POCRA water budget and planning
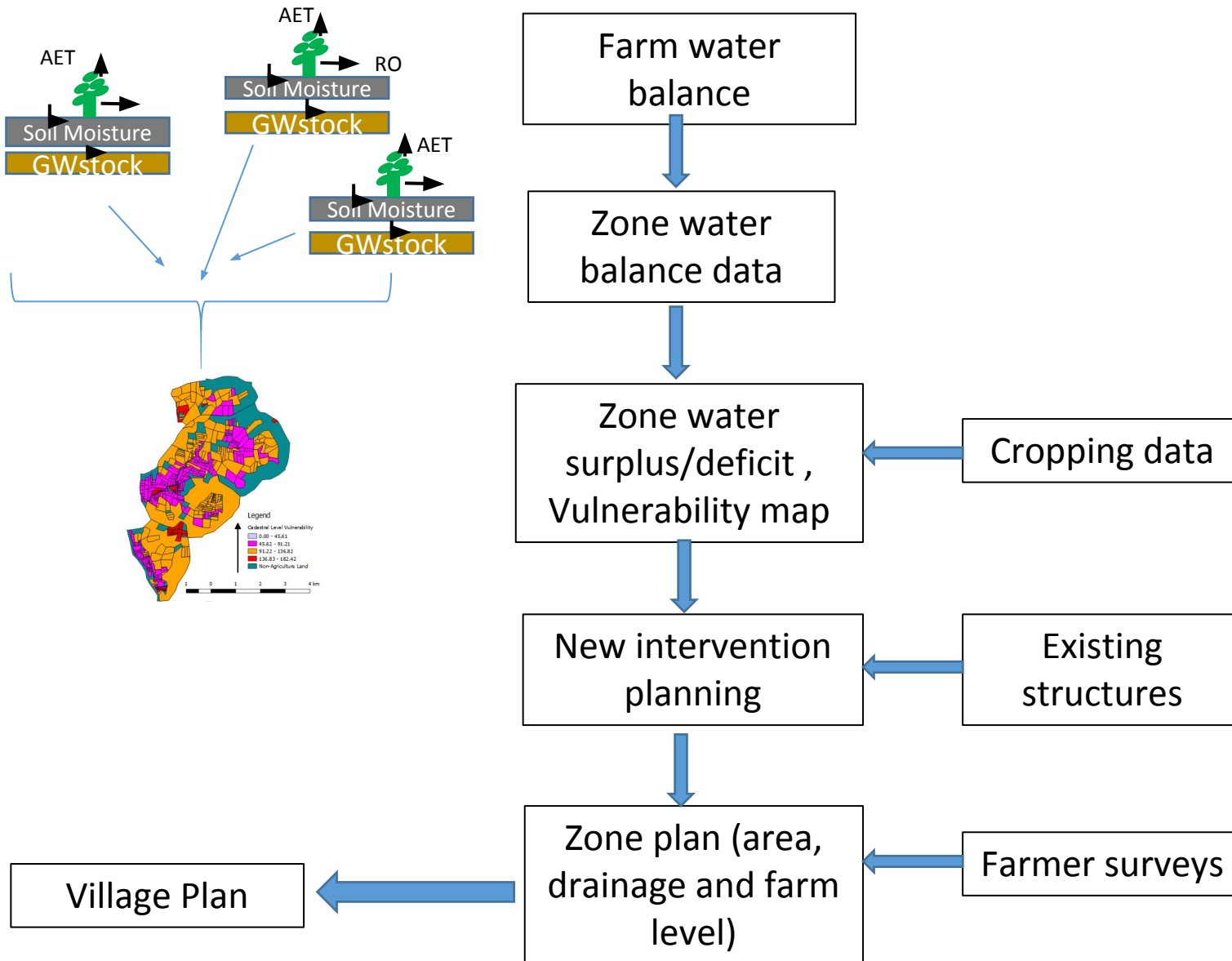
Scope for improvements
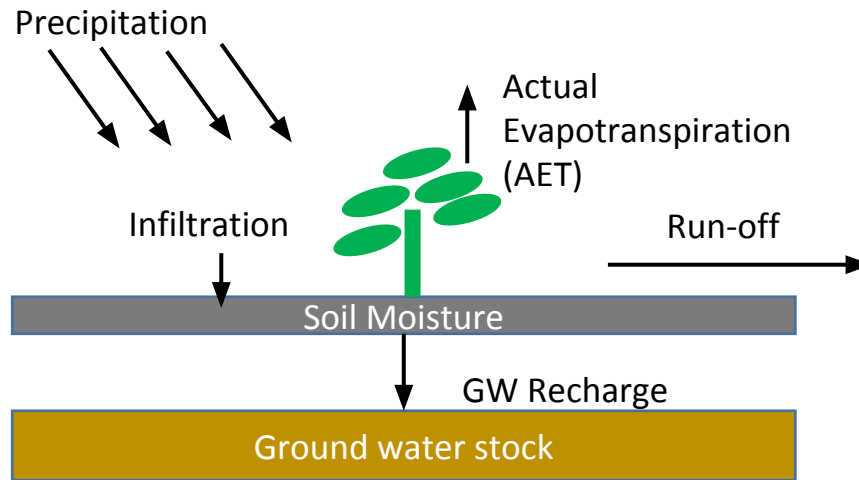
11 May 2018
IITB POCRA Team

Agenda

- Water Balance enabled planning methodology
- Scope for improvements
  - Parameters impacting water balance output
  - Cropping data
  - Link to planning: enabling farm level water access

# Outline of water balance enabled planning

Farm water balance → Zone water balance data → Zone water surplus/deficit, Vulnerability map ← Cropping data → New intervention planning ← Existing structures → Zone plan (area, drainage and farm level) ← Farmer surveys → Village Plan

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Farm level Water balance

Precipitation

Actual Evapotranspiration (AET)

Infiltration

Run-off

Soil Moisture

GW Recharge

Ground water stock

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 function of soil texture input
Soil moisture	Mass balance (based on a two layer cascading soil water model)	

Zones slides here?

