# A Presentation to DoLR GOI

## Basemap Generation and Incorporation of Available Datasets to Create a Digital Land Records System

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*16th October 2024, New Delhi*

# Agenda/Themes

- Overview and Key Inputs (8)
  - Problem statement and solution framework
  - Legacy village survey/cadastral maps
  - Textual information: sub-survey maps
  - Ground control points: ground reality
  - Google farm plots: derived from satellite
- GIS Basemap Generation: Pipeline (9)
  - Global jitter
  - Global GCP-based georeferencing
  - Local georeferencing
  - Validation: statistics and heatmaps
- Metrics and Field Use (8)
  - Key metrics: shape, bund distance, etc
  - Field testing and validation
  - Land records rating and zone identification
- Incorporation of Other Datasets (5)
  - Fixing village boundaries through stitching
  - Reconciliation process: analysis and editing tools to resolve conflicts
  - Subdivisions: enabling subdivisions and merge operations over time
- Applications and Engagement (7)
  - Monitoring of land assets by ownership
  - Urban planning, agricultural schemes, etc
  - Methods of engagement

# Introduction

Problem Overview and Key Input Datasets

# Problem Statement

**Objective:** To reconcile legacy land record datasets, and generate **accurate village basemaps** which are (i) legally valid, and (ii) closely match ground reality (as far as possible), and digital land record systems to support DLR functions.

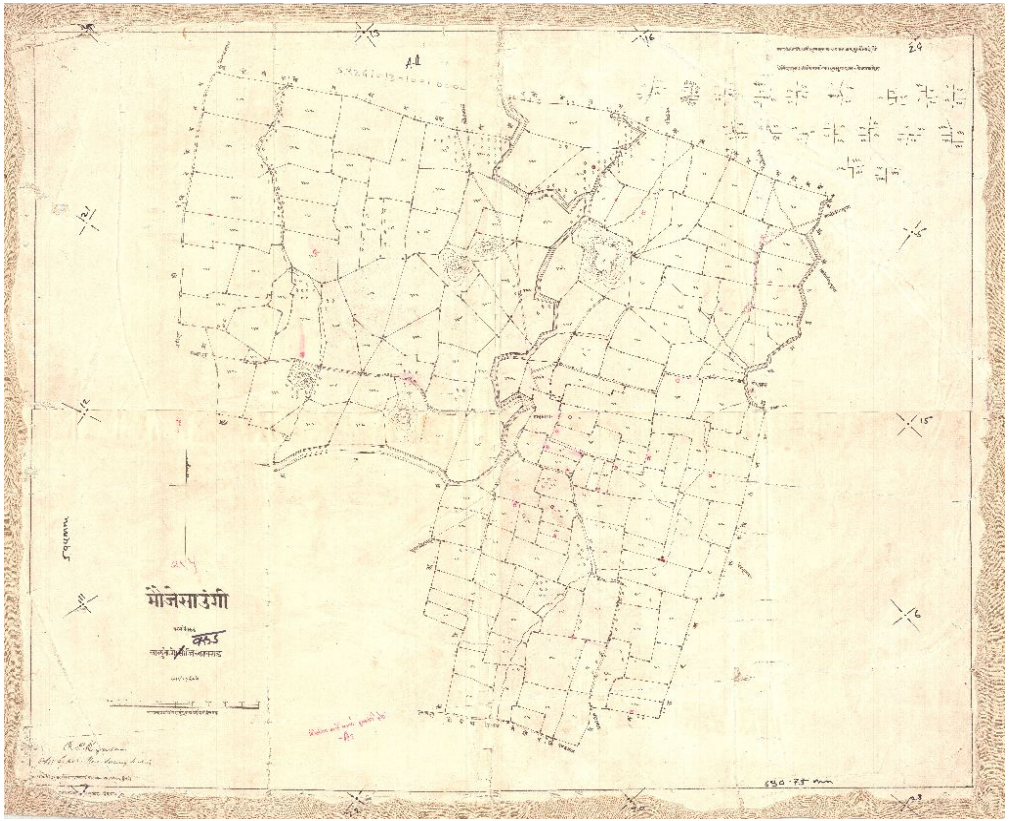
Existing Land Record Data

- Village Survey Map: Digitised set of cadastral/survey polygons
- Approximate Georeferenced Village Boundaries: Used to determine scale and position of village survey map
- Textual Sub-Survey Records: Parcel data at the finest level, mapping ID/area to ownership information

Additional Inputs

- Segmented Farm Plots (Google): Geography of individual farm plots, defined as the lowest granularity of agricultural land use in a given season
- Ground Control Points: Labeled locations of large rocks signifying land tri-junctions

# Input 1: Village Survey Map

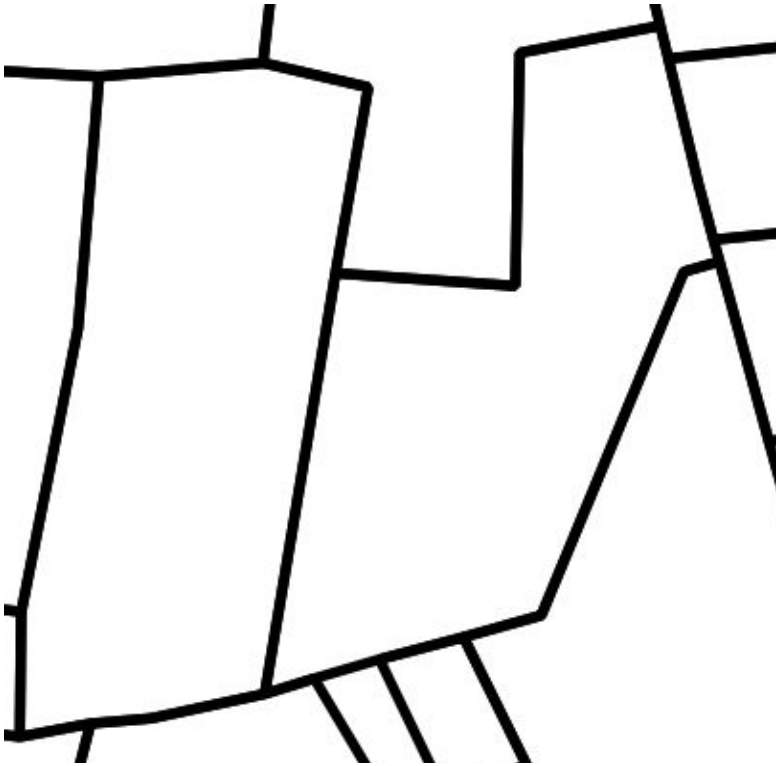



Paper maps: behind 66% of civil court cases in India (property disputes)

They were scanned, converted to GIS geometries by the department. Is this enough?

Digital drawing (Unscaled)

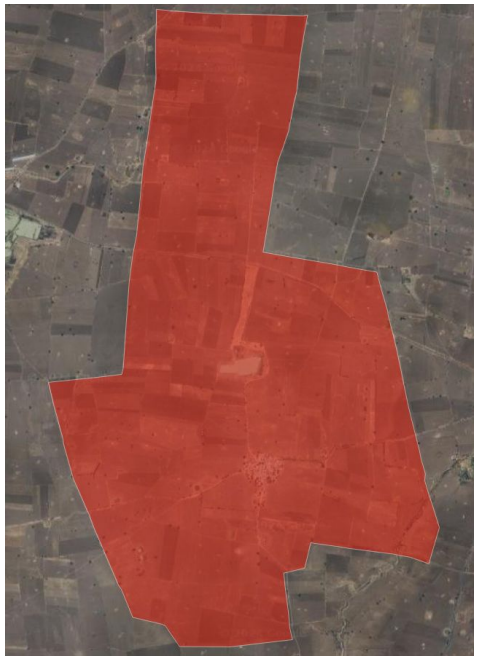
Overlaying the scaled and approximately georeferenced survey maps on modern satellite images finds a mismatch of over 25m across villages in multiple states!



A survey map in Maharashtra

Overlaid on satellite post geo-referencing

# Input 2: Approximate Village Boundaries



GIS village cadastral map, approximately georeferenced and stitched into an area partition by MRSAC in the early 2000s

An approximate village boundary polygon is used to scale and position the survey map. These boundaries are derived from MRSAC cadastrals in Maharashtra.

# Input 3: Google Farm Plots

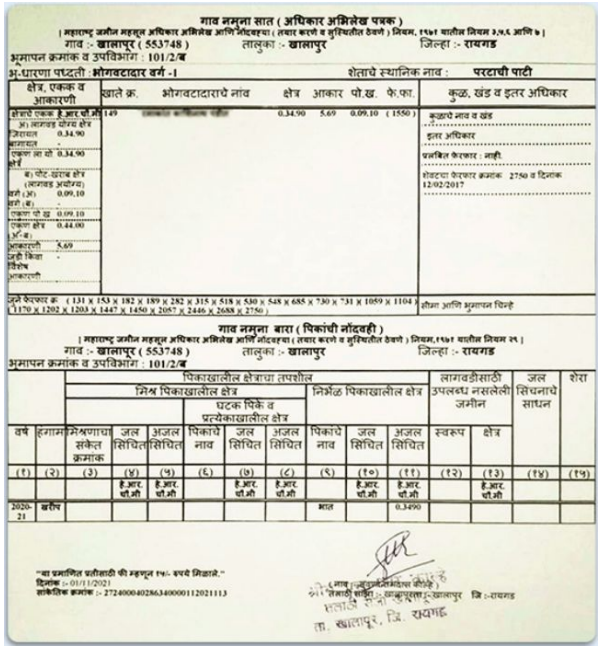
```
POLYGON((75 29, 77 29, 77 29, 75 29))
```

ALU
Segmentation

(Google
Research)

**Segmented farm plots** are crucial for the discretization of land. They divide a region into polygons that are visually distinct in satellite images; ideally, the gaps between these polygons indicate changes in cropping pattern or physical gaps like bunds/roads.

