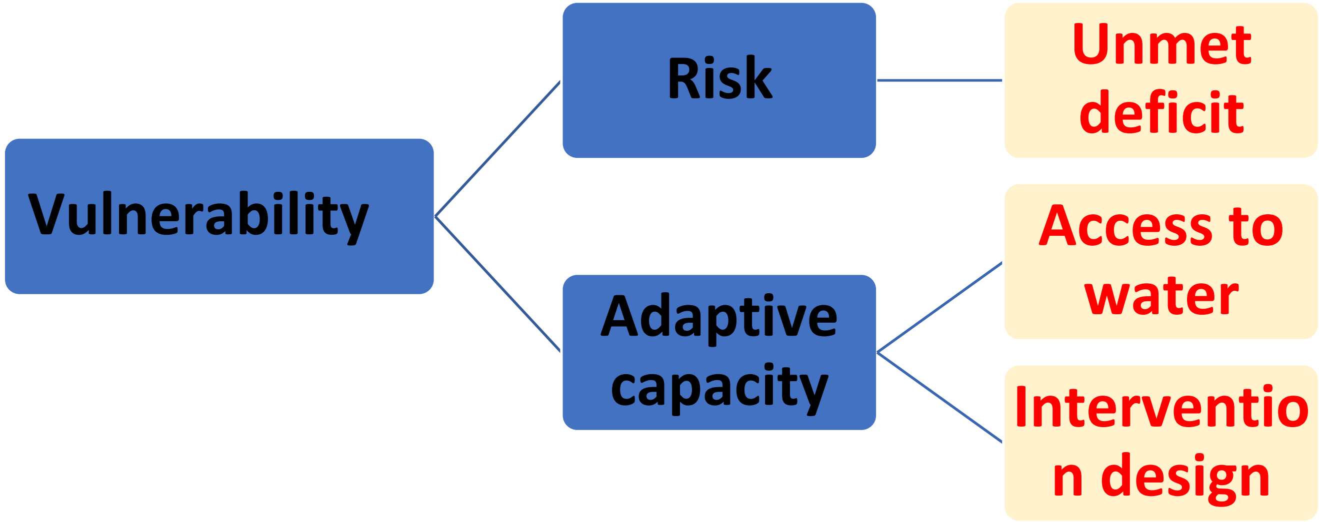
We plot village operating point based on water allocations to various crops from water budget based planning framework.



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.

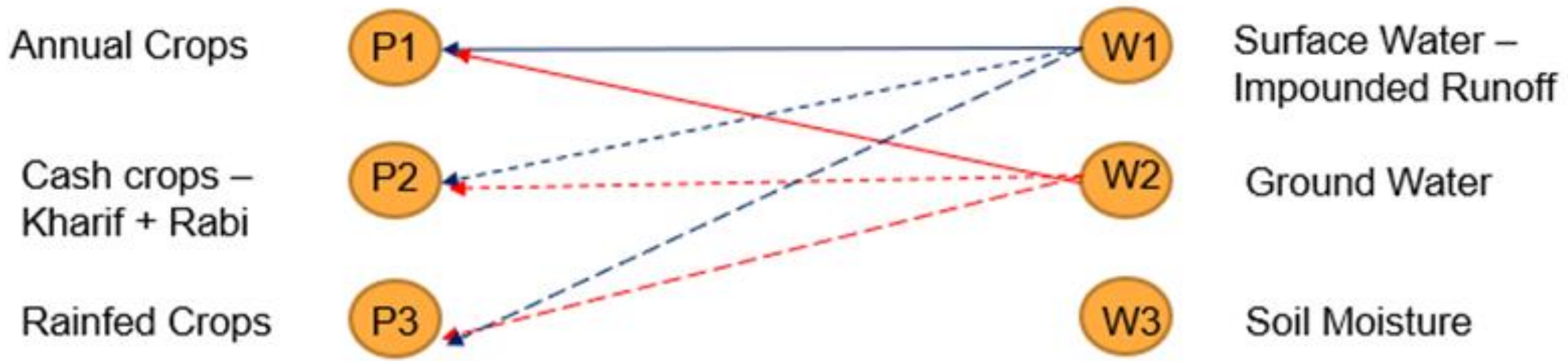
Vulnerability = Risk – Adaptive Capacity



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 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.

Water allocation framework

For intervention design, the demand and supply of water for crops are classified based on the priority and interventions are strategized to convert certain kinds of demands and increase certain kinds of supply.

Demand Side classification			Supply side classification	
P1	100% committed water	Annual crops	W1	Increase water in stream systems
P2	Plan to irrigate (but may be unable to)	Kharif- Rabbi cash crops	W2	Interventions that increase ground water
P3	No plan to irrigate	Rainfed crops	W3	Interventions that increase soil moisture

Water allocations need to be studied and refined based on farming practices.

New structures	Water categorization
Nala kholikaran	W1
Compartment bunding	W2, W3
CNB/Gabion	W1
Loose boulder structure	W2
Lined farm ponds	W1
Community FPs	W1
Percolation tank	W1

- The category of water improved by each intervention type needs to be studied to identify its actual beneficiaries and to plan interventions accordingly.

Schemes under PoCRA

Beneficiaries can apply for various subsidies under PoCRA

Village name	**Annual crops**	**Goat rearing**	**Bee keeping**	**Poultry**	**Silk making**	**Farm associated works**	**Well**	**Rejuvenation of wells**
Paradgaon	125	167	0	167	2	10	122	45
Sprinkler	**Vermicomposting**	**Shednet**	**Polyhouse**	**Pump set**	**HDPE Pipe**	Lining of farm ponds	Drip irrigation	
13	13	13	1	10	23	2	40	