Kharif dry spell impact

Gondala 2017 rainfall - 825 mm

Deficit: PET - AET 67 mm

SM at rabi start : 82 mm
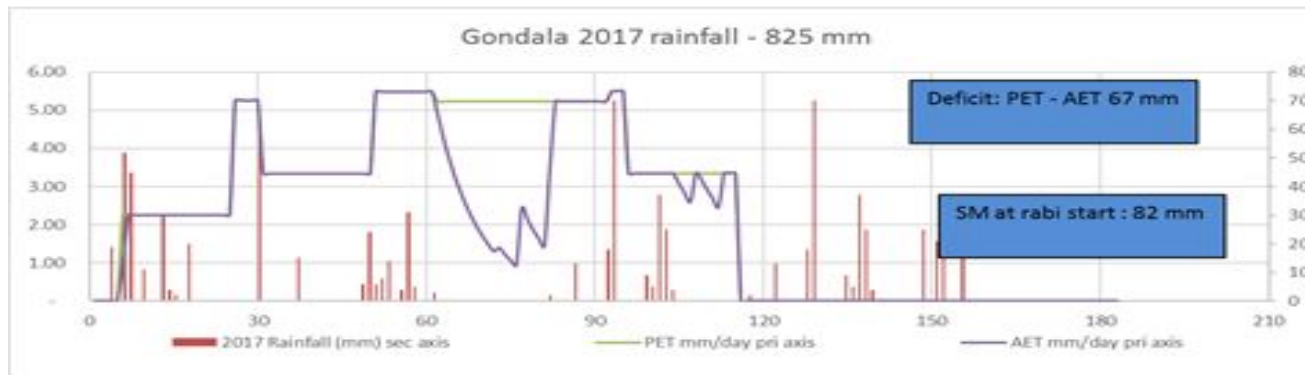
Components (mm)	Year 2017
Rainfall	825.00
Runoff	251.50
Soil Moistur	82.60
GW Rechar	113.83
AET	377.11

Crop: Soyabean

Gondala 2016 Rainfall-837 mm

Deficit: PET - AET 31 mm

SM at rabi start : 82 mm
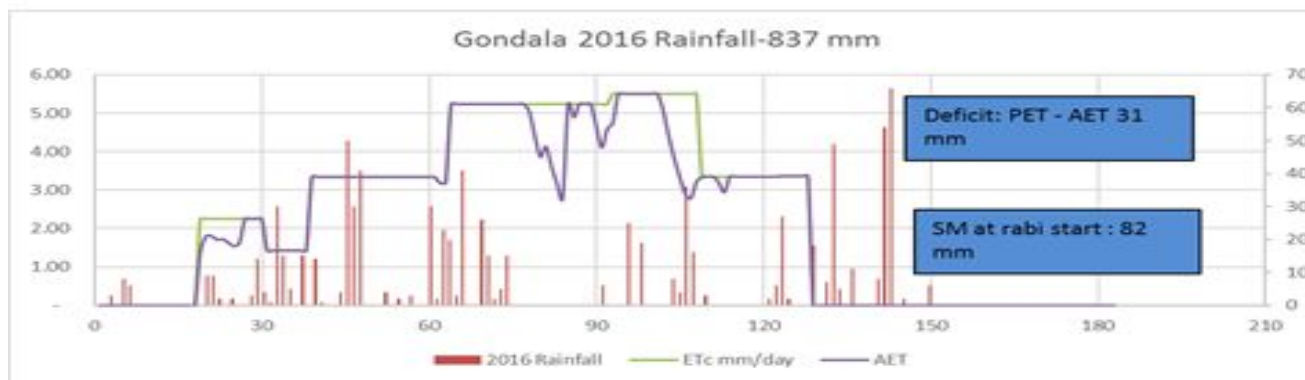
Components (mm)	Year 2016
Rainfall	837.00
Runoff	273.00
Soil Mois tur	82.60
GW Recha	84.40
AET	397.02

