CHENNAI METRO RAIL LIMITED

Innovative Urban Green Restoration and Canopy Recovery through Compensatory Plantation and Tree Transplantation in Chennai Metro Rail

CII National Award for Environmental Best Practices 2026



Background

- CMRL Phase II (Corridors 3, 4 & 5) covers major urban areas of Chennai. → 118.9 kms →128 stations

- Tree removal was unavoidable at select locations due to Metro alignment, stations, road widening, utilities and construction; transplantation was adopted wherever feasible.

- Tree removal can lead to loss of urban canopy, biodiversity, carbon sequestration potential and ecological goods & services.

- Tree removal was undertaken only after statutory approval from the District Green Committee (DGC), with **1:12 compensatory plantation**, transplantation, survival monitoring and casualty replacement.

- **Beyond conventional plantation metrics, CMRL introduced canopy area and canopy volume assessment to measure ecological recovery.**



PHASE II CORRIDORS 3, 4 & 5



Challenges faced

- Dense and highly urbanized project environment
- Limited availability of suitable plantation land
- Unavoidable tree removal for critical Metro infrastructure
- Transplantation of mature trees within constrained urban locations
- Maintaining survival of transplanted trees
- Achieving high survival rate of large-scale compensatory plantation
- Long-term maintenance and casualty replacement
- Restoring canopy rather than merely replacing tree numbers
- Lack of a simple indicator to demonstrate actual ecological recovery

Introduced canopy area and canopy volume assessment to measure ecological recovery

Objective

MINIMISE

Ecological impact of Metro construction

AVOID & TRANSPLANT

Avoid tree removal and transplant trees wherever feasible

COMPENSATE

Compensate unavoidable tree loss through plantation

RESTORE

Restore urban canopy and ecological functions

MEASURE

Track tree survival, canopy recovery and ecological outcomes

REPLICATE

Develop a replicable model for sustainable urban infrastructure

KEY PERFORMANCE INDICATORS

Tree Survival | Canopy Area Recovery | Canopy Volume Recovery | Biodiversity Indicators

Innovative Approach

5,801
Trees felled due to unavoidable Metro construction requirements

1,616
Trees transplanted, with approximately **65%** survival, to minimize tree loss.

76,911
Saplings planted under compensatory plantation, with **86.9%** survival.

- Beyond sapling counting – ecological restoration assessed through canopy area and canopy volume.
- Achieved 62% canopy-area recovery and 48% canopy-volume recovery within 3 years of plantation.
- Scientific monitoring using tree height, crown diameter, canopy density and canopy type.
- Outcome-based approach linking plantation efforts with measurable ecological recovery.
- Provides a replicable model for sustainable urban infrastructure projects

Innovative Approach – Eco Vibrant Units (EVU)

A multi-layer plantation designed as an urban green ecosystem.

Large Canopy Trees – Periphery

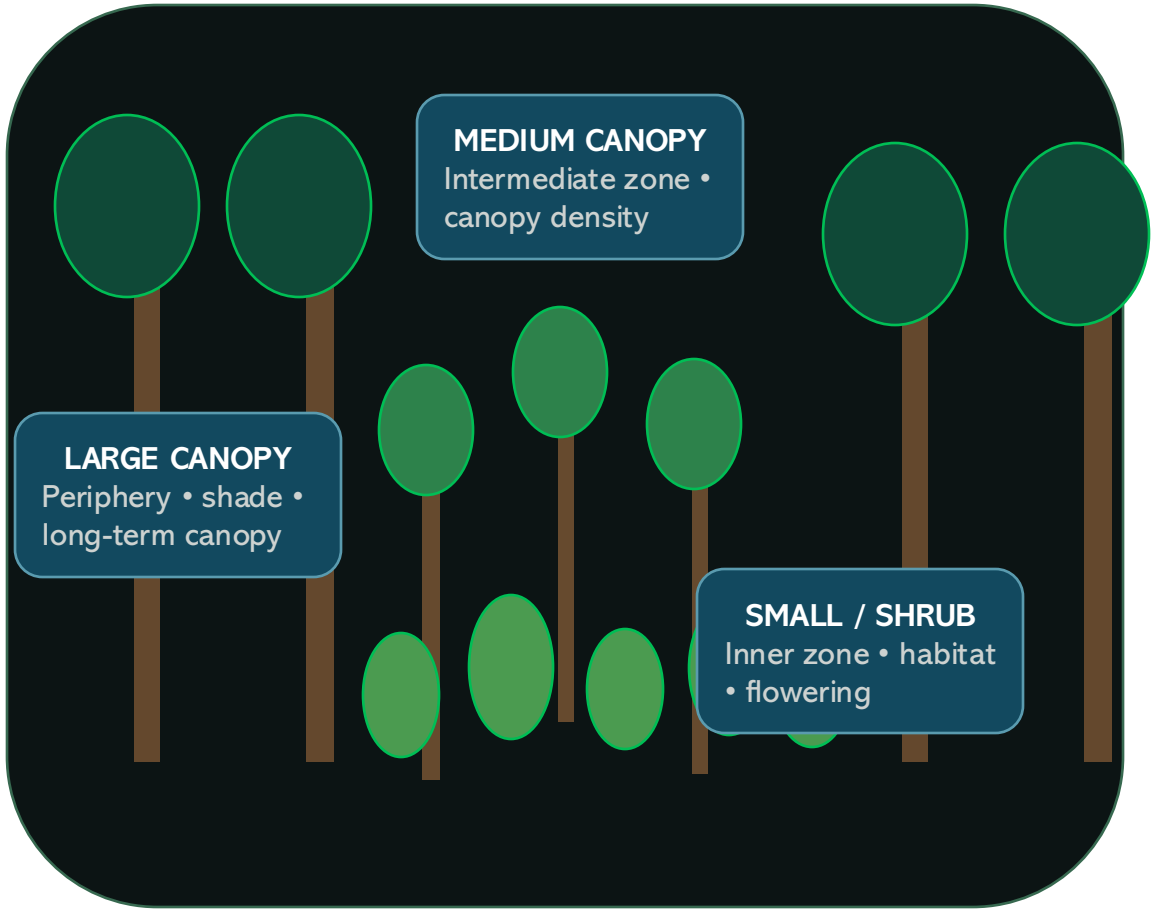
- Form the outer green buffer
- Provide shade and long-term canopy development

Medium Canopy Trees – Intermediate Zone

- Build the middle canopy layer
- Increase vegetation density and habitat value

Small / Shrub Layer – Inner Zone

- Strengthen ground-level vegetation



"EVU is to create biodiversity in the landscape & sustaining the population of flora and fauna."

Innovative Approach – Eco Vibrant Units

Innovative concept of tree plantation called Eco Vibrant Units.

- **Holistic ecological restoration** - Integrates afforestation with restoration of ecological balance.
- **Indigenous species** - Promotes resilient and ecologically suitable tree species.
- **Biodiversity enhancement** - Supports diverse flora and fauna.
- **Water conservation** - Uses low water demand species to reduce water requirements.
- **Pollinator support** - Includes fruit- and flower-bearing species for pollinators and seed dispersers.
- **Ecological resilience** - Enhances biodiversity and natural resource conservation.



Eco Vibrant Unit at Koyambedu

"From conventional plantation to a self-sustaining mini-ecosystem"

Resources required & Execution

KEY RESOURCES

- **Human resources**
  Environment, horticulture and project teams
- **Plantation resources**
  Suitable planting material and designated plantation sites
- **Transplantation resources**
  Equipment and site arrangements for tree relocation
- **Maintenance resources**
  Irrigation, protection and casualty replacement
- **Monitoring resources**
  Survival tracking and canopy assessment

EXECUTION FRAMEWORK

01 TREE ASSESSMENT

Identify trees requiring removal / transplantation

02 AVOID / TRANSPLANT

Avoid removal; transplant established trees where feasible

03 PLANTATION

Implement compensatory plantation

04 MONITOR

Track survival and replace casualties

05 MEASURE

Assess canopy area and canopy volume

06 ASSESS

Evaluate measurable ecological recovery

Quantified Results

Environmental performance measured through survival and canopy recovery

86.9%
Sapling Survival

62%
Canopy-Area Recovery
of original canopy area loss

48%
Canopy-Volume Recovery
of original canopy volume loss

Supporting project outputs

5,801 Trees felled	**1,616** Trees transplanted	**65%** Transplantation survival
76,911 Saplings planted	**659,044 m³** Canopy volume restored	**Within 3 years** Assessment period

Plantation performance is demonstrated through measurable ecological recovery—not tree counts alone.

Environmental Benefits

TANGIBLE ENVIRONMENTAL BENEFITS



CANOPY AREA	CANOPY VOLUME
62%	48%
recovery	recovery

86.9% sapling survival
65% transplantation survival
659,044 m³ canopy volume restored

FIELD OBSERVATIONS
Flowering & fruiting
Bird / fauna activity

INTANGIBLE / ECOSYSTEM BENEFITS

- **Urban Aesthetics** - improved visual quality and green character
- **Biodiversity enhancement** - Supports diverse flora, fauna, pollinators and seed dispersers.
- **Carbon sequestration** - increased carbon storage through tree growth
- **Microclimate Improvement** - shade and moderation of local heat
- **Pollinator Support** – flowering and fruiting species support pollinators
- **Environmental Awareness** - Visible demonstration of sustainable green practices
- **Ecological resilience** - Diverse, multi-layer green systems

Urban Green Restoration – Before & After





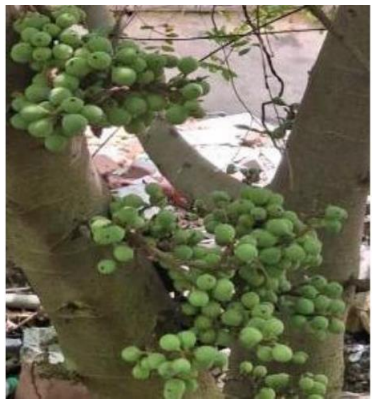
Before

Transplanted tree at Queen Mary's College

After

Observed Biodiversity indicators







Observed nesting activity provides field-level evidence of habitat use within restored plantation areas.
Fruiting demonstrates ecological development of planted green areas beyond survival alone.

Monitoring & Assessment

MONITORING FRAMEWORK

- **Tree / sapling survival**
  Regular monitoring of survival outcomes
- **Transplantation outcome**
  Track transplanted tree survival
- **Casualty replacement**
  Replace plantation casualties
- **Canopy growth**
  Track canopy area and canopy volume
- **Field parameters**
  Height, crown diameter, canopy density and canopy type/form

CANOPY ASSESSMENT METHODOLOGY

01 Baseline
Original green-cover/canopy loss due to project-related tree removal

02 Measure
Tree height • crown diameter

03 Characterise
Canopy density • canopy type/form

04 Repeat
Assessment frequency and monitoring period

05 Calculate
Defined calculation method for canopy recovery
Recovery (%) = Recovered canopy ÷ Original canopy loss × 100

06 Report
Recovery percentage against the defined baseline

Measured outcomes: 62% canopy-area recovery • 48% canopy-volume recovery

Cost Economics

Parameter	Indicative Value
Project Cost	**₹900 Lakhs***
Environmental Economic Benefit	**Investment in Urban Ecological Restoration**
Direct Financial Saving	**Not applicable**
Payback	**Not applicable**

VALUES CREATED

GREEN COVER
Restored

BIODIVERSITY
Supported

CARBON
Sequestration

MICROCLIMATE
Regulation

Performance Against Statutory & Indian Benchmarks

CMRL performance compared with documented statutory / Indian practice references

Parameter	Statutory / Indian Reference	CMRL Performance	Interpretation
Compensatory plantation	Documented Tamil Nadu practice: 1:10	1:12	Higher ratio
Tree transplantation survival	FRI/ICFRE documented reference: 30–60%*	65%	Above range
Sapling survival	No uniform national survival benchmark identified	86.90%	Measured
Ecological outcome assessment	Conventional practice focuses on plantation / survival	Canopy area + canopy volume	Outcome-based
Canopy recovery	No uniform national canopy recovery benchmark identified	62% canopy area / 48% canopy volume	Quantified
Long-term management	Survival monitoring & casualty replacement	Implemented	Adopted

Sources: Tamil Nadu Forest Department / District Green Committee records; FRI/ICFRE reference material

Replication Potential

REPLICATION

5

PROOF POINTS

Designed to scale without losing ecological accountability.

A MODEL BUILT TO TRAVEL

Replication works when the method is measurable and adaptable.

01 **WIDE APPLICABILITY**
Metro Rail, highways, railways and other linear infrastructure.

02 **AVOIDANCE FIRST**
Prioritise tree transplantation before tree removal.

03 **CANOPY METRICS**
Use canopy area and volume as ecological performance indicators.

04 **BUILT INTO EMPS**
Embed survival monitoring and casualty replacement in EMPs.

05 **LOCAL ADAPTABILITY**
Adapt the approach to urban ecology and plantation-site conditions.

Applicable to Metro Rail, highways, railways and other urban / linear infrastructure projects.

Conclusion

CMRL has moved beyond conventional compensatory plantation towards measurable ecological restoration. Through tree transplantation, large-scale plantation, survival monitoring and canopy assessment, the initiative demonstrates tangible recovery of urban green cover and provides a replicable model for sustainable infrastructure development.

01 TRANSPLANT
Relocate established trees

02 PLANT
Expand plantation at scale

03 MONITOR
Track survival outcomes

04 MEASURE
Assess canopy area and volume

From compensatory plantation to measurable ecological restoration.
A replicable pathway for sustainable infrastructure

Thank You!