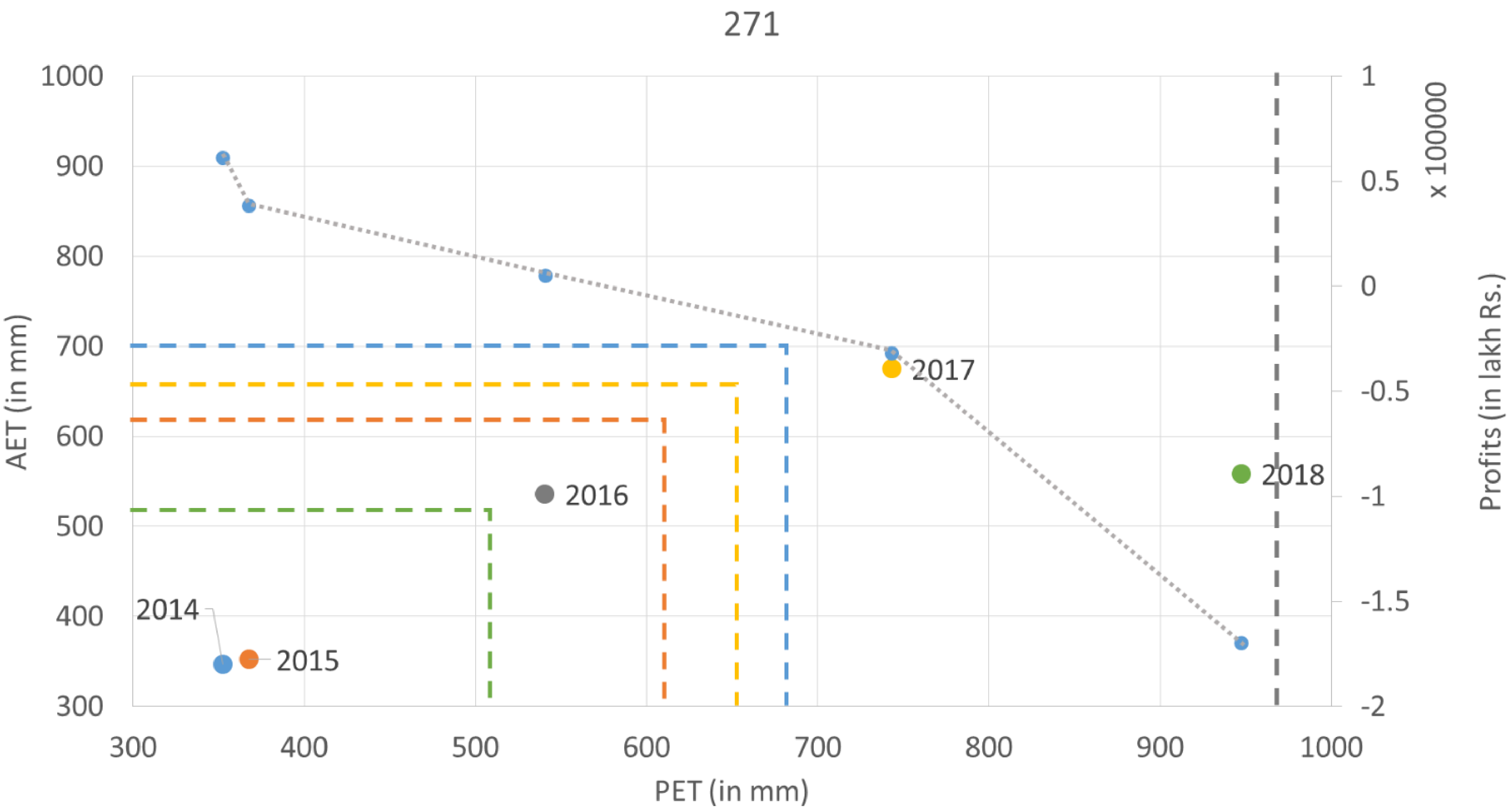
- The scheme for Sweet lime is:
  - 90% of the plants survive in year 1, 50% subsidy of Rs. 30,000 is provided.
  - 80% of the plants survive in year 2, 25% subsidy of Rs. 15,000 is provided.
  - 80% of the plants survive in year 3, 25% subsidy of Rs. 15,000 is provided

- The benefits of such a scheme need to be studied properly and beneficiaries for each scheme selected carefully.

Case 3: Gat no. 271
Farmer name: Yamunabai Dhawale
Location: Away from the stream
Family size: 9
Alternate sources of income: none

Deficit calculation

	2014			2015			2016			2017			2018		
	P1	P2	P3	P1	P2	P3	P1	P2	P3	P1	P2	P3	P1	P2	P3
Area under crop		6			6			4.5		1.5	6		7.5	4	
Deficit		65.42			69.42			65.82		735.2	72.4		1225.3	112.7	
Water allocation										452.3			-		
Water cost	0			0			0			19200			0		
Profit	61,440			38,400			5400			-31,518			-1,69,830		