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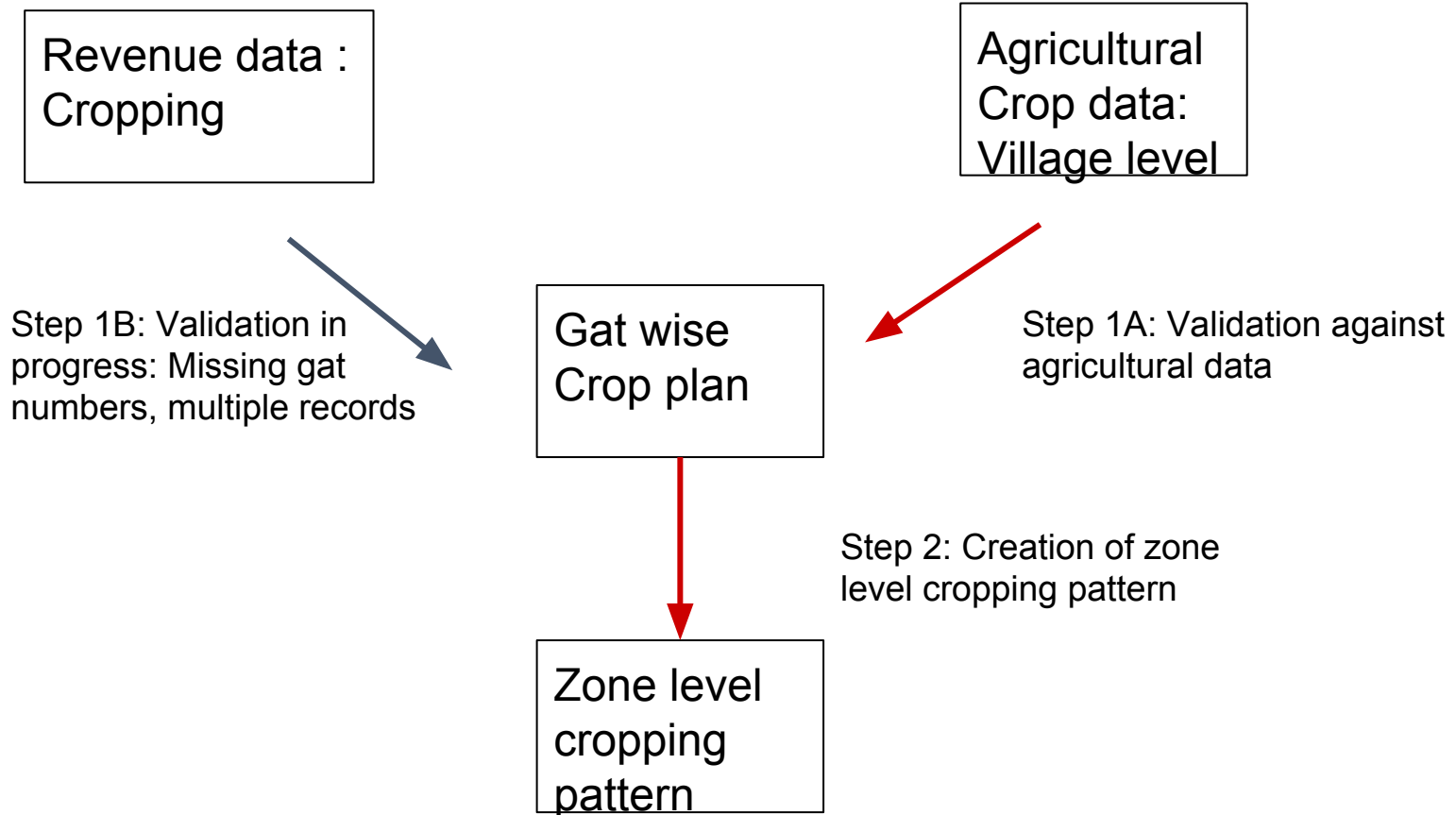
Parameters affecting WB output

- Soil texture mapping to AWC, soil bulk density, conductivity MRSAC soil texture name mapped to values using SPAW (USDA) refinement need for pocra region

- Crop water requirement (PET) refer to *calibration of crop water requirement* doc release
  - Crop Kc (for specific crop variety being used by crop development stage) WALMI and FAO data
  - ET0 (farm location per month) WALMI data for 6 stations by month
  - Non-agricultural LU PET JYS guidelines need for improved data/ guidelines

- Actual Crop ET: crop depletion factor, root depth for the crop variety being used FAO data need for our specific crop varieties

- Curve number, Initial rainfall abstraction SWAT guidelines; need for calibration against field observation

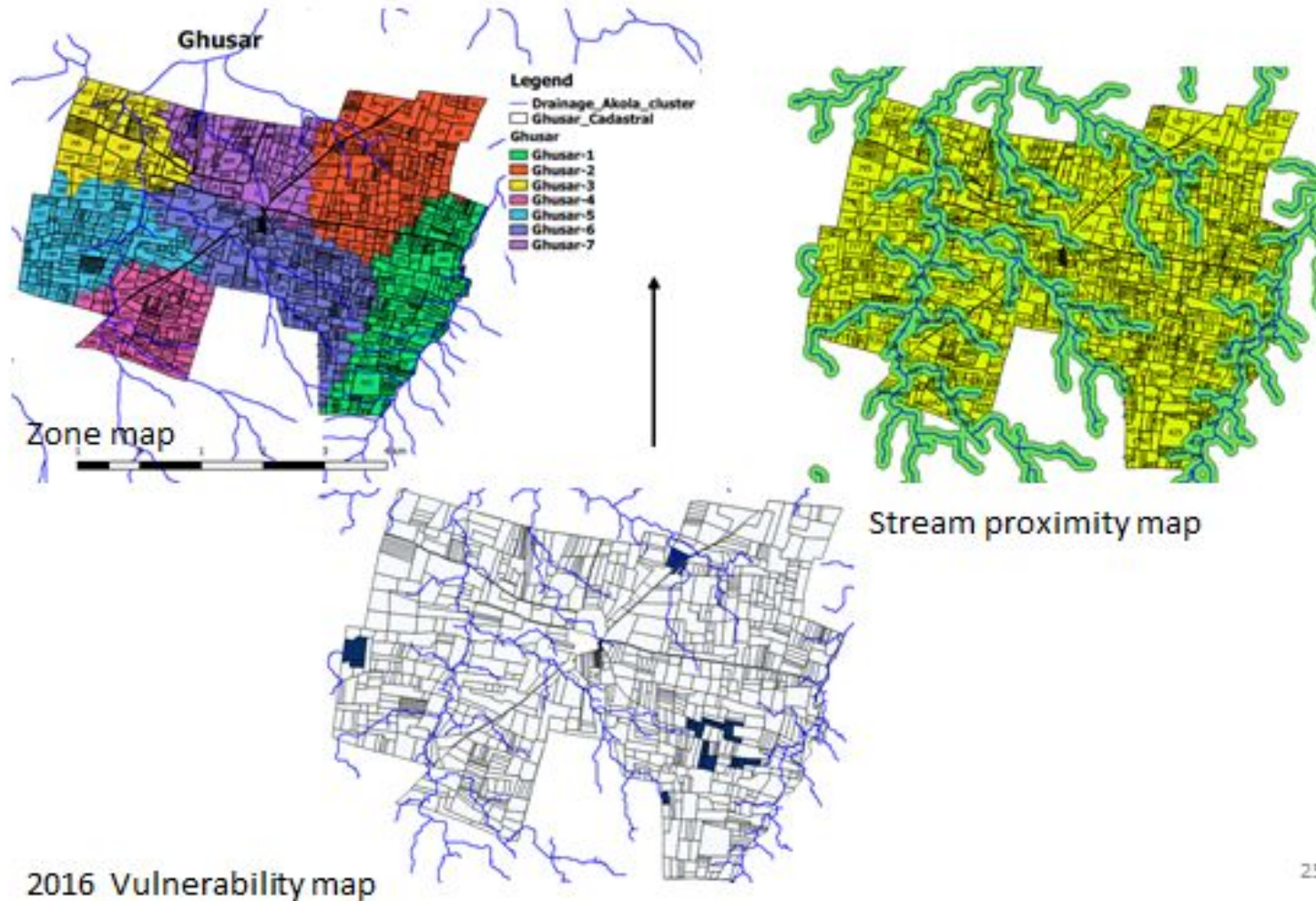- Daily rainfall data Circle level data *need for village level weather stations*

