Data Documentation Protocol

Digital Monitoring, Reporting, and Verification (DMRV)
Framework for the Nagar Van Yojana (NVY)

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Version 1.0 | 2026

1. Introduction & Research Scope

This document outlines the methodological framework, data architecture, and ethical protocols governing the **Nagar Van DMRV Dashboard**. The platform is designed to provide robust Digital Monitoring, Reporting, and Verification of India's urban forestry initiatives under the Nagar Van Yojana (NVY).

The primary objective is to evaluate the socio-cultural, economic, and ecological impacts of urban ecosystems across multiple Indian states. By bridging grassroots action with high-level policy, this framework ensures that environmental commitments—including Nationally Determined Contributions (NDCs)—are tracked with scientific rigor and transparent community validation.

2. Ecological Metrics & Methodologies

The dashboard processes real-time and static variables to calculate environmental benefits. The calculations rely on peer-reviewed geospatial and biochemical models.

2.1 Carbon Sequestration

Urban forests act as critical carbon sinks. The dashboard estimates total Carbon Dioxide equivalent (CO_2e) sequestered based on above-ground biomass (AGB).

> $$\boldsymbol{C} = \boldsymbol{B} \times 0.47$$

Where $\boldsymbol{C}$ is the carbon content in tons, and $\boldsymbol{B}$ represents the dry biomass. The conversion factor of 0.47 is the IPCC standard ratio representing the fraction of carbon in dry wood mass. Total CO_2e is subsequently derived by multiplying $\boldsymbol{C}$ by 3.67.

2.2 Air Quality Mitigation (PM2.5)

Real-time fine particulate matter (PM2.5) tracking is facilitated via Open-Meteo API integrations based on the geographical coordinates of the respective Nagar Van.

- 🟢 **Excellent:** ≤ 15 µg/m³
- 🟡 **Moderate:** 16 – 35 µg/m³
- 🔴 **Poor:** > 35 µg/m³

2.3 Urban Heat Island (UHI) Reduction

The cooling effect of the urban forest canopy is tracked via Land Surface Temperature (LST) differentials.

$$\Delta T = T_{surrounding} - T_{park}$$

Where ΔT represents the ambient temperature reduction measured in degrees Celsius (°C), reflecting the micro-climate cooling capacity of the vegetation.

2.4 Hydrological Recharge

Water infiltration metrics reflect the contribution of urban forests to local groundwater tables, calculated using standard watershed models.

$$V = A \times R \times C_r$$

Where V is the volume of water recharged (Liters), A is the catchment area of the Nagar Van, R is the annual rainfall, and C_r is the runoff coefficient, adjusted for the specific permeability of forested terrain versus surrounding concrete surfaces.

3. Socio-Economic & Governance Indices

Beyond ecology, the framework assesses the human-centric impact of urban forests through Participatory Rural Appraisal (PRA) techniques and standardized valuation models.

3.1 Contingent Valuation Method (CVM)

To assess the non-market value of the urban forest, the platform utilizes CVM to determine the **Average Willingness to Pay (WTP)**. Through surveys with diverse respondent categories (Visitors, Residents, Vendors), the dashboard aggregates the monetary value citizens are willing to contribute monthly toward the maintenance of the ecosystem, providing a tangible metric for policy funding justification.

3.2 Community Well-being (WHO-5)

Psychological and social benefits are quantified using an adapted WHO-5 Well-being Index. Field surveys capture data on community recreational satisfaction, stress reduction, and overall life quality improvements attributed to the Nagar Van access.

> **Target Respondent Typologies**
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> Data stratification is explicitly categorized to ensure unbiased socio-economic profiling. Respondent classes include: Regular Visitors, Local Residents, Vendors/Faacchas (economic dependents), Students/Researchers, Environmentalists, and Government Officials.

4. Technical Infrastructure

The DMRV platform utilizes a modern, decentralized tech stack to ensure data integrity, scalability, and transparent verification.

Component	Technology / Method	Functionality
Geospatial Mapping	Leaflet.js & KML Parsing	Plots verified ecological boundaries and maps localized issue reports via GPS coordinate tracking.
AI Verification	TensorFlow.js (MobileNet)	Client-side image classification. Automatically scans user-uploaded field photos to verify nature/park contexts before data submission.
Data Ingestion	Google Apps Script API	Secure, high-availability endpoints for receiving JSON payloads from the Civic Engagement Form and Issue Tracker.
Live Climate Data	Open-Meteo API	Fetches localized, real-time meteorological and air quality metrics based on dynamic latitude/longitude parameters.

5. Data Privacy & Ethical Guidelines (GDPR Compliance)

All primary data collection adheres to strict academic and ethical standards regarding Personally Identifiable Information (PII).

- **Explicit Consent:** All public contributions mandate active user consent via digital checkboxes before data transmission, confirming the user's agreement to data processing for research purposes.
- **Data Anonymization:** While respondent names are collected for internal research validity, all PII is scrubbed before being aggregated into the macro-level socio-economic dashboard indices.
- **Location Security:** GPS coordinates requested during the "Issue Reporting" phase are strictly utilized for geospatial mapping of infrastructure defects and are not linked to continuous user tracking.
- **Right to Withdrawal:** Respondents retain the right to withdraw their submitted field surveys or grievance reports by contacting the platform administrator.

> **Document Control & Updates**
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> This protocol is subject to iterative refinement. As the National CAMPA research progresses across different climatic zones in India (March – August 2026), normalization factors for biomass and runoff coefficients will be localized to state-specific typologies.