

DoLR Meeting

1st December 2025

Agenda

1. Quick Review of T&C of MoU-II and administrative issues
2. Pending matters about MoU
3. Work outline
4. Going ahead

MoU-II

1. Production of accurate Georeferenced maps for 6 talukas (~ 700 villages)
2. Development of Land Record Ratings for individual plots
3. Fixing of village Boundaries for individual talukas

	Deliverables: IIT Bombay	Responsibilities: DLR
Phase 5 (5 months)	• SOPs and scripts for data validation, and error detection and resolution • Rolling improvements and support in execution of input villages: generation of basemaps (version 1) • Scripts for automatic generation of reports that detail the proximity to validation points (GCPs) and assess overall village map and GCP quality • Impart training to the DLR IT team on running software validation of input data • Intermediate outputs are to be provided for validation periodically • Semi-automatic GCP marking and label verification process with GIS software	• Provide necessary IT infrastructure on ESDS cloud or another provider, as mutually agreed • Hire 4-5 IT team members or more to run IIT's pipeline and validate outputs • Finalize farm plot data source, derived from satellite images by MRSAC or other relevant parties, that match general and accuracy requirements • Execution of transferred software modules for available input villages • Preparation of input data: labeled GCPs, maps and textual data • Quality checking of inputs and outputs with the help of relevant scripts and SOPs • Field validation and relaying validation points and general feedback from SOI

MoU-II

1. Production of accurate Georeferenced maps for 6 talukas (~ 700 villages) (50%)
2. Development of Land Record Ratings for individual plots (20%)
3. Fixing of village Boundaries for individual talukas (30%)

Total Budget: Rs. 149L. First installment Rs 30L received, March 2025.

	Item	Amount (Rs.)
<i>Module 1</i>	2 software developers @90k per month x 9 months	16,20,000
	2 students @50k per month x 9 months	9,00,000
<i>Module 2</i>	1 field engineer / project research associate @60k per month x 9 months	5,40,000
	1 student @50k per month x 9 months	4,50,000
<i>Module 3</i>	1 software developer @90k per month x 9 months	8,10,000
	1 student @50k per month x 9 months	4,50,000
<i>Overall Project</i>	1 delivery lead @135k per month x 9 months	12,15,000
	1 technical lead @135k per month x 9 months	12,15,000
	1 senior software consultant @175k per month x 9 months	15,75,000
	2 faculty @135k per month x 9 months	24,30,000
	Consumables	1,50,000
	Travel	3,00,000

MoU-II

Pending Issues

- No-Objection email for project to hire Terrastack to provide technical manpower at stated terms
- Extension of project beyond MoU end-date

As of now Rs. 30L remains unutilized, and about Rs. 24L work has been done in Phase I

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Phase 4 submission (29th Nov. 2024)

Examination of sources of Errors

- Farm plots
- Algorithmic deficiencies

Automatic village metric evaluation software provided.

- To compare with manual approach

Village Statistics and Heatmaps

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	45.90	72.13
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

February 2025

- MRSAC segmentation found inadequate

Possible reasons for data hold-up

- GCP and labels
- Textual area and geometric area mismatch

Deep-dive of 10 villages

Input Data

District name	Taluka name	Number of villages	Input villages received	Villages submitted by IIT for verification
Beed	Dharur	66	33	33
Buldhana	Malkapur	78	56	0
Chandrapur	Chandrapur	103	0	0
Dhule	Sakri	229	0	0
Raigad	Khalapur	157	0	0
Satara	Karad	225	19	0

Classification: Segmentation



Over-segmentation



Under-segmentation

The diagram shows a network of 10 nodes (1-10) representing different land use types. The nodes are connected by lines, and the connections are labeled with numerical values representing spatial relationships. The diagram is overlaid on a map of land use types.

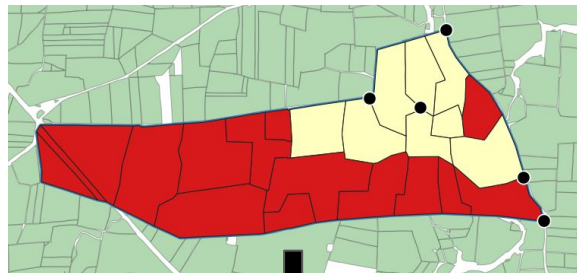
Connections and values:

- 1-2: 4.738
- 1-3: -6.846
- 1-4: 60.872
- 1-5: 49.556
- 1-6: 9.984
- 1-7: 1.777
- 1-8: 13.281
- 1-9: 10.291
- 1-10: -10.143
- 2-3: -4.139
- 2-4: 2.889
- 2-5: -10.555
- 2-6: -12.751
- 2-7: -12.363
- 2-8: 2.95
- 2-9: -12.763
- 2-10: -14.175
- 3-4: 16.836
- 3-5: 49.556
- 3-6: 9.984
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- 8-9: 10.291
- 8-10: -10.143
- 9-10: -10.143

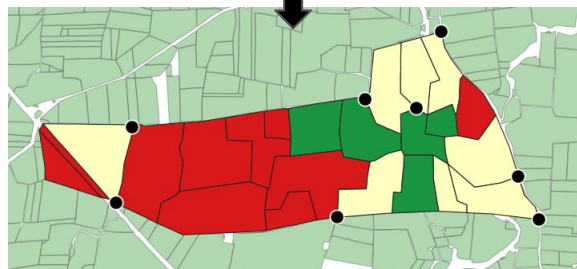
- Vertex distance map for a village

	Total Rows	Min Value	Max Value	Mean Value	Median Value
DONGARPIMPLA	6	0	57.10	22.90	21.78
BADWANI	8	0	53.95	14.89	12.39
HIDADUGI	9	0	26.38	12.17	11.50

GCP Analysis: Label-less Module



Pre-fix DTB
heatmap



Post-fix DTB
heatmap

Label-less georeferencing module:
auto-correction of labels where possible



Error: Clustering of GCPs

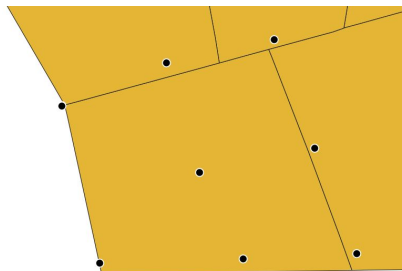
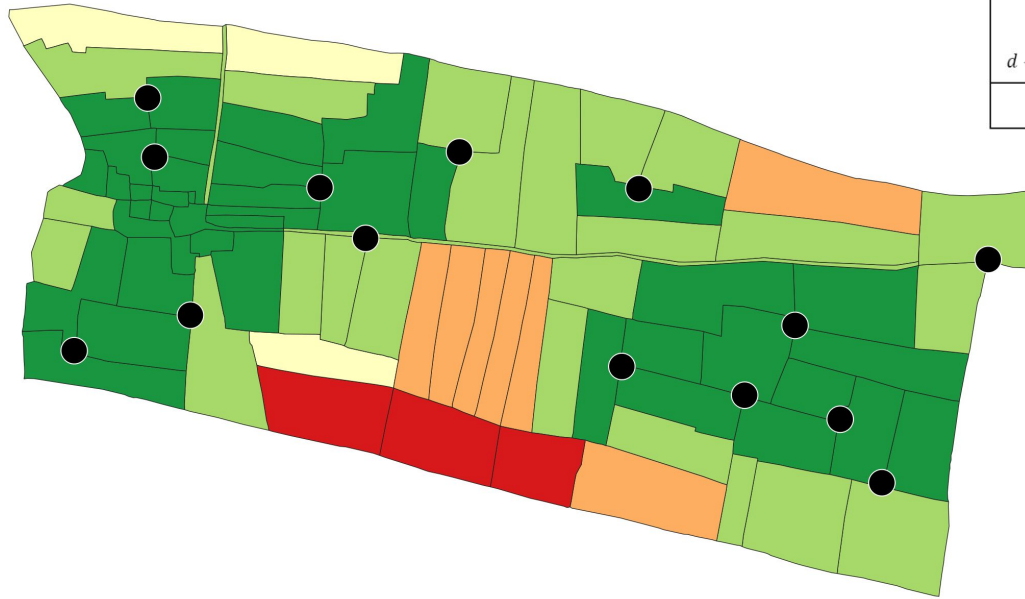