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Zones
Example – Ghusar (saline belt) village inputs
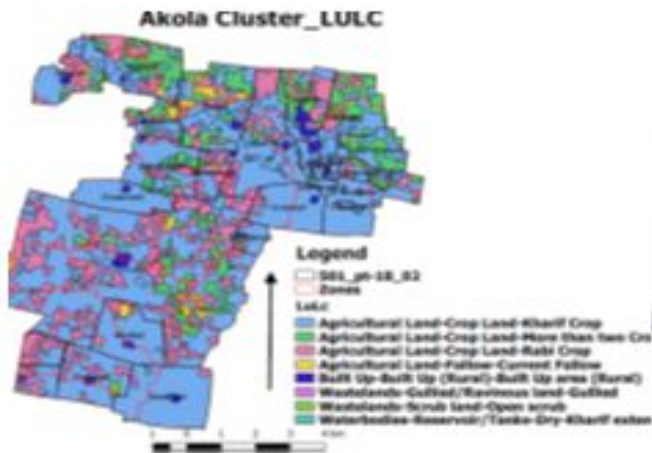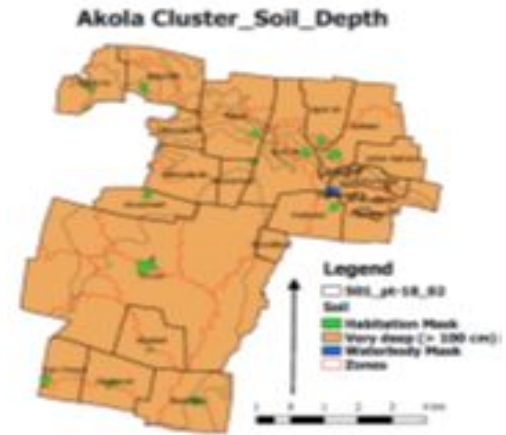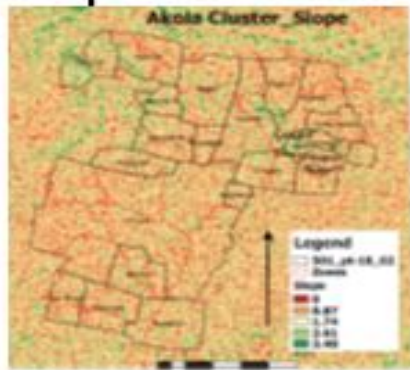
Cropping pattern data reconciliation

Revenue data : Cropping

Agricultural Crop data: Village level

Step 1B: Validation in progress: Missing gat numbers, multiple records

Gat wise Crop plan

Step 1A: Validation against agricultural data

Step 2: Creation of zone level cropping pattern

Zone level cropping pattern

Ghusar: Microplanning kit

Zone map

Stream proximity map

2016 Vulnerability map

Zone xl-sheets picture here

Planning Cycle

Deficit	→	Intervention Plan Crop Plan	→	Access

Plan for Monsoon protective irrigation

Plan for Post Monsoon water requirement

Planning for zonal allocation

Crop Planning for water budget constraints

Budget Check

Targeting Beneficiaries – using vulnerability maps coupled with farm level survey

Targeting Interventions – using stream proximity, vulnerability, soil maps

Targeting Irrigation Facilities – using available maps with farm level survey

Scope for improvement:
1. Fine tune the target by capturing farmers operating point on yield watering curve to get planning fraction for deficit.

Challenges:
1. Accurate zonal cropping pattern data
2. Farm level water source, availability and access data for access planning

Access Issue: Reaching the vulnerable beneficiaries

Vulnerability map

Legend

Cadastral Level Vulnerability
- 0.00 - 45.61
- 45.62 - 91.21
- 91.22 - 136.82
- 136.83 - 182.42
- Non-Agriculture Land

Stream proximity map
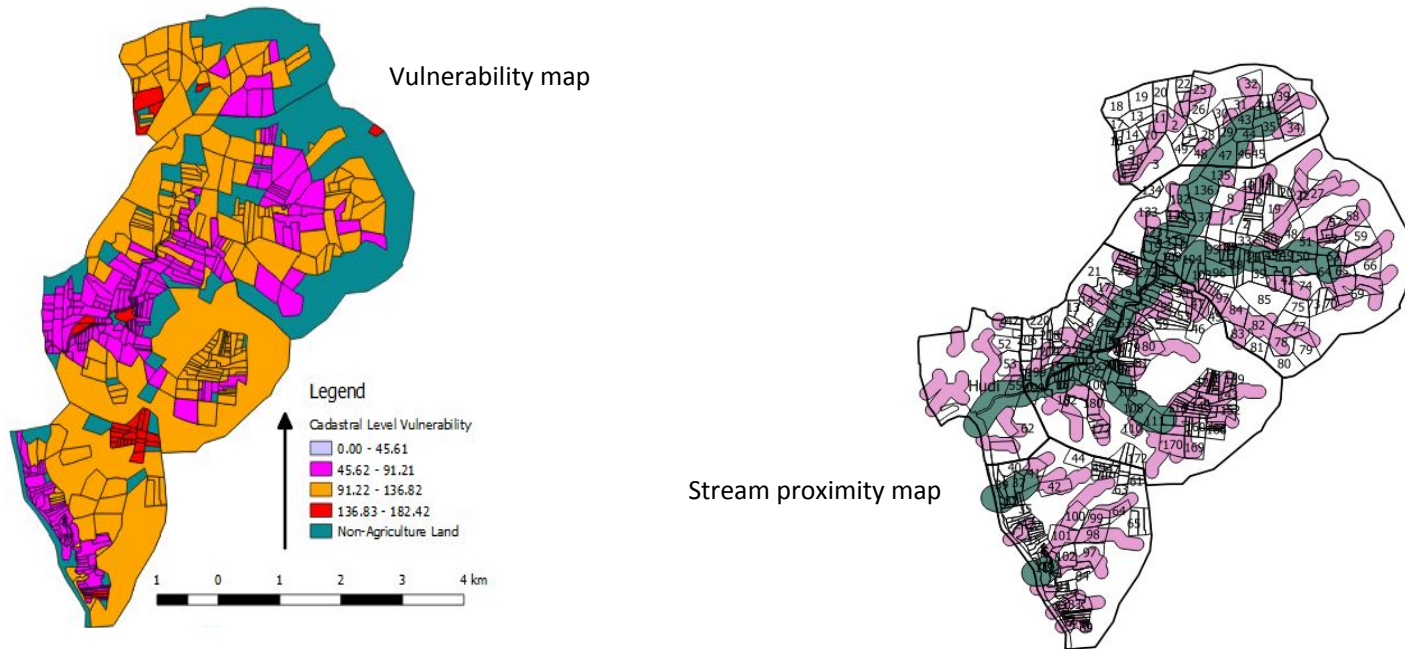
- Coupled with *farm level survey* these maps can be used to target *beneficiaries* and *interventions* in the village
- This can also serve as *farm level metric* for *access to water* and *improvement in yield*

Access Issue: Targeting interventions

Vulnerability map
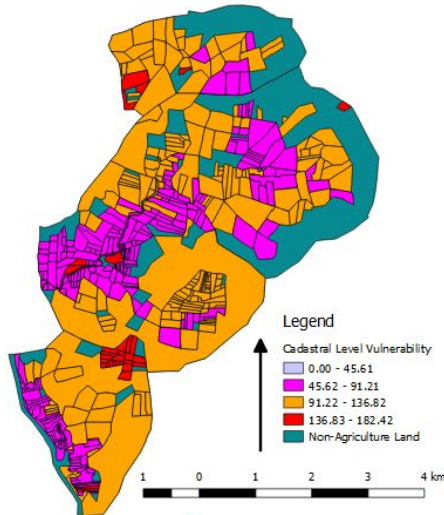
Stream proximity map
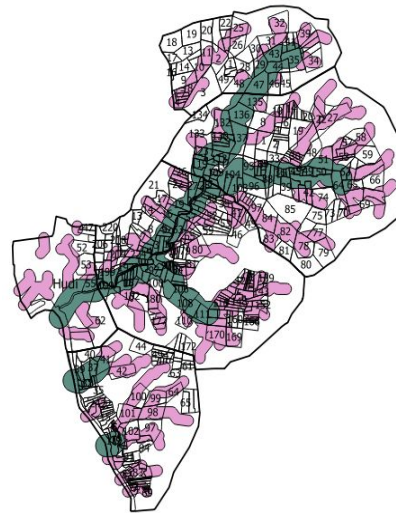
Soil map
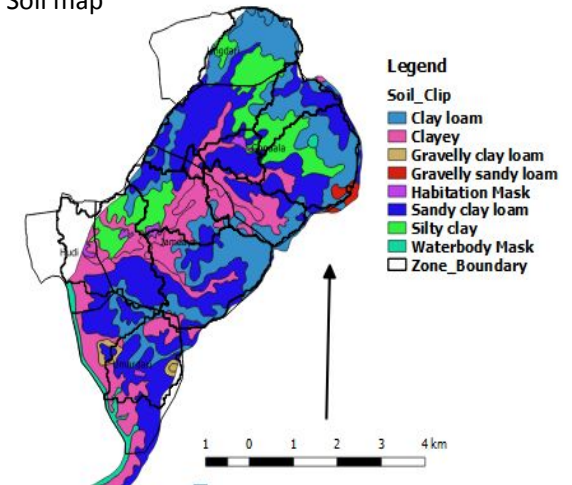
- *Soil type and depth* is an important factor for natural vulnerability of farm (eg - it can be seen that vulnerability is lowest in deep clayey soil)
- Transferring silt to reduce vulnerability can also be an option
- *Stream proximity* can be utilized to plan for stream based interventions – inlet outlet based farm ponds, wells
- Sizing private / community ponds based on water budget runoff as per soil parameters

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Backup: rainfall interpolation analysis

Impact of interpolation on water balance: Example

- Rainfall Circle 1: Narvel, Buldhana
- Rainfall Circle 2: Dharangaon, Buldhana
- Distance – 6 km
- Narvel Rainfall 2017: 638 mm
- Dharangaon Rainfall 2017: 716 mm

Water Balance comparison with interpolated daily rainfall

Circle	Narvel	Dharangaon	Average
rainfall (input)	638	716	677
Runoff	149	198	159
Infiltration	489	517	518
SM	55	55	55
GW recharge	142	175	161
AET	292	287	302
PET (input)	412	411	412
Deficit	120	124	110

Monsoon Deficit
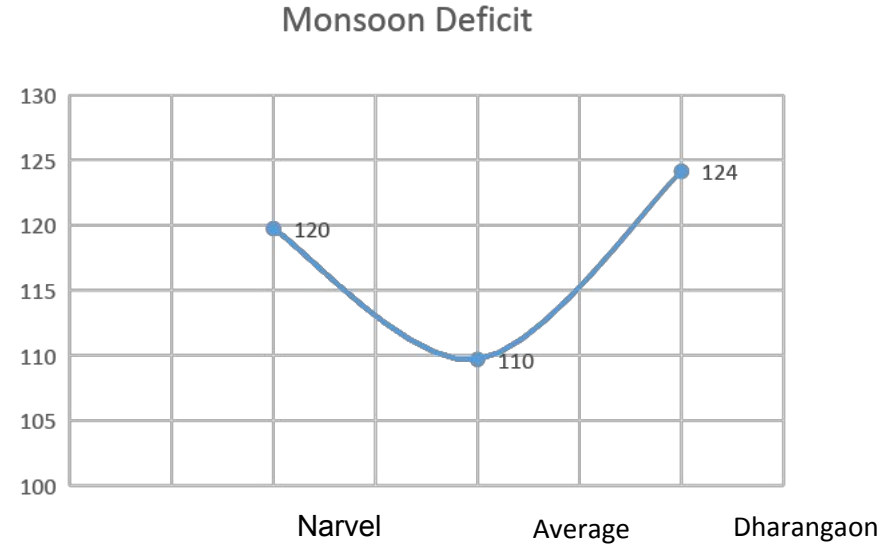
- Interpolation reduces the variance and hence underestimates dry spells and their impact
- Need for village level weather stations for climate resilience