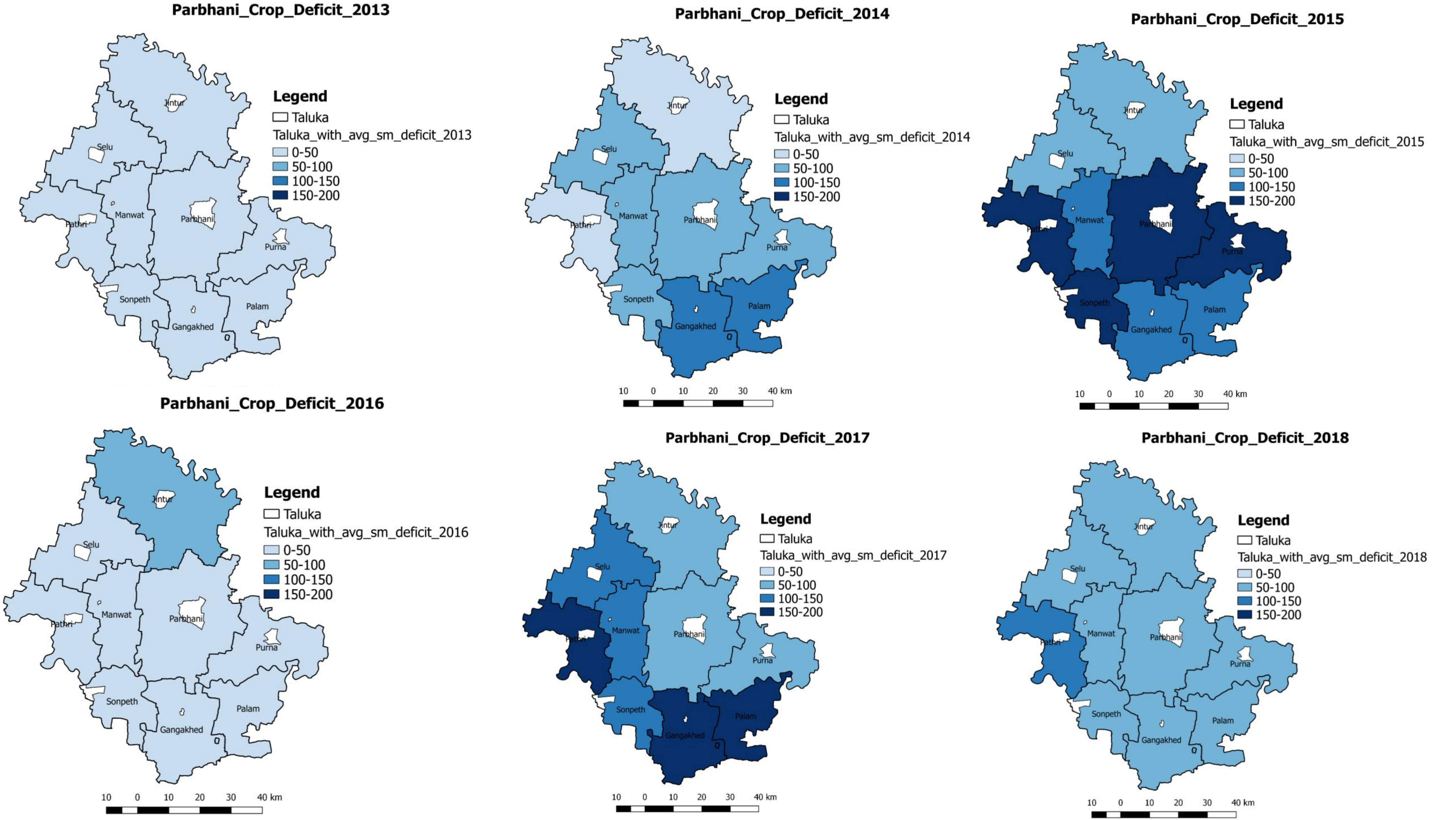


271
1000
900
800
700
600
500
400
300
AET (in mm)
2014
2015
2016
2017
2018
1
0.5
0
-0.5
-1
-1.5
-2
x 100000
Profits (in lakh Rs.)
300
400
500
600
700
800
900
1000
PET (in mm)

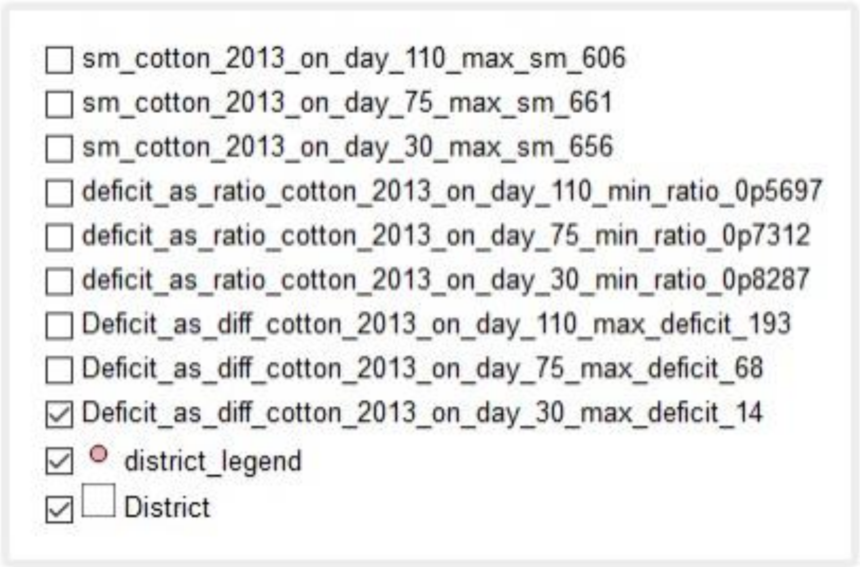
Dashboard (Items E1+E2)

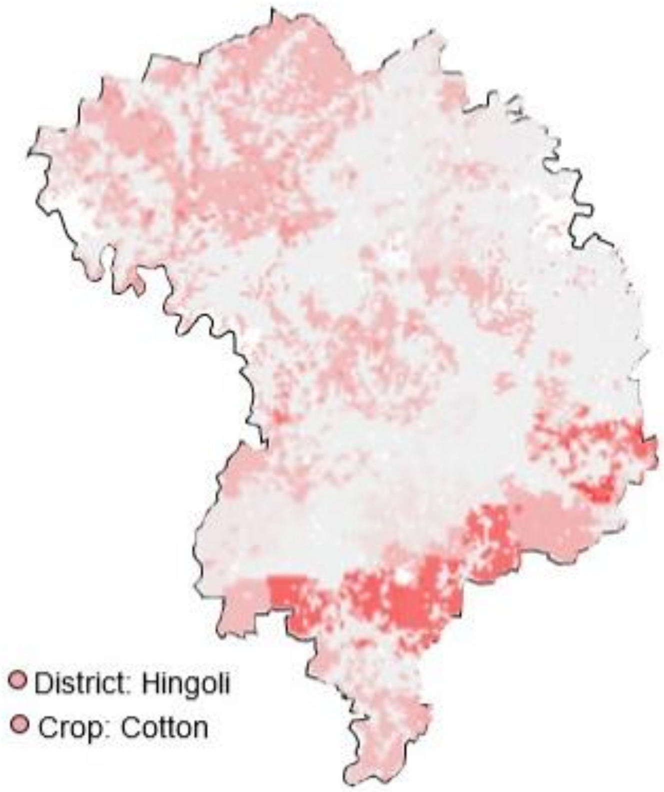
Purpose:

- Immediate:
  - Real-time (daily) geo-referenced tracking of the status of field-level technical parameters; in particular, soil-moisture deficit/crop stress
  - Platform for georeferenced technical/research inputs-outputs
- Extended:
  - Enable the incorporation of technical planning and advisory support
  - Enable the creation of a platform that eases any drudgery in the technical processing components and streamlines the end-to-end technical process.


Parbhani_Crop_Deficit_2013
Legend
Taluka
Taluka_with_avg_sm_deficit_2013
0-50
50-100
100-150
150-200
Jintur
Selu
Manwat
Parbhani
Pathri
Purna
Sonpeth
Gangakhed
Palam
Parbhani_Crop_Deficit_2014
Legend
Taluka
Taluka_with_avg_sm_deficit_2014
0-50
50-100
100-150
150-200
Jintur
Selu
Manwat
Parbhani
Pathri
Purna
Sonpeth
Gangakhed
Palam
10 0 10 20 30 40 km
Parbhani_Crop_Deficit_2015
Legend
Taluka
Taluka_with_avg_sm_deficit_2015
0-50
50-100
100-150
150-200
Jintur
Selu
Manwat
Parbhani
Pathri
Purna
Sonpeth
Gangakhed
Palam
10 0 10 20 30 40 km
Parbhani_Crop_Deficit_2016
Legend
Taluka
Taluka_with_avg_sm_deficit_2016
0-50
50-100
100-150
150-200
Jintur
Selu
Manwat
Parbhani
Pathri
Purna
Sonpeth
Gangakhed
Palam
10 0 10 20 30 40 km
Parbhani_Crop_Deficit_2017
Legend
Taluka
Taluka_with_avg_sm_deficit_2017
0-50
50-100
100-150
150-200
Jintur
Selu
Manwat
Parbhani
Pathri
Purna
Sonpeth
Gangakhed
Palam
10 0 10 20 30 40 km
Parbhani_Crop_Deficit_2018
Legend
Taluka
Taluka_with_avg_sm_deficit_2018
0-50
50-100
100-150
150-200
Jintur
Selu
Manwat
Parbhani
Pathri
Purna
Sonpeth
Gangakhed
Palam
10 0 10 20 30 40 km

