# Mapping Mines in Tamil Nadu: Assessing their restoration potential

2025

Botanical Services, Auroville

*Supported by : Tamil Nadu State Land Use Research Board*

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# Foreword

It gives me great pleasure to present the report titled *"Mapping Mines in Tamil Nadu: Assessing their restoration potential"*. This important study marks a significant step forward in the sustainable management of post-mining landscapes within the state of Tamil Nadu.

Mining, while vital to economic development, often leaves a lasting impact on the environment. The need for informed, science-based strategies to restore and rehabilitate mined lands has never been more critical. This study addresses the need for harnessing the power of geospatial technologies to identify potential mine sites for ecological restoration or further assessment.

Through a rigorous analysis of key parameters—such as soil characteristics, water availability, proximity to ecologically sensitive zones, existing vegetation, topography, and land ownership, the study offers a comprehensive framework for prioritizing mine site restoration efforts. These parameters have been methodically developed to ensure that recommendations are environmentally sound, socially responsible, and practically feasible.

The report not only identifies mining sites across Tamil Nadu but also highlights the broader need for mine site restoration. It provides a clear set of guidelines to be followed in the planning and implementation of restoration initiatives, aiming to ensure ecological balance, improve land usability, and support local biodiversity.

I am confident that the insights and recommendations offered in this report by Botanical Services will serve as a valuable resource for the Government, environmental planners, and other stakeholders committed to sustainable land management. I commend the efforts of Botanical Services, Auroville and Tamil Nadu State Land Use Research Board along with all those involved in this project and look forward to the stakeholders in this field to use the findings of this report to build a greener and more resilient Tamil Nadu.

**Dr J Jeyaranjan**

Executive Vice Chairman
State Planning Commission
Tamil Nadu

# Preface

Mining has long played a significant role in the economic development of Tamil Nadu, contributing to infrastructure growth and industrial advancement. However, the environmental and ecological implications of mining, especially after the exhaustion of resources, pose critical challenges. In recent years, there has been growing recognition of the need for sustainable practices and restoration of mined lands to ensure environmental integrity and community well-being.

This study, titled ***"Identification of Potential Mine Sites in Tamil Nadu for Restoration or Assessment of Mining Sites using Geospatial Information,"*** aims to identify, assess, and prioritize abandoned or underutilized mine sites across the state that hold potential for ecological restoration. The project integrates geospatial technologies to map and analyse various mine types—including limestone, granite, magnesite, vermiculite, fireclay, and rough stone—enabling a data-driven approach to environmental management.

By leveraging satellite imagery, GIS tools, and historical mining data, the study aspires to support the Government, environmental planners, and local authorities in devising strategies for sustainable mine rehabilitation. The insights gained from this work are intended to serve as a foundation for future restoration initiatives, ensuring that degraded landscapes can be transformed into productive or ecologically sound environments.

The scope of this project extends beyond mere identification; it delves into understanding the spatial distribution, extent of degradation, and potential for ecological recovery of each site. By incorporating geospatial data layers such as land use/land cover, topography, vegetation indices, and proximity to sensitive ecosystems or human settlements, the study offers a comprehensive assessment framework. This approach ensures that restoration efforts are not only scientifically grounded but also socially and economically viable. The project also underscores the importance of integrating community perspectives and sustainable land-use planning into future reclamation efforts. Ultimately, this study contributes to the broader objective of environmental stewardship, paving the way for responsible resource management and landscape resilience in Tamil Nadu.

**Paul Blanchflower**

Director

Botanical Services

Auroville

# Acknowledgements

We take this opportunity to express our sincere gratitude to all those who supported and guided us throughout the course of this study titled ***"Identification of Potential Mine Sites in Tamil Nadu for Restoration or Assessment of Mining Sites using Geospatial Information."*** This project would not have been possible without the valuable contributions, encouragement, and cooperation of several individuals and institutions.

- We extend our profound gratitude to the **Government of Tamil Nadu**, **the State Planning Commission**, and the **Tamil Nadu State Land Use Research Board (TNSLURB)** for their generous sponsorship and visionary support of this project. Their commitment to sustainable development and environmental stewardship has been instrumental in enabling this study and fostering meaningful research in the field of geospatial analysis and land restoration.

- **Tmt. Sudha.S, IFS**, Member Secretary, State Planning Commission, Tamil Nadu for the continuous guidance, insightful suggestions, and unwavering support during every stage of the research.

- We gratefully acknowledge **the Mines Department of Tamil Nadu** and the **Assistant Directors (AD)** across districts for their invaluable support and expert guidance in conducting mine site surveys and ground truthing activities.

- **Thiru. S. Govindaraju**, Planning Officer (Land Use Division), State Planning Commission for the unwavering support in consistently monitoring the project's progress and facilitating seamless coordination with the board members.

- **A. Manjula Devi, K. Siva Sankaran, C. Selvarani, N. Sathiyamurthy, P. Muthukumar** for technical expertise and assistance with data collection and geospatial analysis greatly enriched the quality of this project.

# Project Team

| | |
|---|---|
| **Project Lead** | : Mr. Paul Blanchflower |
| **Project Associate** | : Ms. Manjula Arumugam |
| **External Associates** | : Tmt. Sudha.S, IFS,<br>Member Secretary, SPC, Chennai |
| **Remote sensing and GIS** | : Ms. Manjula Arumugam<br>Mrs. Selvarani. C |
| **Mine sites survey** | : Mr. K. Siva Sankaran<br>Mr. N. Sathiyamurthy<br>Mr. P. Muthukumar |
| **Report writing** | : Ms. Manjula Arumugam<br>Mr. Paul Blanchflower |
| **Coordinator** | : Mr. Paul Blanchflower<br>Ms. Manjula Arumugam |

# Contents

## List of Maps, Charts, Graphs & infographics

# Identification of Potential Mine Sites in Tamil Nadu for Restoration

Mining has significantly contributed to Tamil Nadu's industrial and infrastructural growth. However, the legacy of environmental degradation in post-mining landscapes underscores the urgent need for science-based restoration strategies. This report, developed under the broader study titled "Identification of Potential Mine Sites in Tamil Nadu for Restoration or Assessment of Mining Sites using Geospatial Information," presents the framework and methodology to support the restoration of abandoned mines in Tamil Nadu. Integrating geospatial data analysis with on-ground ecological insights, the study emphasizes the importance of phased, sustainable restoration that aligns with environmental, social, and economic priorities. The report serves as a model for transforming mined lands into productive, biodiverse, and resilient ecosystems, contributing to long-term environmental stewardship and informed land-use planning. This study has three objectives,

1. Geo-spatial mapping of mines
2. Developing selection criteria by ground assessment of selected mines
3. Developing Framework methodology for mine restoration potential

Further, the report also provides with few case studies from successful restoration projects and scope for potential restoration in two mines in a detailed manner in the annexure. (Annexure 3)

## 1. Geo-spatial Mapping and analysis of Mines in Tamil Nadu

### 1.1 Introduction

**Mineral Wealth of Tamil Nadu and Mining**

Tamil Nadu boasts a rich mineral wealth, including major minerals like limestone, bauxite, graphite, lignite, magnesite, vermiculite, and iron ore, along with fuel minerals such as crude oil and natural gas. The state also contains an abundance of minor minerals such as clay, granite, sand, black granite, colored granite, rough stone, and jellies (blue metal/ charnockites), black clay, gravel, brick soil/brick clay, soil/earth, feldspar, quartz, gypsum, silica sand, and soapstone. In 2012-13, Tamil Nadu's mineral production was valued at ₹6,152 crore, marking a 2% increase from the previous year and contributing about 2% to India's total mineral production. Key minerals such as lignite, natural gas, crude petroleum, garnet, graphite, limestone, magnesite, marl, and lime kankar accounted for 93% of the state's total production value. The state led in the production of lime kankar, garnet, dunite, magnesite, lignite, and graphite, and was the second-largest producer of vermiculite and fireclay in India (Indian Minerals Yearbook 2013, 52nd Edition).

**The Need for Restoration of Post-Mining Landscapes**

Mining has been a crucial part of human civilization and remains essential to economic growth. However, many sites where mining has ceased present serious environmental concerns and liabilities. It is not sufficient for these closed or abandoned mine sites to merely be safe, stable, and pollution-free. To meet current environmental obligations, these areas should ideally be restored to their pre-mining ecosystems or, at the very least, to a representative state. This

becomes even more important as the world faces climate change, biodiversity loss, land degradation, and desertification. The responsibility for restoring these landscapes often falls on the mining companies, who, by undertaking ecological restoration, can fulfill their social responsibilities and demonstrate leadership in achieving an environmentally sustainable future. Ecological restoration in post-mined areas is thus critical to restoring the highest possible level of biodiversity and ecological balance.

**Benefits of Restoration in Post-Mining Areas**

Restoring post-mining landscapes to their original or representative state is vital for maintaining ecological balance. This process allows for the reshaping of degraded landforms and the creation of diverse habitats by reintroducing native species. Effective restoration can yield significant biodiversity gains, transforming barren, degraded sites into thriving ecosystems. This approach also enhances green cover, which is essential for climate regulation, carbon sequestration, and sustaining healthy ecosystems.

Undertaking this study to identify potential mine sites for restoration is crucial. First, it provides an opportunity to enhance biodiversity by converting degraded mine areas into habitats that can support local flora and fauna. Restoring these sites also significantly contributes to increasing the green cover percentage, which plays a vital role in addressing climate change. Additionally, mapping and planning for mine site restoration facilitates informed land-use planning, allowing Tamil Nadu to balance ecological preservation with developmental needs.

## 1.2 Project Overview

The study titled *"Identification of Potential Mine Sites in Tamil Nadu for Restoration"* aimed to comprehensively map the mines of Tamil Nadu using Geographic Information System (GIS) technology. It also developed a systematic methodology for identifying sites with potential for ecological restoration. Key factors considered in assessing restoration potential included the severity of environmental degradation, restoration feasibility (size of the mine, availability of water, topsoil, quality of planting substrate, land stability, and level of protection), ownership, and biodiversity impact (such as ecological connectivity).

## 1.3 Methodology

Presented below is the methodology of the study:

1. **Mapping mines:** Mapping all the mines in Tamil Nadu by district using secondary data from district reports available on Tamil Nadu mining and district websites, data from TNGIS, data from the mining department, and remote sensing through GIS. This includes identifying the types and number of mines in each district.

2. **Initial Screening and Criteria development:**

    a. Determining the types of mines the project wants to focus on based on **their sizes** (larger area for larger biodiversity gain), **their environmental impact and restorability**. For example, prioritizing mines with **significant environmental degradation** (e.g. large heaps of overburden, the potential for groundwater pollution, dust pollution, etc) and those that have the **potential for successful restoration** (e.g. water availability, slope stability, state and quality of substrate, etc).

b. **Geographic Distribution**: Ensuring representation across different regions of Tamil Nadu to capture variability in environmental conditions and mining practices.
c. **Accessibility and Feasibility:** Prioritizing mines that are accessible for site visits and data collection within the project period, while also identifying **ownership** (categorized accordingly, e.g., government-owned, private company, private person) and determining mines where **access and collaborations are feasible** with the mining parties.

3. **Secondary level of Analysis from initial mines mapping:**

    a. Leveraging the mapping data and utilizing other existing data to identify potential mines for further study. Considering factors such as mine type, mine size, depth, status of operation, ownership, availability of water, and proximity to sensitive ecosystems, access to water/groundwater (when it could be determined through desktop research).

4. **Consultation (where necessary):**

    a. Engaging with Stakeholders such as government agencies, educational institutions such as Anna University, environmental organizations, mining companies, and local communities to understand their perspectives on prioritizing mines for restoration.
    b. Considering factors such as the historical significance of the mine or the area, social context and regulatory status.

5. **Preliminary Site Assessment (Desk-top based):**

    a. Conducting a desktop study to gather information on each identified mine, including its history, environmental impact assessments, restoration plans (if any), and available data on soil, water (both ground water and surface water, vegetation, social context, and ecological connectivity.
    b. Using this information to rank mines based on their restoration potential and urgency.
    c. Shortlist potential mines for site visits based on criteria.

6. **Field Visits and Validation:**

    a. Selecting a subset of mines based on the preliminary assessment for field visits.
    b. During site visits, gather additional data on current environmental conditions, observe ongoing restoration efforts (if any), and assess the feasibility of restoration measures (e.g. availability of water, slope stability of the site, etc).
    c. Refining the selection criteria based on the findings from field visits and adjusting the list of prioritized mines accordingly.

7. **Final Selection, Prioritization, recommendation:**

    a. Consolidating the findings from the initial screening, secondary data analysis, stakeholder consultation, and field visits.
    b. Additionally considering factors such as ecological value, socio-economic impacts, and cost-effectiveness of restoration measures.
    c. Ranking the selected mines (based on types?) based on their restoration potential, feasibility, and urgency.

d. Categorizing mines into types based on the potential for restoration (e.g., Type 1: Very high potential, Type 2: High potential, Type 3: Low potential).
e. Developing a final list of prioritized mines and a framework for restoration efforts.

**Mapping:**

- Producing GIS-based maps of all mines in Tamil Nadu, color-coded to represent different types.
- Developing a third map indicating varying potential for restoration post-ground truthing.

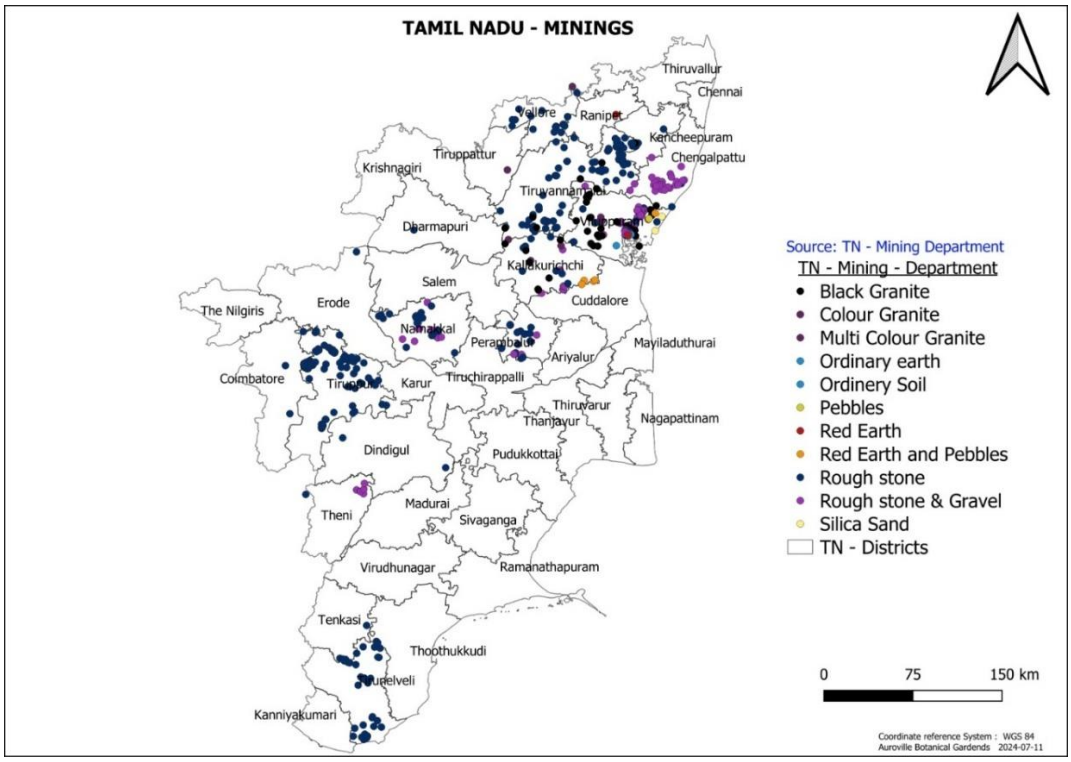

**Infographic 1:** Visual representation of Methodology & Workflow

## 1.3.a Study timeline

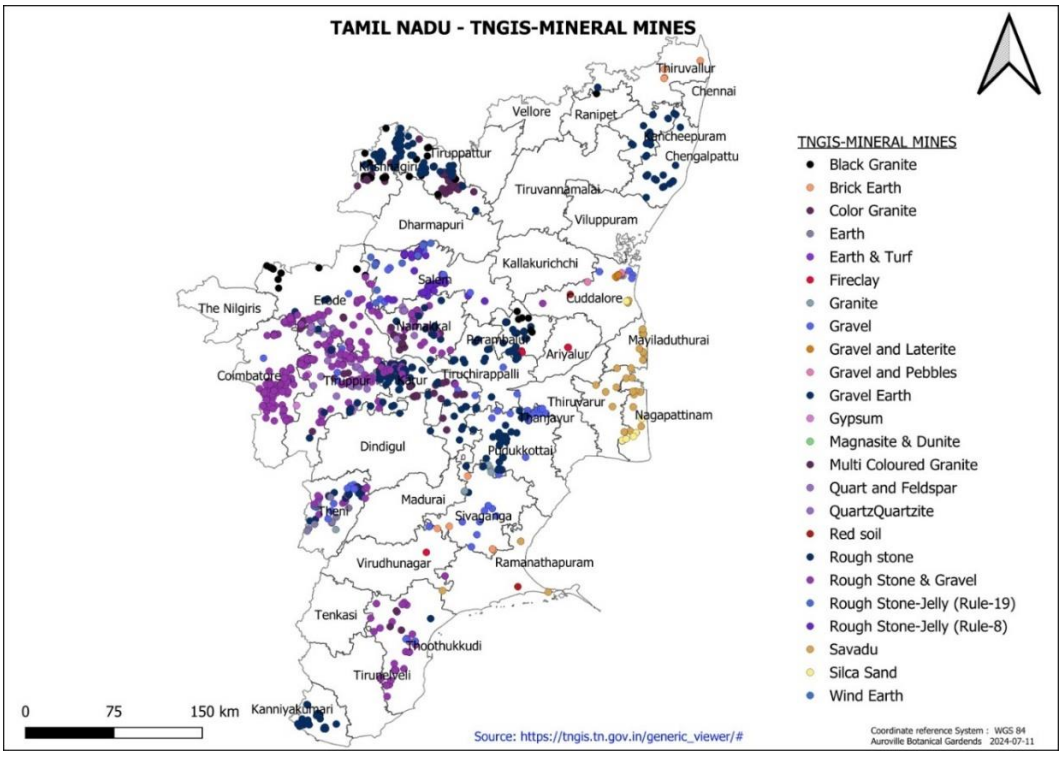
| Activities | Months | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Mar | | Apr | | May | | Jun | | Jul | | Aug | | Sep | | Oct | | Nov | |
| GIS based remote sensing using Google earth (mines of TN - district wise) | | | | | | | | | | | | | | | | | | |
| Data collection from TN- mining website + district reports (analysis and mapping) | | | | | | | | | | | | | | | | | | |
| TN-GIS (mine and soil) data acquisition and mapping (including TN - tempeture, rainfall & water table) | | | | | | | | | | | | | | | | | | |
| TN Mining Department data analysis and mapping | | | | | | | | | | | | | | | | | | |
| Data consolidation and remote sensing to secure missing data | | | | | | | | | | | | | | | | | | |
| Comparitive GIS mapping, selection criterea development research | | | | | | | | | | | | | | | | | | |
| Ground-truthing | | | | | | | | | | | | | | | | | | |
| Analysis | | | | | | | | | | | | | | | | | | |
| Consolidating, finalizing and report writing | | | | | | | | | | | | | | | | | | |

## 1.4 Geo-spatial Mapping of mines

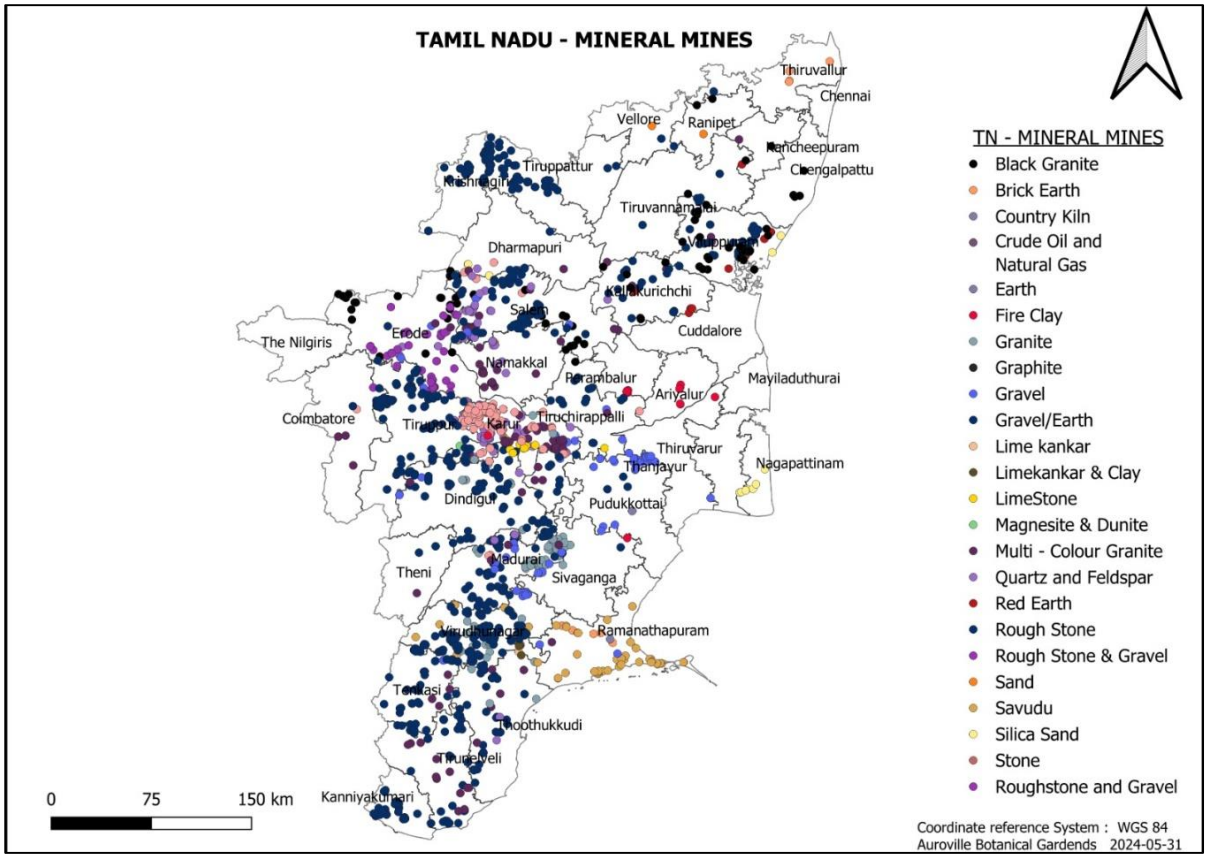
Mapping all the mines in Tamil Nadu by district was conducted using Geographic Information Systems (GIS). This process involved identifying the types and number of mines in each district. The data were obtained from three main sources: secondary data from district reports available on the Tamil Nadu Mining Department and district websites, data from TNGIS, and data provided by the TN mining department.



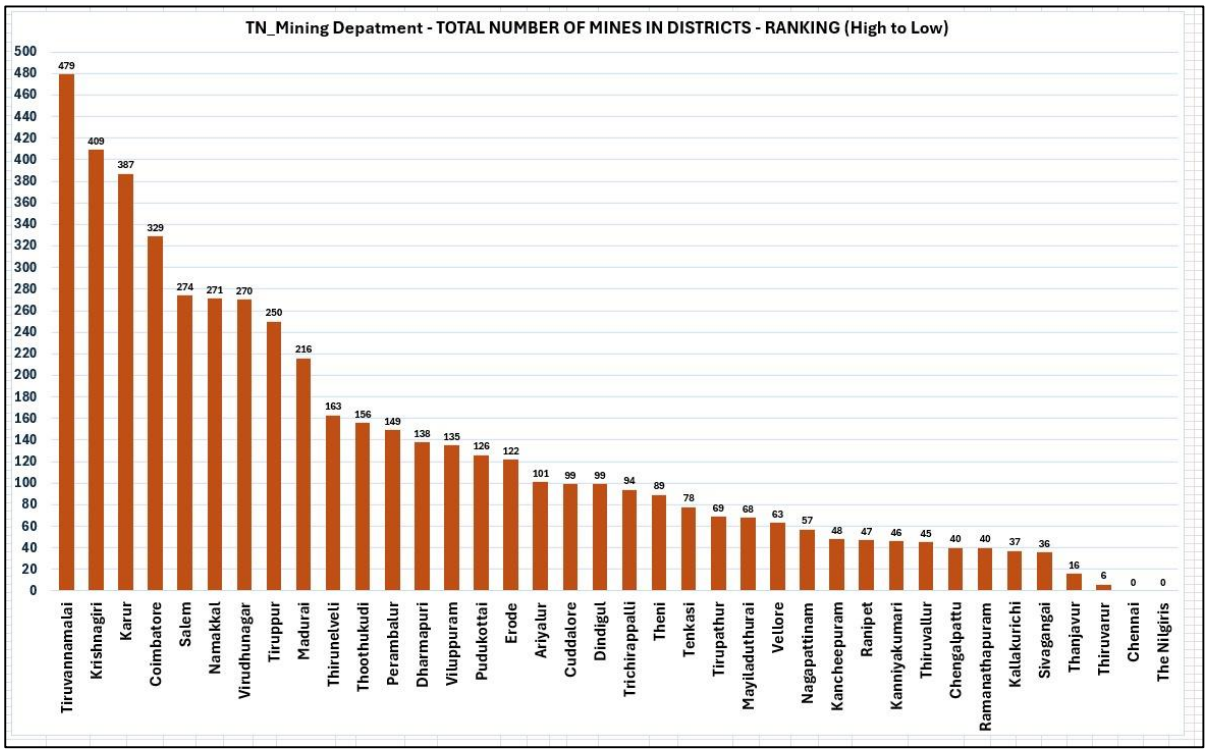

**Map 1:** Overview of Mines of Tamil Nadu (data sourced from TN mining department).



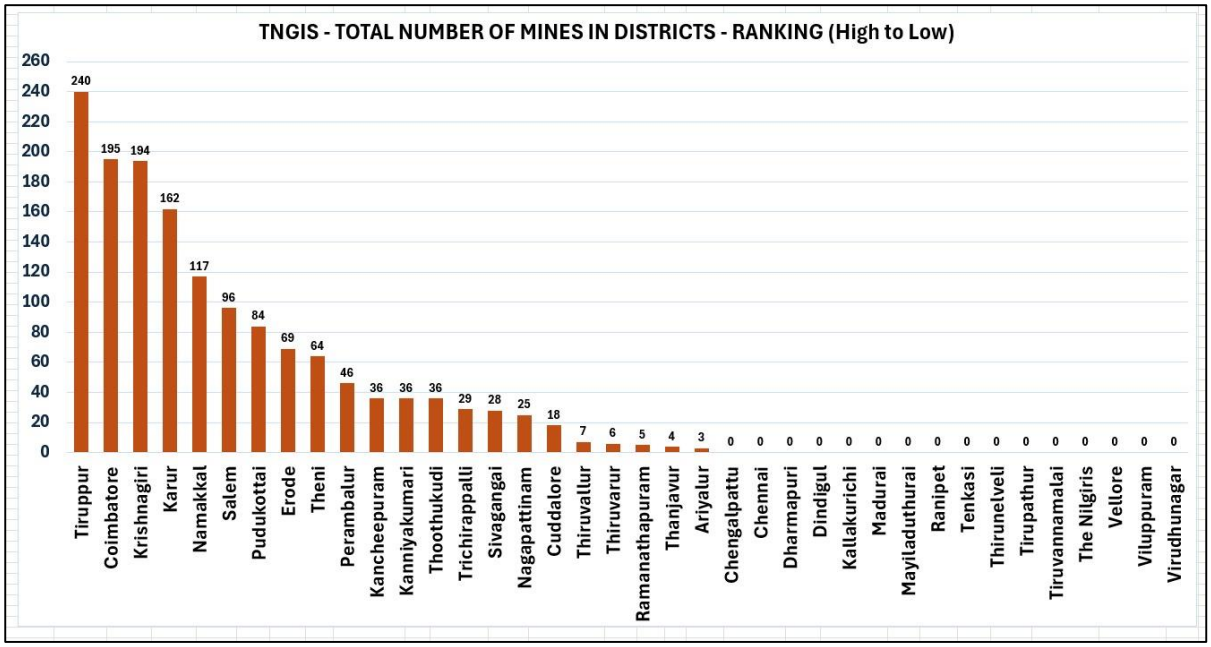

**Map 2:** Overview of Mines of Tamil Nadu (data sourced from TNGIS website).



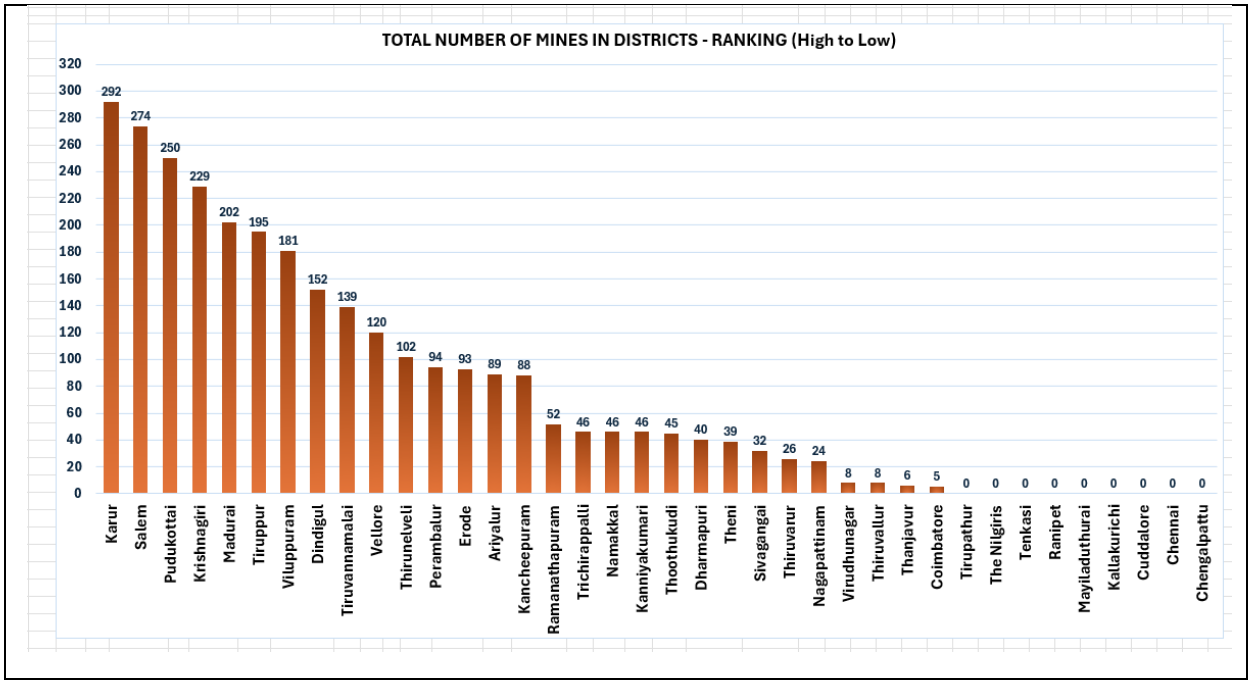

**Map 3:** Overview of Mines of Tamil Nadu (data sourced from district reports).




**Graph 1**: Number of mines across Tamil Nadu districts (data obtained from TN Mining Department).



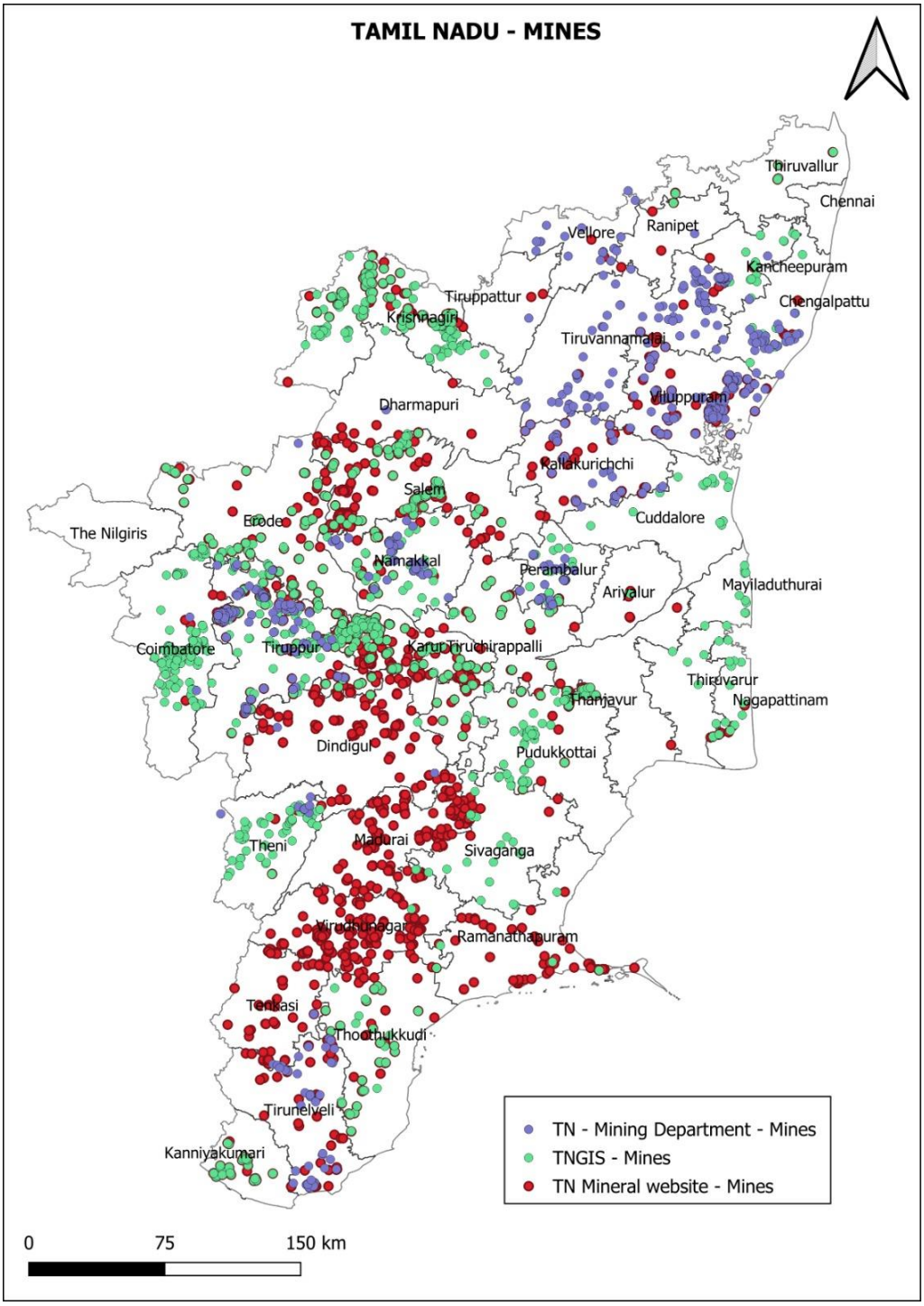

**Graph 2**: Number of mines across Tamil Nadu districts (data obtained from TNGIS website).




**Graph 3**: Number of mines across Tamil Nadu districts (data obtained from district reports).

**Findings from the three maps:**

The combination and individual mapping results of the three datasets produced contrasting maps and differences in the number of mines and coordinates in each district. This discrepancy presented a challenge in achieving consistent and accurate mapping, as well as in the selection of sites for study and ground truthing.




**Map 4:** Concentration and location of mines in Tamil Nadu, (map produced by combining the three different data sets).

However, the mapping process of the three datasets provided preliminary options/hints for site visits, highlighting a few common districts with the highest concentration of different types of mines, such as Salem and Karur.

Furthermore, the pie charts produced for each type of mine across the three different datasets provided insights into the mine types with the highest numbers, e.g., rough stone mines are the most numerous. The pie charts are presented below:

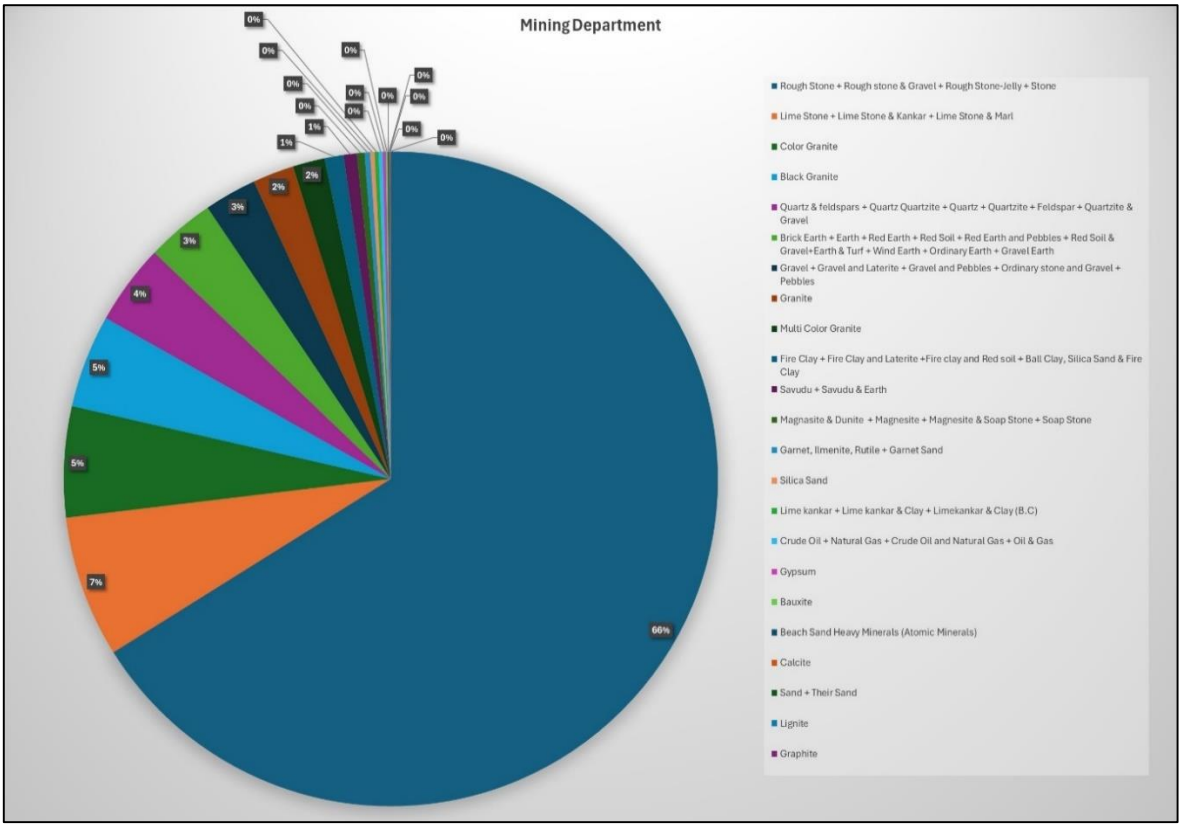



**Chart 1:** Pie chart showing the number of each mine type for TN mining Department dataset

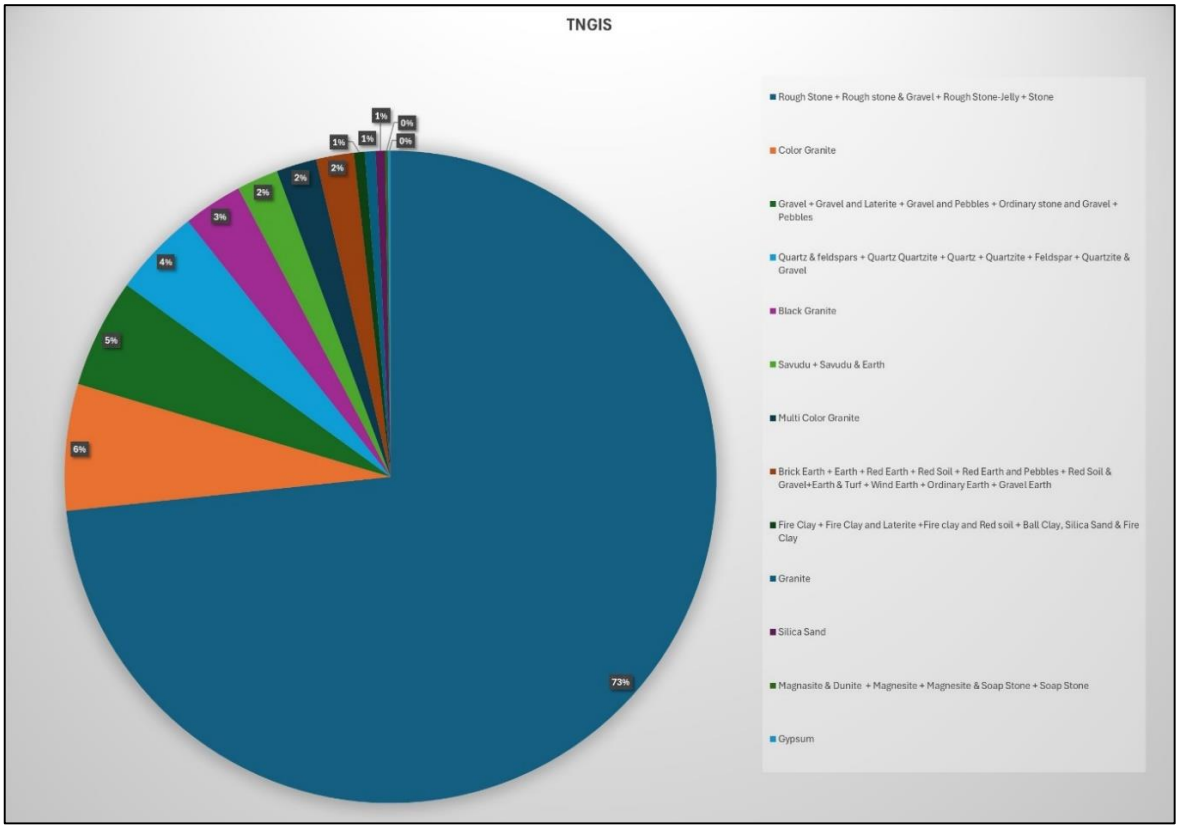



**Chart 2:** Pie chart showing the number of each mine type for TNGIS dataset

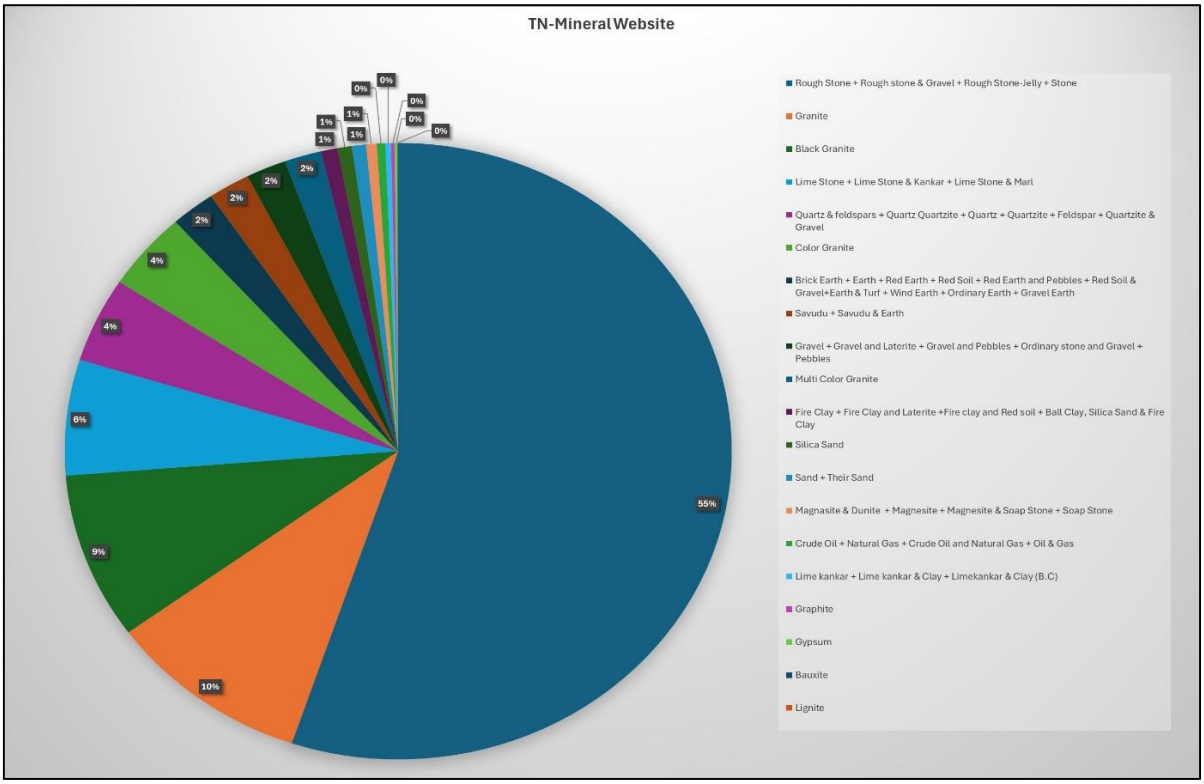



**Chart 3:** Pie chart showing the number of each mine type for district reports dataset

**Limitations of three data sets used in the study:**

This study acknowledges certain limitations associated with each dataset utilized, primarily due to the lack of access to more recent and updated datasets from these sources. The TN District Reports offer detailed coverage of 2,719 mines across 22 mine types; however, the latest accessible data is from 2018, and there is varied representation across districts. Similarly, the TN GIS dataset effectively provides precise coordinates for all 1,515 mine entries covering 13 mine types, although it does not comprehensively include some mine types and certain districts. The TN Mining Department's dataset, covering 5,052 mines across 28 types, provides robust overall information, but complete coordinate data is available only for select districts, and minor data discrepancies were noted for certain locations. Despite these constraints, collectively these datasets provide substantial and valuable insights into mining activities across Tamil Nadu.

4.5

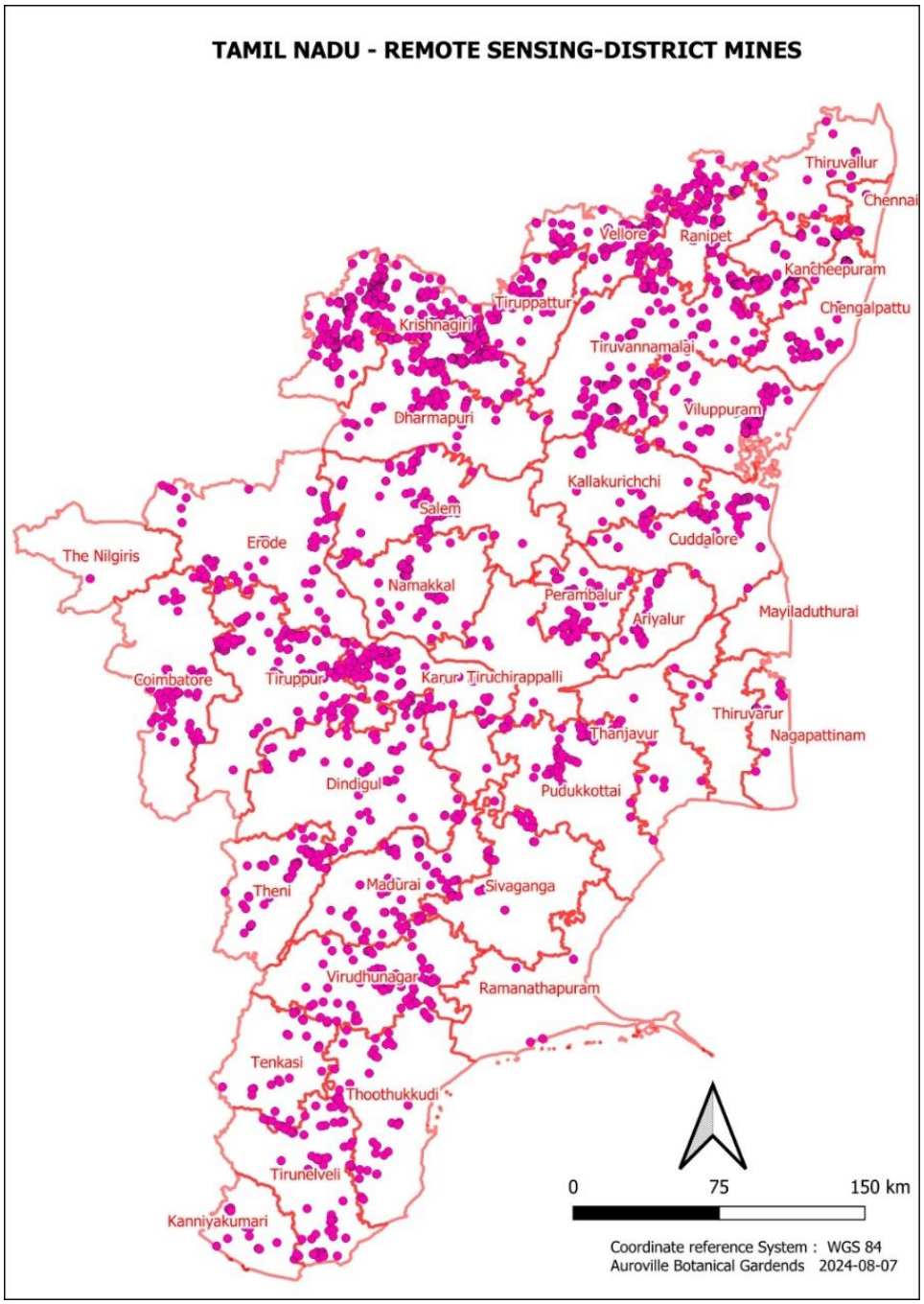
**Fourth data set used in the study:**

As a way forward, it was decided to obtain and use remote sensing GIS data (using Google Earth) to ascertain the current locations of mines in different districts of Tamil Nadu. This data and its coordinates (the fourth dataset) were compared to the three existing datasets to proceed with the study.

**Result:**

At the end of the first part of the study, which was primarily based on GIS mapping, in obtaining the fourth data set, the study was able to accurately identify 3,198 mine locations across various districts in Tamil Nadu using remote sensing. However, discrepancies emerged when comparing these coordinates with those provided by the TN Mining Department and TNGIS, highlighting a need for further validation and cross-referencing with existing datasets. Currently, each mine

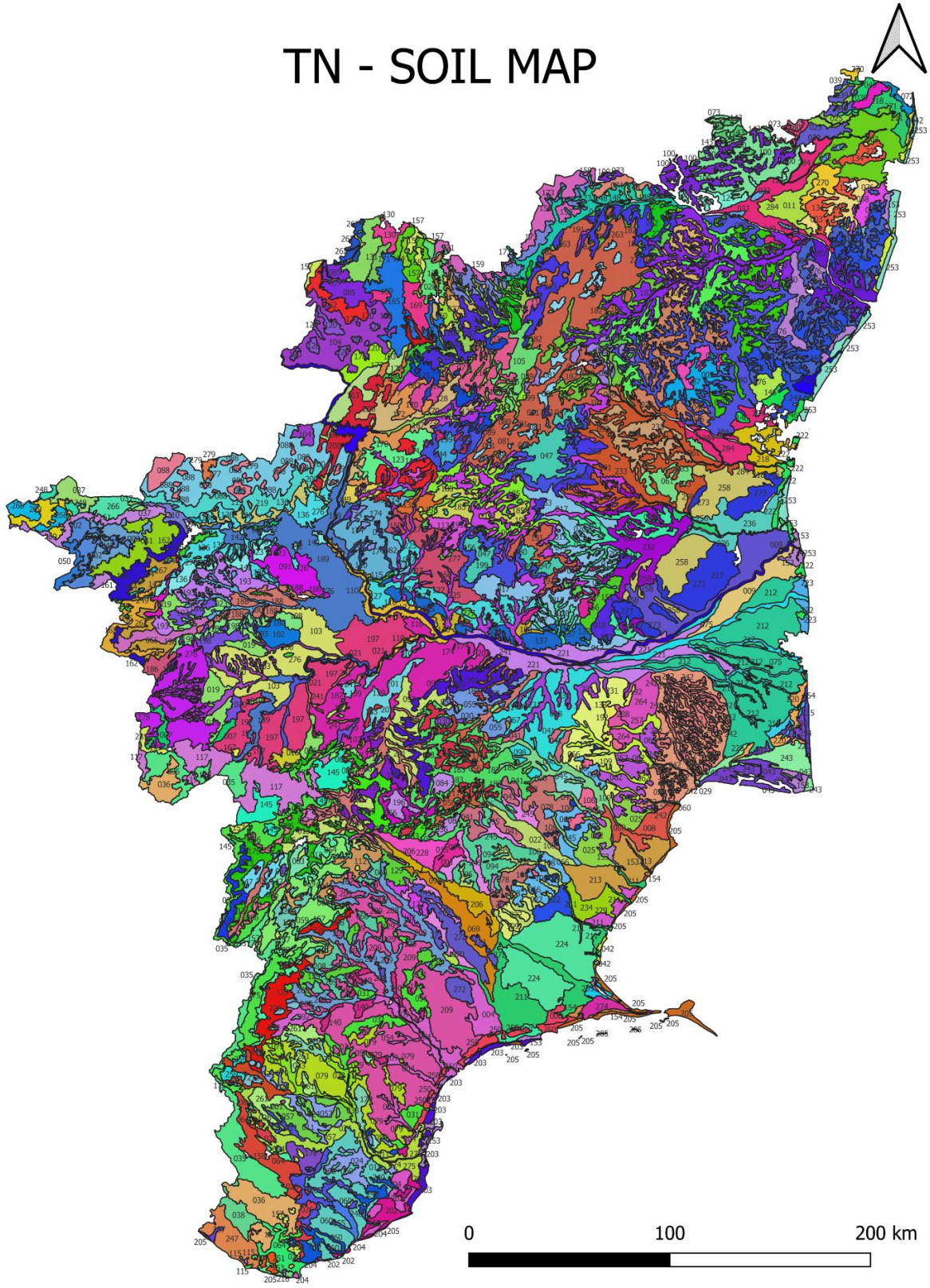
type remains undetermined, underscoring the potential for AI-driven support in the next phase of the study to aid in mine type identification. Additionally, secondary data-based research was conducted to produce soil, rainfall, temperature, forest cover, and water table maps for Tamil Nadu, offering valuable context to enhance the analysis and inform future project phases.



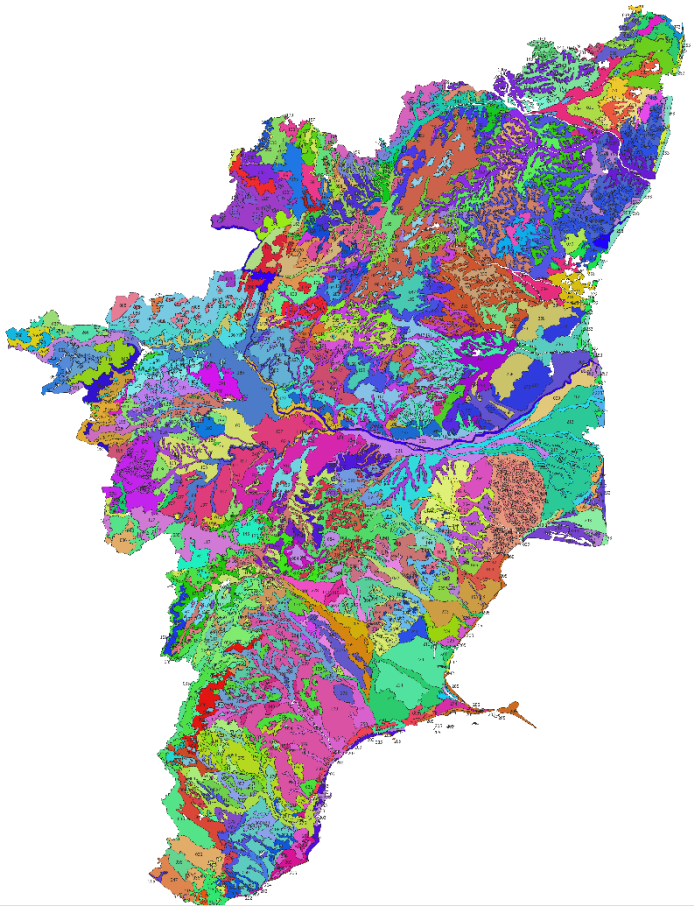

**Map 5:** District-wise distribution of mines in Tamil Nadu, created using data acquired through remote sensing and GIS analysis.

Additionally, secondary data research was conducted, creating soil, rainfall, and temperature maps for Tamil Nadu to further support the study.

**Map 6:** Tamil Nadu soil map



# TN - Soil MAP

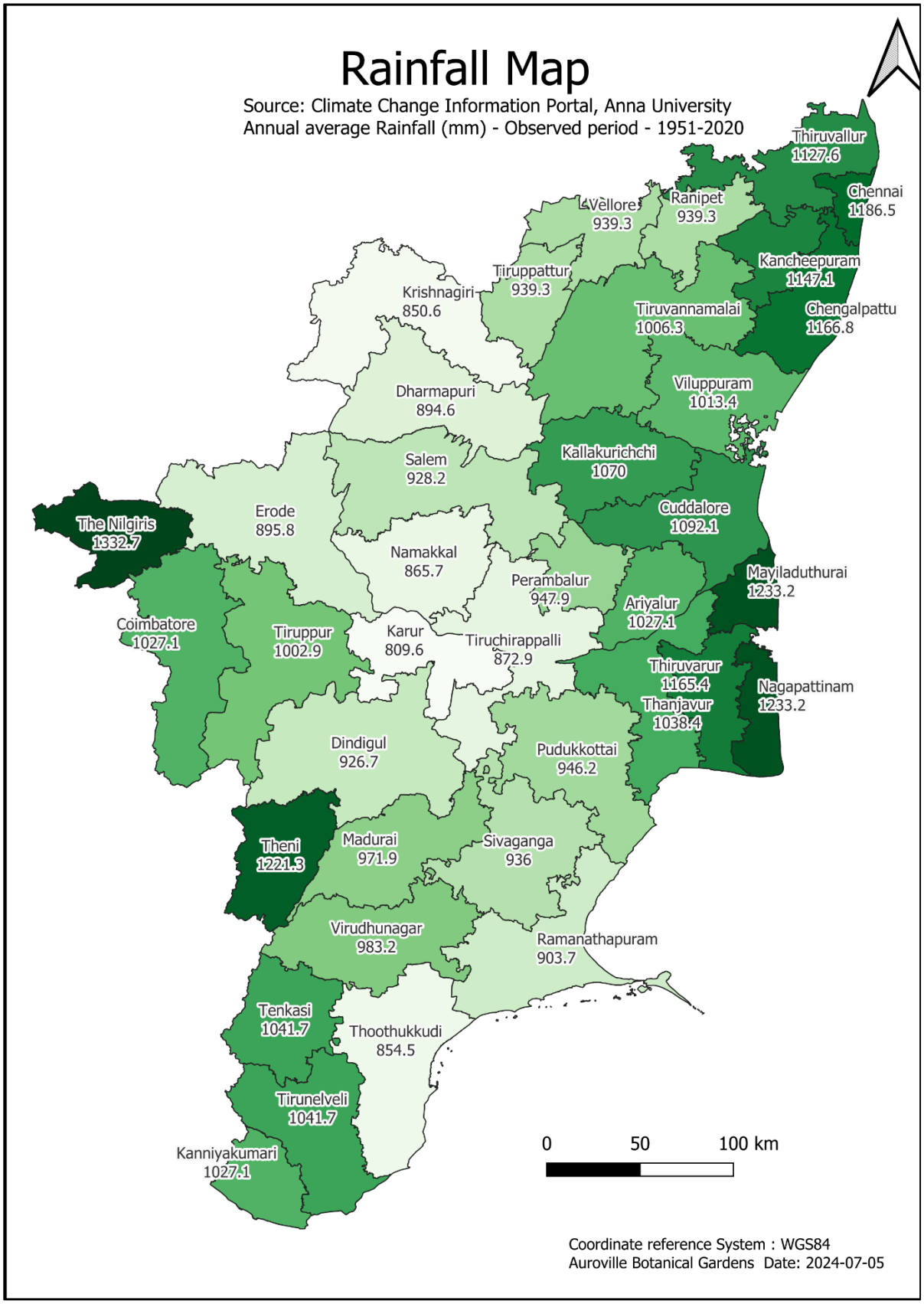


Soil Classification

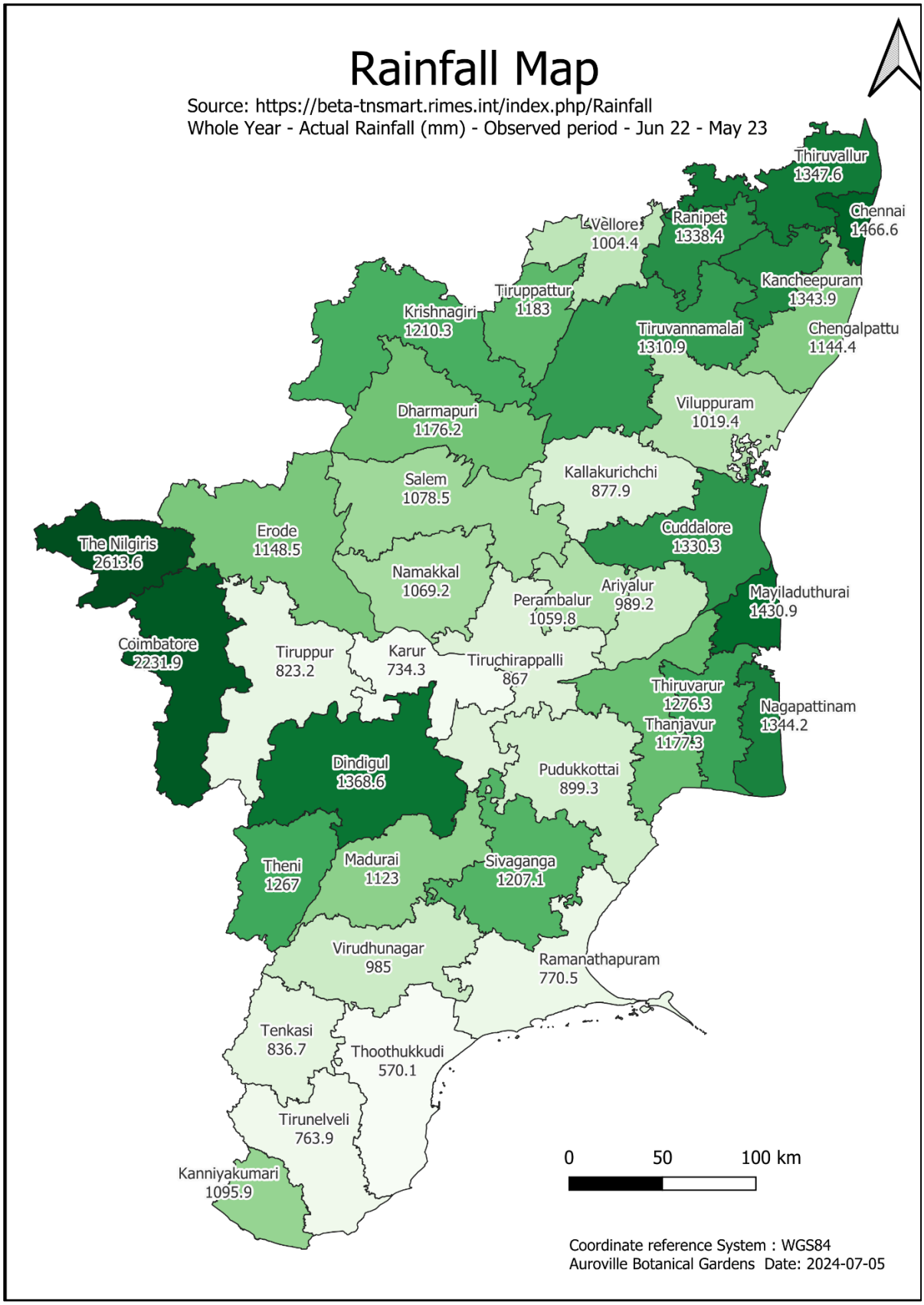
Source of the Map: TNGIS

Coordinate reference system : WGS84
Auroville Botanical Gardens Date:2024-07-03

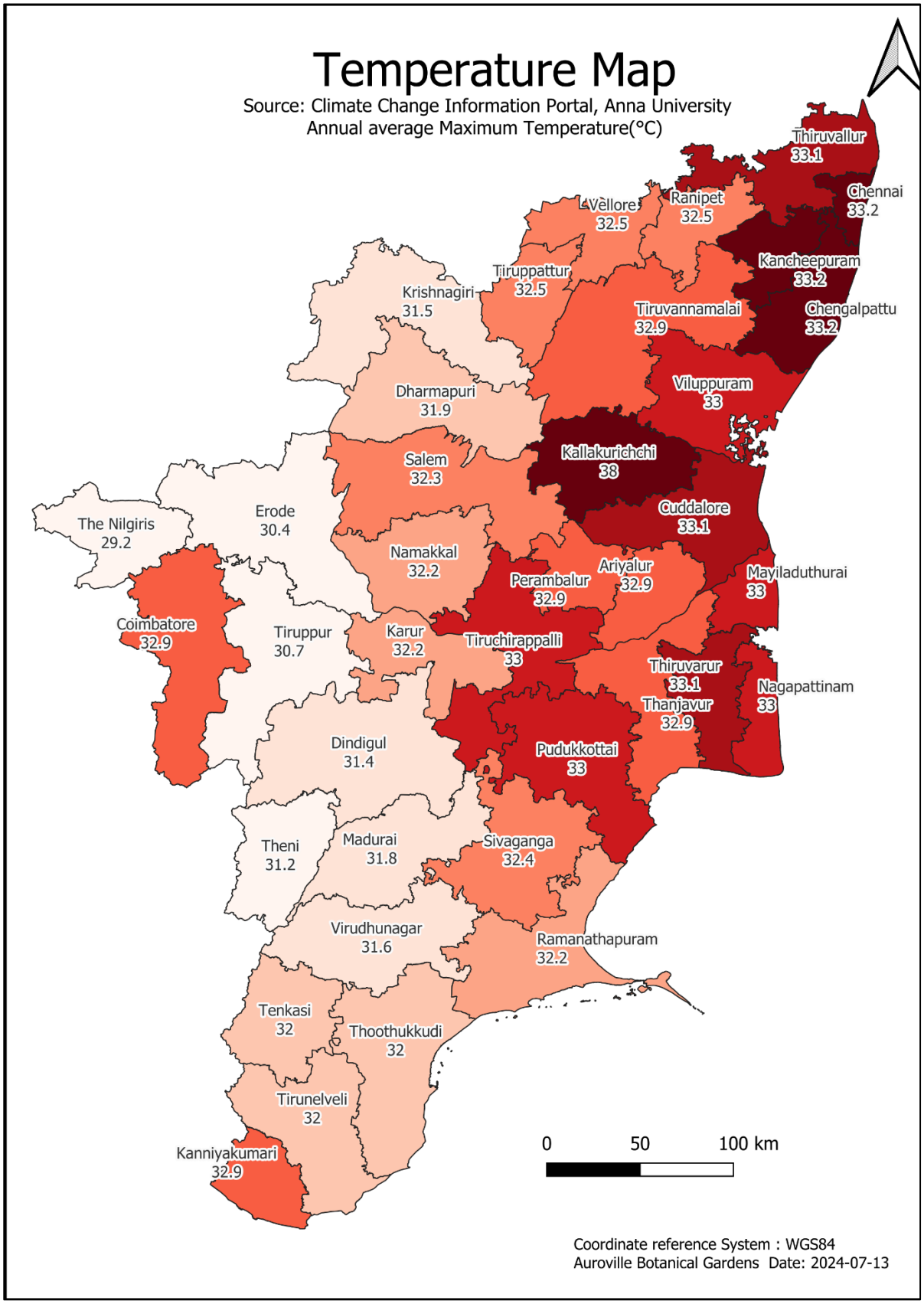
**Map 7:** Tamil Nadu rainfall maps (annual average rainfall (mm) -observed period 1951-2020)



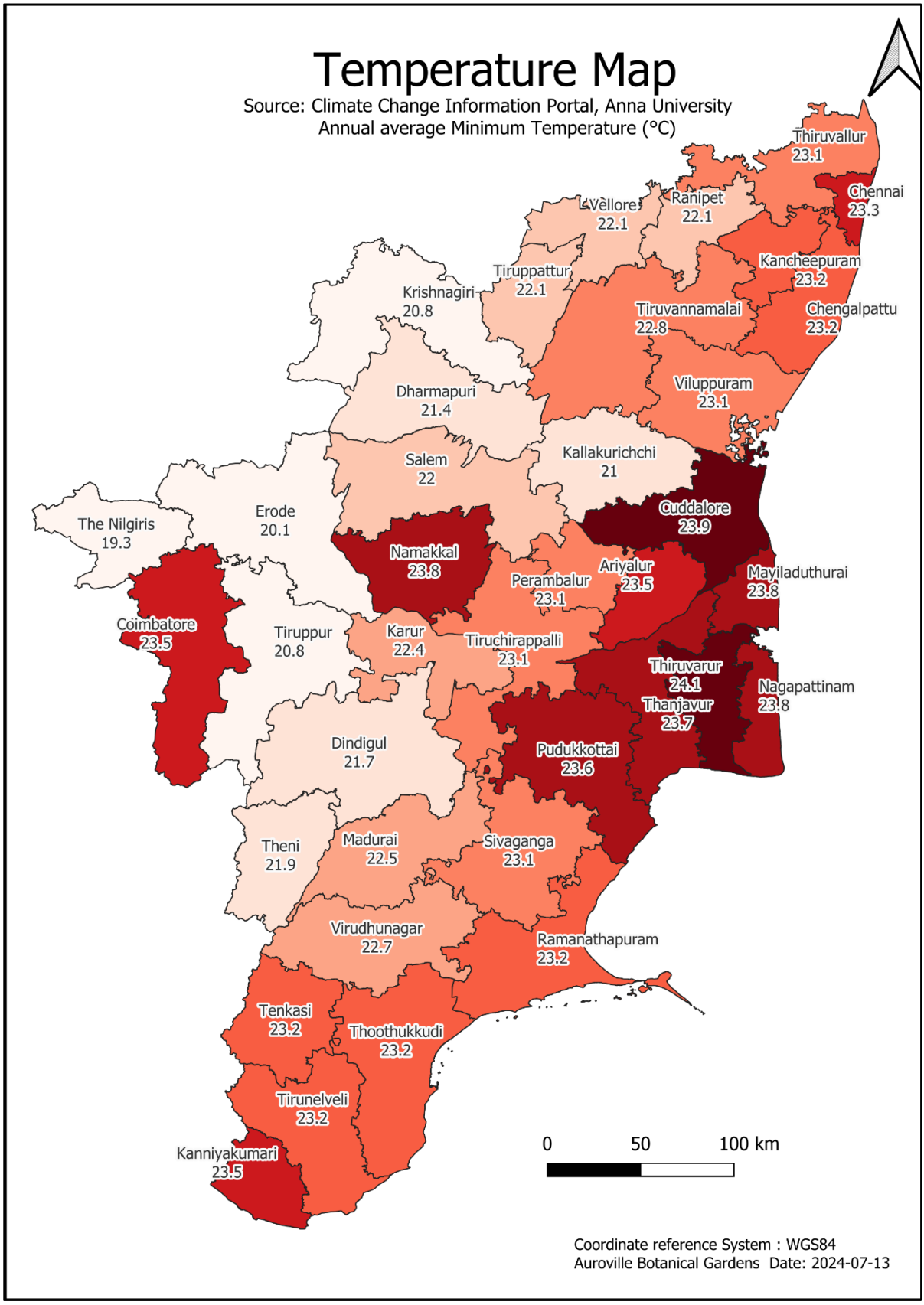
**Map 8**: Tamil Nadu rainfall maps (actual rainfall (mm) -observed period June 22 -May 23)



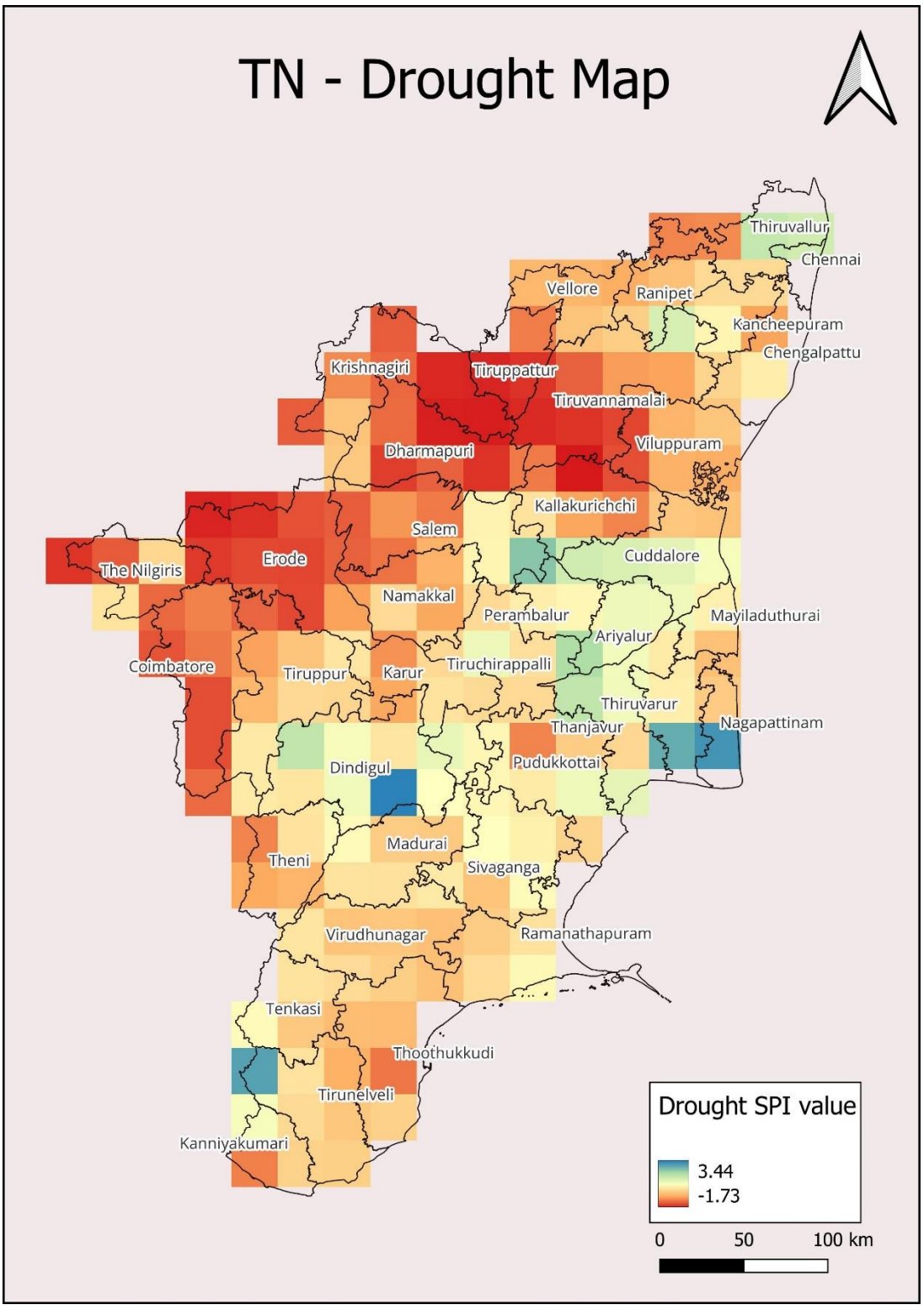
**Map 9:** Tamil Nadu temperature map (annual average maximum temperature (°C))



**Map 10:** Tamil Nadu temperature map (annual average minimum temperature (°C))

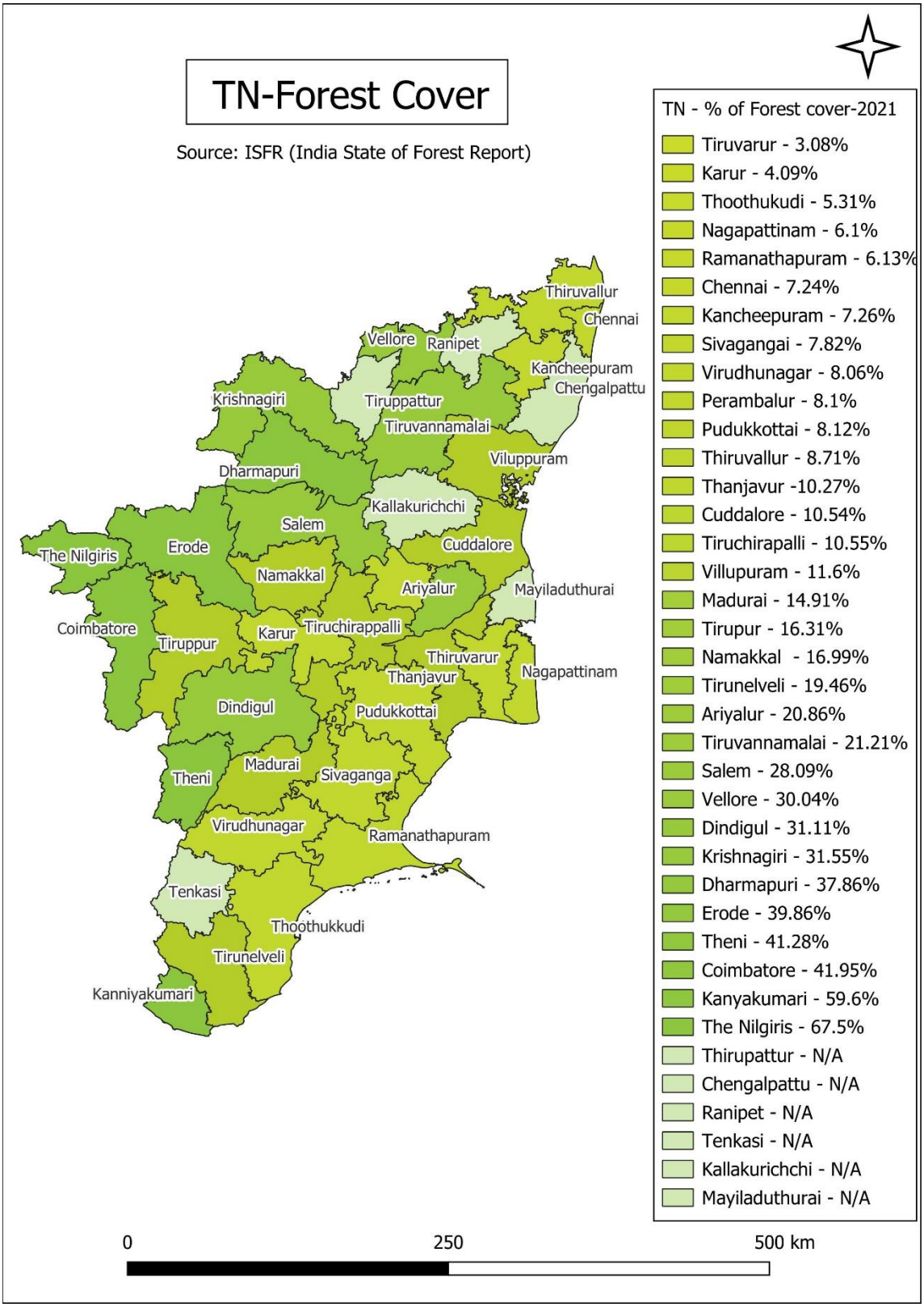


**Map 11:** Drought vulnerability map of Tamil Nadu (presented district-wise)




Drought vulnerability was evaluated using the Standardized Precipitation Index (SPI), calculated with a GitHub-based SPI Utility tool and 30 years of rainfall data (1993–2023) from the Indian Meteorological Department (IMD) at a 27 km spatial resolution. The SPI measures deviations in rainfall from the long-term average to classify meteorological conditions into seven categories: Extremely Wet (SPI ≥ 2.0), Very Wet (1.5–1.99), Moderately Wet (1.0–1.49), Near Normal (-0.99–0.99), Moderately Dry (-1.0–1.49), Severely Dry (-1.5–1.99), and Extremely Dry (SPI ≤ -2.0).

**Map 12:** Forest Cover map of Tamil Nadu (presented district-wise)




Forest cover and related parameters were analysed temporally from 2001 to 2021 using ISFR data. The study also examined forest variables like density, tree cover, and mangrove cover at the district level in Tamil Nadu. Forest cover is classified into High (>33%), Moderate (20–30%), Low (10–20%), and Very Low (0–10%) categories.

# 2. Developing Selection Criteria, Studying Mine Sites Using GIS, and Ground-Truthing Against Set Parameters

## 2.1 Developing selection criteria

Building upon the mapping and data collection efforts from the first phase, this section outlines the criteria developed to systematically select and assess mining sites across Tamil Nadu. Emphasis was placed on identifying suitable mines through clearly defined indicators—such as ownership structure, mine size, potential planting areas, and water resource availability. Additionally, broader methodological criteria were established to evaluate each site's restoration potential comprehensively, guiding subsequent ground-truthing and detailed analysis.

### Initial criteria/ indicators for mine site selection for study:

1. **Ownership**: Private landowners vs. registered companies. Private vs. government. Feasibility for collaboration (co-operative ownership/management team).
2. **Mine size:** Large Size, % mine vs. overburden. Availability of planting area.
3. **Water availability:** Onsite or in the immediate vicinity

### Broader Criteria for Site Study and Assessment (Including Methodology):

Broader criteria/Indicators for assessing 'the potential for restoration' of a mine site and their assessment methodology:

| | Criteria/Indicators | Assessment methodology |
|---|---|---|
| 1 | Ownership | Government/Department records/site visit |
| 2 | Size, % mine vs. overburden | GIS |
| 3 | Level of protection | Site visit/Information from Mine Management |
| 4 | Water availability & Water Quality | GIS + Site visit /information from mine management |
| 5 | Soil availability | Site visit/Information from Mine Management |
| 6 | Lease maturity & status of mining activity | Site visit/Information from Mine Management |
| 7 | Ecological connectivity | GIS + Site visit |
| 8 | Social consideration/Social context of the site | GIS + Site visit |
| 9 | Contact zone | Site visit/Information from Mine Management |
| 10 | Slope stability | Site visit |

**Assessment parameters (for ground-truthing):**

Site assessment framework/parameters (mainly for ground truthing) to help assess the restoration potential of post-mining landscapes.

| Key Criteria | Attributes/factors to look out for | Attention Notes |
|---|---|---|
| **1. Soil Quality and Composition**: | • Soil Type (Black cotton soil, red soil…) | |
| | • Soil texture (Clay, sand, silt, loamy, coarse, granular) | Inference: Soil suitability |
| | • Soil Profile (top layer, middle layer…) | |
| | • Soil pH | |
| | • Nutrient content (if they have done tests) | Nutrient content and organic matter details we might not be able to test or obtain information at this stage. |
| | • Organic matter (observation of litter, organic matter) | |
| | • Potential planting substrate (bed rock, loose soil, etc) | |
| | • Availability/quantity of topsoil for plantation | |
| | • Presence of toxic substances such as heavy metals or acid. – Mine report/pollution control board/mine company | Toxic substances information needs to come from the company's tests or enquiry. |
| **2. Vegetation and Plant Communities:** | • The presence of native species, key species and their diversity on the site and in the immediate surrounding area (5 km radius). | Inference: Potential for plant establishment & growth on soil. |
| | • Presence of assisted natural regeneration onsite. | |

| | | |
|---|---|---|
| | Restoration plans/existing planting activity if any | |
| | • The presence of invasive species (onsite and surrounding area). | Note: Particularly watching out for the dominance of *Prosopis juliflora & Senna simea* plantation |
| | • General health (indication of plant stress presence/absence) of vegetation onsite and /or in the area. | |
| | • Evidence of grazing either domestic or natural or other threats to vegetation. | |
| | • Evidence of fire or natural hazards (natural/unnatural) | |
| | • Reference site(s) in the region | Note: Any healthy ecosystems or forests in the neighbouring area? |
| **3. Hydrology and Water Quality:** | • Water availability for irrigation purposes, source of water (rainwater/surface or groundwater), depth of water source/standing water level pre-and post-monsoon. Groundwater level pre- and post-monsoon. | Inference: Water availability and suitability/irrigation potential. |
| | • Permeability of soil, surface runoff and erosion. | |
| | • Water quality parameters such as temperature, pH, dissolved oxygen, TDS, and nutrient levels. | Might not be able to measure water nutrient level and DO onsite |
| | • The presence of contaminants such as heavy metals or salts in the water. – mine water test report/ pollution control board/mine company | The information on water contamination can come from water test reports, either from the pollution control board/ mine company. |

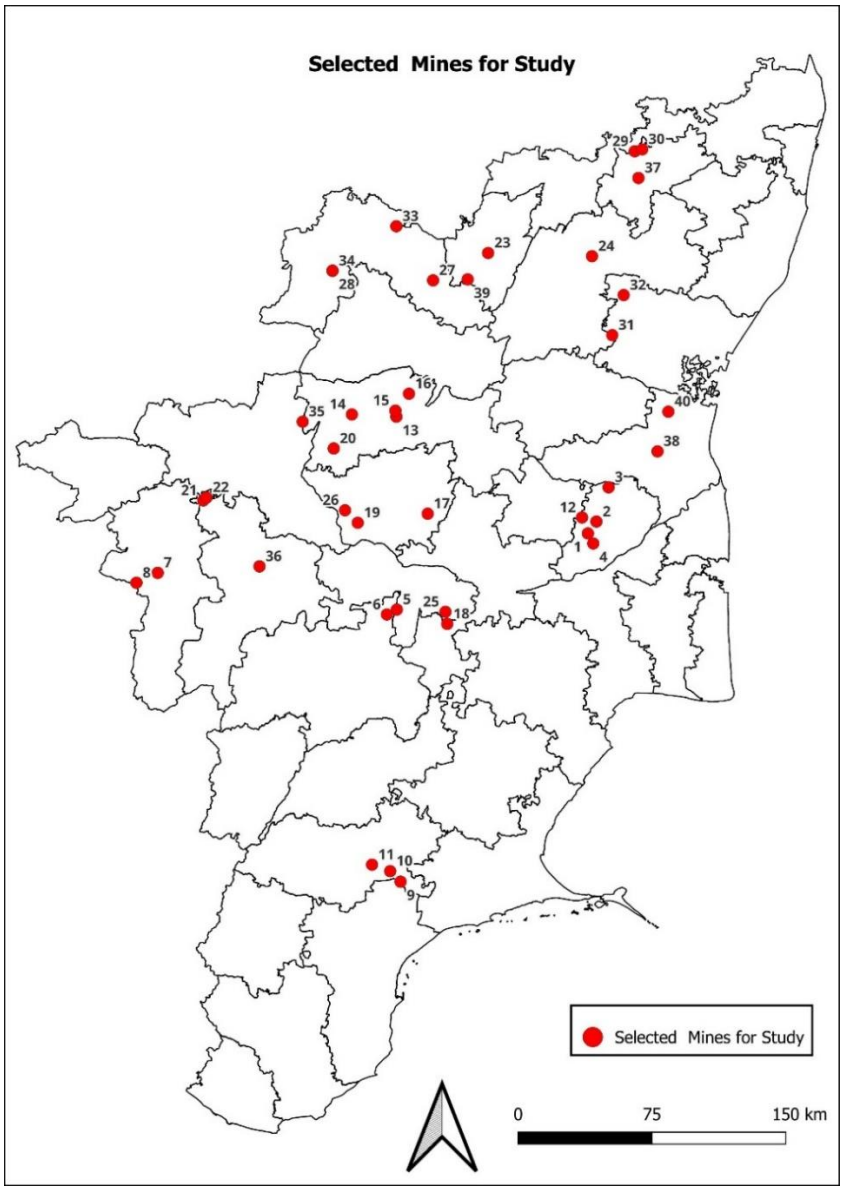
| | | |
|---|---|---|
| **4. Geomorphology and Landscape Structure:**<br>**4a. Overburden** | • General topography of the landscape | Inference: The potential for land/soil stability and erosion control. |
| | • Erosion potential and sediment transport processes. Depth of rills and gullets. | |
| | • The potential for landform recontouring and stabilization. | |
| **4b. Mining areas** | • Landform stability | |
| | • Slope angle and stability | |
| | | |
| | • Benches present or absent | |
| | • Kind of substrate for benches (rock or granite or sandstone) | |
| | • Presence of backfilling and current state of it | |
| **5. Ecological Connectivity:** | • Proximity of the site to interesting/sensitive ecosystems | Information can come from remote sensing but needs to be checked onsite as well. |
| | • The potential for wildlife movement and habitat connectivity. | Inference: relevance and connectivity to other natural areas or restoration sites. Priority sites for immediate restoration in relation to the larger ecology of the landscape. |
| | • The potential for corridors and buffer zones in promoting ecological connectivity with other interesting ecological areas in the immediate surroundings. | |
| **6. Socio-Economic Considerations:** | • Local communities in the surrounding region (livelihood/employment | Information from CSR engagement reports and remote sensing but |

| | | |
|---|---|---|
| | details (directly employed or indirectly employed in the mine) | supported by ground truthing. |
| | • Is there any CSR activities undertaken by the company in the surrounding area | Information might need to come from the company but can be ground-truthed. |
| | • Other potential stakeholders (other neighbours such as other mines or factories or companies, schools, and environmental organization close by) | Inference: The restoration project could potentially provide ecosystem services that benefit the social elements. |
| | • Farming in the surrounding region (what type, what crop, how many crops in a year). | Is it irrigated or seasonal farming (rain dependent) |
| | • Land use in the surrounding region. | Agricultural, agroforestry, mining… |
| | • Historical significance of the area (and the mine site if any) for cultural context. | |
| **7. Site Protection** | • Fencing (non-existent, present but broken (broken but reparable or broken and not reparable), present and functioning) | Note: Regulatory status might have to come from the company or mining department. |
| | • Regulatory status of the site | |
| | • Lease maturity | |
| | • Activity level of the mine | |
| | | |
| *Highlight in Grey: Information can also come from other sources such as test reports, and CSR reports. | | |
| | | |
| *Red: Currently, it is not possible to test, and/or there is no available source to provide this information within the scope and duration of the study. | | |

## 2.2 Studying mines with GIS- ground truthing using set parameters

As part of the study, 40 mine sites were selected across various types in Tamil Nadu, using broad criteria such as ownership, size (percentage of mine vs. overburden), and water availability, with a focus on selecting 4-5 of the largest mines in each category (Limestone, Granite, Bauxite, Lignite, etc). The information provided by the department was utilised to identify these sites. Further GIS analysis was conducted to assess the sites based on the developed site assessment framework (presented above), particularly focusing on parameters such as mine size (open area, mining area, overburden, etc), potential area for restoration, water availability, social setting, green cover and ecological connectivity. This analysis was followed by ground-truthing to verify on-site conditions and assess other remaining parameters such as soil quality & availability, contact zone, geomorphology & slope stability, level of protection, vegetation & plant communities onsite, etc. The study evaluated the suitability of each site for restoration efforts, recommending specific mines for immediate restoration initiatives and broader mine types for large-scale restoration efforts.

**Location of selected mines for detailed study and ground-truthing:**



**Details of selected 40 mines for study:**

| S. No. | Mine Details | Ownership | Location details (Lat & Long) | Size approx (Ha) |
|---|---|---|---|---|
| **Limestone** | | | | |
| 1 | Ariyalur district, Ariyalur Taluk, Periyanagalur Village | Dalmia Cements | 79° 8' 23.12999"<br>11° 7' 43.29001" | 225 |
| 2 | Ariyalur district, Sendurai Taluk, Anandavadi village | TANCEM (TN Govt) | 79° 10' 57.69001"<br>11° 11' 20.31" | 34 |
| 3 | Ariyalur district, Sendurai Taluk, Alathiyur village | Ramco cements | 79° 14' 40.61"<br>11° 21' 47.63002" | 150/160 |
| 4 | Ariyalur district, Sendurai Taluk, Periyathirukonam village | Dalmia cements | 79° 9' 59.89"<br>11° 4' 39" | 162 |
| 5 | Karur district, Kadavur Taluk, Devarmalai village | Chettinad Cements | 78° 10' 4.71"<br>10° 44' 27.48998" | 130 |
| 6 | Dindigual Distict, Gujiliampari Taluk, Dholipatti | | 78° 7' 3.29999"<br>10° 42' 58.07999" | 170 |
| 7 | Coimbatore district, Coimbatore south Taluk, Madukarai | ACC Cements | 76° 57' 8.75002"<br>10° 55' 40.99001" | 83 |
| 8 | Coimbatore district, Coimbatore south Taluk, Walayar | Leased by ACC | 76° 50' 39.28999"<br>10° 52' 39.83999" | 80 |
| **Limekankar** | | | | |
| 9 | Virudhunagar district, Aruppukkottai taluk, Maravarperungudi | Ramco cements | 78° 11' 13.35001"<br>9° 21' 23.01998" | 480 |
| 10 | Virudhunagar district, Aruppukkottai taluk, T.koppuchithampatti | Ramco cements | 78° 8' 3.54998"<br>9° 24' 35.74001" | 294 |
| 11 | Virudhunagar district, Arupukottai taluk, Kurundamadam | RJV Chemicals | 78° 2' 31.07"<br>9° 26' 34.37999" | 216 |
| 12 | Ariyalur district, Ariyalur Taluk, Ottakoil | Ultra tech Cements | 79° 6' 34.21001"<br>11° 12' 36.10001" | 22 |
| **Magnesite** | | | | |
| 13 | Salem District, Salem Taluk, Chettichavadi | IMPL | 78° 9' 57.30998"<br>11° 43' 22.00001" | 56 |
| 14 | Salem district, Metur taluk, Periyasoragai | Govt | 77° 56' 22.53001"<br>11° 44' 3.95002" | 6.3 |
| 15 | Salem district, Omalur Taluk,Kurumbapatti | TANMAG | 78° 9' 38.59999"<br>11° 45' 12.53002" | 200 |
| **Bauxite** | | | | |
| 16 | Salem district, Yercaud taluk, Puliyur | Malco mines | 78° 13' 47.37"<br>11° 50' 22.75001" | 11 |
| 17 | Namakkal district, Namakkal Taluk, Selurnadu | Govt land leased | 78° 19' 30.41"<br>11° 13' 44.49" | 5.2 |
| **Quartz & feldspar** | | | | |
| 18 | Tiruchirappalli district, Mondipatti taluk, Vadugapatti village | Govt land | 78° 25' 28.26998"<br>10° 40' 6.03998" | 17 |
| **White Granite** | | | | |
| 19 | Namakal district, Paramathivelur Taluk, Surampalayam | V .Punitha | 77° 58' 9.76001"<br>11° 10' 58.28999" | 40 |
| 20 | Salem, Sankari taluk, Sariprakad | | 77° 50' 50.58265"<br>11° 33' 39.97548" | |

| | | | | |
|---|---|---|---|---|
| **Colour Granite/Multicolour granite** | | | | |
| 21 | Tiruppur district , Avinashi Taluk, Alathur | Private/ Shivakumar | 77° 11' 3.73999"<br>11° 17' 48.86999" | 25 |
| 22 | Tiruppur district , Avinashi Taluk, Mangarasa valaya palayam | Private | 77° 12' 2.31998"<br>11° 18' 41.77001" | 17 |
| 23 | Tirupattur district, Tirupattur Taluk, Yalagiri hill | G. Achudhan | 78° 37' 56.53999"<br>12° 33' 20.08001" | 15 |
| 24 | Thiruvannamalai district, Polur Taluk, Murugapadi | | 79° 9' 37.19495"<br>12° 32' 22.46113" | 10, 2.8 |
| 25 | Karur district, Kulithalai taluk, Thogamalai | Om Shakthi granites | 78° 24' 54.92999"<br>10° 43' 46.96" | 10.12 |
| 26 | Namakkal district, Parmathivelur taluk, Sithampoondi village | MS Granite exports | 77° 54' 17.66999"<br>11° 14' 47.22" | 2.2 |
| 27 | Krishnagiri district, Krishnagiri Taluk, Pulikunda village | Good luck exports | 78° 21' 8.88001"<br>12° 24' 59.42002" | 2.4 |
| 28 | Krishnagiri distict, Denkanikottai taluk, Sandhanapalli village | Karthik Ganesh | 77° 50' 28.41"<br>12° 27' 58.11001" | 2.27 |
| **Black granite** | | | | |
| 29 | Ranipet district, Sholinganur Taluk, Rendadi village | TANMIN | 79° 22' 39.36"<br>13° 4' 24.71002" | 75 |
| 30 | Ranipet district, Sholinganur Taluk, Kodakal village | | 79° 24' 55.90001"<br>13° 4' 59.76998" | 62, 24,12 |
| 31 | Villupuram district, Gingee taluk, Pothuvai & pazhavalam | Tamin /GOVT of Tamilnadu | 79° 15' 47.63999"<br>12° 8' 15.37001" | 40 |
| 32 | Villupuram district, Melmalaiyanur taluk, Melmalaiyanur | | 79° 19' 17.3114"<br>12° 20' 30.30349" | 10 |
| 33 | Krishnagiri district, Krishnagiri Taluk, Kathiripalli village | A. Murugan | 78° 9' 56.40998"<br>12° 41' 31.42" | 1.94 |
| 34 | Krishnagiri distict, Thenkaanikottai taluk, Sandhanapalli village | Ramachandra granites | 77° 50' 28.75999"<br>12° 27' 52.58999" | 3.9/1.2 |
| **Roughstone & (Roughstone & ) Gravel** | | | | |
| 35 | Erode district, Anthiyur Taluk, Sennampatti village | Private/ KSS stone crusher company private | 77° 41' 22.24"<br>11° 41' 49.72999" | 1.6 |
| 36 | Tiruppur district, Tiruppur south Taluk, South avinashipalayam | Private/ Krishnamoorthy | 77° 28' 11.95176"<br>10° 57' 40.28918" | 10 |
| 37 | Ranipet district, Wallajah taluk, Chittathur village | Bluerock crusher | 79° 23' 47.77001"<br>12° 56' 14.21002" | 8.7 |
| **Lignite** | | | | |
| 38 | Cuddalore district, Kattumannar koil Taluk, Aladnderkoil village | | 79° 29' 35.76794"<br>11° 32' 46.53668" | 90140 |
| **Vermiculite** | | | | |
| 39 | Tiruppattur district, Tiruppattur taluk, Sevathur village | TAMIN/Govt | 78° 31' 42.17999"<br>12° 25' 17.94" | 20 |
| **Fire Clay** | | | | |
| 40 | Cuddalore district, Paruti taluk, Panikkankuppam | TANCEM | 79° 32' 54.66998"<br>11° 44' 53.63999" | 5.5 |
| | | | | |

**Photos from ground-truthing of mine sites in Tamil Nadu**







## 2.3 Brief description of the results

**a. Study results are presented in the following pages**

| S. No. | Village | Ownership | Location details (Lat & Long) | Size (Mine extent) hec | Water Area (hec) | Dump Area (Hec) | % mine VS. overburden | Water availability (On site) | Notes of Ecological connectivity / Water bodies in the surrounding | Slope soil erosion | Existing activity on site | Social context- villages within 5km radius | Soil Describtion | Soil taxonomic | Rock_type & Rock_sediments / Lithology_unit | Min-Temp | Max-Temp | Min-Ele(m) | Avg-Ele (m) | Max-Ele(m) | ClimaticMoistureIndex |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Limestone | | | | | | | | | | | | | | | | | | | | | |
| 1 | Periyanagalur | Dalmia Cements | 79° 8' 23.12999" 11° 7' 43.29001" | 309 | 35.4 | 18.7 | 17% | Yes | At 7 km East Vilangudi extn RF and Manageri RF / A pond is present at 1 km to the east | | | Kallankurichi, Samathuvapuram, Kopliwadi, Thelur, Periyanagalur, Kattupingiyam, Mandaiyankurichi, Srinivasapuram, Kayarlabath, Kushawadi, Pudupalayam, Nerinikkorai, Nikapale, Kadugur | Very deep, imperfectly drained, cracking clay soils of nearly level valleys, moderately eroded; associated with; very deep, imperfectly drained, cracking clay soils. | Fine, montmorillonitic, Typic Chromusterts & Fine, montmorillonitic, Vertic Ustropepts | Fossiliferous Limestone, Shell Limestone & Semi-Consolidated Sediments / Limestone / Shell Limestone | 23.5 | 32.9 | 83 | 93 | 103 | -0.42 |
| 2 | Anandavadi | TANCEM (TN Govt) | 79° 10' 57.69001" 11° 11' 20.31" | 39.2 | 3.7 | 9.5 | 4% | | Vinnankurichi RF | | | Ayanathur, Karmanglem, Kavanur, Ambapur, Valarkkurichi, Soguergued, kilimangalam, Irumbilikurichi, Sirukadambur, Rayapuram, Senniyanam, Kadur, Ayan athur | Very deep, well drained, loamy soils on gently sloping lands, moderately eroded; associated with, deep, well drained, loamy soils. | Fine-loamy, mixed. Oxic Ustropepts & Fine-loamy, mixed, Typic Ustropepts | Limestone and calcareous Shale & Semi-Consolidated Sediments / Shaly Limestone | 23.5 | 32.9 | 119 | 122 | 127 | -0.42 |
| 3 | Alathiyur | Ramco cements | 79° 14' 40.61" 11° 21' 47.63002" | 548 | 44 | 2.9 | 189% | Yes | 4 km East ABANADU RF, 3.5 km west VANGARAM RF / Vellar river present in between the factory and mine. | No | restoration happens | Puthupalayam, Edaiyakurichi, Soyambath, Kottaikadu, Thalavoi north, Silupanur, Eachangadu, Sengamedu, Soundarachilapuram colony, Irulampattu, Pasikulam, Khadeurge, Mullaiyur, Talavoi south, Thavie | Very deep, well drained, clayey soils on gently sloping lands, moderately and severely eroded; associated with; moderately deep, well drained, loamy soils on nearly level lands with slig | Fine, kaolinitic, Kandic Paleustalfs & Fine-loamy, mixed, Kanhaplic Haplustalfs | Limestone and calcareous Shale & Semi-Consolidated Sediments | 23.5 | 32.9 | 62 | 72 | 80 | -0.35 |
| 4 | Periyathirukonam | Dalmia cements | 79° 9' 59.89" 11° 4' 39" | 204 | 33.5 | 9.7 | 21% | Yes | 5 km North east , Vilangudi RF and ulliyankudi RF / Agri water canal is available at 1 km | Yes | Restoration planting | Walakuli, Edayathankudi, Periyathirukkonam, Karuppilakattalai, Kilawalam, Sunkude, Udayavarthiyanur, Chinnapattakadu, Vaippam, Nagamangalam | Very deep, imperfectly drained, cracking clay soils of nearly level valleys, moderately eroded; associated with; very deep, imperfectly drained, cracking clay soils. | Fine, montmorillonitic, Typic Chromusterts & Fine, montmorillonitic, Vertic Ustropepts | Medium clay, Sandy clay, Sandy silt & Unconsolidated Sediments | 23.5 | 32.9 | 59 | 63 | 67 | -0.42 |
| 5 | Devarmalai | Chettinad Cements | 78° 10' 4.71" 10° 44' 27.48998" | 165 | 5.6 | 26 | 6% | Yes | At 7 km south,Sembianatham RF & Toppasamymalai RF | | | Kalayapati, Kurunikulathupatti, Devarmalai, Karungal, Sinnandipatti, Vellaparai, Deendakkal, Viralipatti, Alagapuri, Melappaguthi, Veeranapatti, Eyambalayam, Palayam | Moderately deep, well drained, gravelly clay soils on gently sloping lands, severely eroded; associated with; moderately shallow, well drained, clayey soils. | Clayey-skeletal, mixed, Typic Ustropepts & Fine, mixed, Rhodic Paleustalfs | Hornblende Biotite gneiss, Agmatic gneiss, granitic gneiss, Migmatised gneiss & Gneiss - Granitoid Complex / Charnockite Khondalite Complex / Migmatite Complex | 22.4 | 32.2 | 207 | 216 | 226 | -0.60 |
| 6 | Dholipatti | | 78° 7' 3.29999" 10° 42' 58.07999" | 195 | 8.8 | 36 | 5% | Yes | Sembianatham RF to the South & Toppasamymalai RF | Yes | | Palayam, Komuttipatti, Karikkali, Kottanatham, Vellaparai, Poosaripatti, Seethapatti, Gujiliamparai | Moderately deep, well drained, gravelly clay soils on gently sloping lands, severely eroded; associated with; moderately shallow, well drained, clayey soils. | Clayey-skeletal, mixed, Typic Ustropepts & Fine, mixed, Rhodic Paleustalfs | Calc gneiss , Calc granulite, Crystalline limestone & Metamorphic rocks | 21.7 | 31.4 | 226 | 233 | 242 | -0.58 |

| | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 7 | Madukarai | ACC Cements | 76°57'8.75002" 10°55'40.99001" | 231 | 12.6 | 5 | 46% | Yes | Bolampatti I R.F. | Not su | Not yet | Madukkarai, Kovaipudur, Kuniyamathur, Karthikadai, Seerapalayam, Palathurai | Very deep, well drained, clayey soils on undulating lands, moderately eroded, associated with; very deep, well drained, calcareous loamy soils on gently sloping lands | Fine, mixed. Rhodic Paleustalts & Fine-loamy, mixed, Typic Haplustalfs | Garnet- sillimanite - graphite gneiss, Gamet-Biotite-Sillimanite gneiss & Metamorphic rocks | 23.5 | 32.9 | 389 | 409 | 441 | -0.41 |
| 8 | Walayar | Leased by ACC | 76°50'39.28999" 10°52'39.83999" | 50.6 | 14.2 | 0 | | Yes | Mine present inside the Bolampatti R.F | Yes | Not yet | Pudhupathy, Chinnampathy, Ayyanpathi, Navakkarai, Walayar | Rock outcrops; associated with; moderately shallow, excessively drained, gravelly loam soils on very steeply sloping escarpments and footslopes, severely eroded. | Rock land & Loamy-skeletal, mixed, Typic Eutropepts | Garnet- sillimanite - graphite gneiss, Gamet-Biotite-Sillimanite gneiss & Metamorphic rocks | 23.5 | 32.9 | 267 | 290 | 313 | -0.41 |
| | | | | | | | | | | | | Limekankar | | | | | | | | |
| 9 | Maravarperungudi | Ramco cements | 78°11'13.35001" 9°21'23.01998" | 690 | - | 20.6 | | No | | No | restoration has happened on 80% of the land | Pungamarathupatti, Salukkuvarpatti, Maravarperungudi, Maniakaranpatti, Kanjampatti, Udaiyanathapuram | Very deep, imperfectly drained, calcareous, cracking clay soils on gently sloping lands, moderately eroded; associated with; very deep, imperfectly drained, calcareous, cracking clay soi | Fine, montmoriHonitic, Typic Chromusterts & Fine, montmorillonitic, Vertic Ustropepts | Hornblende Biotite gneiss, Agmatic gneiss, granitic gneiss, Migmatised gneiss & Gneiss - Granitoid Complex / Charnockite Khondalite Complex / Migmatite Complex | 22.7 | 31.6 | 90 | 92 | 93 | -0.55 |
| 10 | T.koppuchithampatti | Ramco cements | 78°8'3.54998" 9°24'35.74001" | 134 | 2.2 | 5 | | Yes | | | It does not look like any plantation has been carried out, but once the mining activity has gotten over, plants seem to have started to grow automatically | Chettipatti, Pandalkudi, Chidambarapuram, Pappakudi, Periya Tumakkundu, Chinna tumakkundu, Maturbatti, Vaduvarpatti | Deep, moderately well drained, cracking clay soils on gently sloping lands, moderately eroded; associated with; deep, imperfectly drained, cracking clay soils. | Fine, montmorillonitic, Vertic Ustropepts & Fine, montmorillonitic, Typic Chromusterts | Hornblende Biotite gneiss, Agmatic gneiss, granitic gneiss, Migmatised gneiss & Gneiss - Granitoid Complex / Charnockite Khondalite Complex / Migmatite Complex | 22.7 | 31.6 | 77 | 91 | 102 | -0.53 |
| 11 | Kurundamadam | RJV Chemicals | 78°2'31.07" 9°26'34.37999" | 180 | 0.3 | | | Yes | Nearby a lake is present | No | It does not look like any plantation has been carried out, but once the mining activity has gotten over, plants seem to have started to grow automatically | Kurundamadam, A. Kalluppatti, Sundaralingapuram, Vaduvarpatti, Mamupypuram, Vellaipuram, Thiruvirunthal Puram, Pudupatti, Kanmaepatti, Podampatti, Chidambarapuram, Chicetykurchi, Chettikurchi | Deep, moderately well drained, cracking clay soils on gently sloping lands, moderately eroded; associated with; deep, imperfectly drained, cracking clay soils. | Fine, montmorillonitic, Vertic Ustropepts & Fine, montmorillonitic, Typic Chromusterts | Hornblende Biotite gneiss, Agmatic gneiss, granitic gneiss, Migmatised gneiss & Gneiss - Granitoid Complex / Charnockite Khondalite Complex / Migmatite Complex | 22.7 | 31.6 | 97 | 99 | 100 | -0.53 |

| | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 12 | Ottakoil | Ultratech Cements | 79° 6' 34.21001" 11° 12' 36.10001" | 68.6 | 1.14 | | | | | No | Not yet | Salaiyankkurichy, K. Poyyur, Srinivasapuram, Thamaraikulam, Govindapuram, Krishnapuram, Kadugur, Amnebda, Manakkal, Kothavasal, Periavenmani West, Kadur South, Sennivanam, Mettupalayam | Very deep, imperfectly drained, cracking clay soils of nearly level valleys, moderately eroded; associated with; very deep, imperfectly drained, cracking clay soils. | Fine, montmorillonitic, Typic Chromusterts & Fine, montmorillonitic, Vertic Ustropepts | Sandstone with clay intercalation, White clay & Semi - Consolidated Sediments | 23.5 | 32.9 | 108 | 111 | 117 | -0.42 |
| **Magnesite** | | | | | | | | | | | | | | | | | | | | |
| 13 | Chettichavadi | IMPL | 78° 9' 57.30998" 11° 43' 22.00001" | 53 | 6.75 | 5.6 | 9% | Yes | Kurumbapatty R.F. is located 0.5 km to the east, while Nagaramalai R.F. is 0.5 km to the southwest. | Yes | Not yet | Chettichawadi Mandop, Kurumbampatti, Kannankurichi, M.Palapatti, Nagamalai RF, Sengaradu, Gundur, Kapputhi RF, Mannarpalayam, Mookaneri, Gorimedu, Hasthampatti, Reddiyur | Moderately shallow, well drained, clayey soils on gently sloping Hands, moderately eroded; associated with; Shallow well drained, gravelly loam soils with slight erosion. | Fine, mixed, Typic Rhodustalfs & Loamy-skeletal, mixed, Typic Ustropepts | Pyroxenite, Gabbro, gabbroic Anorthosite, Dunite, Peridotite & Plutonic Rocks | 22 | 32.3 | 351 | 358 | 366 | -0.46 |
| 14 | Periyasoragai | Govt | 77° 56' 22.53001" 11° 44' 3.95002" | 6.4 | 0.06 | 0.9 | 7% | No | | Yes | Not yet | Periyasoragai, Mallikuttai, Seranganur, Poomattapatti, Pullanur, Mottur, Kunnaroo, Chinnasoragai, Kuppakundam, Shadpatti, Ramireddipatti, Ariyampatti, Kadioor, Periswarakay, Nadarcolli, Athirampatti, Amarakundhi, Koodakallanoor, Arurpatti, Salora, Salavadi, Tachnur, Surappalli, Nalchawar, Dasagappatti, Ellaikutaiyur, Manathal, Tholasampatti, Thondumaniyam, Vedappatti, Parakkallur, Ayamaram, Salora, Selavadi. | Moderately shallow, well drained, clayey soils on gently sloping Hands, moderately eroded; associated with; Shallow well drained, gravelly loam soils with slight erosion. | Fine, mixed, Typic Rhodustalfs & Loamy-skeletal, mixed, Typic Ustropepts | Hornblende Biotite gneiss, Agmatic gneiss, granitic gneiss, Migmatised gneiss & Gneiss - Granitoid Complex / Charnockite Khondalite Complex / Migmatite Complex | 22 | 32.3 | 333 | 337 | 339 | -0.48 |
| 15 | Kurumambapatti | TANMAG | 78° 9' 38.59999" 11° 45' 12.53002" | 117 | 28.5 | 28.19 | 4% | Yes | Mine is located in Kurumbapatty R.F and next to it is the Kurumambadi zoological park. | Yes | Appears to have some activity going on | Kuduvampatti, Sengaradu, Kurumbampatti, Chettichawadi, Thathayangarpatti, Vattakkadu, Mungilpadi, Nagarmalai RF, Gundur. | Moderately shallow, well drained, clayey soils on gently sloping Hands, moderately eroded; associated with; Shallow well drained, gravelly loam soils with slight erosion. | Fine, mixed, Typic Rhodustalfs & Loamy-skeletal, mixed, Typic Ustropepts | Pyroxenite, Gabbro, gabbroic Anorthosite, Dunite, Peridotite & Plutonic Rocks | 22 | 32.3 | 375 | 383 | 405 | -0.46 |
| **Bauxite** | | | | | | | | | | | | | | | | | | | | |
| 16 | Puliyur | Malco mines | 78° 13' 47.37" 11° 50' 22.75001" | 11.5 | | | | No | Mine is present on top of the hill | No | restoration happens, fully planted | Manjakuttai, Semmeduru, Vellakkadai, Mundachedu, Nagloor, Semmanathan, Kadugamarathur, Muluvi, Periyakkadu, Arasamanathur, Solur, Vaniar R.F., Valavandi, Puthur, Mailapatti, Nagalur, Asambur, Sanyasimalai R.F., Meryland R.F., Kotadiyar, Karadivoor. | Deep, well drained, clayey soils on steeply sloping, high hills and hill ranges, severely eroded; associated with; moderately shallow, well drained, loamy soils. | Fine, mixed Typic Argiustolls & Fine-loamy, mixed, Typic Haplustalfs | Charnockite & Gneiss - Granitoid Complex / Charnockite Khondalite Complex / Migmatite Complex | 22 | 32.3 | 1595 | 1628 | 1638 | -0.46 |

| | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 17 | Selurnadu | Govt land leased | 78° 19' 30.41" 11° 13' 44.49" | 4.8 | | | | No | Mine is inside Selurnadu II R.F | No | It does not look like any plantation has been carried out, but once the mining activity has gotten over, plants seem to have started to grow automatically | Kollihill, Selurnadu, Thinnanumadu, Sellur Extension R.F., Jambuthu R.F., Karayankattu Patti | Deep, well drained, clayey soils on moderately sloping, high hills and hill ranges, very severely eroded; associated with; very'deep, well drained, clayey soils on moderately sloping hill | Fine, mixed, Typic Rhodustalfs & Fine, mixed, Typic Haplustalfs | Charnockite & Gneiss - Granitoid Complex / Charnockite Khondalite Complex / Migmatite Complex | 23.8 | 32.2 | 1284 | 1298 | 1306 | -0.57 |
| **Quartz & feldspar** | | | | | | | | | | | | | | | | | | | | |
| 18 | Vadugapatti | Govt land | 78° 25' 28.26998" 10° 40' 6.03998" | 12.1 | 3.6 | | | Yes | At 3 km, Viramalai R.F | No | Not yet | Kottapatti, Thoppampatti, Veerappur, Porundalur, Sevalur, Thogaimalai, Padiripatti, K.Periapatti North, Sathirapatti, Veeramalai R.F. | Deep, well drained, gravelly clay soils on gently sloping lands, moderately eroded, associated with; moderately deep, well drained, calcareous, gravelly loam soils. | Clayey-skeletal, mixed, Rhodic Paleustalfs & Loamy-skeletal, mixed, Typic Rhodustalfs | Hornblende Biotite gneiss, Agmatic gneiss, granitic gneiss, Migmatised gneiss & Gneiss - Granitoid Complex / Charnockite Khondalite Complex / Migmatite Complex | 23.1 | 33 | 171 | 174 | 178 | -0.48 |
| **White Granite** | | | | | | | | | | | | | | | | | | | | |
| 19 | Surampalayam | V .Punitha | 77° 58' 9.76001" 11° 10' 58.28999" | 22.3 | 0.3 | 0.4 | 56% | No | | No | Not yet, active mine site | Surampalayam, Rangampalayam, Sirapalli, Kabilakkurichi, Charipalli, Nadandai, Arthanaripalayam, Madhesampalayam, Karattupalayam, Toptotam, Natanmade, Irukkur, Kabilarmalai, Alagu Kinathupalayam | Moderately shallow, well drained, gravelly loam soils on gently sloping lands, moderately eroded; associated with, moderately shallow, well drained, gravelly clay soils. | Loamy-skeletal, mixed, Typic Rhodustalfs & Clayey-skeletal, mixed, Typic Rhodustalfs | Granite, Lamphrophyre, Pink granite & Gneiss - Granitoid Complex / Charnockite Khondalite Complex / Migmatite Complex | 23.8 | 32.2 | 198 | 200 | 202 | -0.57 |
| 20 | Sariprakad | | 77° 50' 50.58265" 11° 33' 39.97548" | 165 | 10.9 | 4.4 | 38% | Yes | At 3 km, a hill - Suriyamalai R.F. | No | Not yet | Saripraikad, Kunja, Kartikad, Edappadi, Masindrakatur, Parianatur, Kurmba, Kavadikaranur, Malankad, Devannagoundanur, Manakkadu, Thangayur, Velamavals, Chanabkutti, Sadpatanur, Thangayur, Kalaamani, Surivamalai R.F. | Rock outcrops; associated with; shallow. somewhat excessively drained, gravelly loam soils on undulating, isolated hillocks, severely eroded | Rock land & Loamy-skeletal, mixed, Typic Ustropepts | Granite, Lamphrophyre, Pink granite & Gneiss - Granitoid Complex / Charnockite Khondalite Complex / Migmatite Complex | 22 | 32.3 | 249 | 263 | 287 | -0.52 |
| **Colour Granite/Multicolour granite** | | | | | | | | | | | | | | | | | | | | |
| 21 | Alathur | Private/ Shivakumar | 77° 11' 3.73999" 11° 17' 48.86999" | 1.6 | | 0.1 | 16% | No | At 15 km Northwest Modur pethikuttai RF | No | Not yet | Loourthupuram, Peranaickenpudhur, Thandukkaranpalayam, Kanurpudur, Peranaickenpudhur, Chinnakanur, Thimmanayakam Puthur, Sellappavpalayam, Thanner Pandhal. | Moderately shallow, well drained, gravelly loam soils on gently sloping lands, severely eroded; associated with; shallow, well drained, loamy soils. | Loamy-skeletal, mixed, Typic Rhodustalfs & Fine-loamy, mixed, Typic HaplustalTs | Granet granulite, Granite & Gneiss - Granitoid Complex / Charnockite Khondalite Complex / Migmatite Complex | 20.8 | 30.7 | 383 | 386 | 387 | -0.61 |

| | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 22 | Mangarasa valaya pa | Private | 77° 12' 2.31998" 11° 18' 41.77001" | 8.8 | | 0.2 | 44% | Very little | At 12 km northwest Velamundi RF is located | Yes | Not yet | Peranaickenpudhur, Loourthupuram, Thanner Pandhal, Kuttagam, Semmam Palayam, Thandukkaranpalayam, Vaguthugounden Pudur, Marampalayam. | Shallow, well drained, gravelly clay soils on undulating lands, moderately eroded; associated with, moderately shallow, well drained, gravelly loam soils. | Clayey-skeletal, mixed, Lithic Haplustalfs & Loamy-skeletal, mixed, Typic Haplustalfs | Granite, Lamphrophyre, Pink granite & Gneiss - Granitoid Complex / Charnockite Khondalite Complex / Migmatite Complex | 20.8 | 30.7 | 370 | 372 | 374 | -0.61 |
| 23 | Yalagiri hill | G. Achudhan | 78° 37' 56.53999" 12° 33' 20.08001" | 12.3 | 0.1 | 3.4 | 4% | No | Mine is present in Mangalam extn R.F. and Nagaluthu R.F. There is lot of continous RFs / MANGALAM EXTN II | Not su | Not yet, active mine site | Nilavoor, Perumapattu, Yelagiri, Pichanur, Elagiri Village | Very deep, well drained, clayey soils on gently sloping lands, slightly eroded; associated with; very deep, well drained, loamy soils | Fine, mixed, Typic Ustropepts & Fine-loamy, mixed, Typic Haplustalfs | Syenite, Carbonatites, Norite Gabbro,Basic and ultrabasics & Plutonic Rocks | 22.1 | 32.5 | 888 | 995 | 1052 | -0.48 |
| 24 | Murugapadi | | 79° 9' 37.19495" 12° 32' 22.46113" | 22.9 | 1.4 | | | Yes | 1 km north Kelur R.F. / Oghur lake, Murugapadi lake | No | Not yet | Murugapadi, Ogur, Sengunam, Ettivadi, Karikathur, Iyakulathur, Renderipattu, Kunnathur, Kunanture, Kilkarikathur, Mandakolathur, Komananthal, Karaipoondi. | Very deep, moderately well drained, calcareous, clayey soils on nearly level, tank-irrigated lands, slightly eroded; associated with; very deep, moderately well drained, calcareous, crac | Fine, mixed, Typic Ustropepts & Fine, montmorillonitic, Vertic Ustropepts | Charnockite & Gneiss - Granitoid Complex / Charnockite Khondalite Complex / Migmatite Complex | 22.8 | 32.9 | 187 | 190 | 193 | -0.36 |
| 25 | Thogamalai | Om Shakthi granites | 78° 24' 54.92999" 10° 43' 46.96" | 9.9 | 1.1 | 1 | 10% | Very little | To the southwest, 3.5 km, are Naganur R.F. and Veramalai R.F. | No | Not yet | Palaniappa Layout, Thogaimalai, Naganur, Porundalur, Padiripatti, Karuppur, Mela Veliyur, Kalladai, Sangarkallapatti, Akkandimedu, Aakaindamela, Kalvadanayakkanpatti, Padiripatti, Karuppur | Moderately deep, well drained, gravelly clay soils on gently sloping lands, severely eroded; associated with; moderately shallow, well drained, clayey soils. | Clayey-skeletal, mixed, Typic Ustropepts & Fine, mixed, Rhodic Paleustalfs | Hornblende Biotite gneiss, Agmatic gneiss, granitic gneiss, Migmatised gneiss & Gneiss - Granitoid Complex / Charnockite Khondalite Complex / Migmatite Complex | 22.4 | 32.2 | 159 | 167 | 191 | -0.48 |
| 26 | Sithampoondi | MS Granite exports | 77° 54' 17.66999" 11° 14' 47.22" | 27.6 | 0.2 | 8.9 | 3% | No | | No | