IITB Water Team Review

Phase II Delivery
Post Phase II Work

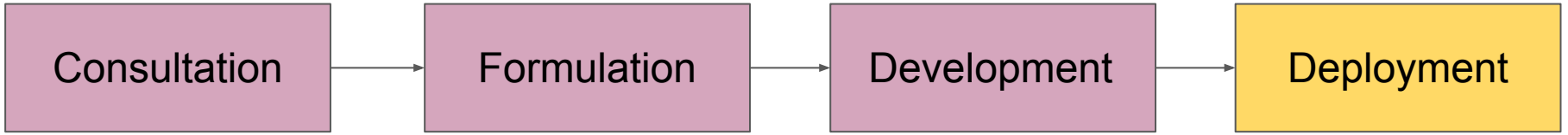
1st February, 2022

Outline

- Well DBT Module
  - Objectives and workflow
  - Deployment strategy and data issues
- Report on Model Validation: Fieldwork
  - Methodology
  - Work done
- Work progress (Post Phase II)
  - Componentwise update on work done

Well DBT Module

Delivery cycle and timelines



Item	Status
Well DBT module - code	Submitted on 29 Nov 2021 (GitLab link shared with PMU) Minor changes related to deployment ongoing
Note on Well DBT module	Submitted on 29 Nov 2021 (Minor changes and corrections ongoing)
Well DBT module - deployment	Hand-holding and assisting PMU IT team (status on next slide)

Deployment strategy and current status

(1) Run the QGIS plugin to compute cadastral deficit for Hingoli.

(2) Validate the output by manual inspection and loading it in QGIS.

(3) Generate well DBT prioritization reports for each village using the plugin output.

(4) Address schema differences between PoCRA dashboard schema and the schema currently in use by the prioritization code.

(5) Create a copy of PoCRA dashboard schema on the PostgreSQL server on our linux workstation.

(6) Load subset for data for Hingoli from PoCRA dashboard into the schema from previous step.

(7) Load DBT and safe villages data into the new schema.

(8) Run the waterbalance plugin against the PoCRA dashboard replica running on our linux workstation.

(9) Generate well DBT prioritization reports from the plugin output and compare them with those generated in step (4).

Link for Hingoli reports: https://drive.google.com/drive/folders/1ISVfKbSq1Knt60ITv2lrPjsrxtsQDx0X?usp=sharing

Well DBT module - objectives

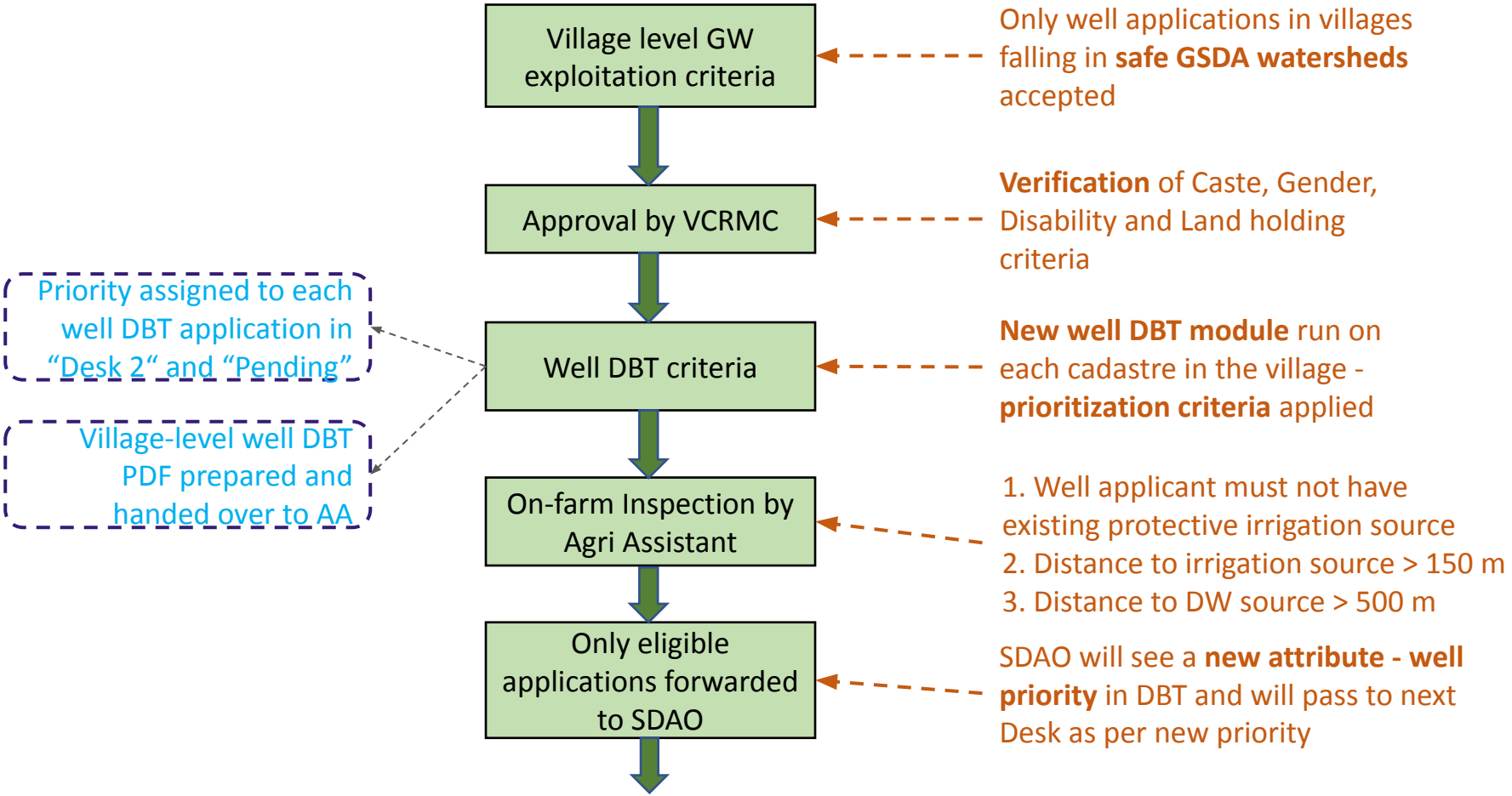
1. To outline a **conceptual framework** for the prioritization of the well applications within a village and to introduce the concept of **on-farm vulnerability** as the core basis for prioritizing the well applications.