# Input 4: Sub-survey textual records



गाव नमुना सात ( अधिकार अभिलेख पत्रक )

गाव :- खालापूर ( 553748 ) तालुका :- खालापूर जिल्हा :- रायगड

भूमापन क्रमांक व उपविभाग : 101/2/ब

भू-धारणा पध्दती : भोगवटादार वर्ग -1 शेताचे स्थानिक नाव : परटाची पाटी

| क्षेत्र, एकक व आकारणी | खाते क्र. | भोगवटादाराचे नाव | क्षेत्र | आकार | पो.ख. | पे.फा. | कुळ, खंड व इतर अधिकार |
|---|---|---|---|---|---|---|---|
| | 149 | | 0.34.90 | 5.69 | 0.09.10 | ( 1550 ) | कुळाचे नाव व खंड<br>इतर अधिकार<br>प्रलंबित फेरफार : नाही.<br>शेरा/फेरफार क्रमांक 2750 व दिनांक 12/02/2017 |

जुने फेरफार क्र. ( 131 x 153 x 182 x 189 x 282 x 315 x 518 x 530 x 548 x 685 x 730 x 731 x 1059 x 1104 x 1170 x 1202 x 1203 x 1447 x 1450 x 2057 x 2446 x 2688 x 2750 ) शेरा आणि भूमापन चिन्हे

गाव नमुना बारा ( पिकांची नोंदवही )

गाव :- खालापूर ( 553748 ) तालुका :- खालापूर जिल्हा :- रायगड

भूमापन क्रमांक व उपविभाग : 101/2/ब

| | | पिकाखालील क्षेत्राचा तपशील | | | | | | | | | लागवडीसाठी उपलब्ध नसलेली जमीन | | जल सिंचनाचे साधन | शेरा |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | मिश्र पिकाखालील क्षेत्र | | | घटक पिके व प्रत्येकाखालील क्षेत्र | | | निर्भळ पिकाखालील क्षेत्र | | | | | | |
| वर्ष | हंगाम | मिश्रणाचा सांकेतांक क्रमांक | जल सिंचित | अजल सिंचित | पिकाचे नाव | जल सिंचित | अजल सिंचित | पिकाचे नाव | जल सिंचित | अजल सिंचित | स्वरूप | क्षेत्र | | |
| (१) | (२) | (३) | (४) | (५) | (६) | (७) | (८) | (९) | (१०) | (११) | (१२) | (१३) | (१४) | (१५) |
| | | | हे.आर. चौ.मी | हे.आर. चौ.मी | | हे.आर. चौ.मी | हे.आर. चौ.मी | | हे.आर. चौ.मी | हे.आर. चौ.मी | | हे.आर. चौ.मी | | |
| 2020-21 | बारीक | | | | | | | भात | | 0.3490 | | | | |

"या प्रमाणित प्रतीसाठी फी म्हणून १५/- रुपये मिळाले."

दिनांक :- 01/11/2021

सांकेतांक क्रमांक :- 27240004028634000011202111 3

तलाठी सजा :- खालापूर ता. :-खालापूर जि :-रायगड

तलाठी सजा खालापूर ता. खालापूर, जि. रायगड

Sub-survey 7/12 textual records for 101/2/B: total area is 0.34 Ha

| Sr_No | Gat_No | Gat_No_Area_Ha_R_Sqm |
|---|---|---|
| 1 | 1 | 0.20 |
| 2 | 2 | 0.15 |
| 3 | 3 | 0.12 |
| 4 | 4 | 0.09 |
| 5 | 5 | 0.04 |
| 6 | 6 | 0.03 |
| 7 | 7 | 0.02 |
| 8 | 8 | 0.03 |
| 9 | 9 | 0.02 |
| 10 | 10 | 0.06 |
| 11 | 11 | 0.03 |
| 12 | 12 | 0.03 |
| 13 | 13 | 0.04 |

Textual Gat area data for Anterweli, Taluka :- Gangakhed, Parbhani

# Input 5: Ground Control Points (GCPs)

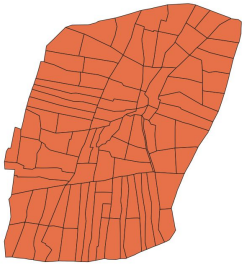
GCPs (black): Important junctions on the map

- Stones installed into the ground by the British are identified by local surveyors
- These stones are collected on ground via rovers
- Each GCP's corresponding vertex on the map is identified and labelled

# Survey Basemap Generation

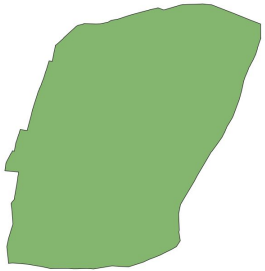
## Review of Software Pipeline Developed

# Input Data Sources for Basemap Generation



| आकारबंद (गटाचे) | |
|---|---|
| गांवचा नमुना नं.1 | |
| वाघलगांव ता.गंगाखेड | |
| गट नंबर | एकूण क्षेत्र हे.आर. |
| 1 | 3.57 |
| 2 | 3.30 |
| 3 | 4.23 |

Vectorised survey map (Map 0) + Akarbandh

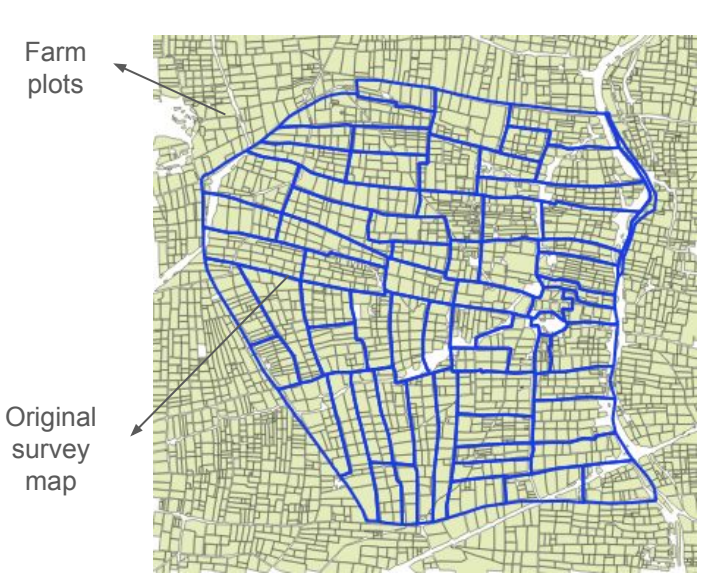


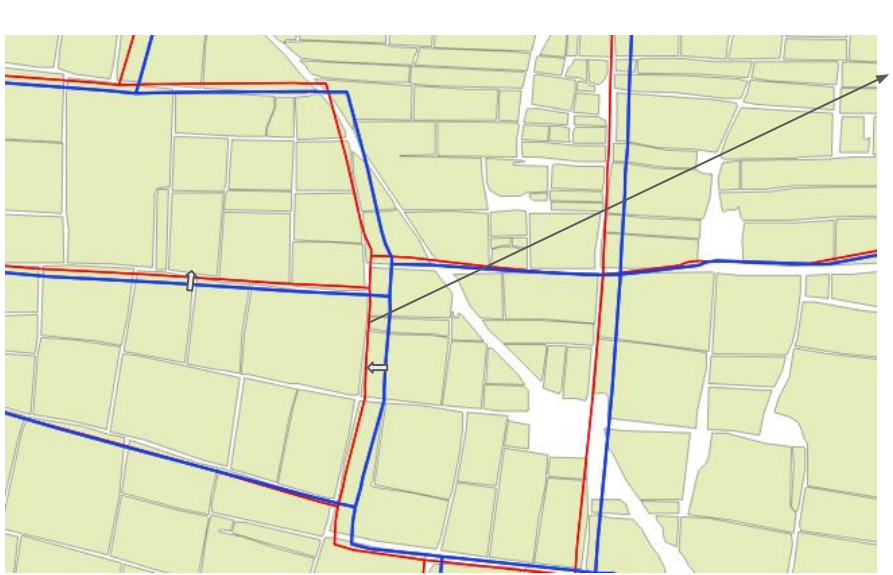
Approximately georeferenced village boundary

Google farm plots


Ground Control Points (GCPs)

