



**Facilitating Climate-informed Prioritisation of Road Maintenance through Road Asset Management System: The Case of Kerala RMMS**

Dr Bhavesh Jain  
Consultant- RAMS  
TRL, India

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INDIA CHAPTER

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# Why Operation & Maintenance of Roads matter?

## Key challenges:

- Hazards- Landslides, Frequent floods, coastal erosion
- Rapid deterioration due to extreme rainfall & weather variability
- High Replacement cost and poor Level of Service
- Limited redundancy & high socio-economic impact of disruptions

## Why O&M is critical:

- Even well-designed roads degrade faster without monitoring
- Resilient O&M ensures continuity of connectivity
- Climate change is increasing frequency & severity of hazards.

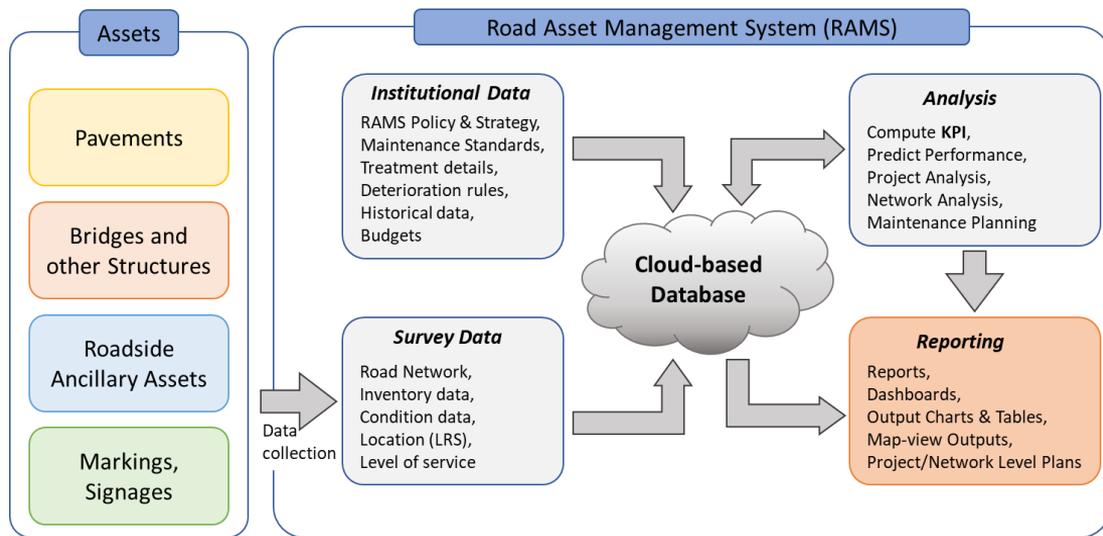




# What is Road Asset Management System (RAMS)?

## RAMS provides:

- Full asset inventory (roads, bridges, drainage)
- Condition monitoring and deterioration modelling
- Lifecycle cost analysis and prioritized maintenance planning
- A unified platform linking data → decisions → budgeting



Source: OECD

## Why it matters for resilience:

RAMS integrates asset performance with hazard exposure, enabling predictive, not reactive, maintenance.



# Why Climate Resilience in RAMS?

- Providing a unified digital platform for managing asset, condition, and performance data.
- Integrating historical and projected hazard datasets such as floods, landslides, and extreme rainfall.
- Enabling spatial visualisation of hazard exposure and asset vulnerability.
- Supporting predictive maintenance planning that targets high-risk and high-criticality sections.





# iROADS - TRL's Climate-informed RAMS Solution



iROADS is a Total Roads Asset Management System – **One platform** for operational, tactical and strategic activities

- Cloud-native, Software-as-a-Service (SaaS) global platform
- API-based, mobile-first with easy integration with other systems
- Multi-asset: pavement, structures (bridges, tunnels, culverts), drainage, signage, etc.
- Web-based with integrated mobile companion apps
- Fully capable of managing hazard risk and vulnerability spatial data to make climate-informed decision
- Fully spatially enabled to manage and visualise spatial data with ease



## Operational

Maintenance activities management: inspections, surveys and works

## Tactical

Pavement scheme optioneering, maintenance programme planning

## Strategic

Investment scenario planning, multi-year analyses, network KPIs



INDIA CHAPTER

# iROADS Global Reach



National Highways, UK

Malta

Kerala PWD, India

OR Tambo, SA

LGED, Bangladesh

Vanuatu



INDIA CHAPTER

# Case Study: Climate-informed RAMS in Kerala

## Context:

- 31,000 km road network
- Terrain: Western Ghats, midlands & low-lying coastal areas
- Frequent floods, landslides & coastal erosion
- Need for unified, climate-aware asset management

## iROADS Implementation (By TRL):

- State-wide inventory + condition survey (NSV + FWD)
- HDM-4 integrated forward works programme
- Real-time cloud platform
- Public & engineer mobile applications
- Climate module for hazard-risk integration



Kerala- "God's Own Country"



# Case Study: Bottlenecks in KPWD's Operations

KPWD encountered several significant challenges in their earlier operations:



**Lack of Information:** The department lacked accurate records without a robust system to keep and update inventory and condition data of road assets.



**Ineffective Resource Allocation:** Ad-hoc fund allocation resulted from unreliable data, neglecting priority areas.



**Siloed Information:** The lack of a unified system for data collection and access meant that knowledge remained localized to specific engineers.



**Inefficient Communication:** No efficient process for gathering and monitoring public issues/queries regarding road conditions.



# Case Study: *iROADS* as Kerala RMMS

The screenshot displays the iROADS user interface. On the left is a vertical navigation menu with icons for home, layers, location, search, favorites, help, and user profile. The main area is a map of Kerala, India, with a dense network of blue lines representing roads. A search bar at the top of the map area contains the text "Q Search by Asset ID, Road Name, Road Number". On the right side, a "Summary Info" panel is open, showing details for a selected road section:

- Section Label:** KPWD/EKM/SH/63/1
- Measured Section Length (m):** 25500
- Road Number:** 63
- Road Name:** Vypin Pallipuram Road
- Road Type:** Four Lane Road

Below the summary panel, the "Latest Survey" section shows:

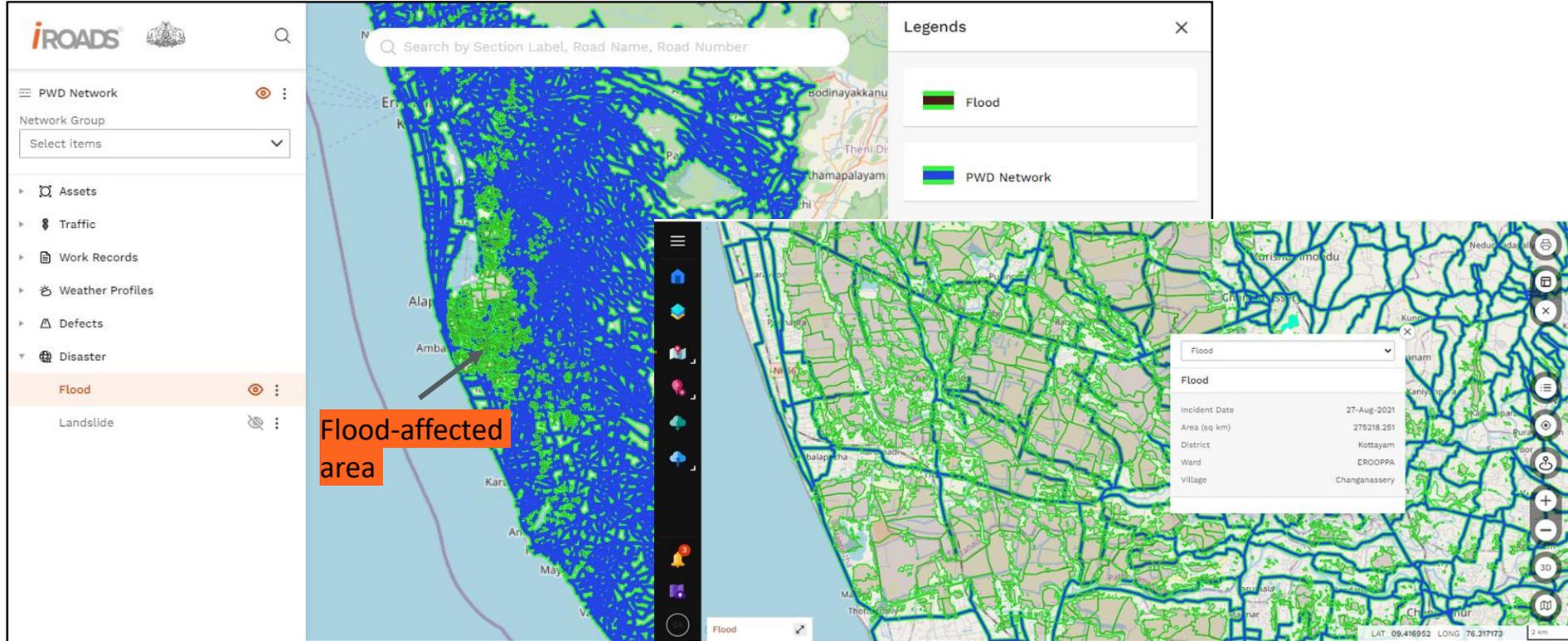
- Survey Type\*:** FWD SURVEY
- Survey Name:** 378\_PWD-FWD\_EKMSH63dummv.csv(58)
- Chainage Marker:** Off

At the bottom of the map, the coordinates are displayed as LONG 75.538576 and LAT 11.165312, along with a 50 km scale bar.

*User Interface of Kerala RMMS (iROADS) with Kerala's road network*



# Integrating Climate Resilience Module within iROADS



*Integration of historical flood data with Kerala road network to assess flood risk factor*



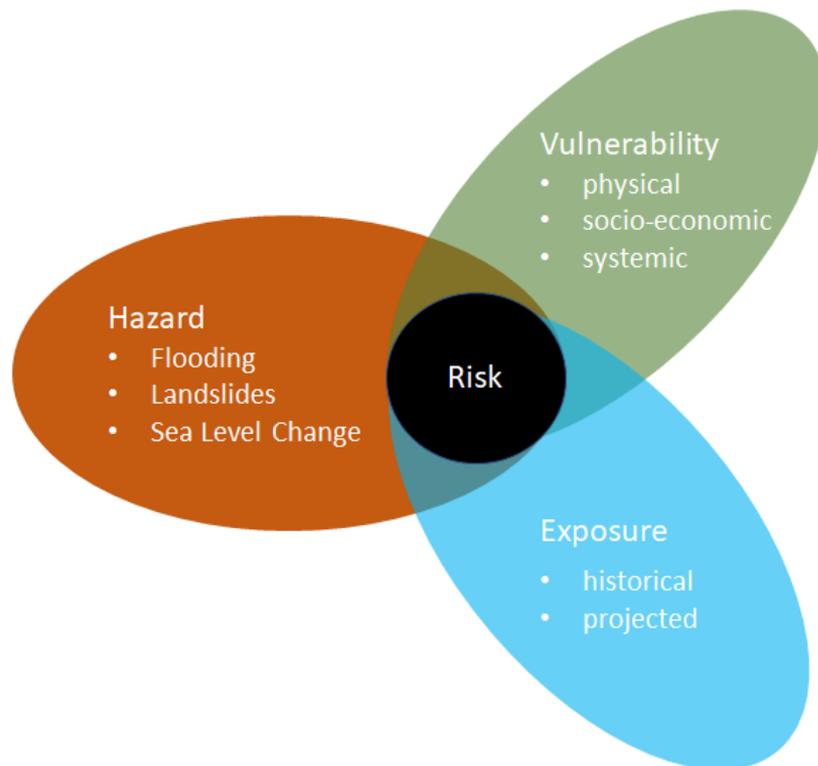
# Integrating Climate Resilience Module within *iROADS*

## Steps:

1. Identify hazards (flood, landslide, coastal surge)
2. Determine exposure (road segments, structures, slopes)
3. Assess vulnerability (drainage condition, slope angle, pavement type)
4. Assign risk scores
5. Generate climate-informed maintenance plan
6. Optimize budget using lifecycle cost analysis

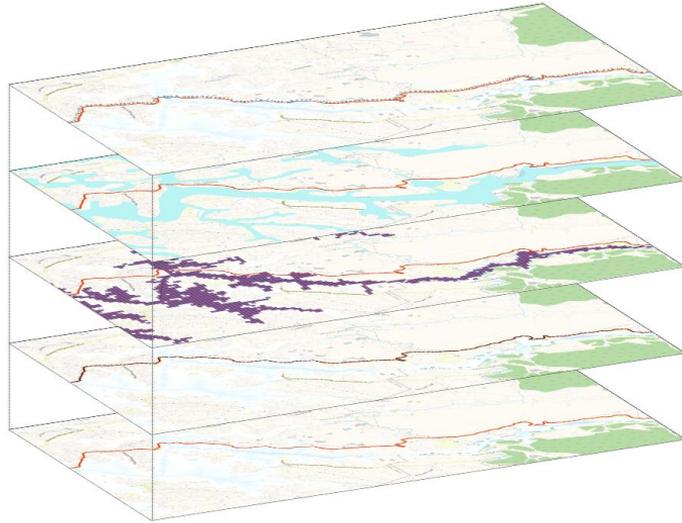
## Benefit:

Limited funds are directed to the most critical and hazard-prone assets.

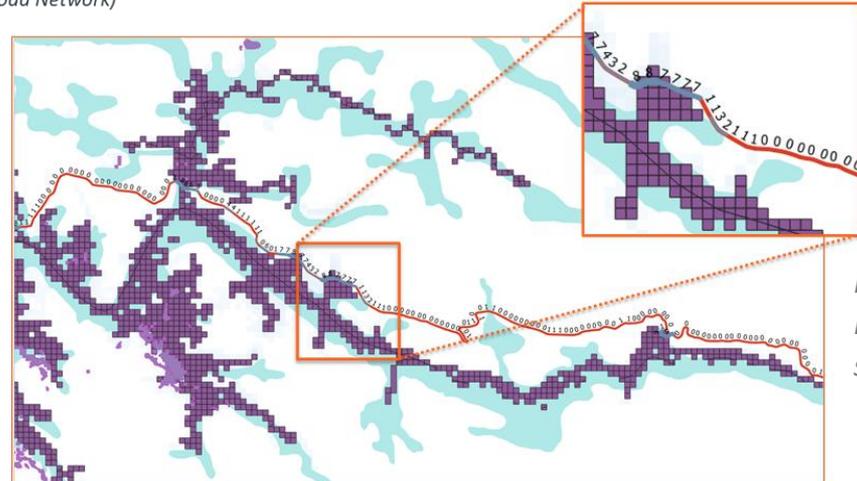




# Integrating Climate Resilience Module within *i*ROADS



1. CRN (Core Road Network)
2. CRN split into 100 m segments
3. CRN-100 overlaid with 10-year NRSC extents
4. CRN-100 overlaid with NCESS flood prone areas
5. CRN-100 overlaid with RCP 8.5 25-year flood projections

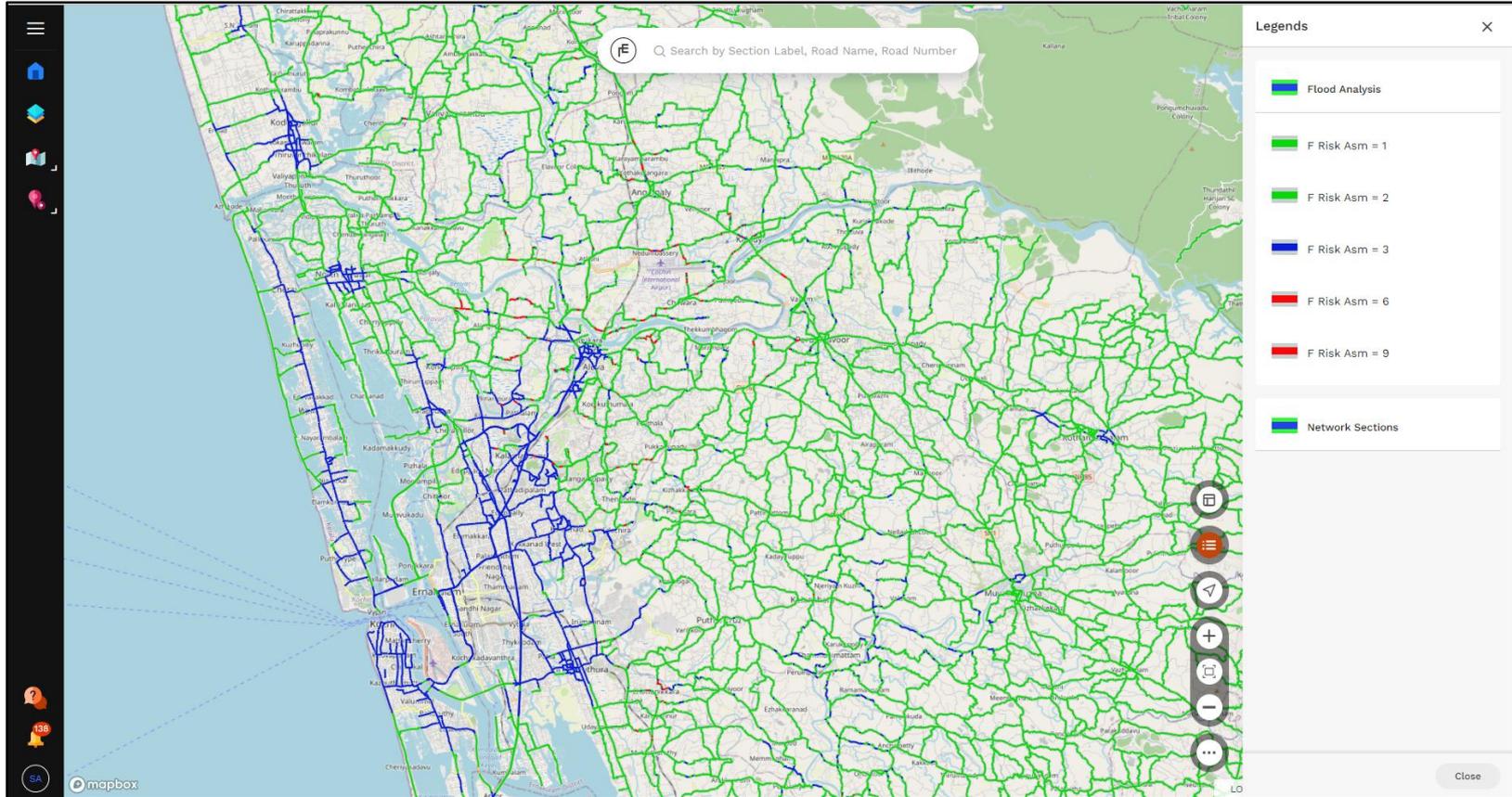


*Flood Exposure Index for 100 m segments*

***Section overlay analysis to compute flood exposure for risk assessment***



# Integrating Climate Resilience Module within *iROADS*



***Assessment of Flood Risk Factors Based on Exposure and Impact***



# Benefits achieved in Kerala with *iROADS*

- **Risk-informed maintenance**

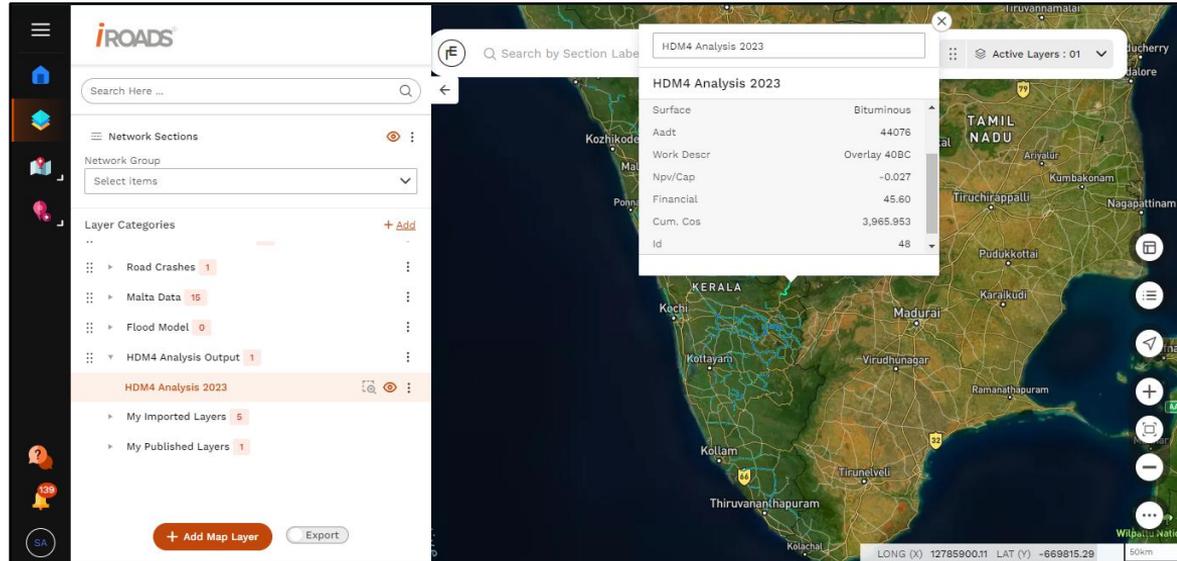
- Critical corridors protected against floods & landslides.