Geo-referenced monitoring illustrated for Hingoli district

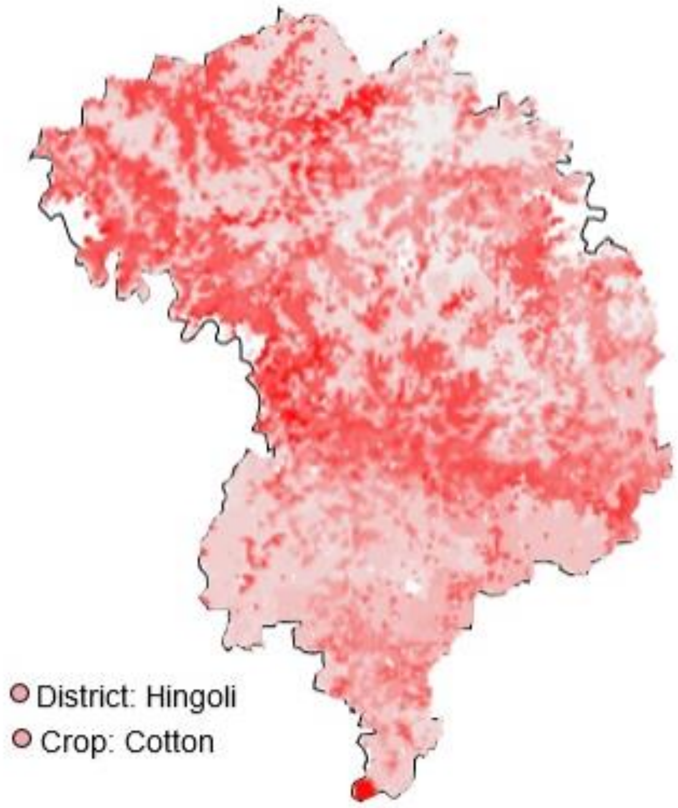




(More details, options and features to be added in the actual implementation)

PET - AET on day 30

Geo-referenced monitoring illustrated for Hingoli district



PET - AET on day 110

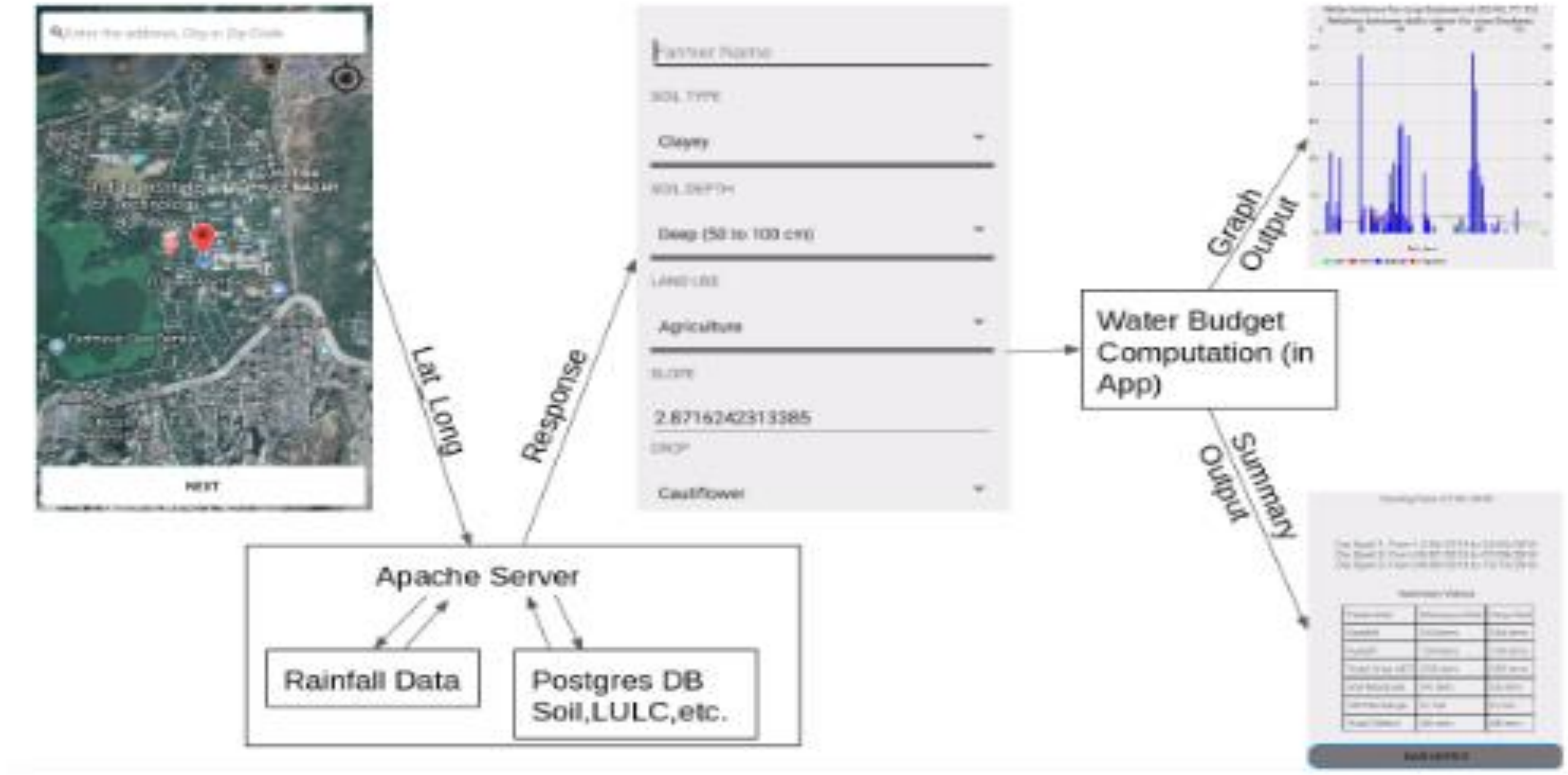
G Research and support from Agri University

Research and support from Agri University

- Crop wise Kc values, duration and its stages can help in better estimation of the crop water requirement.
  - Impact of micro irrigation on Kc or crop water requirement.
- Impact of non Ag land use types(forest, fallow, wasteland) and interventions like CCT, compartment bunding on groundwater recharge.
- In case of limited availability of water and requirement of deficit irrigation farmer must maximize the Water Productivity.
  - In the example of quinoa crop water productivity is maximum between 300mm to 400mm.
  - Knowing such operating points can help farmers maximize yield with limited amount of water.
- Incorporation of PoCRA procedures into students field work and training for the same.

