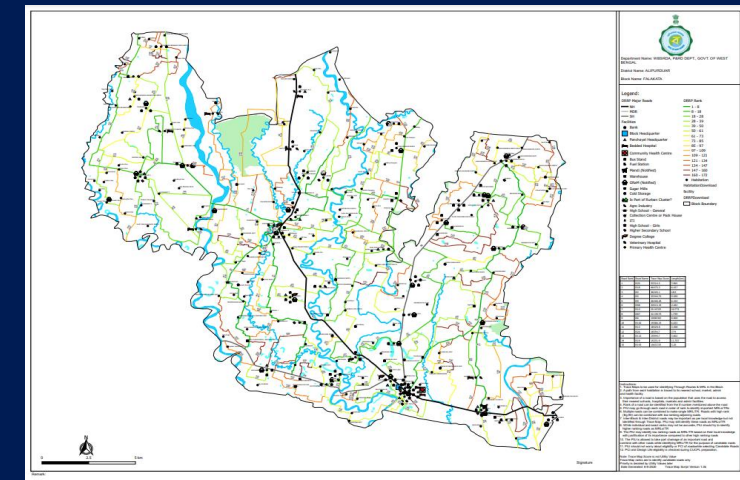
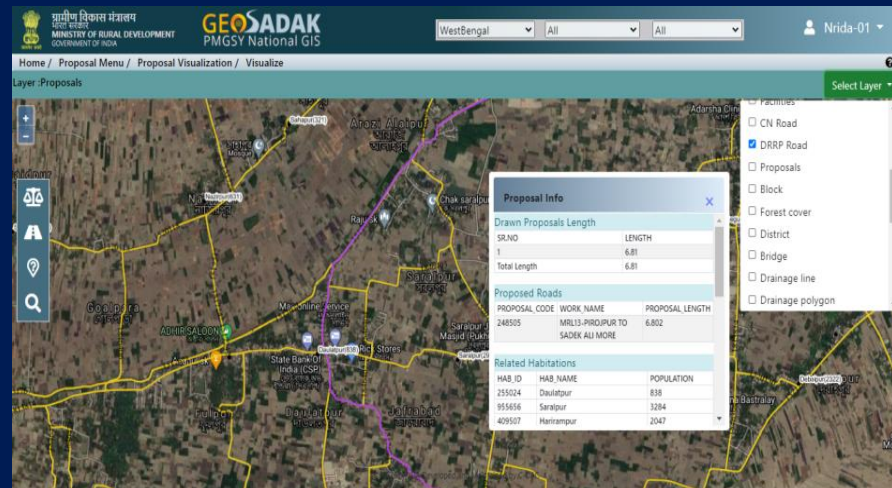
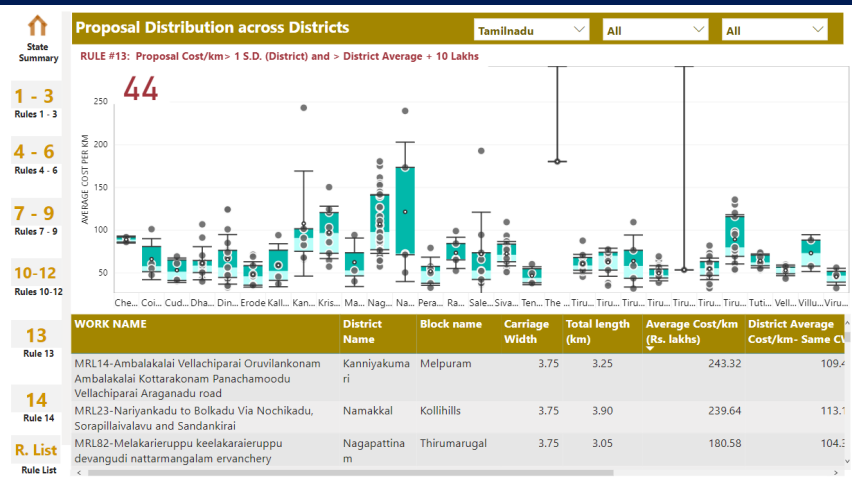




Data-Driven Planning of Rural Roads: Algorithms, GIS and Process Re-engineering in PMGSY



Harsh Nisar
 Lead Data Scientist
 Data & Insights Unit
 Ministry of Rural Development, Government of India

Here, students cross rivers to reach school



K. Srinivasa Rao

SRIKAKULAM:, AUGUST 12, 2014 00:30 IST
UPDATED: AUGUST 12, 2014 01:19 IST

SHARE ARTICLE | f | t | r | w | e | 8 | PRINT | A | A | A



Despite their pleas to build a bridge, these Gujarat kids swim daily to reach school

Drenched, the girls wring their churidaar-kurta uniforms before reaching out for their slippers.



Written by Aditi Raja | Vadodra | Updated: August 4, 2014 5:56:45 pm

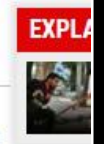


LIVE BLOG

- Jamia, AMU protest LIVE Updates: Students lead protest at India Gate, read Preamble of Constitution
3 hours ago
- Darbar trailer launch LIVE UPDATES: ... is a 'bad cop' in

ts LIVE updates:
ts assault on soul of
andhi

r 16 episode LIVE
r Rashami Desai and



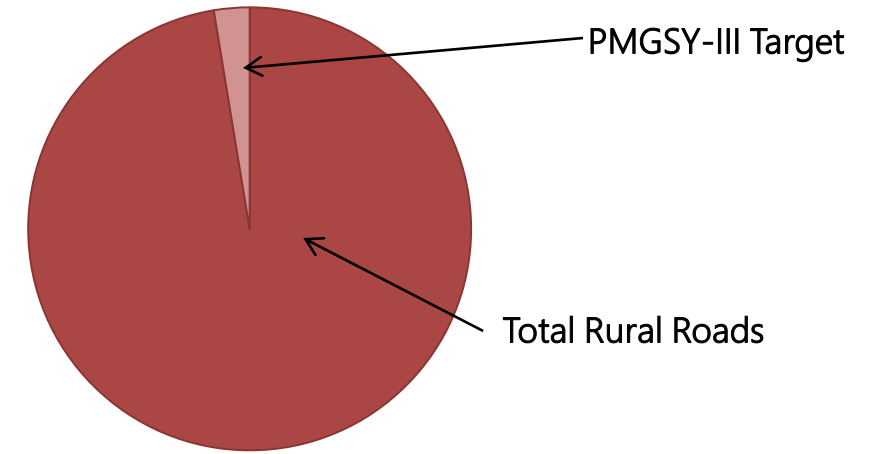
Pregnant woman carried for 6 km in cloth cradle in Erode

By Asia News International

PMGSY-III

Consolidating rural access to schools, hospitals and agro markets
1,25,000 km

Competing demands: MP/MLA, Local Industry, Panchayat and Citizens. Parallel funds – Temple board, Mandi board, District Mining Funds



How to find the most optimum road for PMGSY-III?

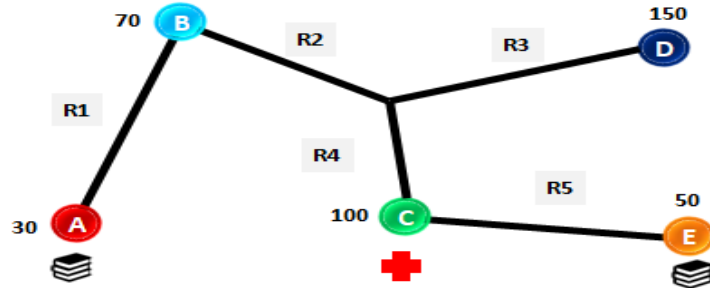
PMGSY-II Planning (Baseline)

Stage 1 – DRRP Preparation

Exhaustive survey of all Roads, Facilities and Habitations through tabular data-entry in excel sheets.

Plain listing.