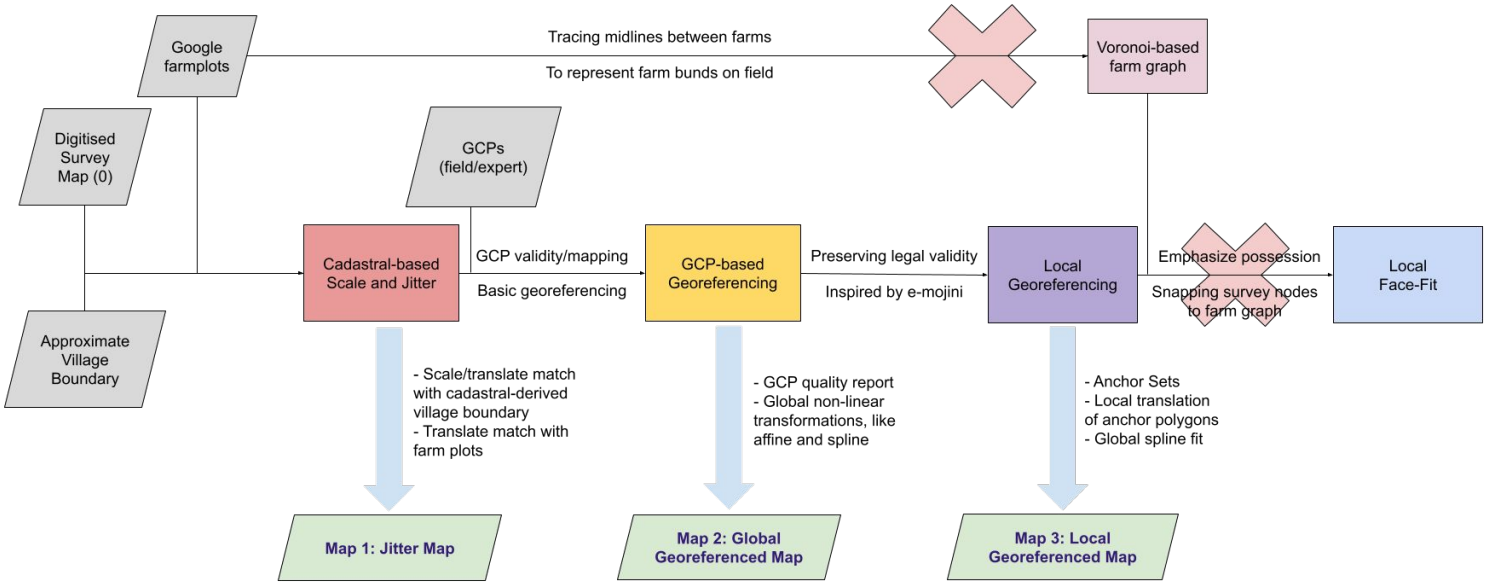
# Overview of Problem Statement



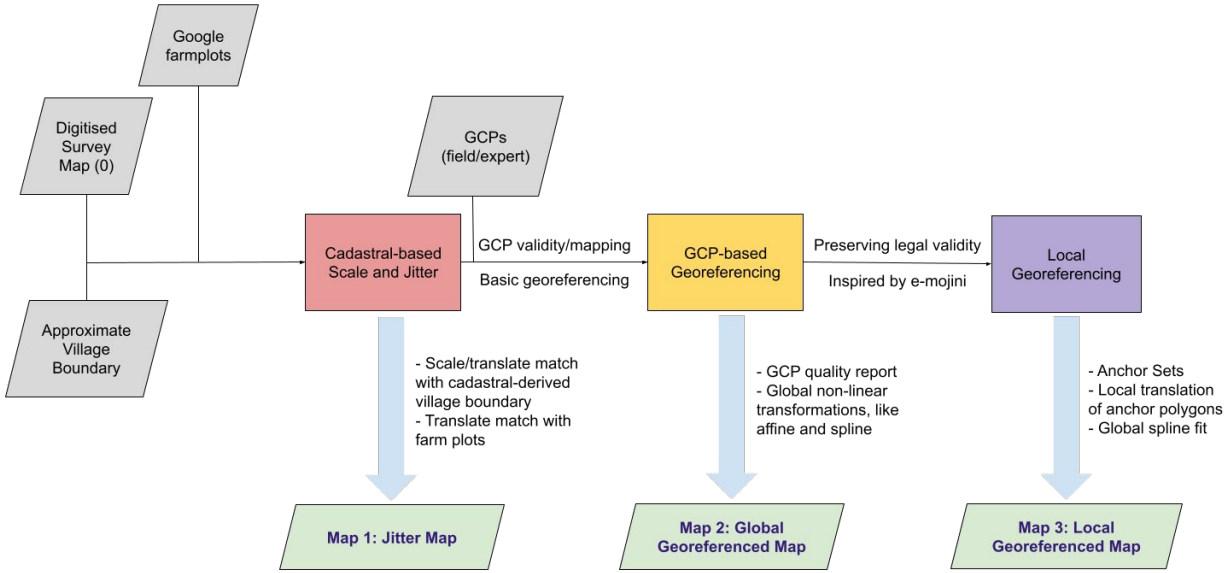

**Main Idea:** To match approximately georeferenced basemaps with farm plots so that areas are broady preserved and distortion is minimal

# Pipeline Summary



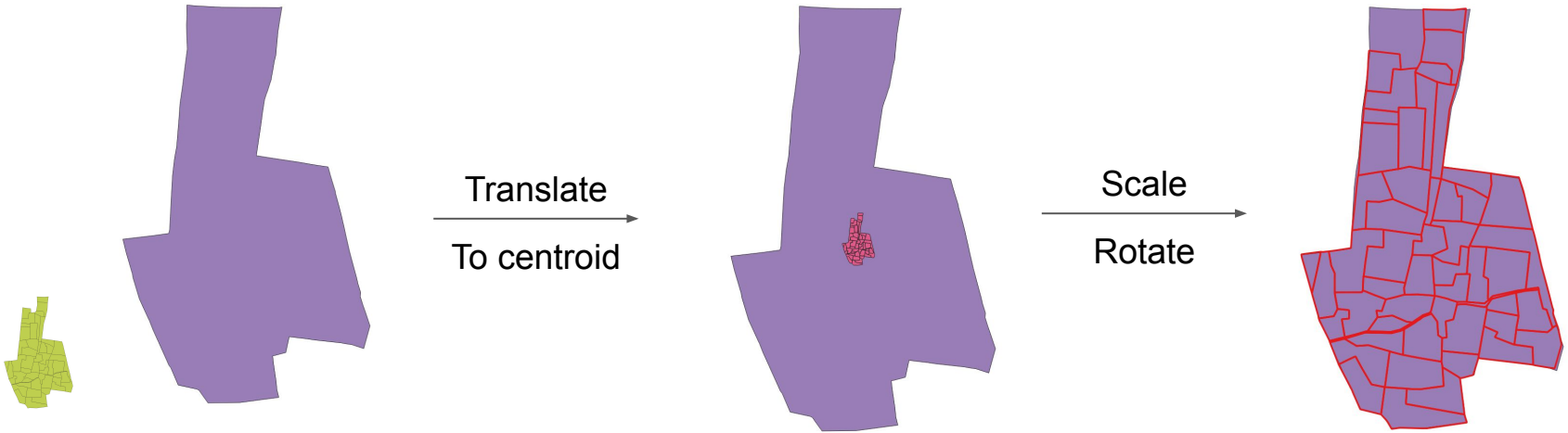

Original plan: adjust the survey polygon shapes using vertex editing to better align with agricultural possession. **Current: Upon request of the DoLR GoM, limited changes to local translation only (LG).**

# Pipeline Summary



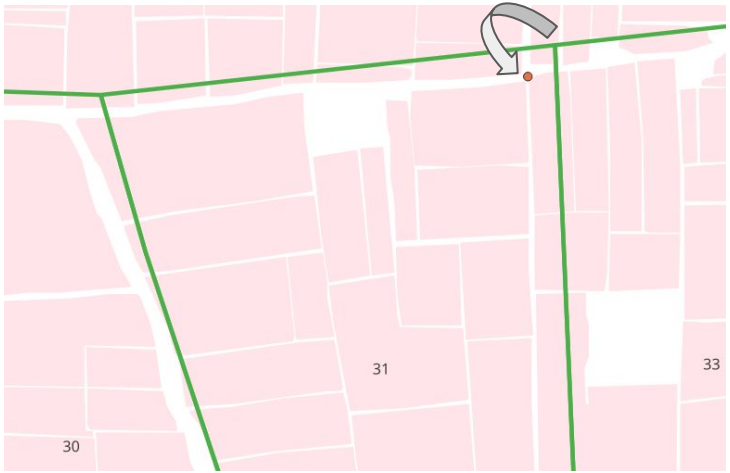

Original plan: adjust the survey polygon shapes using vertex editing to better align with agricultural possession. **Current: Upon request of the DoLR GoM, limited changes to local translation only (LG).**

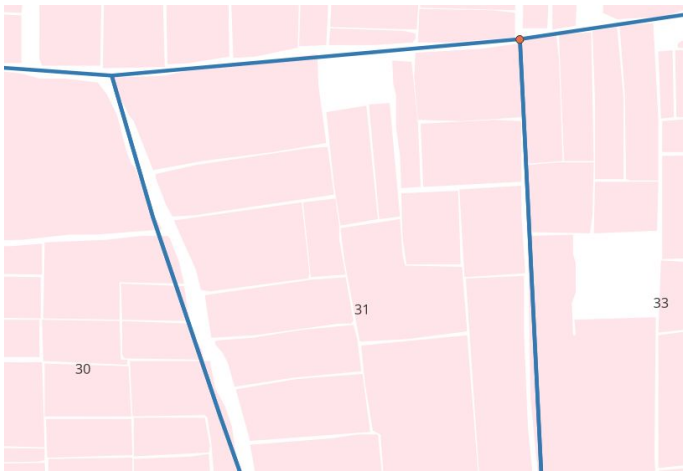
# Step 1: Global Jitter




| Input | Reference | Output | Processing |
|---|---|---|---|
| Original survey map, or Map 0 (green) | Village boundary (purple), Google farm plots (not shown) | “Jitter map”, or Map 1 (red) | Map 1 is produced by performing global **scale, translate and rotate** operations to best fit survey map with respect to cadastrals, and then farm plots. |