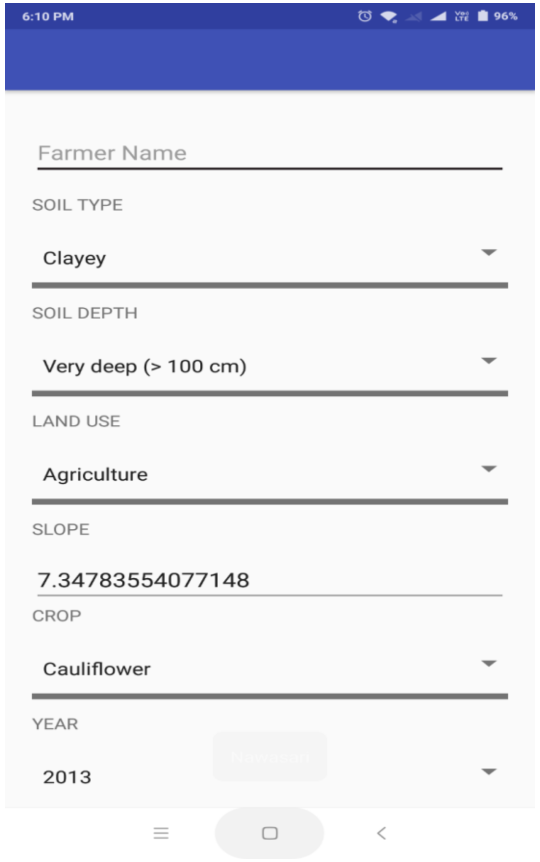
Android App Demo

System Design

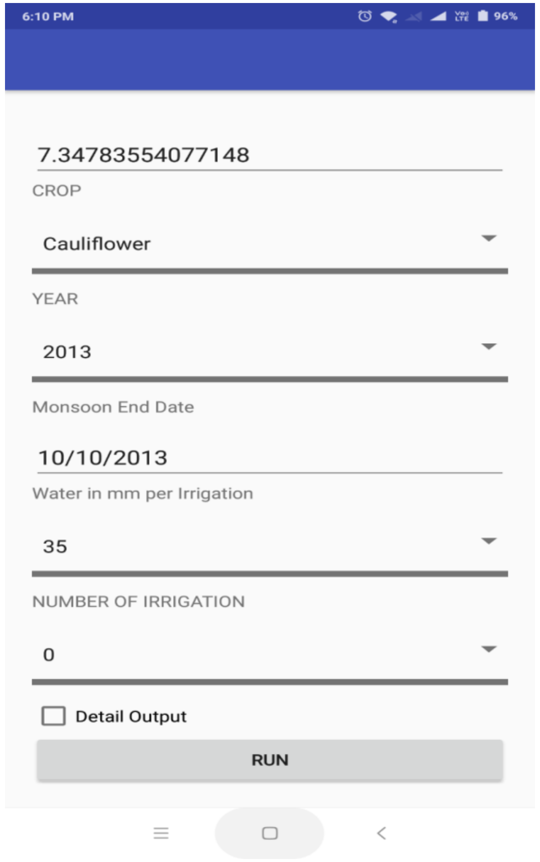


App Working & Features

Location Displayed



Values Fetched from Server



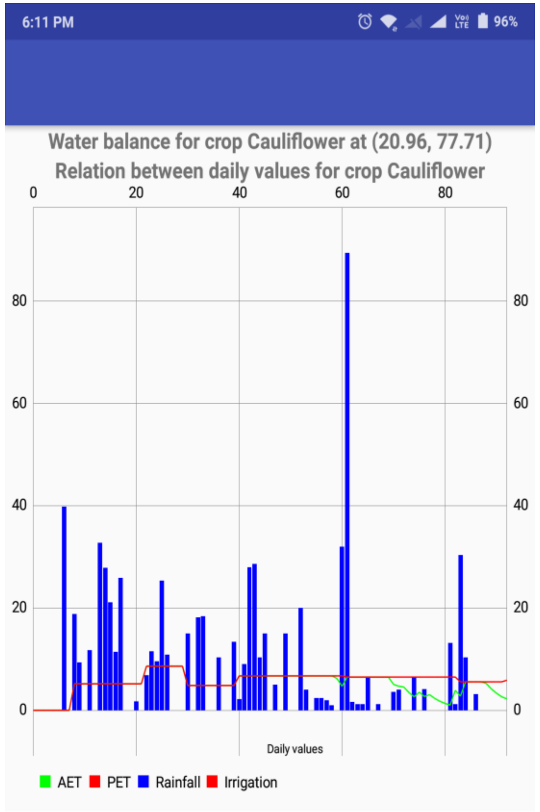
Click Run for Output

-Farmer Name-Required

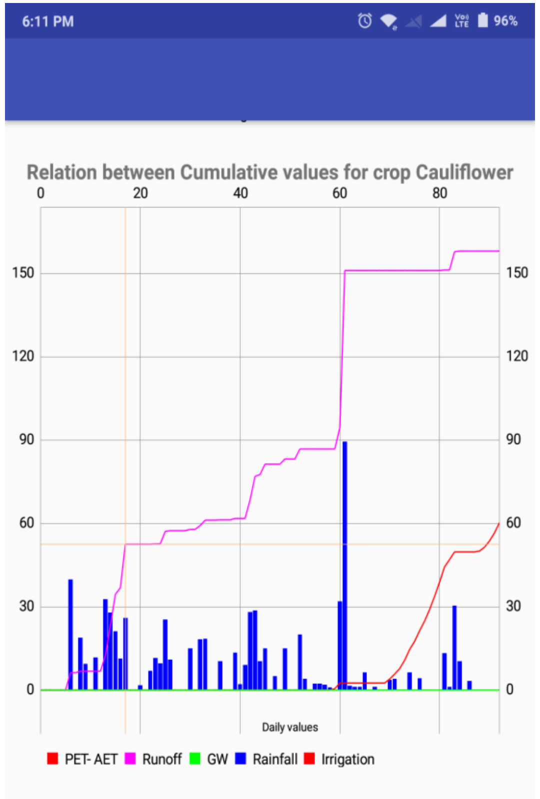
-Check “Detail Output” for daily computation values