2. To design the **prioritization criteria** based on the above concept and to formulate the core functionality to translate the prioritization criteria into concrete and quantifiable indicators using the IITB water budget model at cadastre-level.

3. To incorporate the proposed indicators into the **existing framework** by integrating with the existing prioritization criteria as per well DBT guidelines.

4. To design the architecture and develop the **GIS-based well DBT prioritization module** using Python, Postgres and QGIS plugin and to create a **well-tested prototype** which can be deployed on the PoCRA server by the PMU IT team.

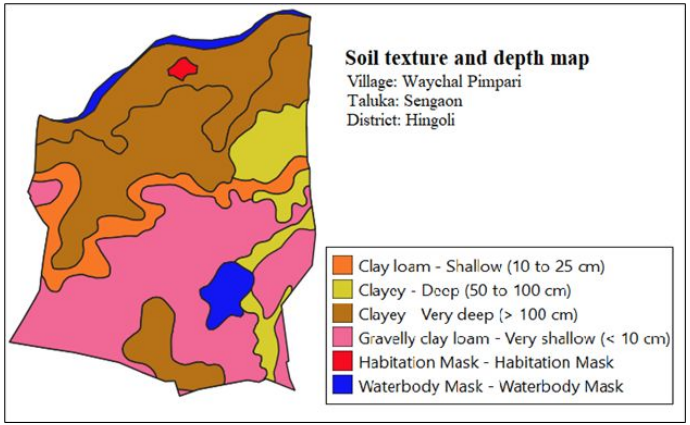
Well DBT module - workflow

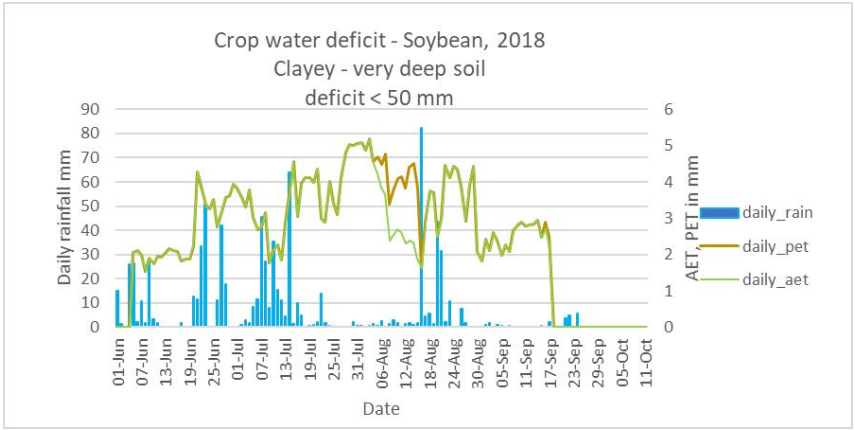


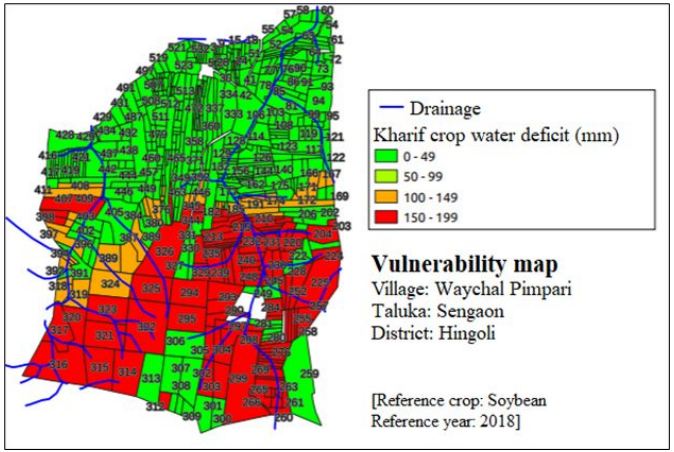
Well DBT module - prioritization criteria

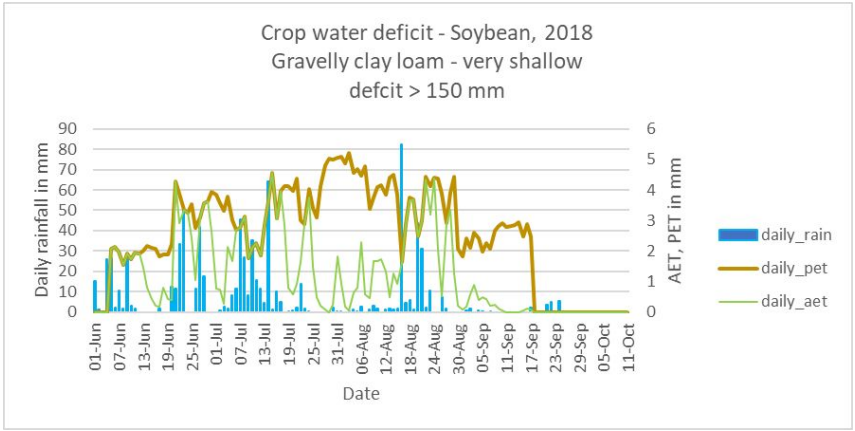
Criteria	**Proxies used**	**Method for quantification**	**Data sources used**
Biophysical vulnerability – kharif season	Kharif crop water deficit in mm	IITB water budget model run for each cadastre in the village	SKymet weather data, MRSAC soil maps
Biophysical vulnerability – ability to take rabi crop	Land use category	LULC class = Only kharif given the highest priority	MRSAC land use map
Social vulnerability	Caste, Gender	Priority given to Caste (ST, SC) , Gender (F, M)	As entered in the DBT application
Socio-economic vulnerability	Land holding	Lower the land-holding, higher the priority	As entered in the DBT application