# Step 2: Global GCP-based Georeferencing

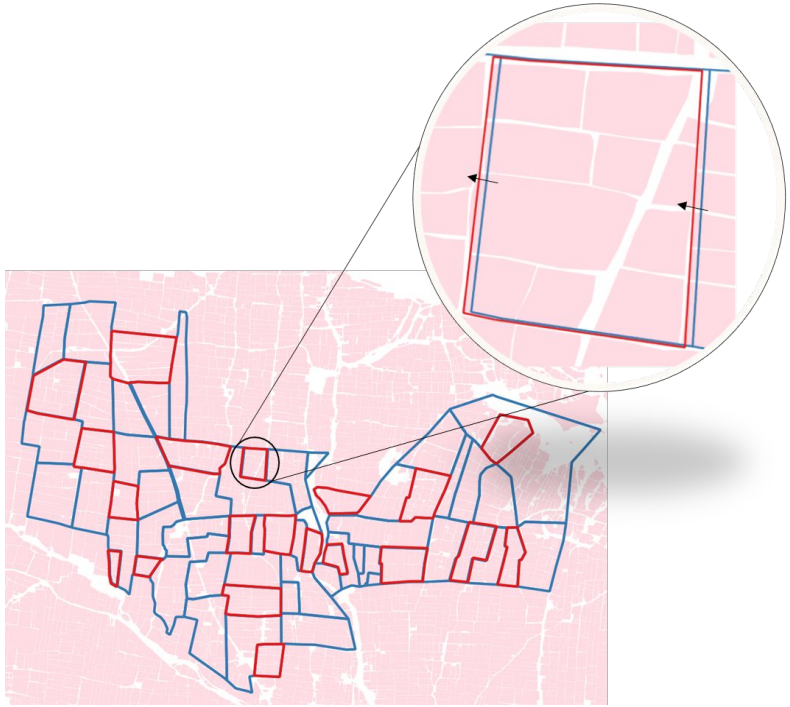



| Input | Reference | Output | Processing |
|---|---|---|---|
| Jitter Map (Map 1) | GCPs (orange), Farm plots (pink) | Global georeferenced map (Map 2) | Survey nodes are mapped onto GCPs, and global transformations are used to optimize GCP-survey distance; the method maximizing farm plot match with low distortion is chosen. |

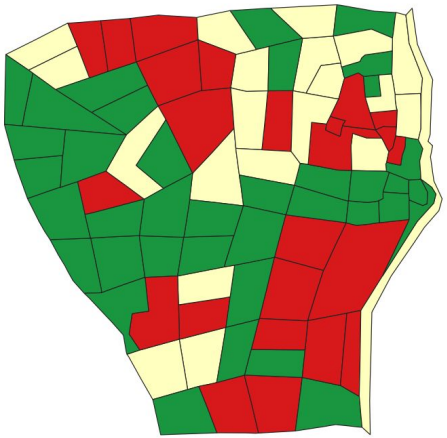
# Step 3: Local Georeferencing: Allowing local transformations

| | |
|---|---|
| Input | Global georeferenced map, or Map 2 (blue) |
| Reference | Farm plots (pink) |
| Output | LG Map, or Map 3 |
| Processing | (a) Iso-jitter: Each survey plot is translated to minimize excess area with respect to farm plots.<br>(b) Anchor polygons: Plots that meet quality standards are selected; namely excess area (<5%), farm intersection (>50%), area (>1.5 hectares).<br>(c) Global spline: Nodes of anchors are used as a reference to spline transform the map. |



Anchor polygons (red) are translated to fit farm plots, and Map 2 is transformed to match these polygons.

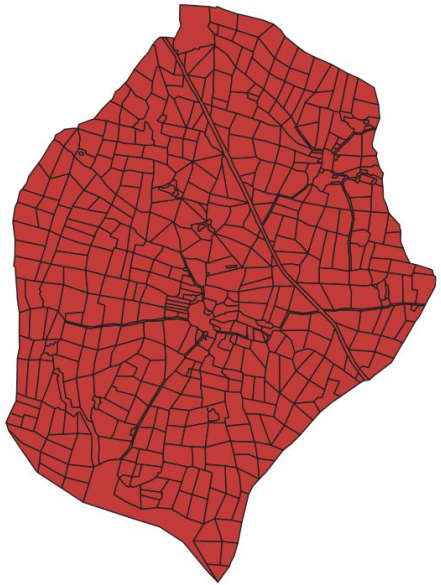
# Validation



| Sr. No. | village | Number of Survey Plots | | | | Georeferenced Output | Refined Output | | | Possession Boundaries | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Total | Non-Integer | Vaild (unique, alphanumeric survey numbers) | Akarbandh Validity | % of survey numbers with over 95% farm rating | % of survey numbers within 5% of akarbandh area | % of survey numbers within 5% of geo-referenced area and perimeter | % of survey numbers within 5% of geo-referenced area and deviation | % of survey numbers within 5% of akarbandh area | % of survey numbers within 5% of geo-referenced deviation | % of survey numbers within 5% of geo-referenced area and deviation |
| 0 | deolanabk | 184 | 12 | 138 | 103 | 39.86 | 32.61 | 45.65 | 23.19 | 34.78 | 20.29 | 16.67 |
| 1 | waghalgaon | 67 | 2 | 65 | 60 | 50.77 | 61.54 | 58.46 | 30.77 | 63.08 | 33.85 | 32.31 |
| 2 | khatnapur | 23 | 4 | 19 | 18 | 10.53 | 42.11 | 42.11 | 10.53 | 26.32 | 26.32 | 21.05 |
| 3 | shekhapur | 66 | 4 | 57 | 11 | 28.07 | 10.53 | 49.12 | 14.04 | 8.77 | 7.02 | 5.26 |
| 4 | matargaon | 41 | 4 | 36 | 33 | 58.33 | 63.89 | 77.78 | 61.11 | 61.11 | 63.89 | 61.11 |
| 5 | deolanakh | 41 | 2 | 36 | 35 | 50.00 | 63.89 | 66.67 | 47.22 | 69.44 | 41.67 | 41.67 |
| 6 | dagdagad | 52 | 3 | 49 | 48 | 83.67 | 71.43 | 75.51 | 63.27 | 75.51 | 69.39 | 65.31 |
| 7 | kharburdi | 59 | 3 | 40 | 0 | 50.00 | 0.00 | 75.00 | 47.50 | 0.00 | 20.00 | 15.00 |
| 8 | gopa | 78 | 3 | 75 | 73 | 76.00 | 74.67 | 62.67 | 46.67 | 82.67 | 64.00 | 53.33 |
| 9 | virshi | 84 | 3 | 79 | 76 | 69.62 | 65.82 | 68.35 | 43.04 | 78.48 | 46.84 | 43.04 |
| 10 | nirgudibk | 60 | 5 | 54 | 52 | 9.26 | 51.85 | 53.70 | 16.67 | 51.85 | 7.41 | 5.56 |

| Input | Reference | Output | Processing |
|---|---|---|---|
| LG Map (3) | GG Map (2), Farm plots, GCPs | Heatmaps and Statistics | Various quality metrics such as shape deviation, textual area difference, and average distance to bund are added to the survey map tables. Village statistics tables are also generated. |

# Similar issues in Telangana: mismatch with ground reality



| DMV_Code_2356005 | |
|---|---|
| V_Name | Kurmaidu |
| (Derived) | |
| (Actions) | |
| OBJECTID | 394 |
| Parcel_num | 293 |
| Remarks | NULL |
| V_Name | Kurmaidu |
| M_Name | Chintha Palle |
| D_Name | Nalgonda |
| DMV_Code | 2356005 |
| Shape_Leng | 0.00906448206003 |
| LandUse_Fr | Dry |
| LUCodeTiff | 08 |
| STCode | 0 |
| Shape_Le_1 | 0.00888692423572 |
| Shape_Area | 4.13068249945e-06 |

A village cadastral map with attributes in Telangana


Zoom-in: vertex distance between survey map (blue) and farm plot (red) gap is 26 meters

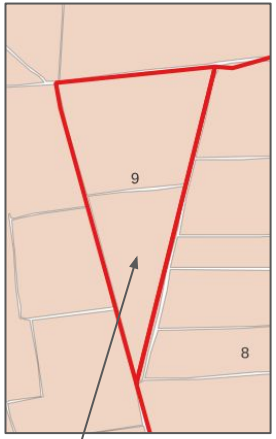
# Statistics and Validation

Formulation of metrics and application via heatmaps on generated basemaps

# Key Metrics

## Textual Metric: Area difference

| Survey_No | Survey_No_Area_Ha_R |
|---|---|
| 1 | 3.37 |
| 2 | 5.06 |
| 3 | 6.71 |
| 4 | 12.91 |
| 5 | 4.36 |
| 6 | 9.18 |
| 7 | 3.46 |
| 8 | 7.45 |
| 9 | 2.49 |
| 10 | 12.85 |
| 11 | 7.90 |
| 12 | 10.30 |
| 13 | 9.83 |
| 14 | 9.76 |

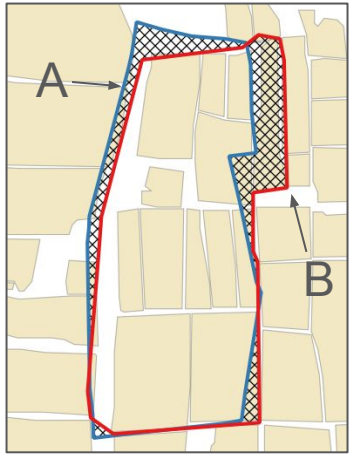



Akarbandh Area
2.49 Ha

GIS Area
2.41 Ha

Area Diff = 100*(2.41-2.49)/2.49
= -3%

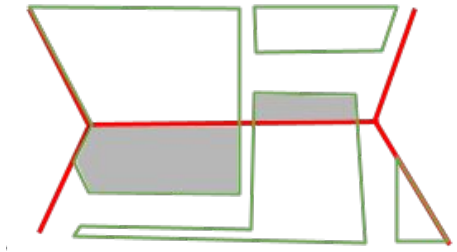
## GIS Metric: Shape deviation with original map




Blue :- Original (A)
Red :- Final (B)
Shaded :- Area not common to both polygon, i.e. (A∪B)-(A∩B)