Illustration: GCP that does not
correspond to any vertex

Errors observed in GCP quality in Phase 4 villages:
clustering and point mismatch

GCP Analysis: Spread Over Village



$$Spread_rating(GCPs) = 1 - \prod_{all\ GCPs} (1 - e^{-x_i/d})$$

$x_i \rightarrow$ distance of the point of interest from GCP number i
 $d \rightarrow$ normalization factor calculated per village: $d = 1.5 * \sqrt{(average\ area\ of\ survey\ plot)}$

Formula for computing spread of virtual GCPs

GCP Spread Rating in Gopa: 74% (deficit in red area)

Textual-geometric area mismatch

Village	No. of plots with akar. area	Total No. of survey plots	Scaling factor (georef)	Error (%)
adyal	132	151	1.034277278	21.8974835
bhalsi	57	63	1.015184288	5.501574653
akoli	90	92	1.012382762	7.122797125
khadgaon	81	82	1.017088965	9.218186899
antapur	47	53	0.469586732	2.848558581
antarweli	115	160	1.006903482	132.9873319
badwani	132	216	1.136764779	169.9639097
bailmarkheda	31	34	1.069024122	47.51960347
adyal	132	151	1.034277278	21.8974835

[Link](#) to the complete sheet with data for both georef and survey_original

Methodology

- **Compute Ratios (<r>):** For each plot, calculate the ratio between its geometric area and textual (recorded) area.
- **Scaling Factor (f):** Take the average of the logarithms of these ratios to find the overall scaling factor.
- **Error (e):** Calculate the variance of the ratios to estimate the percentage error.

Way Ahead

- **Wide range of data issues** - IITB has helped with validation modules and will continue to help
- **Decide on overall strategy - Wire-frame, prepare map, validate on the ground**
 - **Select and publish key GCPs to community**
 - **Mark important roads - planned and unplanned**
 - **Run LG after that.**
- **Decide on farm plots**
- **Build IT team**

Way Ahead - Details

In the office

- Prepare village-level data - area, labelled GCPs and survey maps. Run validation checks.

Establish Wire-frame

- Establish key (old+new) GCPs - through surveys and community agreement, and **give error margins**.
- Mark important planned and unplanned roads with community and land records staff.