-All fields can be adjusted manually

Output Graphs



Daily values for Crop



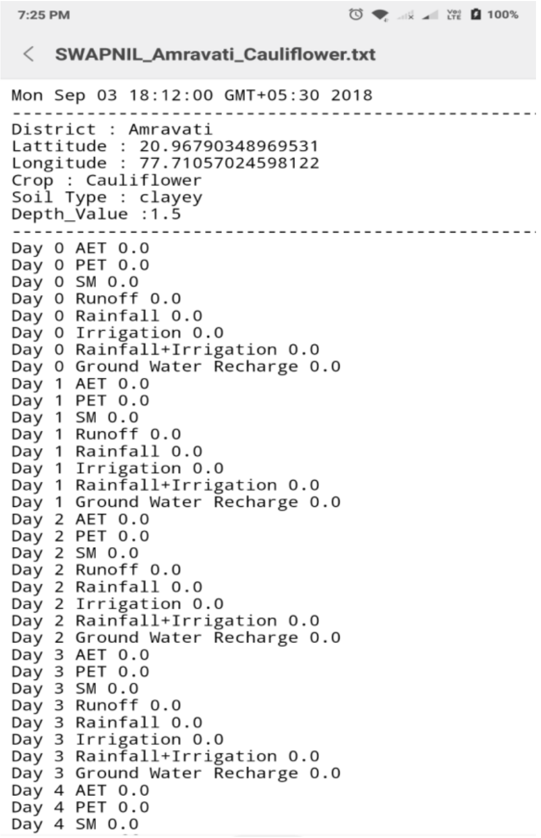
Cumulative values for Crop

Summary values for Crop

-Computation values include:

- PET
- AET
- PET-AET
- Runoff
- GW
- Rainfall
- Irrigation

-"Save Output" option will generate a report will

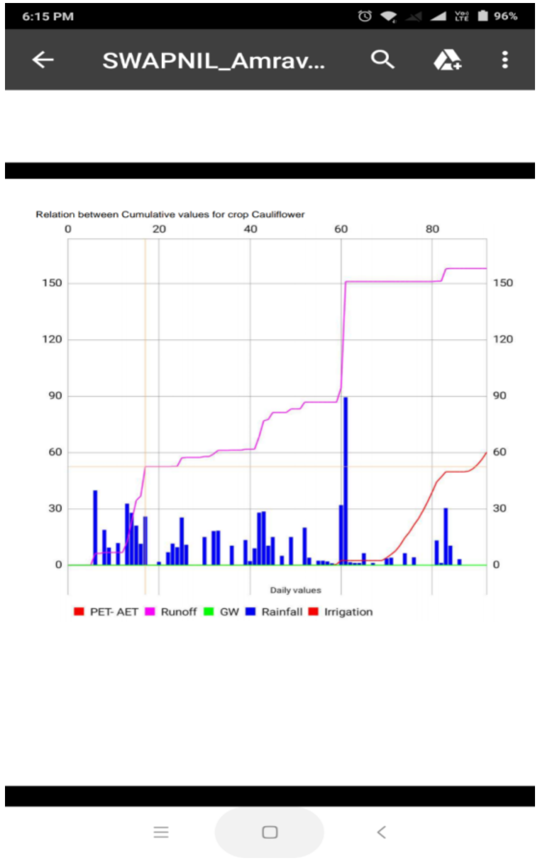


7:25 PM

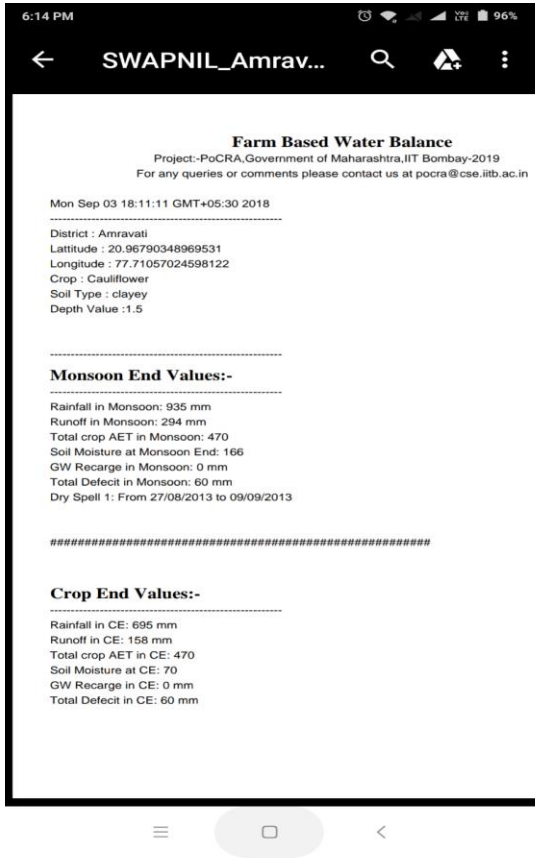
SWAPNIL_Amravati_Cauliflower.txt

```
Mon Sep 03 18:12:00 GMT+05:30 2018
-------------------------------------------------------
District : Amravati
Lattitude : 20.96790348969531
Longitude : 77.71057024598122
Crop : Cauliflower
Soil Type : clayey
Depth_Value :1.5
-------------------------------------------------------
Day 0 AET 0.0
Day 0 PET 0.0
Day 0 SM 0.0
Day 0 Runoff 0.0
Day 0 Rainfall 0.0
Day 0 Irrigation 0.0
Day 0 Rainfall+Irrigation 0.0
Day 0 Ground Water Recharge 0.0
Day 1 AET 0.0
Day 1 PET 0.0
Day 1 SM 0.0
Day 1 Runoff 0.0
Day 1 Rainfall 0.0
Day 1 Irrigation 0.0
Day 1 Rainfall+Irrigation 0.0
Day 1 Ground Water Recharge 0.0
Day 2 AET 0.0
Day 2 PET 0.0
Day 2 SM 0.0
Day 2 Runoff 0.0
Day 2 Rainfall 0.0
Day 2 Irrigation 0.0
Day 2 Rainfall+Irrigation 0.0
Day 2 Ground Water Recharge 0.0
Day 3 AET 0.0
Day 3 PET 0.0
Day 3 SM 0.0
Day 3 Runoff 0.0
Day 3 Rainfall 0.0
Day 3 Irrigation 0.0
Day 3 Rainfall+Irrigation 0.0
Day 3 Ground Water Recharge 0.0
Day 4 AET 0.0
Day 4 PET 0.0
Day 4 SM 0.0
```

Daily Values Log



Output Saved in Report



6:14 PM

SWAPNIL_Amrav...