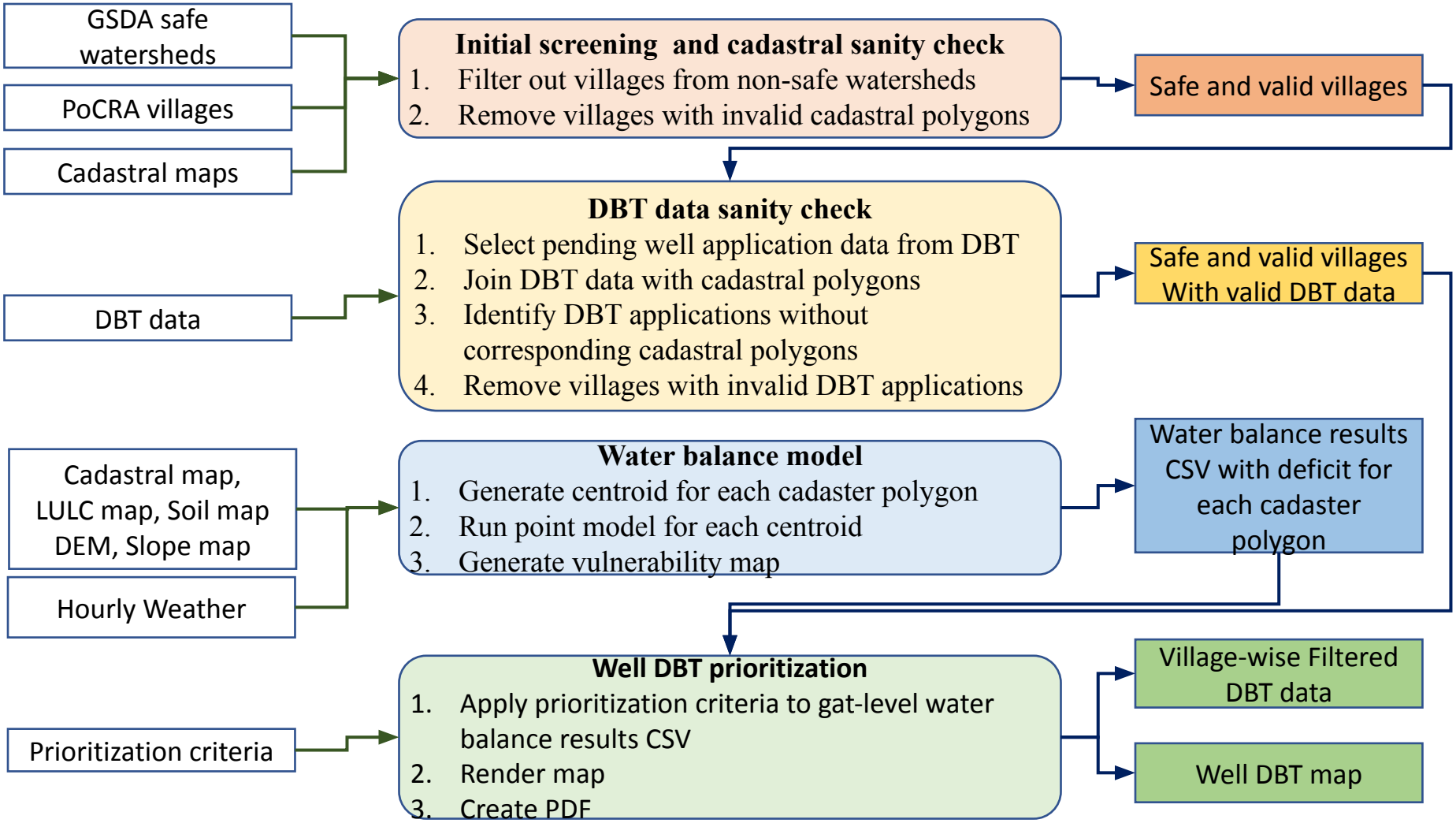
Biophysical on-farm vulnerability - quantification