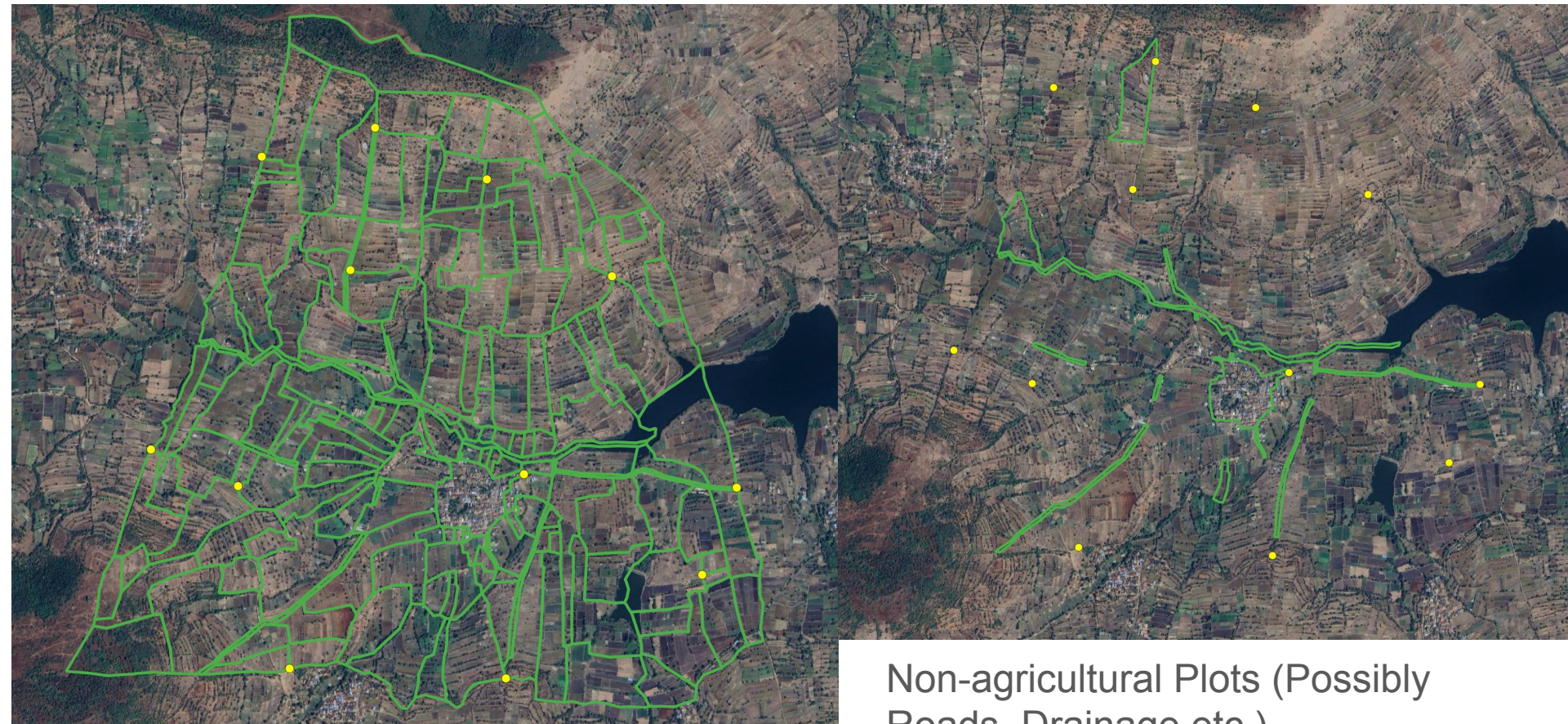
IITB Prepares maps

- Do error analysis and fit survey map using jitter and non-linear maps
- Use area fit and farm fit to identify anchor plots - LG
- Examine E-mojni plots and analyse
- Evolve standard rating and assign to each survey plot.

Validation in the field

- Provide mechanisms and guidelines for reconciliation

Wireframe for a sample Village - Hidadugi : GCPs and Roads



Hidadugi : GCPs (yellow) overlaid on Google Satellite tile

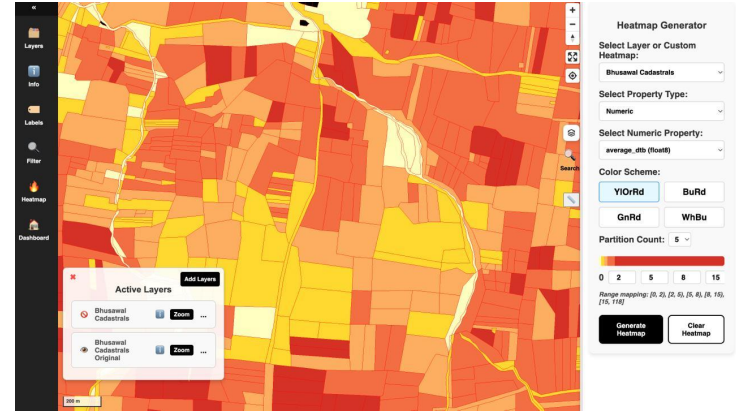
Non-agricultural Plots (Possibly
Roads, Drainage, etc.)

Analysis for Field Visits

District	Taluka	Village	% of plots with akarbandh-area diff < 5% for all plots	Same as before, for plots with non-null entry	GCP RMS Error: Simple affine (m)	GCP RMS Error (m): Georef	% plots with avg_dtb < 5m : Simple affine	% plots with avg_dtb < 5m : Georef
Kolhapur	Gadhinglaj	Hidadugi	63.9	93.3	9.5	6.6	87.3	86.7
Kolhapur	Gadhinglaj	Manwad	52.2	55.0	61.3	12.6	58.8	94.9
Amravati	Bhatkuli	Sarbalampur	73.3	73.3	5.7	4.7	66.7	73.3
Amravati	Bhatkuli	Jawara	1.5	13.3	9.0	6.8	33.8	45
Nagpur	Bhiwapur	Jambhurda	56.0	61.2	7.0	4.9	74	76
Nagpur	Bhiwapur	Indapur	7.3	8.6	6.5	9.6	43.9	68.3
Parbhani	Gangakhed	Badwani	23.6	90.9	12.8	1.1	66.9	64
Parbhani	Gangakhed	Dongarpimpla	42.2	67.3	18.3	2.5	81.9	77