Deviation (shaded area)
= 100 * ((A∪B)-(A∩B)) / (2*A)
= 11 %

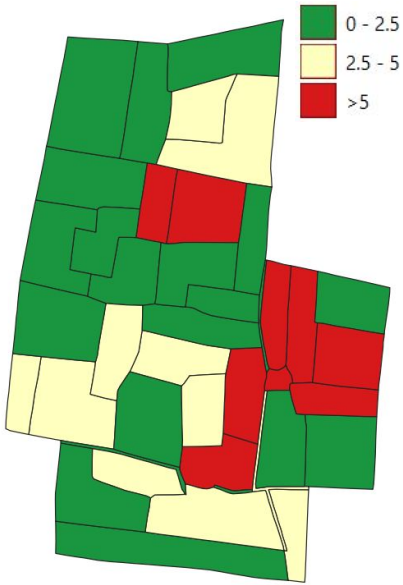
## Possession Metric: Average Distance to Bund



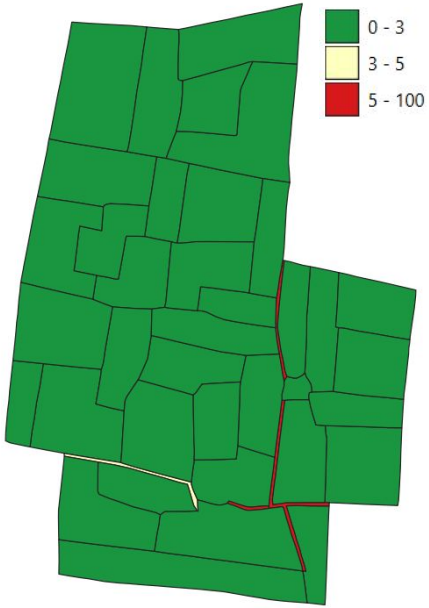
$$\text{Distance of edge from bundh} = \frac{\text{Area of shaded region}}{\text{length of edge}}$$

The average distance to farm bund is computed for each survey edge individually, representing the distance to bund on the field.

# Heatmaps for a Good Village: Taluka Bhatkuli




Average distance to bund heatmap for “Indapur” village in Bhatkuli



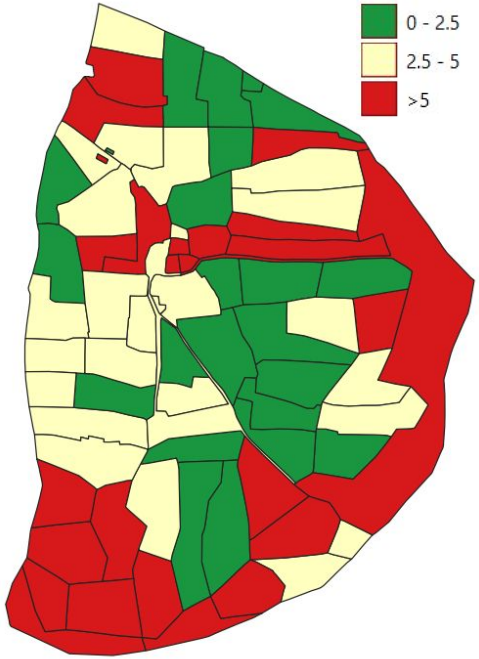

Shape deviation heatmap for “Indapur” village in Bhatkuli


Map 2
ADB:
5.55

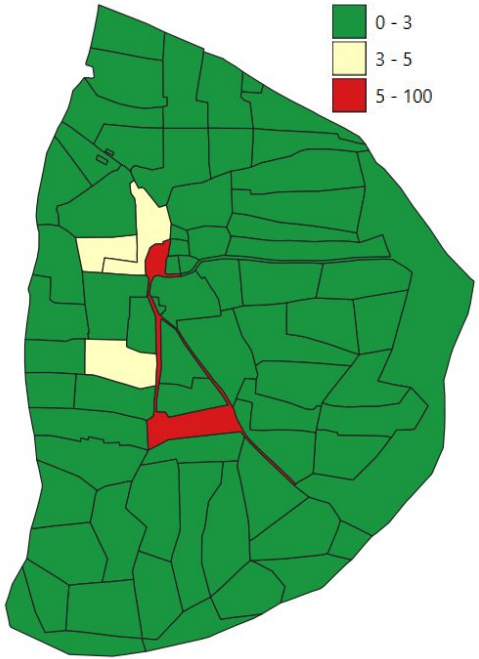
Map 3
ADB:
0.57

Average DTB: Appropriate fit found with farm plots through local transformations

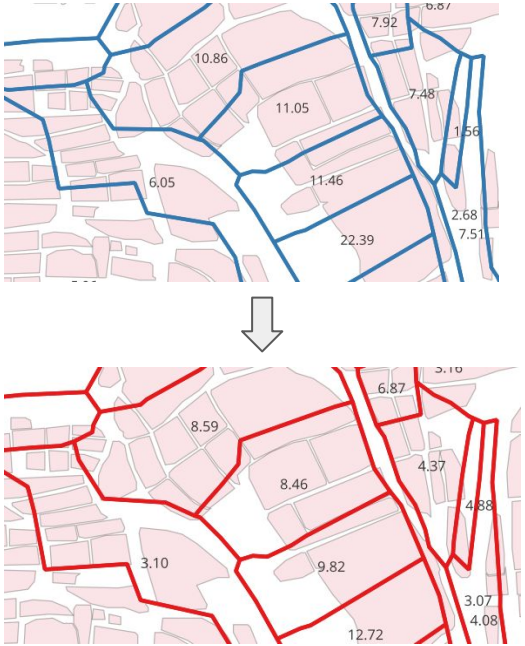
# Heatmaps for a Bad Village: Taluka Gadhinglaj




Average distance to bund heatmap for “Mankadevi” village in Gadhinglaj




Shape deviation heatmap for “Mankadevi” village in Gadhinglaj



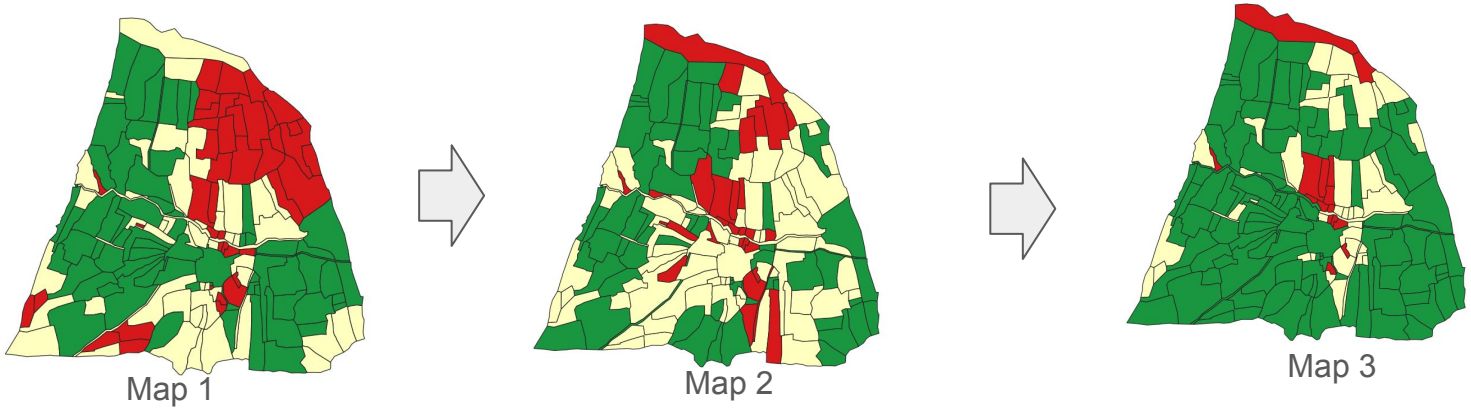

Map 2
ADB:
11.05

Map 3
ADB:
8.46

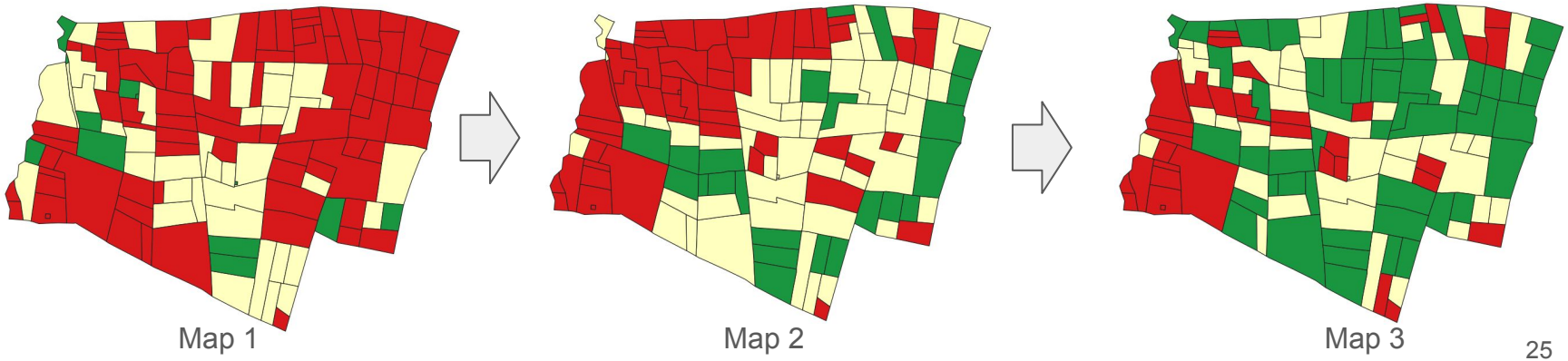
For bad talukas, field work is needed to reconcile internal boundaries