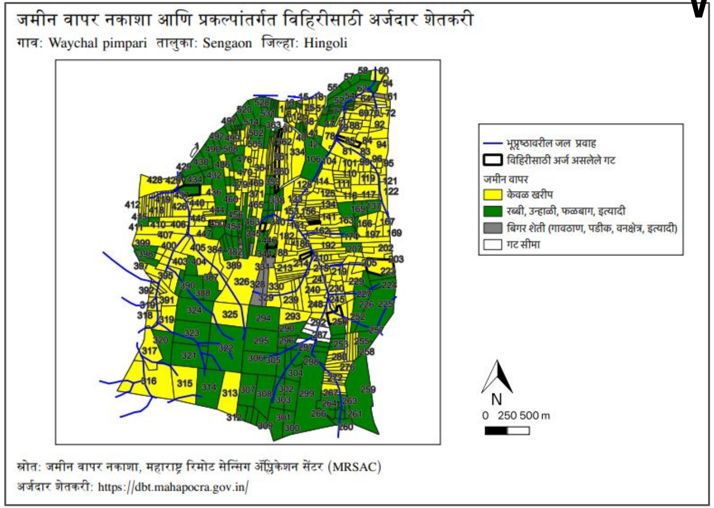




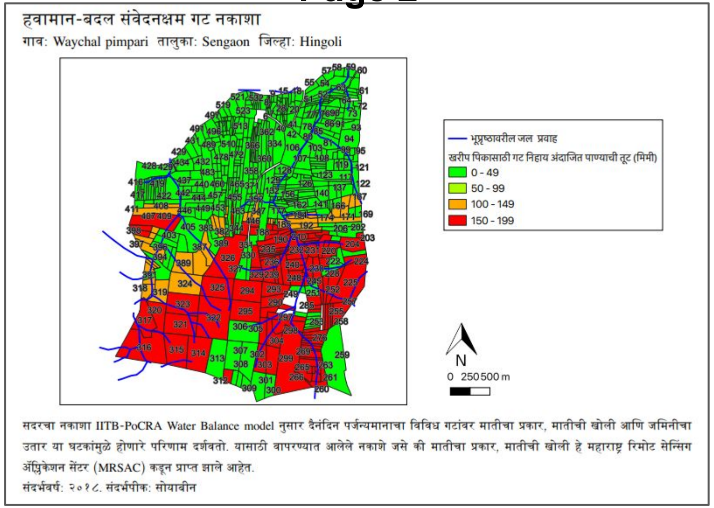

GSDA safe watersheds
PoCRA villages
Cadastral maps
Initial screening and cadastral sanity check
1. Filter out villages from non-safe watersheds
2. Remove villages with invalid cadastral polygons
Safe and valid villages
DBT data sanity check
1. Select pending well application data from DBT
2. Join DBT data with cadastral polygons
3. Identify DBT applications without corresponding cadastral polygons
4. Remove villages with invalid DBT applications
DBT data
Safe and valid villages With valid DBT data
Cadastral map, LULC map, Soil map DEM, Slope map
Hourly Weather
Water balance model
1. Generate centroid for each cadaster polygon
2. Run point model for each centroid
3. Generate vulnerability map
Water balance results CSV with deficit for each cadaster polygon
Well DBT prioritization
1. Apply prioritization criteria to gat-level water balance results CSV
2. Render map
3. Create PDF
Prioritization criteria
Village-wise Filtered DBT data
Well DBT map

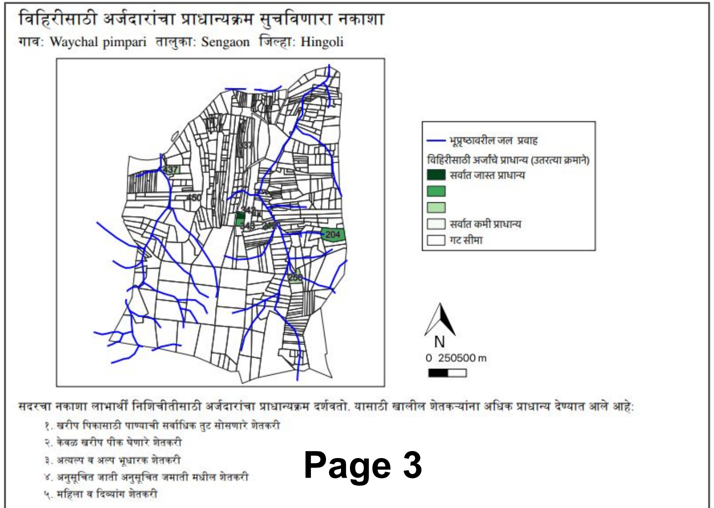
Well DBT report for each Village

Page 1



Page 2





Page 3

Sample report
Waychal Pimpari
(Hingoli)

गाव: Waychal pimpari तालुका: Sengaon जिल्हा: Hingoli

अर्जदार शेतकऱ्यांमधून विहिरीसाठी लाभार्थी निवडताना खालील प्राधान्यक्रम विचारात घेतला जावा. अंतिम लाभार्थी निश्चित करण्यापूर्वी प्रस्तुत प्राधान्यक्रमानुसार शेतकऱ्याशी संपर्क साधून आणि गटाला प्रत्यक्ष भेट देऊन सर्व बाबींची पडताळणी करण्यात यावी. जमिनीवरील वस्तुस्थिती आणि शेवटच्या पानावरील सूचना, तसेच प्रकल्प व्यवस्थापन कक्षाकडून वेळोवेळी प्रसारित झालेल्या मार्गदर्शक सूचना लक्षात घेऊन अंतिम लाभार्थी शेतकऱ्यांची यादी निश्चित करण्यात यावी.

प्राधान्य क्रम	नोंदणी क्रमांक	अर्जदार	गट नंबर
1	5457860072	सुजानाबाई रमेश वाबळे	212
2	5457860113	दत्ता नत्थुजी वाबळे	342
3	5457860105	परशुराम बळीराम वायचाळ	204
4	5457860013	विनोद बळीराम वाबळे	343
5	5457860071	गोवर्धन गजानन गिरी	250
6	5457860035	उत्तमराव प्रल्हाद वायचाळ	437
7	5457860061	शिवाजी तुळशीराम वायचळ	450
8	5457860038	गजानन दाजीबा कोन्धे	337
9	5457860029	गंगाराम मोहनजी इंगळे	82

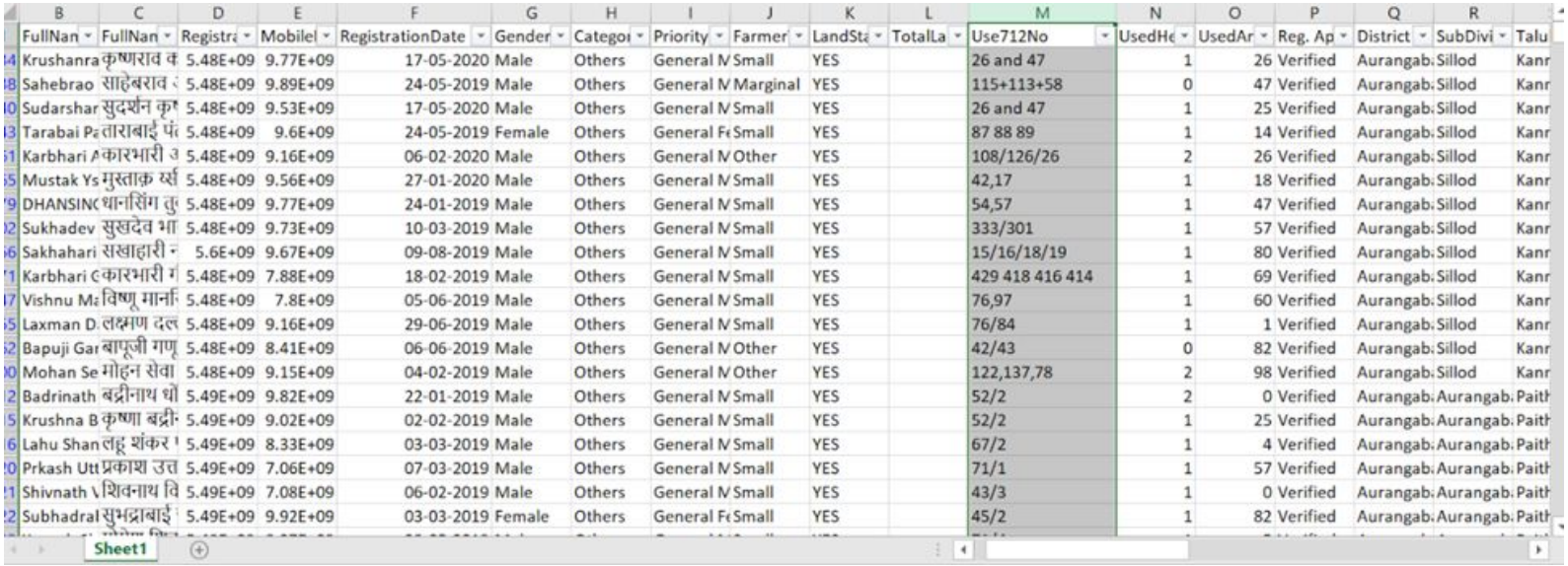
लाभार्थी निश्चितीसाठी मार्गदर्शक सूचना

* संरक्षित सिंचनाची सोय नसणाऱ्या सर्व अर्जदार शेतकऱ्यांना लाभ देय झाल्यानंतरच सिंचनाची सोय असणाऱ्या अर्जदारांचा लाभासाठी विचार करण्यात यावा.
* प्रास्तवित नवीन विहीर व पिण्याच्या पाण्याचा सार्वजनिक स्रोत यातील अंतर ५०० मीटर पेक्षा कमी असल्यास लाभ देय नाही.
* प्रास्तवित नवीन विहीर व अस्तित्वात असणाऱ्या पिण्याच्या पाण्याचा स्रोत व्यतिरिक्त इतर विहिरींचे अंतर १५० मीटर पेक्षा कमी असल्यास लाभ देय नाही.

Page 4 and onwards

Well DBT module - key data issues

- Tiny cadastres
- Duplicate Gat no. within same village
- Multiple villages with same village census code
- Incorrect Gat no. values in DBT applications



	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	
	FullNan	FullNan	Registra	Mobilel	RegistrationDate	Gender	Categor	Priority	Farmer	LandSta	TotalLa	Use712No	UsedHe	UsedAr	Reg. Ap	District	SubDivi	Talu
4	Krushanra	कृष्णराव क	5.48E+09	9.77E+09	17-05-2020	Male	Others	General N	Small	YES		26 and 47	1	26	Verified	Aurangab	Sillod	Kanr
8	Sahebrao	साहेबराव	5.48E+09	9.89E+09	24-05-2019	Male	Others	General N	Marginal	YES		115+113+58	0	47	Verified	Aurangab	Sillod	Kanr
0	Sudarshar	सुदर्शन कृ	5.48E+09	9.53E+09	17-05-2020	Male	Others	General N	Small	YES		26 and 47	1	25	Verified	Aurangab	Sillod	Kanr
3	Tarabai Pa	ताराबाई पं	5.48E+09	9.6E+09	24-05-2019	Female	Others	General Fe	Small	YES		87 88 89	1	14	Verified	Aurangab	Sillod	Kanr
1	Karbhari A	कारभारी उ	5.48E+09	9.16E+09	06-02-2020	Male	Others	General N	Other	YES		108/126/26	2	26	Verified	Aurangab	Sillod	Kanr
5	Mustak Ys	मुस्ताक यस	5.48E+09	9.56E+09	27-01-2020	Male	Others	General N	Small	YES		42,17	1	18	Verified	Aurangab	Sillod	Kanr
9	DHANSIN	धानसिंग तु	5.48E+09	9.77E+09	24-01-2019	Male	Others	General N	Small	YES		54,57	1	47	Verified	Aurangab	Sillod	Kanr
2	Sukhadev	सुखदेव भा	5.48E+09	9.73E+09	10-03-2019	Male	Others	General N	Small	YES		333/301	1	57	Verified	Aurangab	Sillod	Kanr
6	Sakhahari	सखाहारी न	5.6E+09	9.67E+09	09-08-2019	Male	Others	General N	Small	YES		15/16/18/19	1	80	Verified	Aurangab	Sillod	Kanr
1	Karbhari G	कारभारी म	5.48E+09	7.88E+09	18-02-2019	Male	Others	General N	Small	YES		429 418 416 414	1	69	Verified	Aurangab	Sillod	Kanr
7	Vishnu Ma	विष्णू मानि	5.48E+09	7.8E+09	05-06-2019	Male	Others	General N	Small	YES		76,97	1	60	Verified	Aurangab	Sillod	Kanr
5	Laxman D	लक्ष्मण दल	5.48E+09	9.16E+09	29-06-2019	Male	Others	General N	Small	YES		76/84	1	1	Verified	Aurangab	Sillod	Kanr
2	Bapuji Gar	बापूजी गणू	5.48E+09	8.41E+09	06-06-2019	Male	Others	General N	Other	YES		42/43	0	82	Verified	Aurangab	Sillod	Kanr
0	Mohan Se	मोहन सेवा	5.48E+09	9.15E+09	04-02-2019	Male	Others	General N	Other	YES		122,137,78	2	98	Verified	Aurangab	Sillod	Kanr
2	Badrinath	बद्रीनाथ धो	5.49E+09	9.82E+09	22-01-2019	Male	Others	General N	Small	YES		52/2	2	0	Verified	Aurangab	Aurangab	Paith
5	Krushna B	कृष्णा बद्री	5.49E+09	9.02E+09	02-02-2019	Male	Others	General N	Small	YES		52/2	1	25	Verified	Aurangab	Aurangab	Paith
6	Lahu Shan	लहू शंकर	5.49E+09	8.33E+09	03-03-2019	Male	Others	General N	Small	YES		67/2	1	4	Verified	Aurangab	Aurangab	Paith
0	Prkash Utt	प्रकाश उत्त	5.49E+09	7.06E+09	07-03-2019	Male	Others	General N	Small	YES		71/1	1	57	Verified	Aurangab	Aurangab	Paith
1	Shivnath \	शिवनाथ वि	5.49E+09	7.08E+09	06-02-2019	Male	Others	General N	Small	YES		43/3	1	0	Verified	Aurangab	Aurangab	Paith
2	Subhadral	सुभद्राबाई	5.49E+09	9.92E+09	03-03-2019	Female	Others	General Fe	Small	YES		45/2	1	82	Verified	Aurangab	Aurangab	Paith

Sheet1

Conclusion

- Well DBT module provides a robust design and framework for **identifying and targeting the beneficiaries** at the village level
- This module can be **enhanced further** to incorporate other key attributes at the farm and village level such as stream proximity, seasonal groundwater availability, yields etc. in order to make targeting more sharper.
- With the **IT stack** and the DBT portal, such tools may also be **applied to other benefits** in PoCRA and even to other watershed programs in the future.

Report on Model Validation: Fieldwork (Phase II)

Background

- Deliverables for Model Validation Component - 3 Reports
  - Interim Report - At the end of Phase II
  - Interim Report - At the end of Phase III
  - Final Report - At the end of Phase VI
- Interim Report - Report on Model Validation: Fieldwork
  - Methodology, installation set-up, fieldwork conducted during monsoon
- Interim Report - Report on Model Validation: Kharif
  - Results from Kharif season, fieldwork conducted post monsoon season
- Final Report - Report on Model Validation: Rabi and Overall Closure
  - Results of the study during Rabi season and overall closure of the exercise

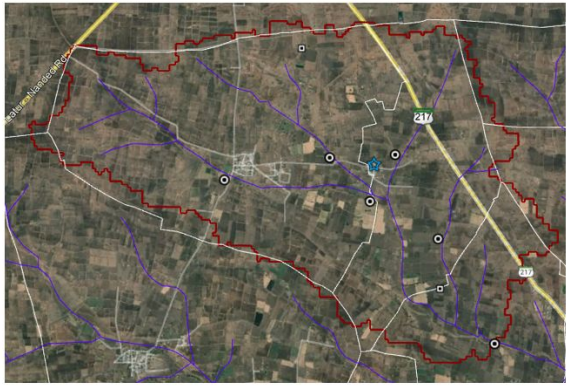
Overall Methodology

Model Component	Scale	Method to be used	On-field activities
Surface Runoff	Farm	V notch with water level sensors	Total 7 farms to be monitored
	Regional / Catchment	Water level sensors on CNB	Sensors installed at 21 locations (including catchments and their sub-catchments)
Soil Moisture	Point / Farm	Soil moisture sensors	Total 5 farms to be monitored (2 locations per farm)
Groundwater recharge	Regional / Catchment	Monitoring of well water levels and estimation of groundwater extraction based on farmers interviews and measurements	About 15 wells in the catchment to be monitored during kharif and rabi seasons
AET (Indirect)	Point / Farm	Structured interviews with farmers	About 15 farmers in the catchment to be surveyed in kharif and rabi seasons

Work Done

- Selection of clusters → Selection of catchments → Selection of sites
- Instruments installed: Importance and Challenges faced
  - Rain gauge,
  - Water level monitoring systems (CNBs - regional, as well as V notch - farm),
  - Soil moisture monitoring systems
- Installation of instruments
  - Preparatory works required
  - Installation procedure
  - Monitoring and maintenance of instruments
- Fieldwork: Flow measurement, farmer interviews

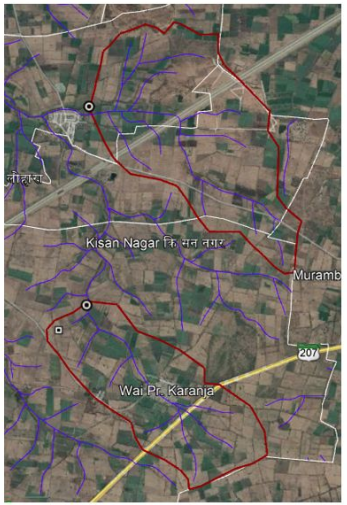
Loha Cluster



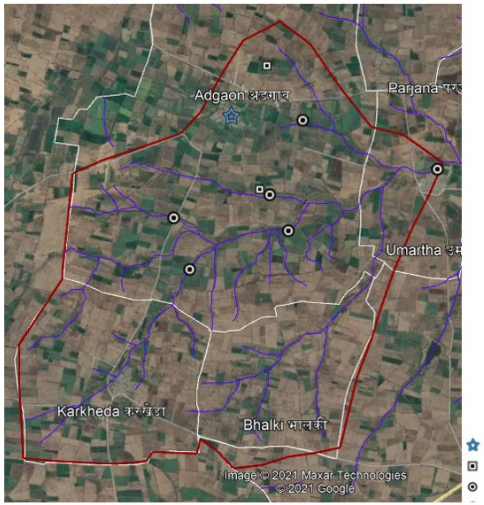
Ahmedpur Cluster

- Rain gauge
- V-notch and soil moisture sensors
- Water level sensor on CNB
- Water level sensor in Percolation Tank

Selected Catchments and Site locations



Karanja Cluster



Ner Cluster

- Rain gauge
- V-notch and soil moisture sensors
- Water level sensor on CNB

(a) Stilling well (regular)

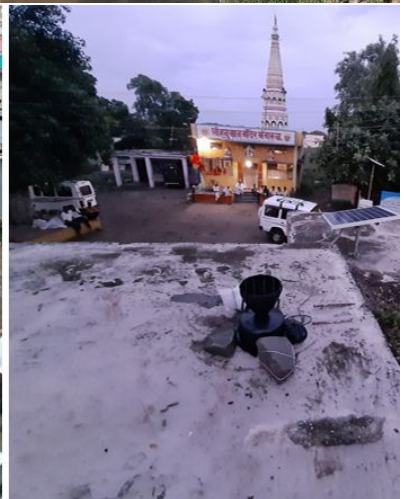
(b) Stilling well (regular + ultrasonic)

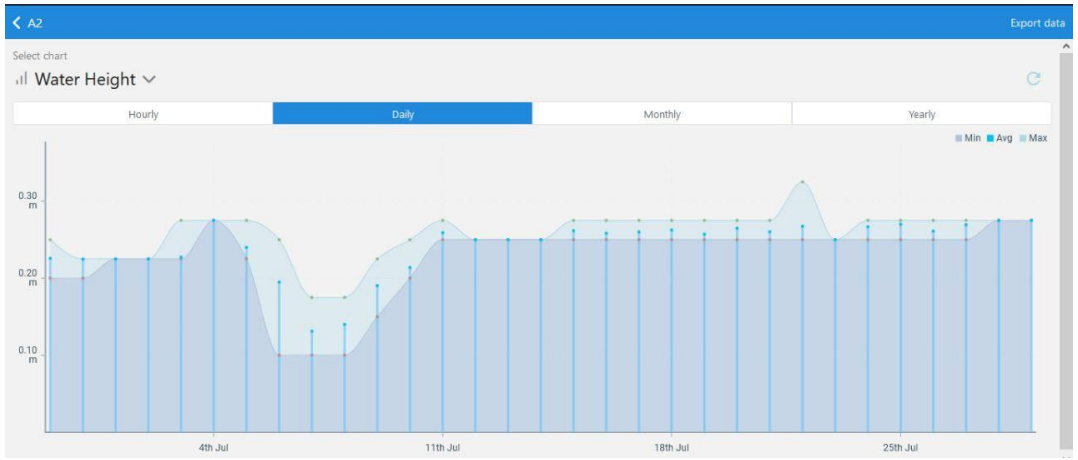
(c) Direct mounting (regular)

(d) Direct mounting (regular + ultrasonic)

Effect of Dry Spell on Crop Yield

Sr. No.		
Date		
Farmer Name		
Village		
Gat No.		
Lat		
Long		
Area of the land parcel		Acre
Type of soil		(Good/चांगली, Medium/मध्यम, Poor/हलकी)
Depth of soil		feet
Crop		
Sowing date		
Duration of the crop		days
Crop variety		
Source of seeds		(Mahabeej/ Private/ From previous year)
Expected yield this year		Q/A
Maximum yield fetched from the parcel of land		Q/A
Minimum assured yield for the parcel of land		Q/A
Frequently observed yield for the parcel of land (सर्वसाधारण उत्पन्न)		Q/A
Number of dry spells this year		(1/2/3/4)
Occurrence of dry spell at crop stage		Immediately after sowing/ Flowering/ Pod formation/ Seed formation
Duration of each of the dry spell		(About 10 days/About 2 weeks/ About 3 weeks/More than 3 weeks
Irrigation facility		(Yes /No)
Source of irrigation		(Well/ Bore/ CNB/ Nallah/ Percolation tank/ Other)
Location of irrigation source		(Near or in the land parcel/ Away from the land parcel)
If away from the farm, distance of water source from the farm		meters
Type of irrigation used		(Furrow/Sprinkler/Drip)
Number of waterings provided		(1/2)
Date of waterings provided		
Yield loss due to dry spells considering no watering		Q/A
Yield loss due to dry spells considering actual waterings (0/1/2) provided		Q/A

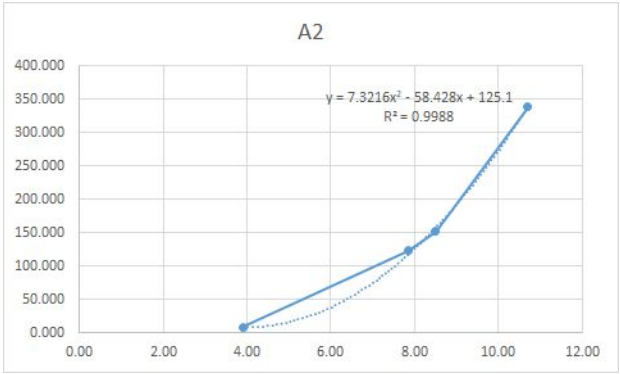




Work Progress (Post Phase II)

Component A: Model Validation

- Fieldwork - Post monsoon
  - Well level monitoring (2 rounds completed, 3rd is underway)
  - Collection of soil sample for texture analysis
- Deskwork
  - Comparison and analysis of the sensor data
- Planned work
  - Study of texture analysis of soil samples - results from NBSS awaited
  - Comparison and analysis of the sensor data



Component B: Community Extension

- Fieldwork
  - Fieldwork in Adgaon and Mangrul for proposed community meeting
- Deskwork
  - Design of the survey format for data collection
  - Preliminary analysis of the data on crop yield
- Planned work
  - Analysis of the data on irrigation infrastructure, feasibility of water transfers
  - Field visit during mid February

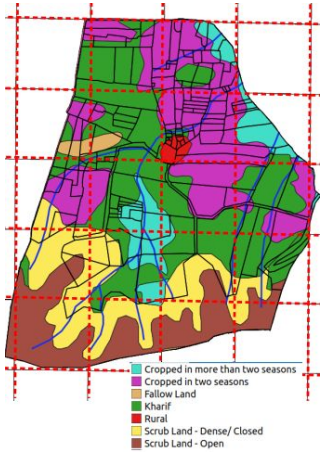
Farmer Interviews

Component C: Regional Geography

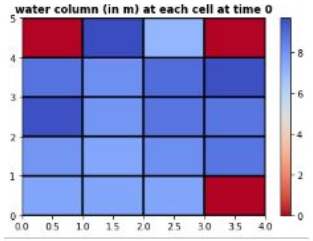
- Fieldwork
  - Installation, monitoring and maintenance of the water level sensors in wells
- Deskwork
  - Design of the baby model for understanding groundwater flows and reallocation of the grondwater
  - Testing of the model results against the standard mainstream model is underway
- Planned work
  - Fieldwork in February
  - Strategy for integration of the baby model
  - Design of the framework for implementation of regional geography

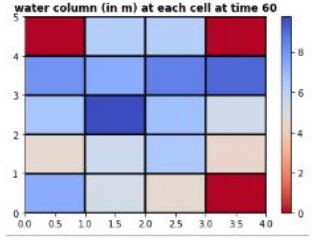
Grid Model for Groundwater Flows

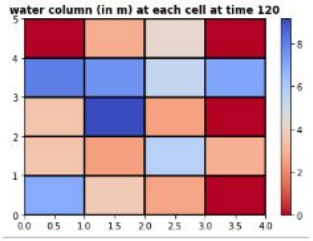
- About Discrete Grid Model for simulation
  - Village divided in 500m by 500m size cells
  - Regions according to LULC of village
- Case Study of Mangrul
  - Preliminary results
  - How head values will change for a given cropping pattern - match reasonably with the farmer narratives
  - Water shared between regions - how much water will be available according to regions
  - Can suggest optimal cropping pattern

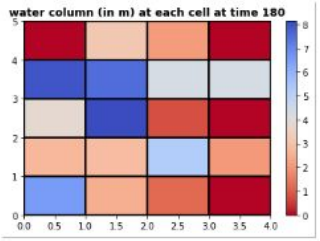


x 0	c 420	e 415	x 0
b 430	b 425	d 420	e 425
c 440	e 430	d 440	d 450
b 470	c 460	b 470	b 480
a 480	a 490	a 500	x 0









Comparison between water balance with and without Rabi extraction

For Mangrul

- Water demand of 210 TCM i.e. around 60% of the stock present at monsoon end
- Demand was fulfilled by 87 TCM water from baseflow and 123 TCM from GW stock
- Stream proximity regions (d and e) have more demand than the available stock in the region - gw from other regions get reallocated to these regions
- In the upper reaches, reduced groundwater water outflows supported the extra demand, while, in the lower parts, the reduction in inflows caused overall groundwater levels to drop significantly, to meet the demand.

With rabi - without rabi (all flow in TCM)	Region a	Region b	Region c	Region d	Region e	Total
Total Area (Ha)	75	125	75	75	75	425
Initial GW Stock	56.7	104.78	67.07	66.3	61.53	356.38
Excess Demand Met (I)	0	15.19	53.48	69.25	73.12	211.04
From Reduced GW Stock (II)	-3.27	2.91	35.82	38.63	49.22	123.31
From Reduced BF (III)	0	1.94	0	24.2	61.57	87.71
Reduction in Inflows (IV)	-0.74	7.09	7.62	29.35	40.14	83.46
Reduction in Outflows (V)	2.53	17.43	25.28	35.76	2.47	83.47

Component D: Rabi Planning

- Preliminary fieldwork
  - FGDs with farmers on rabi plan for the year
  - Well level monitoring
- Planned Work
  - Deskwork: Design of the formats for data collection