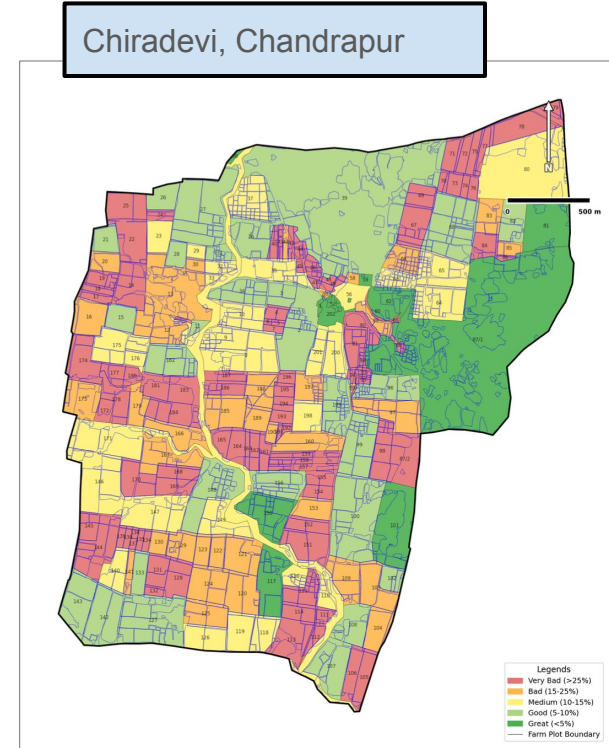
Terrastack already provides ...

- Pre- and Post- LG maps for Jalgaon, including taluka and village boundaries
- Farm plots, cropping pattern, cadastral-level area mismatch heat maps
- Plot-level mismatch, ownership, khata number and agri., water and commercial information



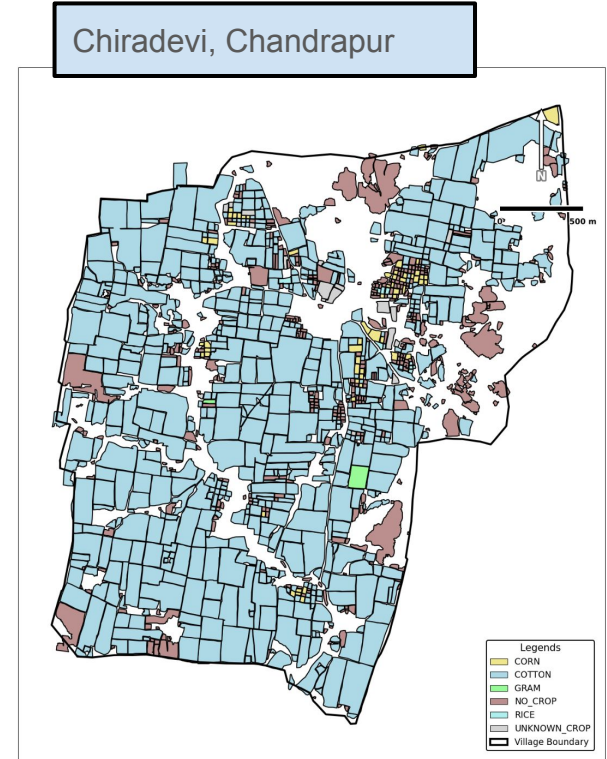
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- Pre- and Post- LG maps for Jalgaon, including taluka and village boundaries
- Farm plots, cropping pattern, cadastral-level area mismatch heat maps
- Plot-level mismatch, ownership, khata number and agri., water and commercial information
- We can add and integrate other layers - E-mojni, GCPs etc.



Today

- **Agreement on Terrastack to provide technical support as per MoU terms**
- **Extension of end-date of MoU and project**
- **Acceptance of Google ALU farm plots.**
- **Wide range of data issues** - IITB has helped with validation modules and will continue to help
- **Decide on overall strategy** - Wire-frame, prepare map, validate on the ground - 8 sample villages
 - **Select and publish key GCPs to community**
 - **Mark important roads - planned and unplanned**
 - **Run LG after that.**
- **Form IT team**