# Visualizing DTB Metric Change across the Pipeline

Hidadugi




Itner



# Statistics for villages in Pilot MoU

*A summary of LG OUTPUTS for chosen villages across 5 talukas for Phase 4 delivery.*

| village | No. of survey plots | No. of anchor polygons | % of survey numbers within 3% of georeferenced area, perimeter and deviation | % of survey plots in LG with average bund distance < 2.5m | % of survey plots with average bund distance < 5m |
|---|---|---|---|---|---|
| akoli | 92 | 17 | 86.67 | 34.44 | 70.00 |
| shipgaon | 58 | 12 | 100.00 | 55.56 | 72.22 |
| kanfodi | 66 | 14 | 96.23 | 30.19 | 66.04 |
| jasapur | 54 | 6 | 100.00 | 17.65 | 50.98 |
| indapur | 41 | 9 | 97.14 | 51.43 | 80.00 |
| harangul | 64 | 14 | 62.30 | 16.39 | 40.98 |
| bhaddarpur | 63 | 13 | 100.00 | 41.67 | 66.67 |
| waghoda | 39 | 4 | 94.74 | 15.79 | 36.85 |
| dahatonda | 13 | 4 | 92.31 | 23.07 | 69.23 |
| banpimpla | 43 | 7 | 90.00 | 12.50 | 42.50 |
| kharbi | 31 | 7 | 100.00 | 64.29 | 78.57 |

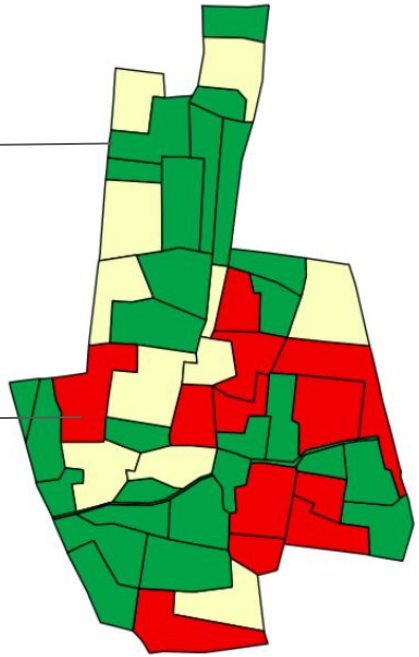
## Overall Observations

- Total number of villages with successful map generation: **107**
- Total number of invalid villages: **20** (largely torn survey map or missing village boundary data)
- Area-perimeter-deviation metric: almost all polygons **consistently pass 3%** constraint
- Average DTB metric: variable from **taluka to taluka**; generally good in areas like Bhatkuli, but poor in Gadhinglaj

# Field Validation

Green: under 3% excess area

Red: above 5% excess area



A village in MH: coloured by quality

Black: points measured on the field

Red: georeferenced map

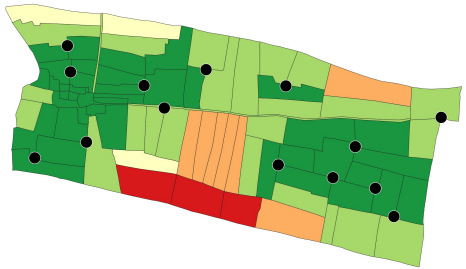
Avg. error: 2.2m

There was a large correlation between rating indicators developed and the actual field error in pilot villages.

# MoU-I achievements

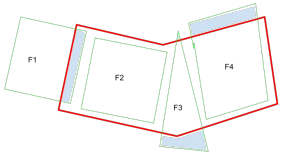
## Execution

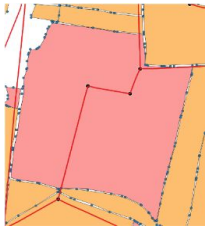
- Data validation and basemap generation of 120 villages in 5 districts
- Heatmaps and statistics created for all villages, to help with GIS verification and field use
- Pilot software developed and deployed on cloud



## R&D

- Metrics developed: DTB, deviation, etc
- Bad farm plot recognition
- Farm bund generation
- Void handling: roads, rivers, gaothans
- Distortion-limiting LG transformations



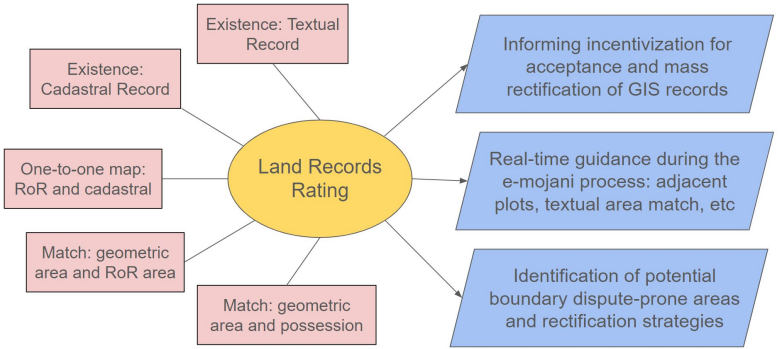
## Processes

- Data Validation Protocols
- GCP Labeling and Spatial Distribution SOPs
- Software Training and Execution

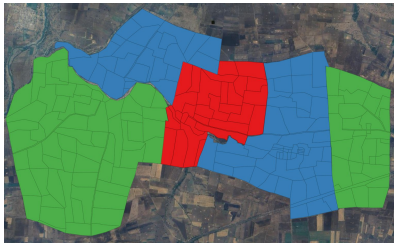
# MoU Addendum: Scale, Upstream, Downstream Integration

Module 1: Production of **Accurate Georeferenced Maps** for 6 Talukas (773 Villages)

| | | Survey plots | | | | Georeferenced Output | | Refined Output | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Village | Total | Non-integer | Valid (unique, alphanumeric survey numbers) | Akarbandh Validity | % of survey numbers within 3% of akarbandh area | % of survey numbers with over 97% farm rating | % of survey numbers within 3% of akarbandh area | % of survey numbers within 3% of geo-referenced area and perimeter | % of survey numbers within 3% of geo-referenced deviation | % of survey numbers within 3% of geo-referenced area, perimeter and deviation | % of survey numbers within 3% of geo-referenced area and deviation | % of survey numbers with over 97% farm rating |
| 0 | dagdagad | 92 | 3 | 49 | 48 | 73.47 | 51.02 | 71.43 | 63.27 | 69.39 | 59.18 | 59.18 | 69.39 |
| 1 | deolanakk | 174 | 11 | 125 | 95 | 17.60 | 5.60 | 23.20 | 37.60 | 30.40 | 25.60 | 26.40 | 28.00 |
| 2 | deolanakh | 41 | 2 | 36 | 37 | 55.26 | 39.47 | 50.00 | 44.74 | 31.58 | 28.95 | 28.95 | 63.16 |
| 3 | gaya | 78 | 3 | 74 | 72 | 84.96 | 38.19 | 59.46 | 45.95 | 41.89 | 36.49 | 37.84 | 74.32 |
| 4 | kharbandi | 59 | 3 | 46 | 0 | 0.00 | 13.04 | 0.00 | 56.52 | 36.96 | 28.26 | 28.26 | 36.96 |
| 5 | khatnapur | 23 | 4 | 19 | 19 | 88.42 | 5.26 | 63.16 | 78.95 | 89.47 | 73.68 | 78.95 | 15.79 |
| 6 | malanpuni | 41 | 4 | 36 | 32 | 90.33 | 36.11 | 55.56 | 52.78 | 50.00 | 38.11 | 36.11 | 61.11 |
| 7 | ringuddik | 59 | 4 | 51 | 51 | 49.02 | 0.00 | 37.25 | 50.98 | 21.57 | 21.57 | 21.57 | 25.49 |
| 8 | shekhapur | 66 | 4 | 62 | 13 | 4.84 | 40.32 | 6.45 | 46.77 | 45.16 | 35.48 | 35.48 | 62.90 |
| 9 | vinchi | 84 | 3 | 81 | 76 | 62.96 | 44.44 | 53.09 | 59.26 | 48.15 | 40.74 | 43.21 | 61.73 |
| 10 | waghalpuni | 67 | 2 | 66 | 60 | 59.46 | 15.38 | 40.00 | 47.69 | 29.23 | 23.08 | 23.08 | 92.31 |
| 11 | sarjapur | 169 | 9 | 155 | 142 | 46.39 | 47.10 | 29.03 | 28.39 | 19.35 | 14.19 | 14.84 | 72.26 |
| 12 | lokhetgaon | 275 | 30 | 63 | 44 | 39.68 | 17.46 | 22.22 | 44.44 | 42.86 | 34.92 | 34.92 | 42.86 |
| 13 | kanjal | 97 | 9 | 41 | 35 | 19.51 | 39.02 | 28.00 | 17.07 | 14.63 | 12.20 | 12.20 | 60.98 |




Module 2: Development of **Land Record Rating** for Individual Survey Plots based on available land record data for villages in Pilot talukas

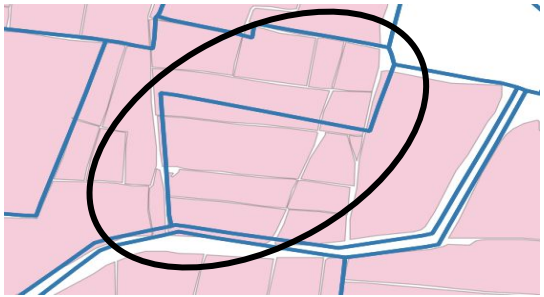


Module 3: Fixing of **Village Boundaries** for selected talukas

# Digital Land Records System

Creating a complete land record management system that supports DLR functions

# Module 2: Zone Identification for Internal Reconciliation



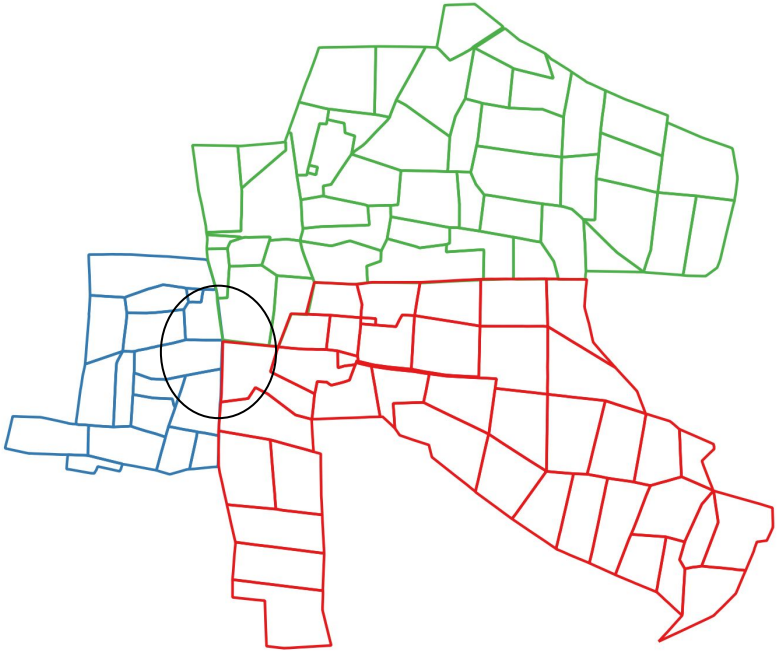
Identification: Plots that require internal reconciliation