Analysis of Croppin 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
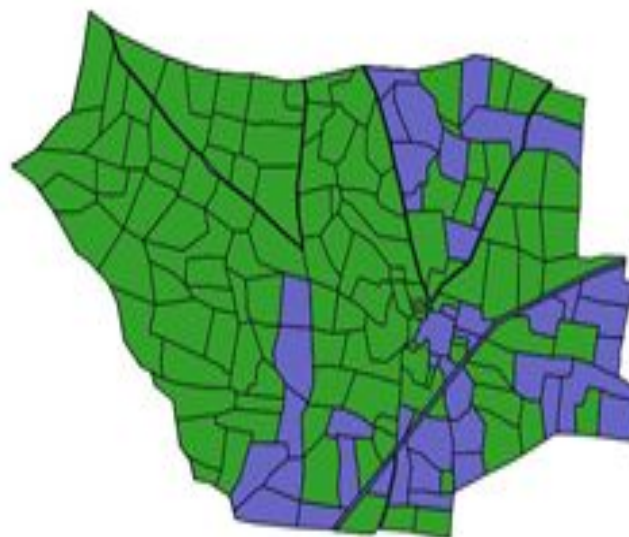
Cropping data analysis for Wai, Washim
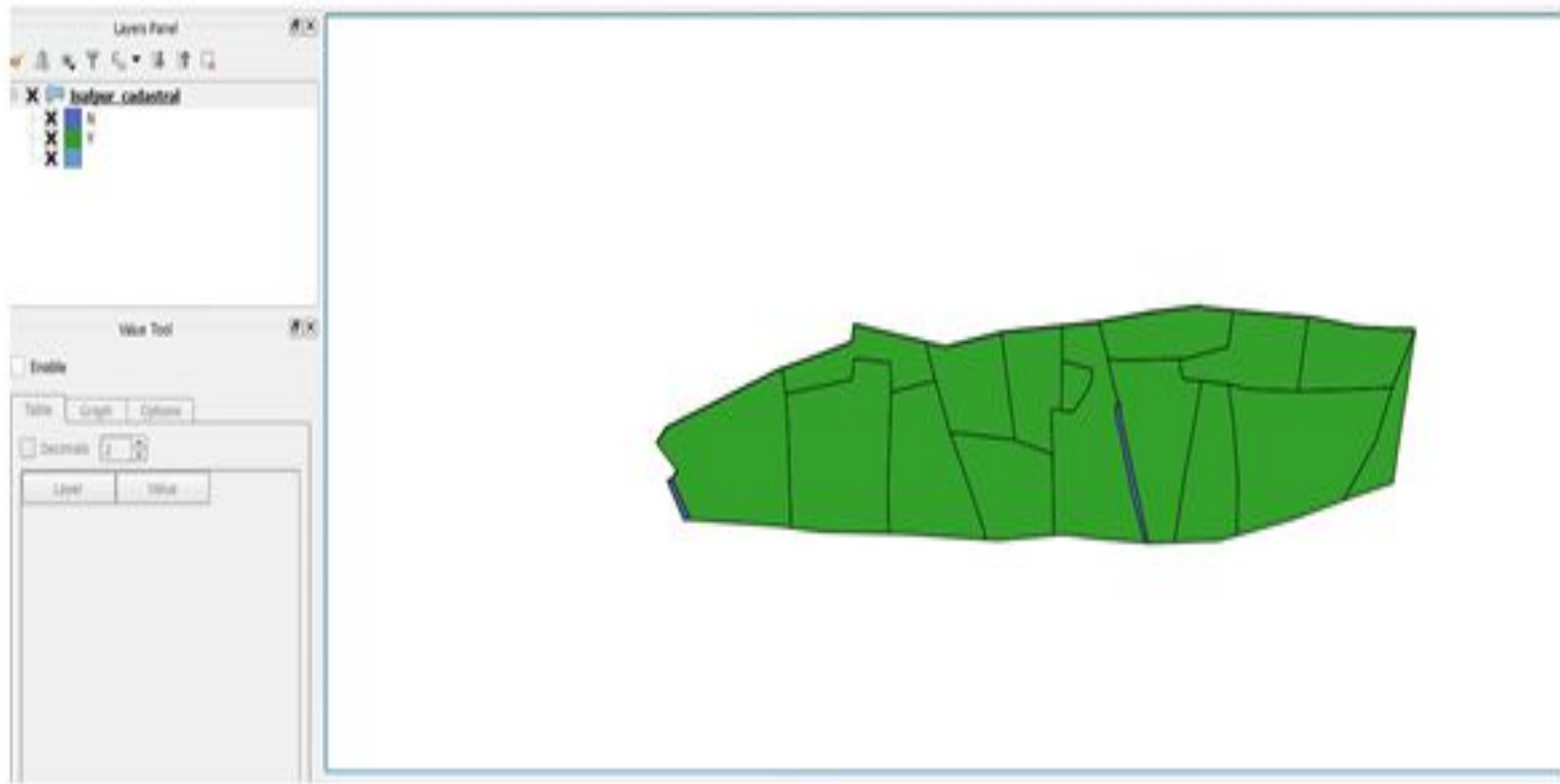
Cropping data analysis for Isafpur, Washim
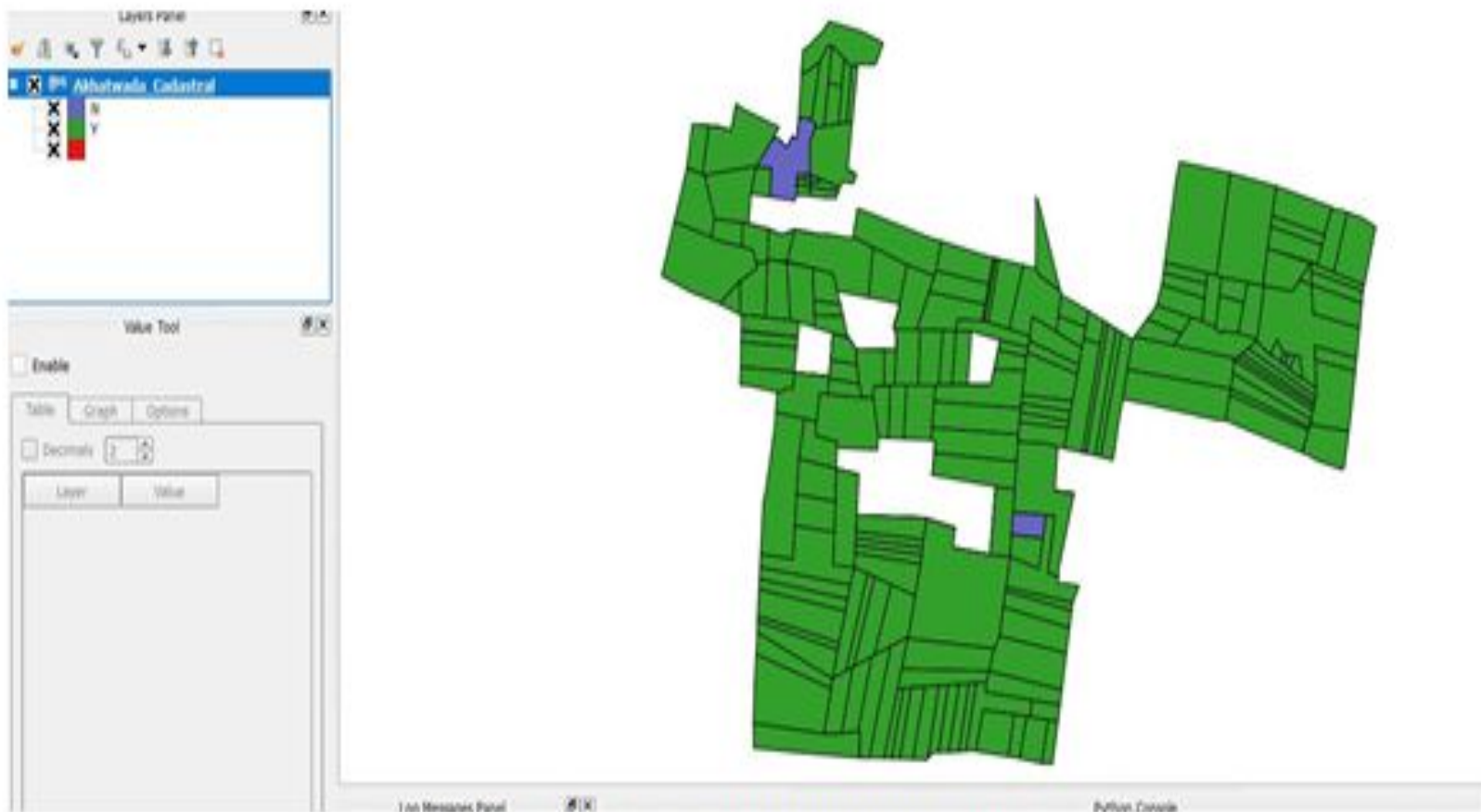
Cropping data analysis for Akhatwada, Akola

Cropping data analysis for Marodi, Akola

Ghusar Post monsoon computation (good year and bad year)