- Example: Road sections in Alappuzha, Kottayam & Pathanamthitta mapped for flood vulnerability prioritised for preventive maintenance.

- **Improved field operations**

Mobile app reporting >> faster defect detection.

- **Optimised budget**

HDM-4 + climate risk >> better allocation of funds..



*HDM-4 analysis results represented using iROADS*



# Benefits achieved in Kerala with iROADS

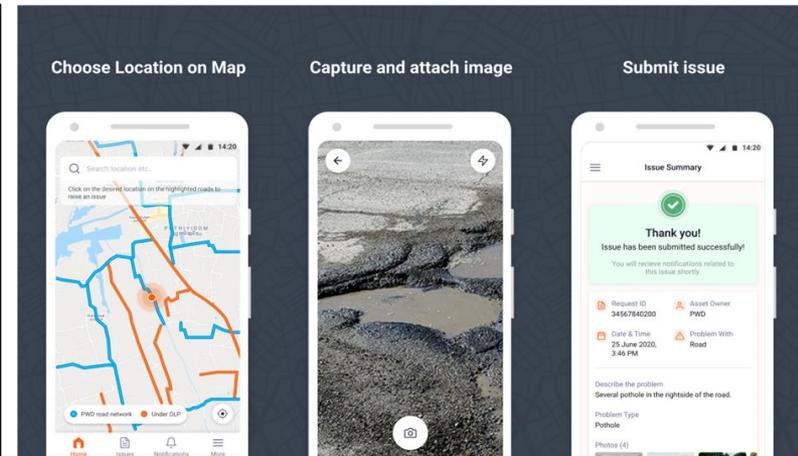
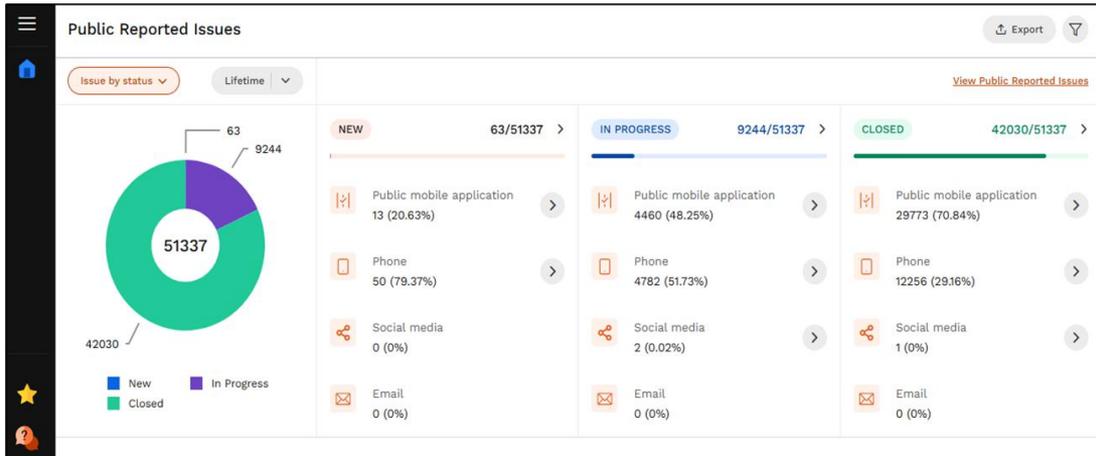


## Public participation

- Crowdsourced pothole reporting >> faster response (83% reduction in wait time).

## Enhanced resilience

- Better readiness through early warnings & hazard mapping- Automated alerts to KPWD officials (SMS, email, app).



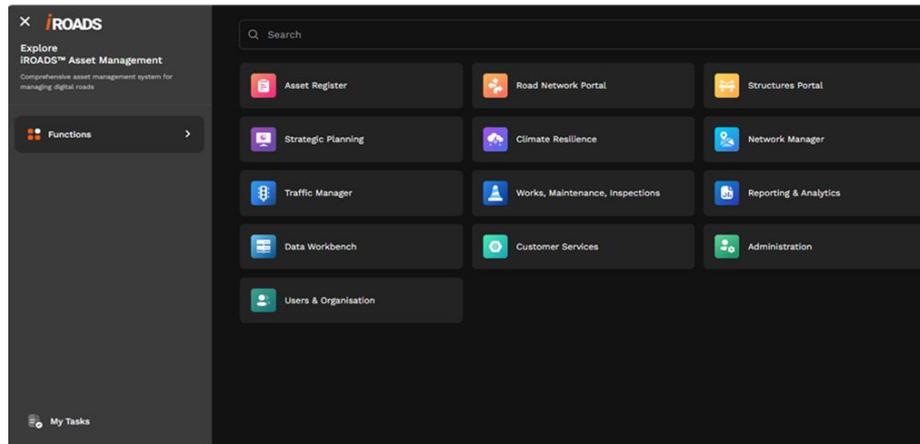
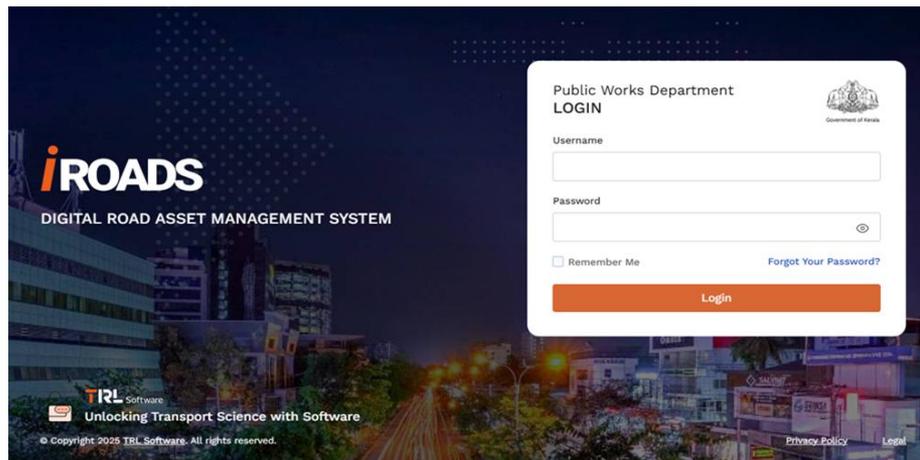


# Summary

- O&M is the backbone of resilience, especially in states like Kerala, prone to Climate Change
- RAMS + Climate Module transforms maintenance into proactive, risk-based system
- Data-driven inspections improve safety & reduce lifecycle costs
- Kerala's iROADS demonstrates the value of unified asset + hazard information

## Way Forward

- Build institutional capacity for climate-informed RAMS
- Use community reporting and mobile tools to expand field coverage





## Questions?

**Dr Bhavesh Jain**  
Consultant- RAMS

[bjain@trl.co.uk](mailto:bjain@trl.co.uk)  
+91 9660001993

TRL | Carnival Infopark Phase 1 | Kakkanad | Kochi  
Kerala | 682030 | India