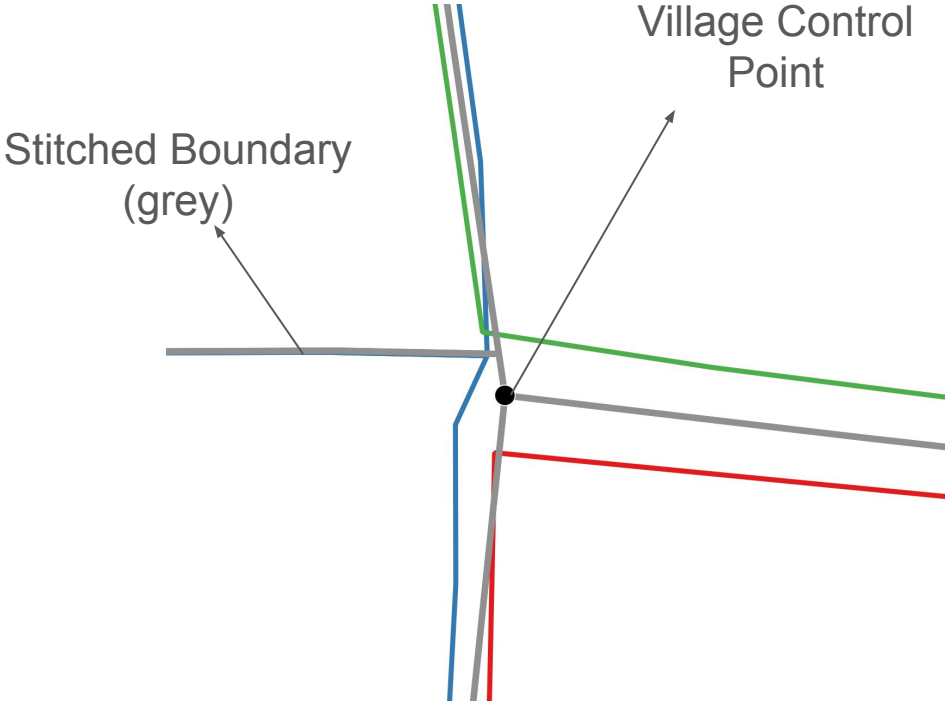

Merged boundaries: polygons merged across red edges


Average DTB heatmap: original map


Average DTB heatmap: merged map

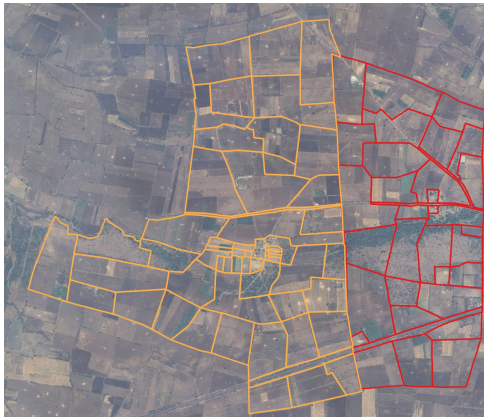
# Module 3: Stitching Village Boundaries






**Objective:** To create a complete village partition, made through stitching village borders where appropriate and amending boundary plots without distortion.

# Junction-Midline Mapping and Issues with Scale

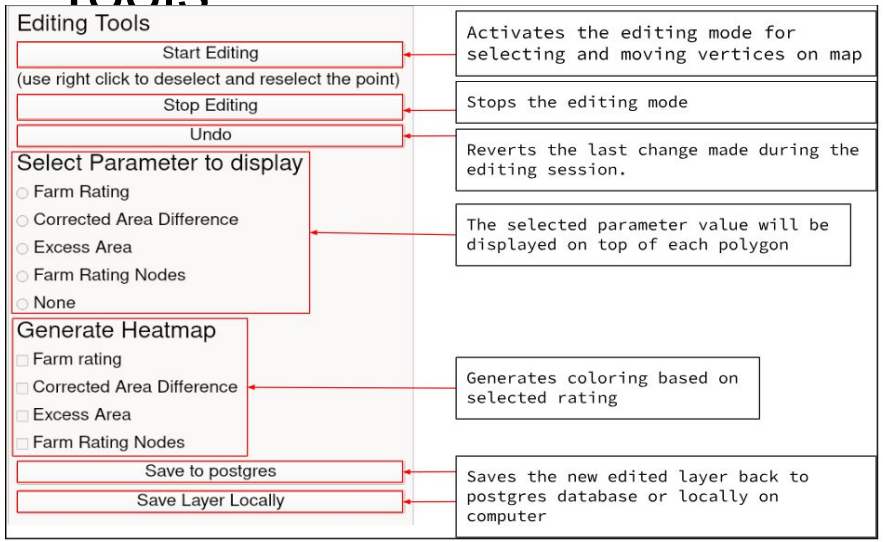


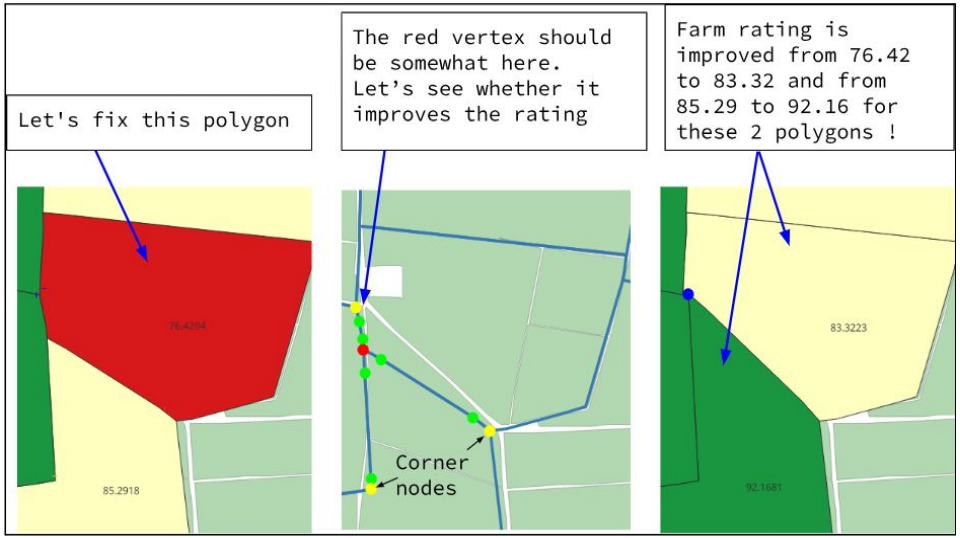
The border tri-junctions are mapped to the shared boundary, ensuring that roads remain aligned.

Issues to be tackled while performing bottom-up village survey map stitching:

- Road alignment: Preserving continuity of roads spanning across villages
- Unmapped area: Detecting village roads and other government land that is unmapped at boundaries

# Beyond Basemaps: Reconciliation through Real-time Tools



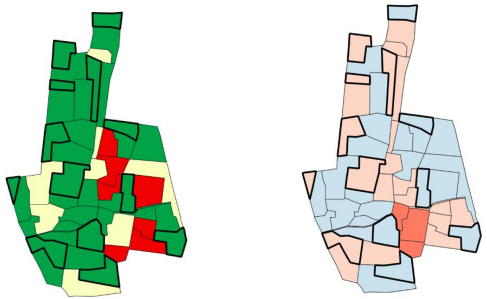




A land reconciliation system: The way to systematically resolve boundary conflicts through real-time visual metric tracking and editor tools

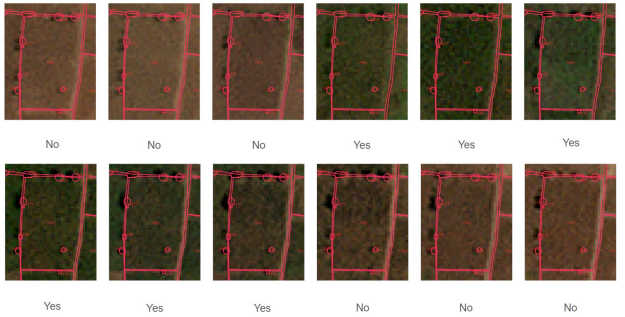
# Use Cases and Engagement

Direct and indirect applications of produced basemaps and developed systems

# Applications

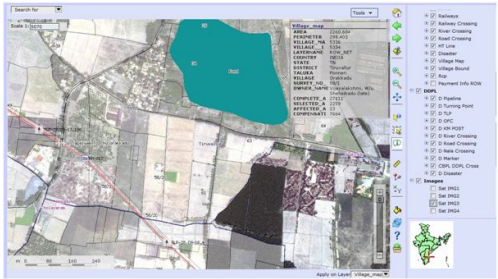


E-Mojani: Automatic Fixing for 50%+ Plots (High LRR)



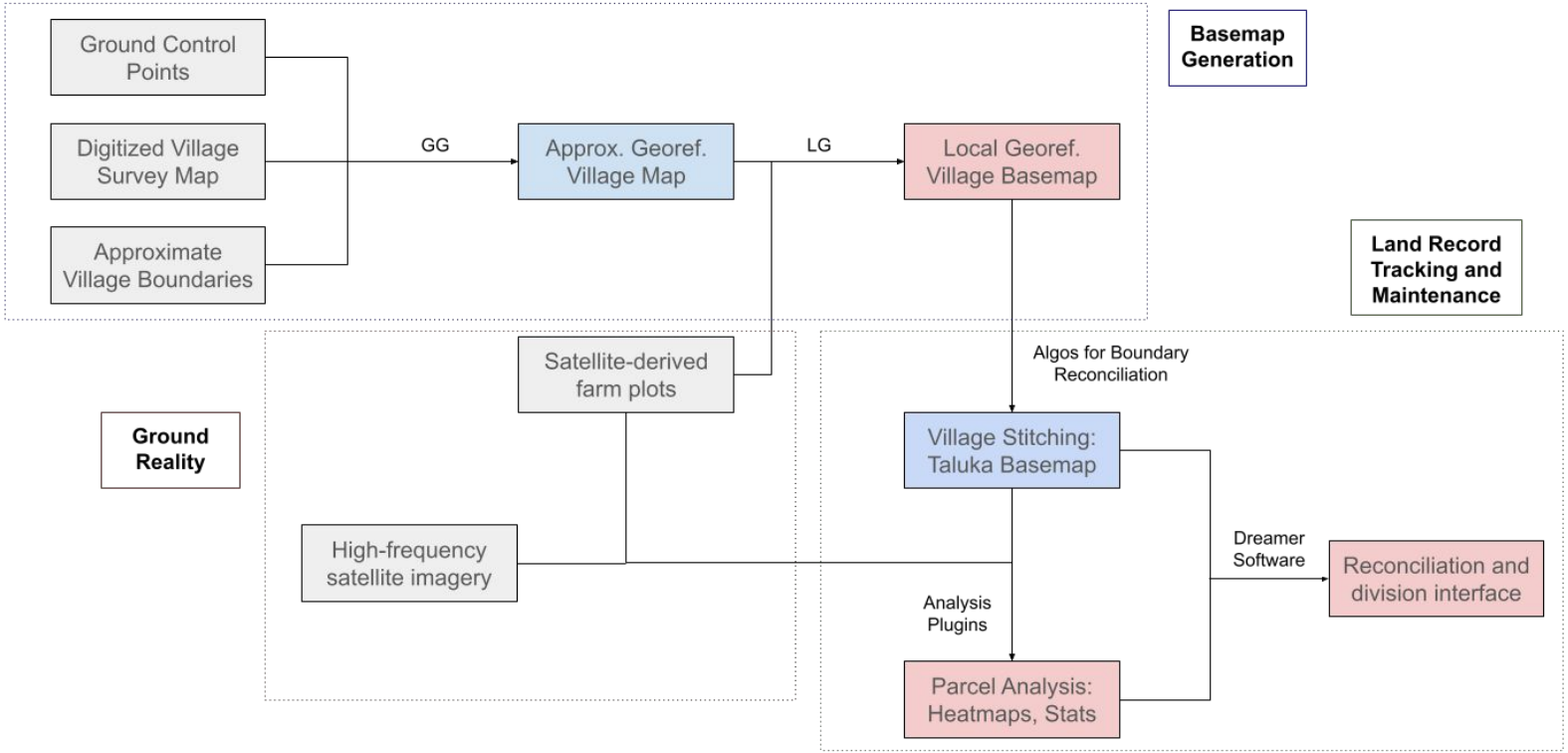

Agricultural Monitoring: Insurance and Subsidy Transfer

Urban Planning: Better base maps are useful for road mapping, etc



Efficiency in Land Development and Transfer

# Land Records Framework: Overview



# Introduction to Terrastack Tech. Pvt. Ltd.

Milind Sohoni

- Co-founder at TTPL
- Professor CSE, IIT Bombay
- Head CTARA, IITB (‘11-’16)
- Executed projects like PoCRA, UMA, etc with state and national governments

Aaryan Dangi

- Co-founder at TTPL
- B. Tech. IIT Bombay CSE ‘25

IIT Bombay SINE Business Incubator

Incubated by SINE, IIT Bombay in February 2024

GISE HUB Geospatial Information Science & Engineering

Prototyping grant given for land records work: October 2024

AGU ADVANCING EARTH AND SPACE SCIENCE

Team invited to present our work on land records: November 2023

# Introduction to Terrastack Tech. Pvt. Ltd.

Asim Rama Praveen

- Core Team, TTPL
- Software Engineering at Greenplum, etc for 20+ years

Bharat Adsul

- Core Team, TTPL
- Professor CSE at IIT Bombay

Lisan Kadivar

- Core Team, TTPL
- IIT Bombay CSE ‘25

## Our Mission

We want to solve problems for individual farmers and landowners, and the agencies that support them.

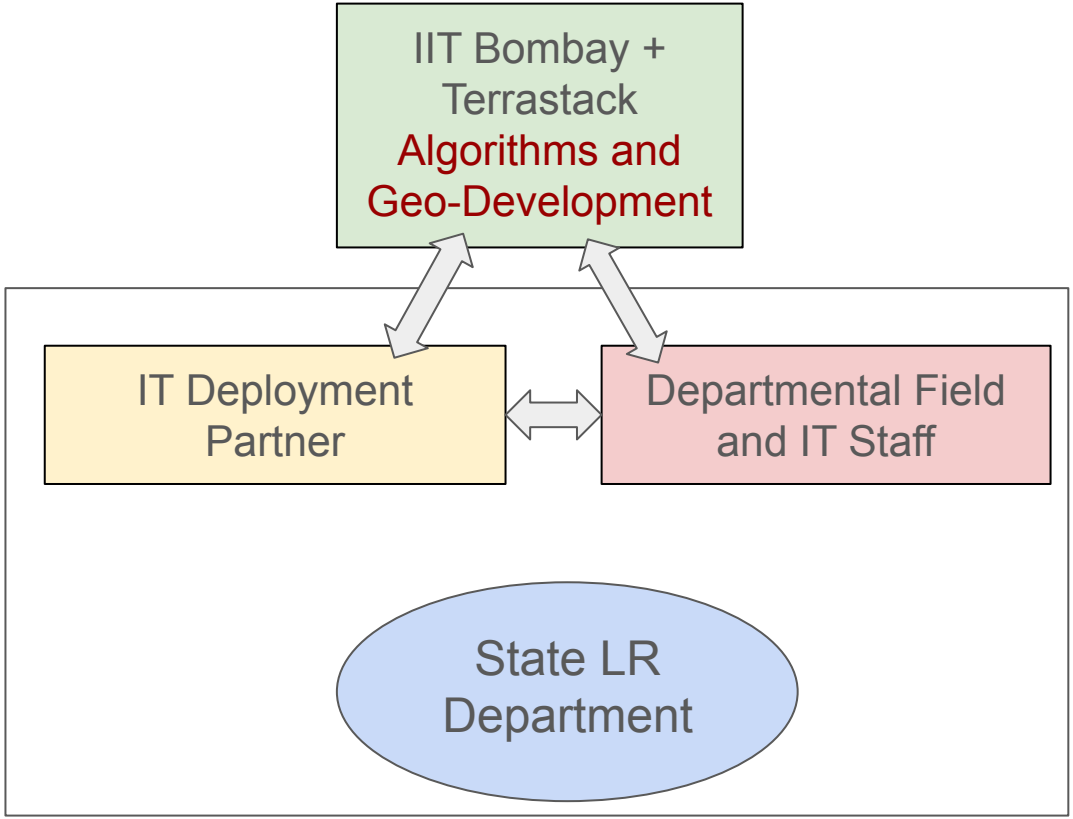
## Our vision

Our aim is to build an end-to-end digital land records system, that allows for the modeling and analysis of land assets and events.

# Typical Engagements

| Module 3: Fixing of Village Boundaries for Pilot talukas | | |
|---|---|---|
| | Deliverables: IIT Bombay | Responsibilities: DLR |
| Phase 5<br>(5 months) | • Report on the internal and external incoherence for existing village boundaries and area gaps between villages<br>• Release of alpha version of module: reconciliation of village boundaries<br>• Intermediate outputs made available from the end of third month onwards<br>• Outputs and statistics produced for 2 talukas | • Preparation of relevant input data (original village boundary data)<br>• Assistance with phrasing rules to be followed when facing issues such as (i) road networks spread over multiple villages, (ii) missing village boundary roads on the survey map, (iii) overlapping road and stream polygons, and (iv) problems of a similar nature<br>• Designate IT staff to liaison with the IITB team<br>• To liaison with SOI for validation purposes of outputs |
| Phase 6<br>(4 months) | • Release of beta version of module as per SOI recommendations and feedback<br>• Incorporation of developed pipeline into Module 1 software<br>• Rolling improvements and support in execution of module | • Field validation of maps and relaying feedback from the field<br>• Quality checking of inputs and outputs with the help of relevant scripts and SOPs |

Phase-wise delivery: MoU between GoM and IIT Bombay




Multi-partite engagements: building and scaling state-wise land record systems

# What do we need to know to work with other states?

- Structure and quality of existing maps, and their formats
- Availability and accuracy of Ground Control Points (GCPs)
- Choice of metrics for optimization
- Current formalisation processes and legal status of already “modernised” land parcels
- Procedures for reconciliation of disputes and subdivision of land
- Decision on a reliable proxy for ground reality

# A Peek into Our Team