Farm Based Water Balance

Project:-PoCRA,Government of Maharashtra,IIT Bombay-2019

For any queries or comments please contact us at pocra@cse.iitb.ac.in

Mon Sep 03 18:11:11 GMT+05:30 2018

District : Amravati
Lattitude : 20.96790348969531
Longitude : 77.71057024598122
Crop : Cauliflower
Soil Type : clayey
Depth Value :1.5

Monsoon End Values:-

Rainfall in Monsoon: 935 mm
Runoff in Monsoon: 294 mm
Total crop AET in Monsoon: 470
Soil Moisture at Monsoon End: 166
GW Recharge in Monsoon: 0 mm
Total Defecit in Monsoon: 60 mm
Dry Spell 1: From 27/08/2013 to 09/09/2013

Crop End Values:-

Rainfall in CE: 695 mm
Runoff in CE: 158 mm
Total crop AET in CE: 470
Soil Moisture at CE: 70
GW Recarge in CE: 0 mm
Total Defecit in CE: 60 mm

Summary Values Saved in Report

-The report will be generated with name as: FarmerName_DistrictName_CropName.pdf at location “storage/emulated/0”.

-The daily log value file (if checked) will be generated at location “storage/emulated/

Way Ahead

- Improvement in soil maps
- Extension to all districts
- Extension to farmer water budgeting app.
- Calibration for yield - use in *Paisewari* estimation.

- Workshop to present app logic and improvement based upon feedback.

Crop cutting experiment data for calibration

Information regarding yield obtained for various crops in the CCE plots can help us find the operating points for various crops.

Following Information should be collected through interviews and testing.

- Soil properties of CCE plot
- Irrigation applied
- Crop growth e.g height, number of plants, stages
- Treatment used
- Insect/pest attack







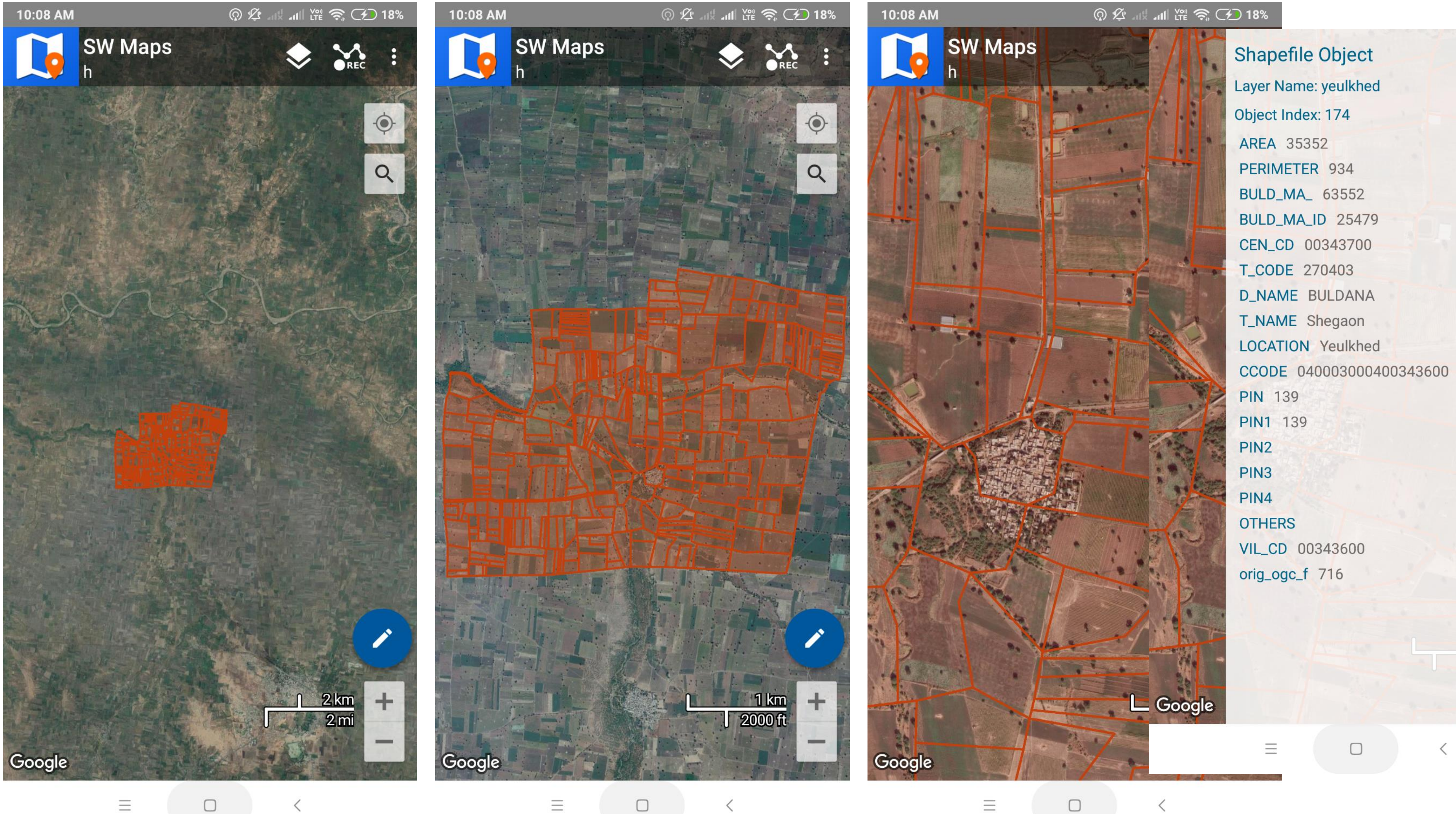

Field Work and Experiment


Latitude: 19.612667
Longitude: 76.151712
Elevation: 457.87m
Accuracy: 3.2m
Azimuth: 245° (SW)
Pitch: -13.2° (2.9°)
Time: 04-07-2018 12:26
Note: Water level of Well
paradgoan
Powered by Ar


e: 19.610574
ude: 76.134328
on: 461.09m
cy: 14.0m
06-07-2018 13:00
dhav field well
Powered by NoteCar

Non irrigated and irrigated Cotton

Thank You


10:08 AM
SW Maps
h
2 km
2 mi
Google
1 km
2000 ft
Shapefile Object
Layer Name: yeulkhed
Object Index: 174
AREA 35352
PERIMETER 934
BULD_MA_ 63552
BULD_MA_ID 25479
CEN_CD 00343700
T_CODE 270403
D_NAME BULDANA
T_NAME Shegaon
LOCATION Yeulkhed
CCODE 040003000400343600
PIN 139
PIN1 139
PIN2
PIN3
PIN4
OTHERS
VIL_CD 00343600
orig_ogc_f 716