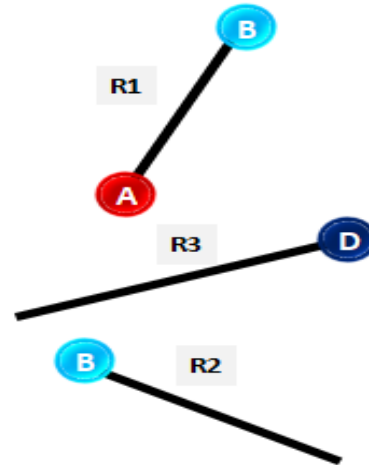
Let's assume block has target for only 1 road



Stage 2 – Candidate Road Identification

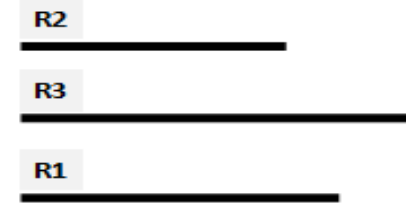
PIU identifies important roads based on local field knowledge and public representatives.

Eg. PIU selects 3 Roads



Stage 3 – CUCPL Priority List Generation

Each selected Road is scored in Excel on **Utility Value** based on population and facilities **directly** benefitted Good condition roads eliminated.



| Road | Utility Value | PCI |
|------|---------------|-----|
| R2 | 33.2 | 2.1 |
| R3 | 13.4 | 1.2 |
| R1 | 12.0 | 4 |



Stage 4 – Audit and Approvals

Audit of random 15% DPR for cost/design by Centre and 100% by STA.

SLSC, PRE-EC and EC approvals

States came to NRRDA after completing all 3 Stages together

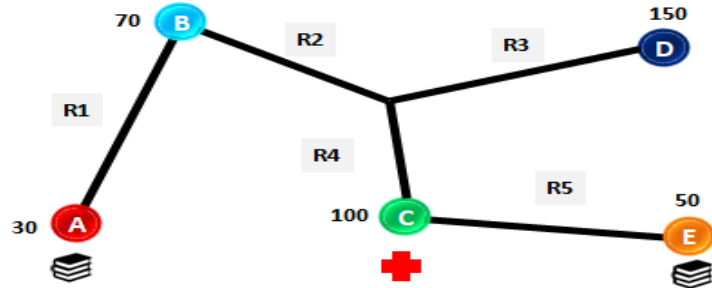
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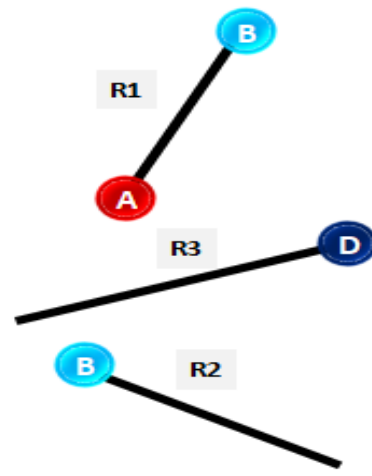
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Stage 2 – Candidate Road Identification

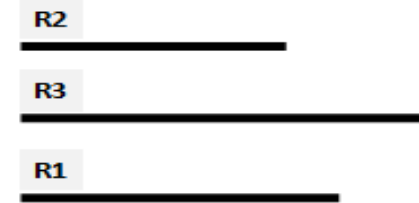
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Stage 4 – Audit and Approvals

Audit of **random 15%** DPR for **cost/design** by Centre and 100% by STA.

SLSC, PRE-EC and EC approvals

States came to NRRDA after completing all 3 Stages together

Key concerns

Tabular inventory of roads, habitations and facilities which are inherently spatial for rural road planning

Entirely **offline** process prone to manipulation with no point for early intervention

Subjective selection of candidate roads leading to unfair competition [large vested interests in road construction]

No independent source of data for road-use or traffic for rural roads at nation-scale

Manual mapping of “Benefitted Habitations” for Utility Value calculation allowing for rigging [excess/insufficient mapping]

No evidence to prove road’s being proposed exist in poor condition [except for scrutiny sample]

Random sampling to identify roads to be scrutinized leading to **sub-optimal** cost reduction and time-use

No GIS alignments of the roads being sanctioned at the time

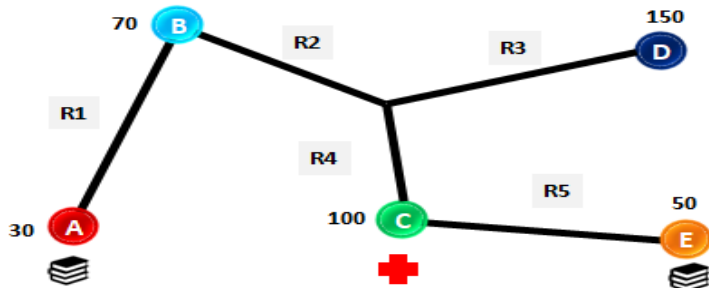
No planning audit for selection quality of roads [Primary focus was cost of roads selected]

PMGSY-III Planning

Stage 1 – DRRP Preparation

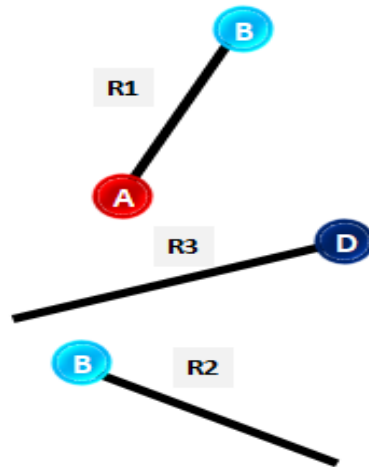
Exhaustive survey of all Roads, Facilities and Habitations and does ~~tabular data entry~~ *mapping on GIS and geo-tagged pictures*.

Let's assume block has target for only 1 road



Stage 2 – Candidate Road Identification

PIU identifies important roads based on local field knowledge, public representatives *and top ranking Trace Map* Roads



Stage 3 – CUCPL Priority List Generation

Each selected Road is scored on Utility Value based on population and facilities indirectly benefitted and sorted by system. Good condition roads based on *geo-tagged PCI pictures* are eliminated.

| Rank | Utility Value | PCI |
|------|---------------|-----|
| R5 | 55.5 | 2.4 |
| R4 | 45.4 | 2.3 |
| R2 | 33.2 | 2.1 |
| R3 | 13.4 | 1.2 |
| R1 | 12.0 | 4 |



Stage 4 – Audit and Approvals

Audit of ~~random~~ **algorithm based** 15% DPR for cost/design by Centre and 100% by STA. **Planning Audit** stage introduced to monitor utility of roads proposed on GIS. SLSC, PRE-EC and EC approvals

Each State separately completed online in modular manner

End to End PMGSY-III Planning Process

OMMAS

Habitation, DRRP and Facility Master

Trace Map Module

Candidate Road Module

Priority List Generation

Proposal Module

Planning Audit

DPR Audit

MP Consent, SLSC and EC

Facility Survey
7,70,000+ facilities geo-tagged through mobile app



Habitation & DRRP Survey on GIS
1 million habitations & 2.5 million km rural roads



Trace Map Tool
Multi-objective network optimization algorithm to identify important TR/MRLs and quantify the importance of every rural road in India

Identification of TR/MRLs:

1. MP Recommendations
2. Trace Map Algorithm
3. Local Elected Representatives
4. PIU Field Knowledge

Auto-mapping of Benefitted Habitations based on GIS API

Geo-tagged photo survey of each road to assess pavement condition



Priority List Generation:

1. Ranking based on **Utility Value**
2. Eliminating roads in good condition
3. Eliminating roads in Design Life Period
4. Eliminating very small proposals
5. Road selection only in order of system priority

| Sl. No. | MP Name | MP No. | MP Length (km) | MP Status |
|---------|---------|--------|----------------|-----------|
| 1 | ... | ... | ... | ... |
| 2 | ... | ... | ... | ... |
| 3 | ... | ... | ... | ... |
| 4 | ... | ... | ... | ... |
| 5 | ... | ... | ... | ... |

OMMAS doesn't permit entering proposal if not in order of priority

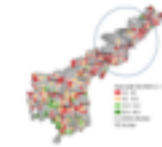
Drawing of Proposal Alignments on GEOSADAK (GIS ERP) by District Engineers



Planning Audit
Vetting Utility of Individual Proposals on GEOSADAK



Analyzing Geographical Parity



Ensure Candidate Road Coverage
Giving go ahead for DPR preparation

AI/ML Model to Flag Road's with Majority Surface in Good Condition



Anomaly Detection BI Tool to identify proposals with abnormal cost or design based on historical data