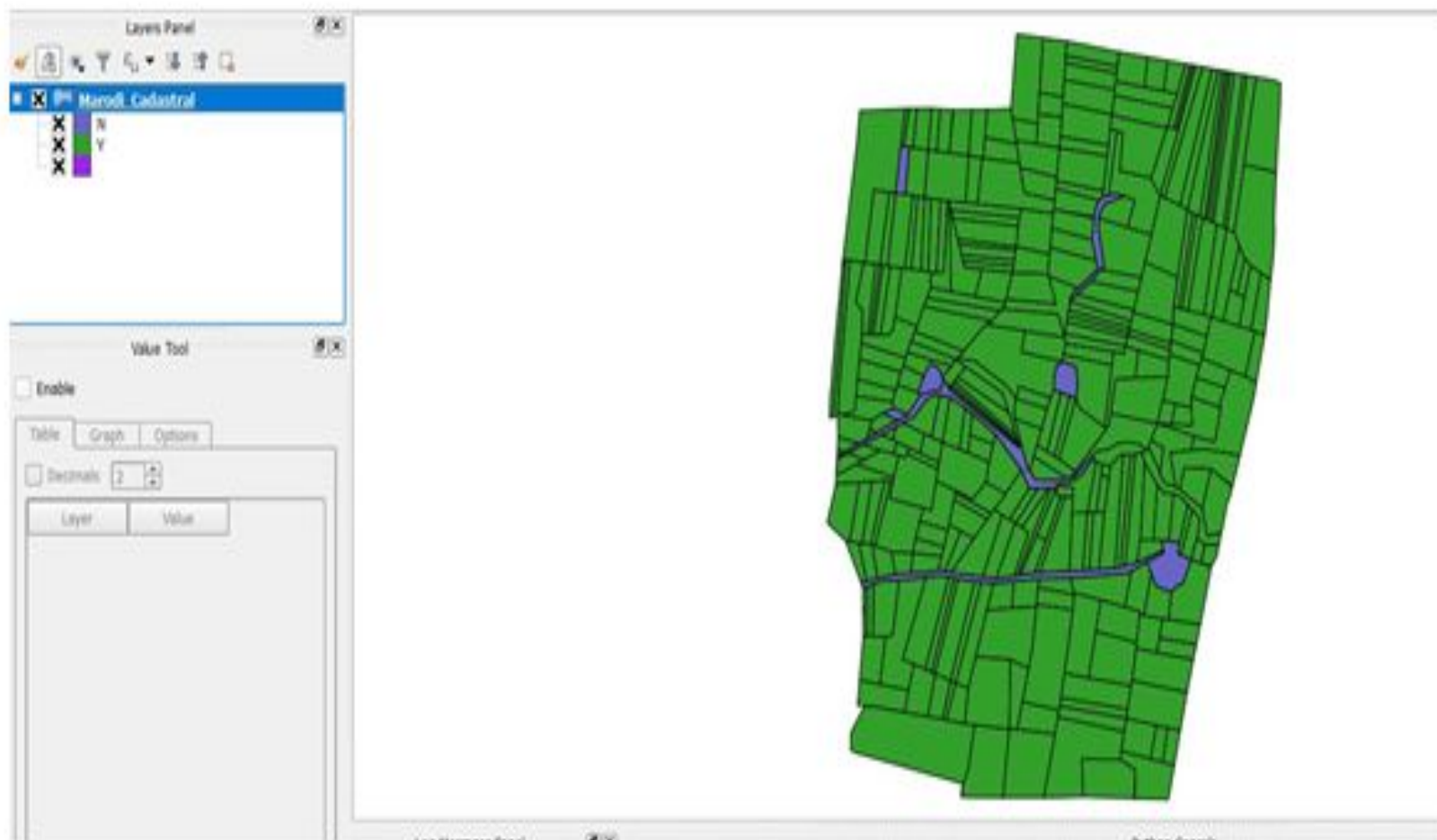| 2017: Rainfall 550mm	PET Monsoon End	AET Monsoon End	Monsoon Deficit(PET-AET)	GW Recharge in Monsoon	Runoff in Monsoon	Soil Moisture Monsoon end	Post Monsoon PET
Cotton	401.09	381.15	19.95	-	76.93	76.92	389.13
Moong	261.37	228.09	33.28	-	116.66	190.25	-
Tur	376.04	359.13	16.91	-	90.45	85.42	242.37
Soyabean	434.56	377.16	57.39	-	69.08	88.76	-
Harbhara	-	-	-	-	-	-	250.00
2016: Rainfall 920mm	PET Monsoon End	AET Monsoon End	Monsoon Deficit(PET-AET)	GW Recharge in Monsoon	Runoff in Monsoon	Soil Moisture Monsoon end	Post Monsoon PET
Cotton	342.51	337.27	5.24	-	410.14	113.60	424.43
Udid	232.12	228.80	3.32	4.68	426.45	201.06	-
Tur	314.97	295.34	19.63	-	437.19	126.45	288.90
Soyabean	403.78	346.98	56.80	-	402.37	111.65	18.62

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Ghusar field inputs: cropping pattern and current structures

Crop	Ghusar 1	Ghusar 2	Ghusar 3	Ghusar 4	Ghusar 5	Ghusar 6	Ghusar 7	Total village
Soybean	20	21.29	0	0	0	15.6	10.11	67
Jowar	14	6	8	7	4	20	13	72
Cotton	314.92	375	70	67.89	149	348.95	257	1582.76
Moong	52	90	182	177	220	70	26	817
Udid	5	4	5	5	7	12	6	44
Tur	55	65	35	30	27	60	20	292
Total	460.92	561.29	300	286.89	407	526.55	332.11	2874.76
Ag Area	461.92	561.29	300	297.41	407.73	526.55	332.11	2887.01
Non Ag	0.27	0	0	0	0	0	0	
Farm ponds	33	30	34	19	21	36	39	212

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