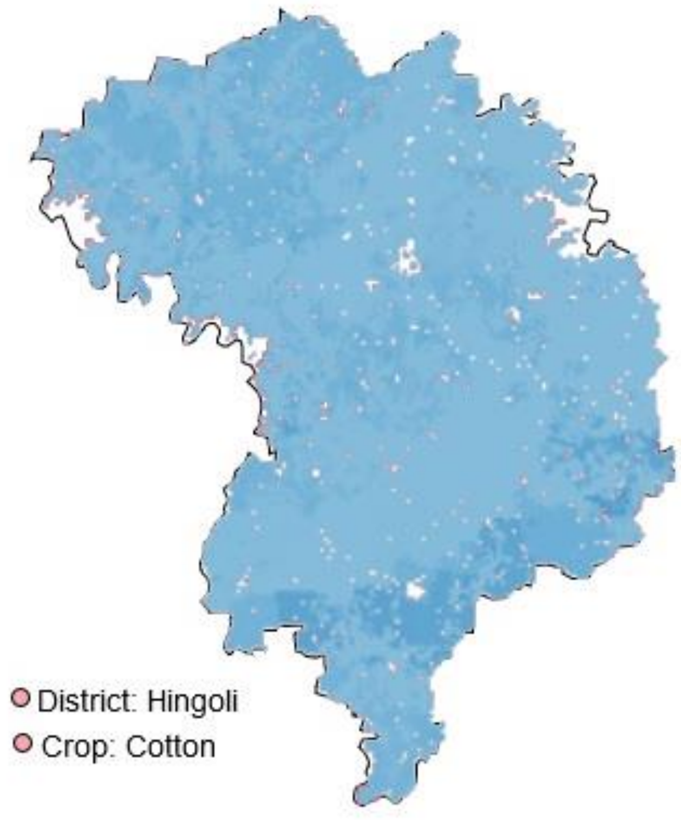
Advantages

- Accurate linking of farmer and his related data
- Digitization can help in further analysis of the gathered data
- Asset marking and help the administrators to analyze the quality and quantity of the structures marked
- Can provide decision support with respect to providing tanker support,building new wells,etc.

Marodi Village Water Balance

Rainfall	845.6	558.1	506.4	921.8	546.0	675.58
All Values are in TCM	Village_2013	Village_2014	Village_2015	Village_2016	Village_2017	Average_Village
Monsoon protective irrigation req. (deficit)	293.6	150.3	814.3	186.7	644.3	417.8
Storage Available for Crops In Monsoon	7.7	7.7	7.7	7.7	7.7	7.7
GW Available for Crops in Monsoon	32.9	0.3	0.0	14.9	2.3	10.1
Monsoon Balance: Current Supply - Demand	-253.0	-142.2	-806.7	-164.1	-634.3	-400.1
Monsoon Protective Irrigation Index	0.14	0.05	0.01	0.12	0.02	0.04
Rabi Total Water Requirement	1163.8	2117.9	1333.6	1404.3	1092.3	1422.4
Drinking Water Requirement	20.2	20.2	20.2	20.2	20.2	20.2
Water Available from Soil Moisture	373.6	273.5	72.4	387.2	146.8	250.7
Water Available from GW	65.9	0.6	0.0	29.8	4.5	20.2
Storage Available for Crops in Rabi Season	7.7	7.7	7.7	7.7	7.7	7.7
Rabi Balance: GW supply+SM+structures-Rabi Demand-Drinking Water	-716.6	-1836.1	-1253.5	-979.5	-933.2	-1143.8
Post Monsson Protective Irrigation Index	0.38	0.13	0.06	0.30	0.14	0.20
Water Available from Runoff	759.9	628.8	453.3	1096.7	237.1	635.1
Additional Water Available for Impounding	744.5	613.4	437.9	1081.3	221.7	619.8

Geo-referenced monitoring illustrated for Hingoli district



- [ ] sm_cotton_2013_on_day_110_max_sm_606
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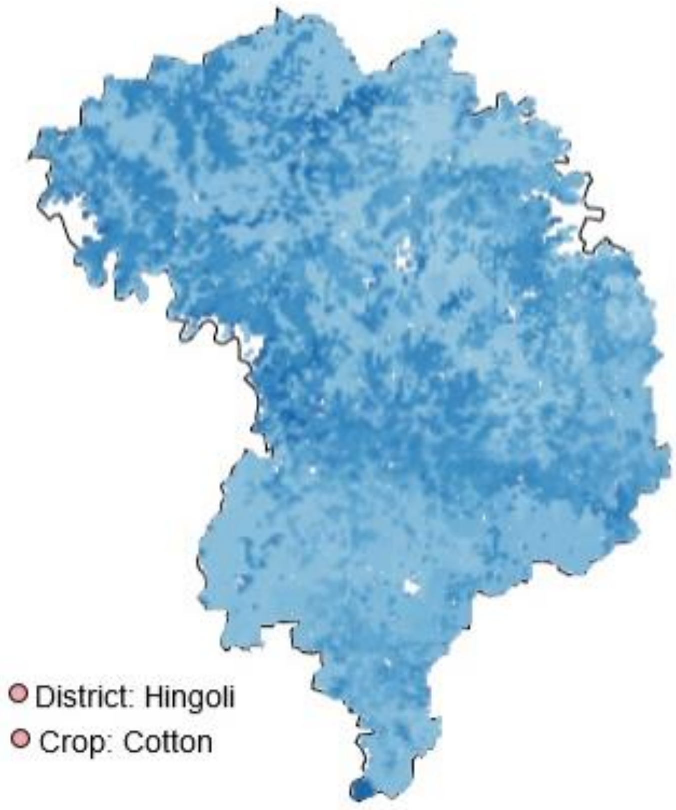
- [x] deficit_as_ratio_cotton_2013_on_day_30_min_ratio_0p8287
- [x] Deficit_as_diff_cotton_2013_on_day_110_max_deficit_193
- [x] Deficit_as_diff_cotton_2013_on_day_75_max_deficit_68
- [x] Deficit_as_diff_cotton_2013_on_day_30_max_deficit_14
- [x] district_legend
- [x] District

AET / PET on day
30

Geo-referenced monitoring illustrated for Hingoli district



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- [x] Deficit_as_diff_cotton_2013_on_day_30_max_deficit_14
- [x] district_legend
- [x] District

AET / PET on day 110

Results

Attribute-**Surface Texture**

Area-Yavatmal

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

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

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

Maximum Value in Row

Maximum Value in Column

Maximum Value in both Row & Column

Way ahead

- Thus, there are significant transfers of w1 + w2 water from p3 farmers to p1 or p2 farmers
- Identifying recharge and discharge areas to estimate the intra-zone flow transfers is important. PoCRA zones if realigned with this logic, can help in estimating these regional natural transfers of water
- These are important factors which need to be considered while planning for the interventions.
- New models required
  - Water balance for impounding structures to determine actual gw rechagred (currently only volume of impounding structure considered which might underestimate the gw recharge)
  - Simple thumbnail conceptual GW flow model for intra-zone flows which can be verified / validated by MODFLOW

3 month