MP Consent and SLSC

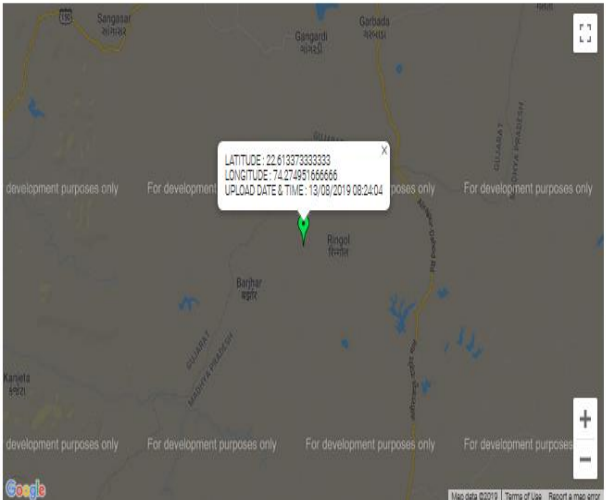
Approval on respective proposal list from Hon. Member of Parliament Approval of entire proposal by SLSC

PRE-EC & EC
Empowered Committee Meeting Chaired by Secretary, MoRD

GeoPMGSY Mobile APP | Geo-tagging Rural Facilities



| Facility Details | | | | | |
|------------------------|------------------------|---------------------|-----------------------|--------------|-----------------|
| DISTRICT : | Abrajpur | BLOCK : | Bhabra | HABITATION : | Ringol |
| FACILITY TYPE : | Transport/ Admin | FACILITY CATEGORY : | Panchayat Headquarter | ADDRESS : | ringol , 457882 |
| FACILITY DESCRIPTION : | Panchayat headquarters | | | | |



7,70,000+ rural facilities geo-tagged with photographs across Rural India
 Released under Government Open Data License
 One of the largest publicly available geo-tagged rural datasets released by GoI

High Schools, CHCs, Bedded Hospitals, Cold Storages, Warehouses, Banks, Fuel Stations, Panchayat HQs, Block HQs, Mandis etc

<http://omms.nic.in/Home/PMGSYRuralDataset/>

100% GIS based Inventory | Rural Roads & Habitations

25 million km ie more than half of India's entire road network digitized on GIS

1 million habitations with population digitized on GIS covering almost all rural settlements, tolas etc.

Took more than 3 years to complete from start to end

One of largest rural GIS datasets



Without this investment – the following algorithms and re-engineering wouldn't have been possible

Trace Maps

Multi-objective transport planning algorithm

Basic Principle

Each habitation should have access to nearest school, hospital, market and administrative buildings

Identify nearest facilities of every kind and draw the route from the habitation to each of the facilities

Eg. Routes from Habitation A to nearest high school, hospital, agricultural market etc

22 such routes for every habitation – termed as its routes of fundamental access

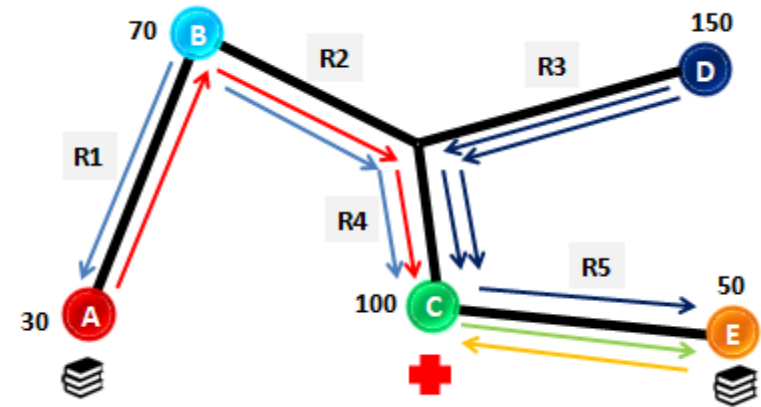
Repeat it for 1 million habitations ie 22 million fundamental routes

Identify the roads which are part of these 22 million routes and calculate importance based on the destination facilities and population of habitation using the route

Convert this information into Block Level Trace Map Ranks with color coded roads and ranks.

Written in PyQGIS and GRASS [works offline as QGIS plugin]

Code is made open source and can be used by State Schemes



Inputs:

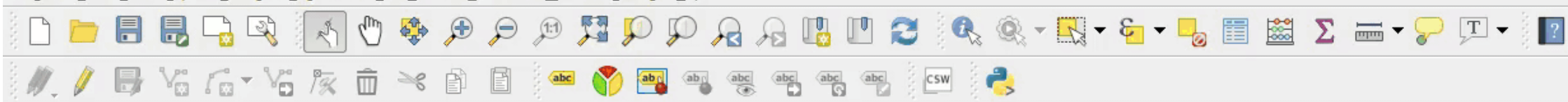
Geo-tagged facilities

Habitation & rural road shapefiles

Outputs

Trace Map PDF

Trace Rank CSV



Browser Panel

- Project home
- Home
- Favourites
- C:/
- D:/
- E:/
- DB2
- MSSQL
- Oracle
- PostGIS
- Spatialite

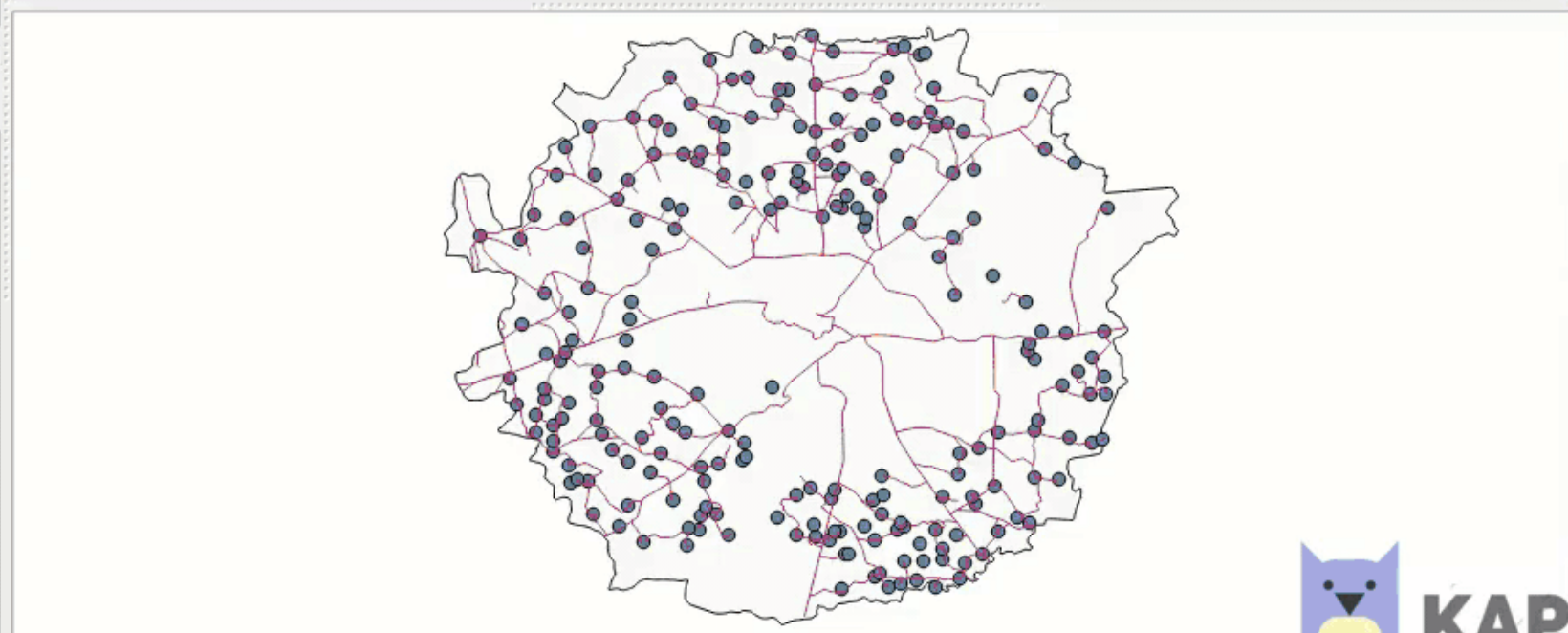
Python Console

```

1 Python Console
2 Use iface to access QGIS API interface or Type help(iface) for more info
3

```

>>> |



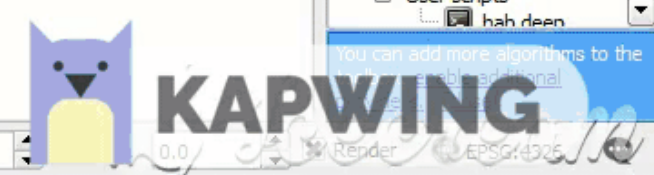
Layers Panel

- DRRP
- FacilityDownload
- HabitationDownload
- DRRPDownload
- HABITATION
- Block_Boundary

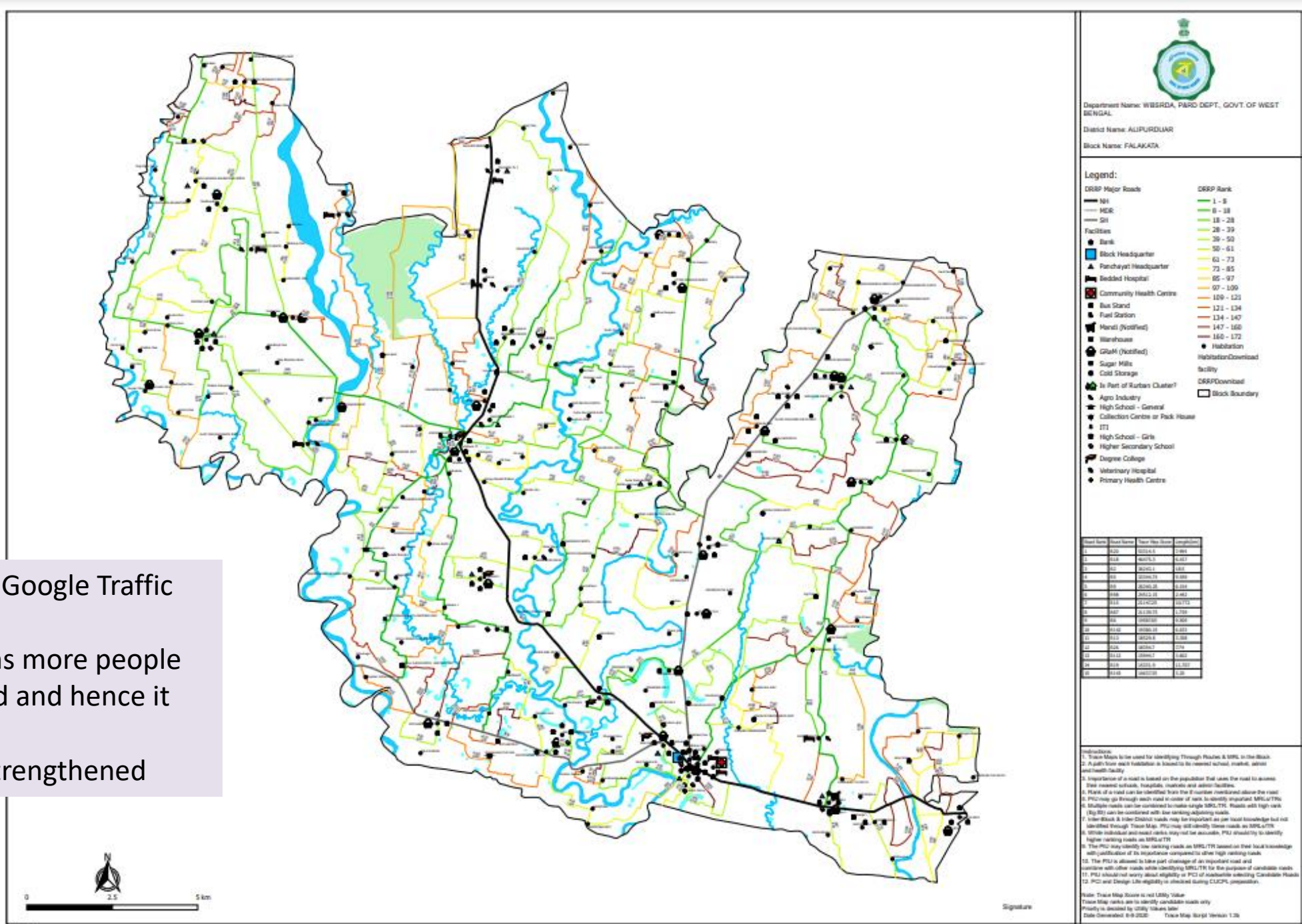
Processing Toolbox

Search...

- Recently used algorithms
 - Extract by attribute
 - v.type - Change t...
 - Trace Map v1.2
 - Convert geometry...
 - v.build.check - Ch...
 - Clip Tool PMGSY
- GDAL/OGR [48 geoa...
- GRASS GIS 7 comman...
- Models [0 geoa...
- QGIS geocalgorithms [1...
- SAGA (2.3.2) [353 ge...
- Scripts [11 geoa...
- Routing tools
 - Clip Tool PMGSY
 - tm split
 - trace map 20 ...
 - trace map rj
 - Trace Map v1...
 - Trace Map v1...
 - Trace Map v1.1
 - Trace Map v1.2
 - Tracemap 20 8
 - Tracemap 31 7
- Tools
 - Add script fro...
 - Create new s...
 - Create script ...
 - Get scripts fr...
- User scripts
 - hab_deep



Opposite of Google Traffic Maps:
Green means more people use this road and hence it should be upgraded/strengthened



Remark:

Signature

We make it mandatory to consider the top-15 trace map ranked road as part of the "Candidate Roads". Rest remains as-is.

Guiding principle was to not override field knowledge or political representation but ensure roads with most impact are selected

Existing and Trusted Utility Value based final selection was retained. Trace Map is used just to make the competition fair.

Trace Map high ranking roads



PIU Field Knowledge



MP/MLA/Panchayat Recommendations



Candidate Road Pool

Instead of changing rules of the race – we just ensure that race is competitive

Pradhan Mantri Gram Sadak Yojana
PMGSY3 CUCPL Details

| STATE : Chhattisgarh DISTRICT : Bijapur BLOCK : Bijapur | | | | | | | | | | Candidate Road Composition* (No roads of less than 10 years of design life can be taken up under PMGSY-III.) | | | | | | | | | | |
|---|---------------|------------|-------------|-----------------------|---|-----------------------|------------------------------------|---------------|------------------------|--|------------------|------------|--------|----------------|--------------|--|-----------------|----------------------------------|------------------------------------|---|
| Rank | District Name | Block Name | Road Number | Candidate Road Length | Candidate Road Eligibility (should be greater than equal to 5 km) | Eligible CUCPL Length | Road Name | Utility Value | Trace Map Minimum Rank | DRRP Road Name | DRRP Road Number | Road Owner | Length | Trace Map Rank | Weighted PCI | PCI Eligibility (Less than equal to 3) | Eligible Length | Is Completed Under PMGSY-I or II | Is Partly/Fully Under Design Life? | Years Elapsed Since Road Completion (31st March, 2020 is reference) |
| 1 | Bijapur | Bijapur | MRL05 | 0.800 | Not Eligible | 0.800 | Bijapur To Rawatpara | 12.50 | 10.000 | Bijapur to Rawatpara (887362) | L061 | OTHERS | 0.800 | 10.000 | 3.00 | Yes | 0.800 | N/A | N/A | N/A |
| 2 | Bijapur | Bijapur | MRL10 | 5.000 | Eligible | 5.000 | Midte To (Toynar-Eramnar) Road | 11.40 | 6.000 | Midte to Toynar (1314664) | RR(TRACK)092 | CRRDA | 2.000 | 12.000 | 1.50 | Yes | 2.000 | N/A | N/A | N/A |
| | | | | | | | | | | T01(Bijapur to Naimed) to Midte Road (887656) | L077 | CRRDA | 3.000 | 6.000 | 2.00 | Yes | 3.000 | | Yes | 0 |
| | | | | | | | | | | T01(Bijapur to Naimed) to Midte Road (887656) | L077 | CRRDA | 3.000 | 6.000 | 2.00 | Yes | 3.000 | | Yes | 0 |
| 3 | Bijapur | Bijapur | MRL04 | 6.500 | Eligible | 6.500 | Dugoli To (Dhanora-Toynar) Road | 9.08 | 6.000 | T04(Toynar road Km 6.00) to Papanpal (887653) | L074 | CRRDA | 2.000 | 44.000 | 2.00 | Yes | 2.000 | N/A | N/A | N/A |
| | | | | | | | | | | T01(Bijapur to Naimed) to Midte Road (887656) | L077 | CRRDA | 2.800 | 6.000 | 2.71 | Yes | 2.800 | | Yes | 0 |
| | | | | | | | | | | T01(Bijapur to Naimed) to Midte Road (887656) | L077 | CRRDA | 2.800 | 6.000 | 2.71 | Yes | 2.800 | | Yes | 0 |
| | | | | | | | | | | Papanpal to Patelpara (887655) | L076 | CRRDA | 1.700 | 59.000 | 2.00 | Yes | 1.700 | N/A | N/A | N/A |
| 4 | Bijapur | Bijapur | MRL03 | 6.500 | Eligible | 6.500 | Bijapur To Sanghpara | 6.77 | 4.000 | Bijapur to Itpal (887361) | L060 | OTHERS | 5.000 | 4.000 | 3.00 | Yes | 5.000 | N/A | N/A | N/A |
| | | | | | | | | | | Itpal To Sanghpara (889477) | RR(TRACK)97 | CRRDA | 1.500 | 31.000 | 2.00 | Yes | 1.500 | N/A | N/A | N/A |
| 5 | Bijapur | Bijapur | MRL09 | 13.780 | Eligible | 13.780 | Toynar To (Naimed-Kutru) Road | 6.31 | 8.000 | (Naimed-Farsegarh Road) km 3.0 to Earamnar (887657) | L078 | CRRDA | 3.380 | 8.000 | 2.00 | Yes | 3.380 | N/A | N/A | N/A |
| | | | | | | | | | | Toynar to Patelpara (887650) | L071 | CRRDA | 2.400 | 9.000 | 2.10 | Yes | 2.400 | N/A | N/A | N/A |
| | | | | | | | | | | ERAMNAR TO TOYNAR (1318826) | RR(TRACK)088 | CRRDA | 8.000 | 13.000 | 1.00 | Yes | 8.000 | N/A | N/A | N/A |
| 6 | Bijapur | Bijapur | MRL07 | 0.950 | Not Eligible | 0.950 | Gangaloor to Gagrapara | 5.26 | 14.000 | Gangaloor to Gagrapara (887339) | L038 | CRRDA | 0.950 | 14.000 | 2.00 | Yes | 0.950 | N/A | N/A | N/A |
| 7 | Bijapur | Bijapur | MRL02 | 15.000 | Eligible | 15.000 | NH16 (Chinnakodepal) To Kandulnar | 4.20 | 7.000 | T04(Bhopalpatnam-Jagdarpur) to Kandulnar (887367) | L066 | CRRDA | 15.000 | 7.000 | 1.13 | Yes | 15.000 | N/A | N/A | N/A |
| 8 | Bijapur | Bijapur | T02 | 41.350 | Eligible | 41.350 | Bijapur to Hiroli | 4.06 | 2.000 | Bijapur to Hiroli (887663) | T02 | OTHERS | 41.350 | 2.000 | 2.60 | Yes | 41.350 | Completed | Yes | 0 |
| 9 | Bijapur | Bijapur | MRL06 | 6.800 | Eligible | 6.800 | NH16 To Block Colony | 2.94 | 11.000 | NH 16 MANJHIPARA TO ROUTPARA (1314738) | RR(TRACK)111 | CRRDA | 3.800 | 11.000 | 2.66 | Yes | 3.800 | N/A | N/A | N/A |
| | | | | | | | | | | T01 to Turnar (887359) | L058 | OTHERS | 3.000 | 25.000 | 3.00 | Yes | 3.000 | N/A | N/A | N/A |
| 10 | Bijapur | Bijapur | MRL08 | 1.900 | Not Eligible | 1.900 | Gangaloor to Potiyapara | 2.63 | 15.000 | Gangaloor to Potiyapara (887340) | L039 | CRRDA | 1.900 | 15.000 | 2.21 | Yes | 1.900 | N/A | N/A | N/A |
| 11 | Bijapur | Bijapur | MRL01 | 25.000 | Eligible | 25.000 | Bijapur To Naimed via Turnar | 2.52 | 1.000 | Bijapur to Turnar (887046) | L024 | CRRDA | 10.000 | 1.000 | 2.25 | Yes | 10.000 | N/A | N/A | N/A |
| | | | | | | | | | | TUMNAR TO PEDDAPARA (1314677) | RR(TRACK)105 | CRRDA | 8.000 | 100.000 | 2.00 | Yes | 8.000 | N/A | N/A | N/A |
| | | | | | | | | | | Naimed to Peedapara (887045) | L023 | PWD | 7.000 | 5.000 | 3.00 | Yes | 7.000 | N/A | N/A | N/A |
| 12 | Bijapur | Bijapur | T01 | 36.000 | Eligible | 36.000 | T02 (Gangaloor) To Karrepara | 1.89 | 3.000 | T02 to Karrepara (887664) | T03 | OTHERS | 36.000 | 3.000 | 1.00 | Yes | 36.000 | N/A | N/A | N/A |

GeoSADAK | Democratizing Use of GIS in Decision Making

- Login based GIS ERP solution
- First of its kind indigenous WebGIS built by C-DAC using FOSS instead of propriety & expensive softwares such as ArcGIS
- User roles for District Engineer, State Admin, NRIDA
- Tightly integrated with OMMAS
- Hosts 14+ layers such as water bodies, forest, rural facilities, quarries, railways etc
- Multiple Basemaps (OSM, Google and Bhuvan)
- 1 million habitations & 2.5 million km rural road network
- User can update and add new GIS features directly on the system by point-and-click mechanism
- Eliminates requirement GIS specialists for basic tasks
- Used in PMGSY-III for tracing and submitting alignments for Planning Audits by central and state teams
- APIs being developed to open this data publicly
- Benefitted Habitation API to provide OMMAS with habitations in 5 km path distance of every candidate road

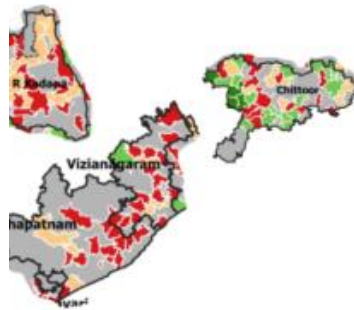
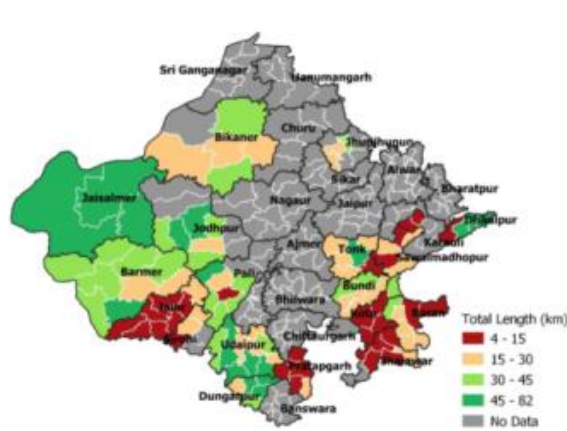
Moving from static post-facto mapping to GIS first and enabled process flows, decision making and algorithms



Pradhan Mantri Gram Sadak Yojana (PMGSY) was launched by the Government of India to provide connectivity to unconnected habitations in order to provide continuing access to economic and social services thus increasing the agricultural incomes, employment and other

Planning Audits| Bringing Road Selection to the forefront

- Newly added separate high-level stage just for auditing the selection of roads in the state
- Heavy use of GIS, Remote Sensing and other algorithms
- Ensuring PMGSY-III Road Selection Policy is followed in letter & spirit
- Sampled based scrutiny of roads with large Trace Ranks on Satellite Imagery
 - This was not possible before because lack of data on road importance for every rural road in India
- Rejection of proposals which are meeting programme objectives
 - Eg. Roads leading to mines or serving very small population or through private farms, parallel to existing roads etc.
- Verifying State's target allocation strategy to ensure internal target is distributed fairly (especially in backward areas).
- DPR preparation is given go-ahead only after completion of Planning Audit



Verifying geographic coverage of proposals

Identifying roads not serving PMGSY-III objectives



Anomaly Detection Tool | Smart Sampling for DPR Scrutiny

- After Planning Audit and preparation of DPRs, the cost & design specifications of proposals are uploaded on OMMAS
- Central Team is supposed to scrutinize 15% of the DPRs in-depth
- Usually – these DPRs are selected randomly or based on simple averages
- Anomaly Detection Tool was created to give score to each DPR on how *anomalous* it's cost or design is
- It is mix of domain expert rules and unsupervised learning rules
- The output is visualized on a BI tool for ease of use
- Samples for scrutiny of states are derived from this tool

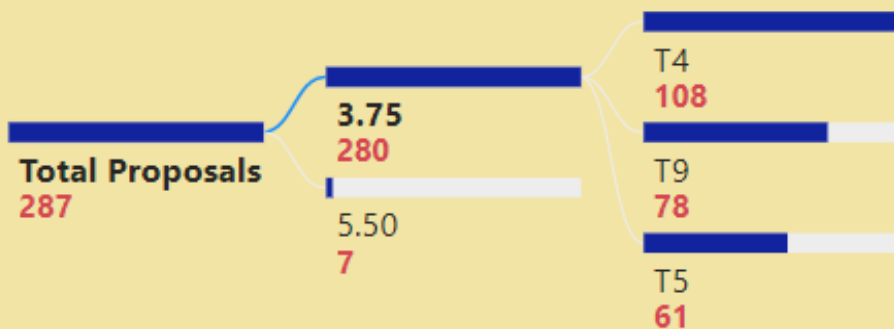
Proposal Analysis Summary

Tamilnadu

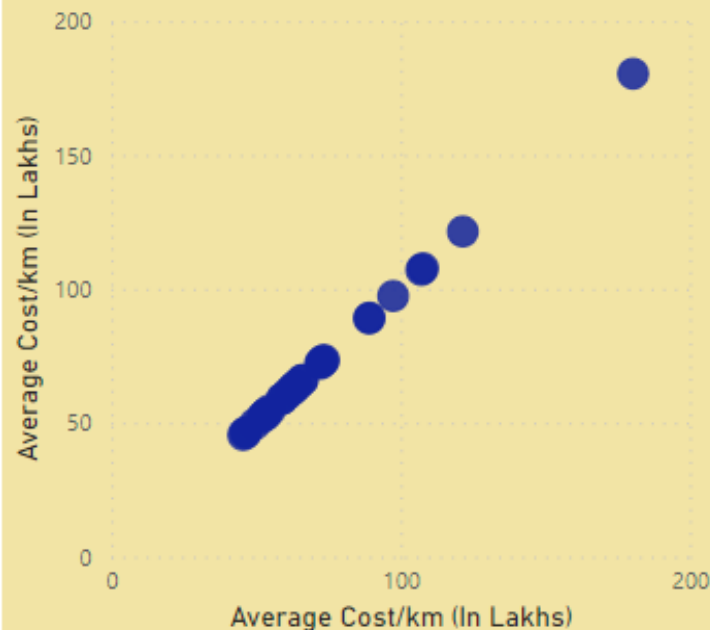
All

Proposals by Traffic Name and Carriage Width

CARRIAGE WI... 3.75
TRAFFIC NAME



Average Cost in Districts



287

TOTAL PROPOSALS

1,302.86

TOTAL LENGTH (km)

957

Total Cost (Rs. Crores)

73.43

Avg Cost/km (Rs. Lakhs)

| Carriage Width | 3.75 | | | | | 5.50 | | | |
|----------------|--------------|----------------|-------------------|------------------------|---------------------------------|-----------------------------|----------------|-------------------|------------------------|
| | Traffic Name | Proposal Count | Total Length (km) | Total Cost (Rs. Lakhs) | Total Pavement Cost (Rs. Lakhs) | Average Cost/km (Rs. Lakhs) | Proposal Count | Total Length (km) | Total Cost (Rs. Lakhs) |
| IRC 37 | | 5 | 27.17 | 1,714.12 | 1,038.52 | 63.10 | 7 | 51.95 | 6,967.09 |
| T4 | | 108 | 448.07 | 35,469.64 | 19,046.67 | 79.16 | | | |
| T5 | | 61 | 259.87 | 16,126.15 | 7,784.86 | 62.05 | | | |
| T6 | | 27 | 116.04 | 6,677.91 | 3,329.28 | 57.55 | | | |
| T7 | | 1 | 5.05 | 373.99 | 160.92 | 74.06 | | | |
| T9 | | 78 | 394.71 | 28,340.78 | 15,989.99 | 71.80 | | | |
| Total | | 280 | 1,250.91 | 88,702.59 | 47,350.24 | 70.91 | 7 | 51.95 | 6,967.09 |



State Summary



District Summary



Rules



Anomaly Score



State
Summary

1 - 3

Rules 1 - 3

4 - 6

Rules 4 - 6

7 - 9

Rules 7 - 9

10-12

Rules 10-

13

Rule 13

14

Rule 14

R. List

Rule List

List of Rules

| Rule No. | Rule Description | Rule Weightage |
|----------|--|----------------|
| 1 | Proposals with Furniture Cost > 3% of Total Cost | 10 |
| 2 | Proposals with Pucca Drain Length > 2X CC Length | 10 |
| 3 | Proposals with Traffic category < T9 and BM not 0 | 20 |
| 4 | Proposals with BT+CC+WBM = Length and Sub base cost > 10% Pavement cost | 30 |
| 5 | Proposals with BT+CC+WBM = Length and Subgrade cost > 10% Pavement cost | 30 |
| 6 | Proposals with CW > 3.75 and Average Cost/km > 1.4* Avg Cost/km for CW=3.75 | 0 |
| 7 | Proposals with Carriage Width > 5.5 and Higher Specification Cost = 0 | 20 |
| 8 | Proposed Total Length > 1.10*Eligible Length and Higher Specs cost = 0 | 0 |
| 9 | PCI (2-3)= Eligible Length and Pavement Cost > 60% State Average Pavement cost | 30 |
| 10 | Proposals with CD works/km > 2 and Avg CD Cost/no. > District Avg | 20 |
| 11 | Proposals with CC Length > 2 and CC Length > 50% Total Length | 10 |
| 12 | Proposals with T = T6/T7/T8 and WBM Cost/km > 1.5 State Avg WBM Cost/km for T <= T5 | 20 |
| 13 | Proposal Cost/km > 1 Standard Deviation (District) and > District Average + 10 Lakhs | 30 |
| 14 | Protection Cost > 1 Standard Deviation (District) and > District Average + 7 Lakhs | 20 |



State Summary

1 - 3

Rules 1 - 3

4 - 6

Rules 4 - 6

7 - 9

Rules 7 - 9

10-12

Rules 10-12

13

Rule 13

14

Rule 14

R. List

Rule List

Proposals Violating Rules 4 - 6

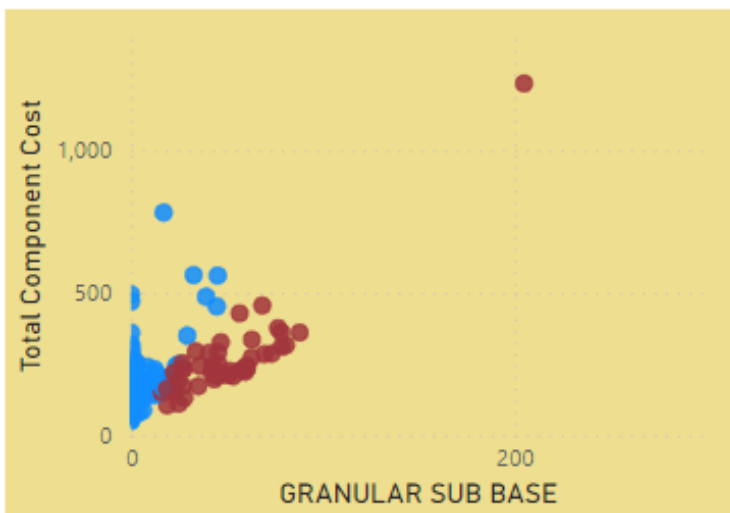
Tamilnadu

All

RULE #4:

Proposals with BT+CC+WBM = Length and Sub base cost > 10% Pavement cost

49

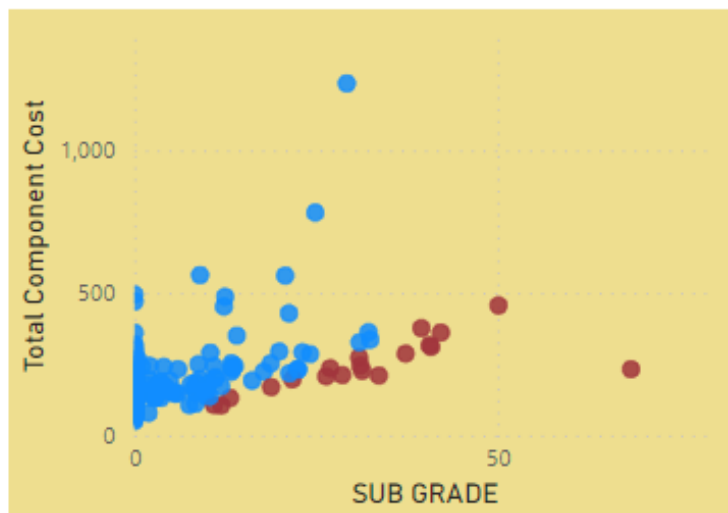


| WORK NAME | Subbase Cost/WBM Cost |
|---|-----------------------|
| MRL47-Keelasalai -Anjamanai to Mukkavattam Via Naraiyanpuram | 26.62% |
| MRL82-Melakarieruppu keelakaraieruppu devangudi nattarmangalam ervanchery | 25.66% |
| MRL07-Manaloor-Anaiseri road to Muthaneri Nallukurichi road via keelakula | 25.65% |
| MRL76-Dharmathanapuram road to Muthaneri | 25.55% |

RULE #5:

Proposals with BT+CC+WBM = Length and Sugrade cost > 10% Pavement cost

19

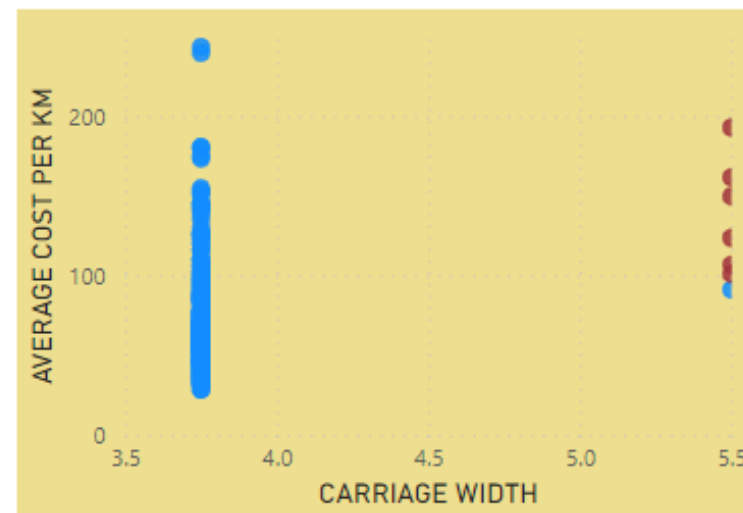


| WORK NAME | Subgrade Cost/WBM Cost |
|--|------------------------|
| MRL01-Nangoor to kathiruppu Sembathaniruppu Via Keelaiyur | 13.83% |
| MRL01-Thudiyalur to mangarai (via) 24,Veerapandi | 11.35% |
| MRL03-Melavidangalur Kadambankudi sattiyakudi 119 anakudi West street Road | 16.01% |
| MRL07-Manaloor-Anaiseri road to Muthaneri | 11.43% |

RULE #6:

Proposals with CW >3.75 and Average Cost/km > 1.4* Avg Cost/km for CW=3.75

6



| WORK NAME | CARRIAGE WIDTH | AVERAGE COST |
|--|----------------|--------------|
| MRL01-Thirupoondi Karapidagai Sadayankottagam Road | 5.50 | |
| MRL02-Mappadugai to Kadalengudi road | 5.50 | |
| MRL02-Thudiyalur to Maruthamalai | 5.50 | |
| MRL02-Vathalagundu Usilampatti road to Dullimankottai road | 5.50 | |



State
Summary

1 - 3

Rules 1 - 3

4 - 6

Rules 4 - 6

7 - 9

Rules 7 - 9

10-12

Rules 10-12

13

Rule 13

14

Rule 14

R. List

Rule List

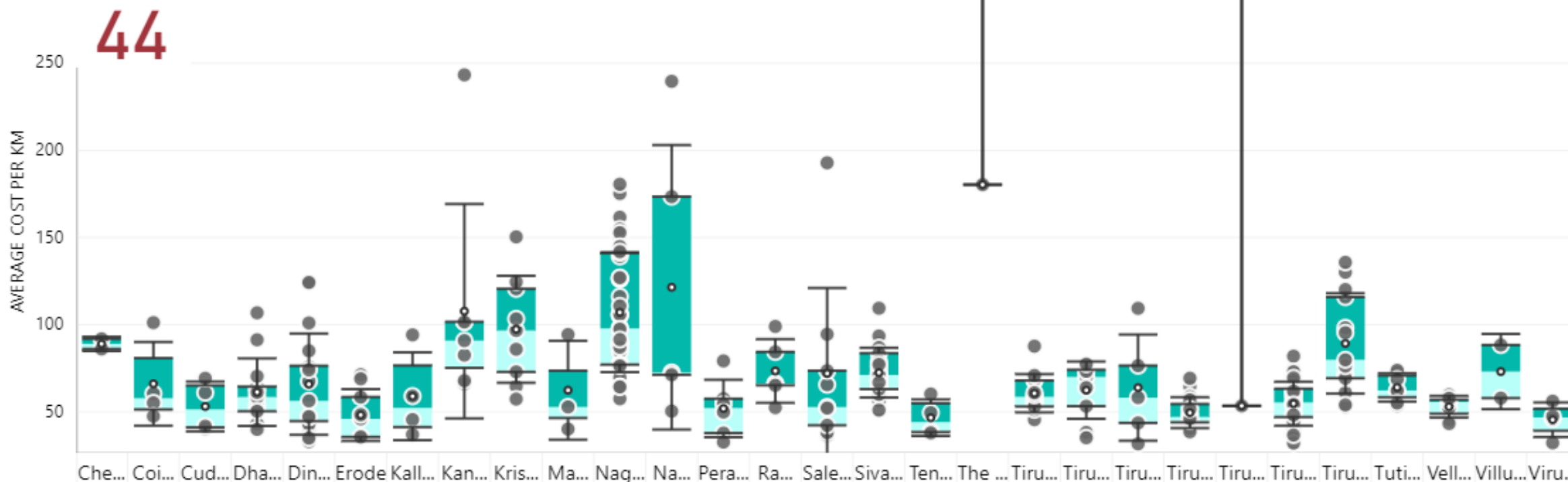
Proposal Distribution across Districts

Tamilnadu

All

All

RULE #13: Proposal Cost/km > 1 S.D. (District) and > District Average + 10 Lakhs



| WORK NAME | District Name | Block name | Carriage Width | Total length (km) | Average Cost/km (Rs. lakhs) | District Average Cost/km- Same CV |
|--|---------------|--------------|----------------|-------------------|-----------------------------|-----------------------------------|
| MRL14-Ambalakai Vellachiparai Oruvilankonam Ambalakai Kottarakonam Panachamoodu Vellachiparai Araganadu road | Kanniyakumari | Melpuram | 3.75 | 3.25 | 243.32 | 109.4 |
| MRL23-Nariyankadu to Bolkadu Via Nochikadu, Sorapillaivalavu and Sandankirai | Namakkal | Kollihills | 3.75 | 3.90 | 239.64 | 113.1 |
| MRL82-Melakarieruppu keelakaraieruppu devangudi nattarmangalam ervanchery | Nagapattinam | Thirumarugal | 3.75 | 3.05 | 180.58 | 104.3 |

AI for Road Surface Detection [SADAK-AI]

- PMGSY-III is only for taking up road which are currently in poor condition
- Sometimes, PIUs propose roads which are largely in good condition
- These roads are either not eligible or candidates for cost reduction
- To verify surface condition – central teams looks at random proposals and goes through their pictures which is time consuming
- A ResNet34 architecture based deep learning model was trained in-house which can classify road surface pictures as poor or good with more than 90%+ accuracy.
- The model goes through the pictures automatically and flags a select sample of proposals which it believes are largely in good condition
- Only proposals where more than 60% of pictures are marked by model in good condition are checked by central team.

Cost of Development:
Rs 0/-
Developed 100% in-house

Average Pictures Checked
Before Each PRE-EC by Model:
5,000-10,000



```
{ 'Prediction': 'Good',  
  'Probability': 0.99305 }
```



```
{ 'Prediction': 'Poor',  
  'Probability': 0.96015 }
```

People

Resources

C-DAC staffing increased by 30% for PMGSY-III

NRIDA created in-house position for Data Scientist and GIS Specialist

SRRDA provided with funding to setup GIS Cells in HQ [manpower + hardware]

Capacity Building

NRIDA created GIS course for civil engineers based on PMGSY examples

Continuous role-based trainings to all officers from Block to State level
[500+ hours of training]

Leadership & Policy Support

Major reform and re-engineering required 100% backing from leadership

NRIDA, CDAC, SRRDA and MORD were all on the same page regarding reforms.

Algorithm institutionalized in Original Guidelines

Management of Change

Selection of roads is political and high-stakes situation. Many high-level meetings were had with elected representatives both at the centre and at the state to get acceptance for the new and improved process of selection of roads.

Learnings

Investing in Data & Infra

Farseeing investments needed + focus on use eventually

Digitization of DRRP and Habitations initiated in 2015 much before PMGSY-III use-case was identified.

Data Quality Linked to State Capacity

- Algorithm needs good quality data.
- Good data requires proper monitoring of digitization effort + high quality local vendors
- States with poor overall capacity also didn't have good quality data
- They could not proceed with road selection process till data quality was fixed. State most need of roads may get roads delayed

Algorithmic Assumptions

- Even simple algorithms have assumptions or edge cases which can adversely impact outcomes
- Do people go their nearest facilities, if so, with the shortest path?
- Can habitations be treated as points?
- Do people only access facilities within the block they reside?

Building In-house capacity & Use of FOSS

Entire intervention cost nothing apart from the salaries of existing staff

Need to invest in inhouse specialized talent

Algorithms written in Python, QGIS, PyTorch etc.

Learnings

Human  Algorithms

Use algorithms to support or nudge but with balancing of human oversight.
Algorithms can never be perfect

- Trace Map only ranks road based on simulated traffic but final combination of roads to make routes is decided based on field logic
- Field Engineer can select as many roads apart from Top-15 as candidate roads
- MPs to be recommended mandatorily while selecting candidate roads
- Final selection based on **Utility Value** which is pre-existing logic.
- Even SADAK-AI and Anomaly Tool are to do smart sampling for human verification & not to replace humans

68% roads proposed are recommended by Trace Maps.

22% cases the road proposed by field logic or MPs have more Utility Value than the Trace Map roads

Open Data – From Physical to Digital Goods

- Data collected for planning is too valuable for single-use
- 800,000 facilities, 2.5 million km roads and 1 million habitations have released as open data
- Roads in itself act as multipliers for various services
- Planners, startups, academics etc are invited to build solutions on top of that data to ensure first mile delivery of services

<https://geosadak-pmgsy.nic.in/opendata/>

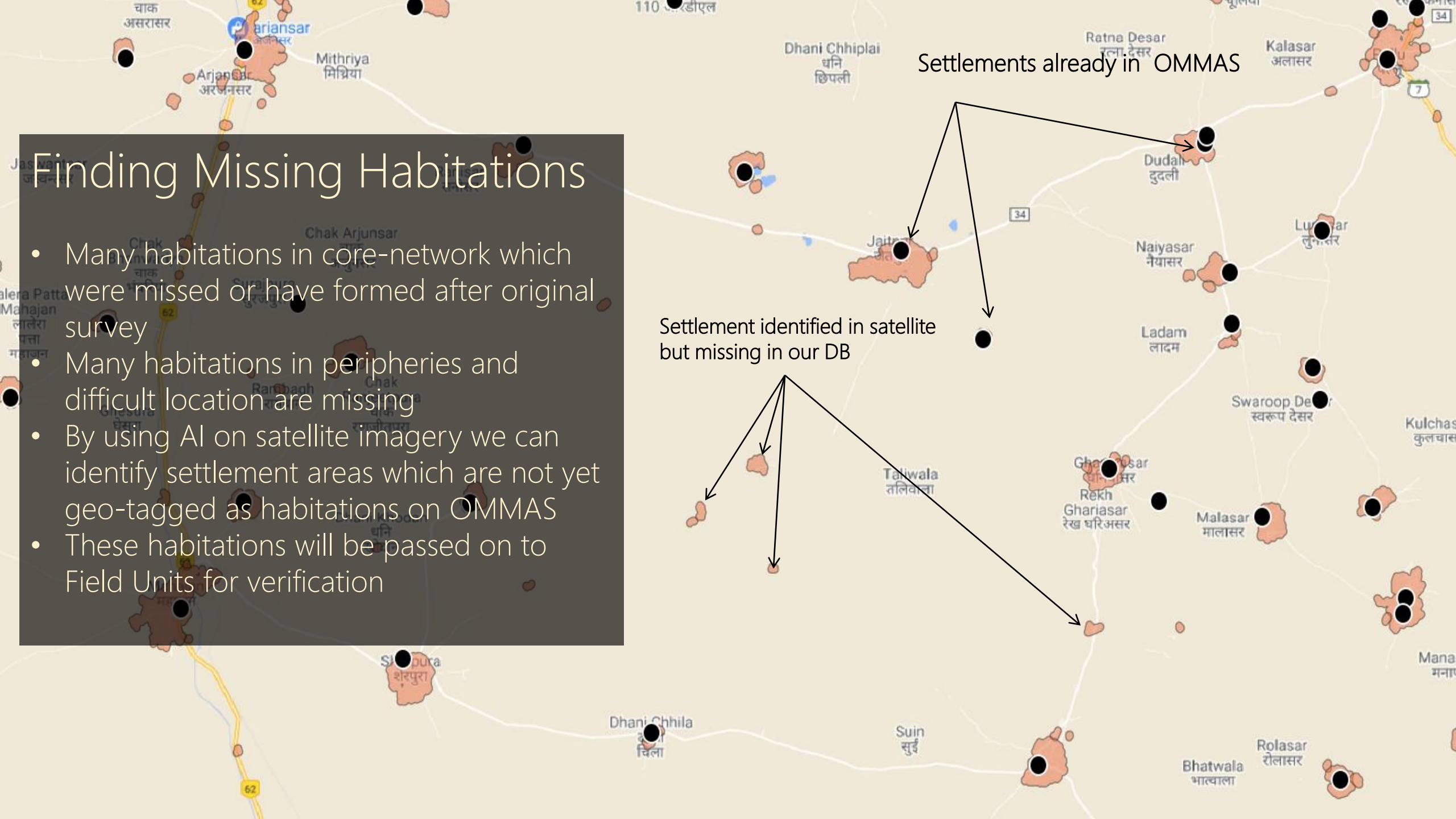
11,000+ downloads in two months

Finding Missing Habitations

- Many habitations in core-network which were missed or have formed after original survey
- Many habitations in peripheries and difficult location are missing
- By using AI on satellite imagery we can identify settlement areas which are not yet geo-tagged as habitations on OMMAS
- These habitations will be passed on to Field Units for verification

Settlements already in OMMAS

Settlement identified in satellite but missing in our DB



Thank You

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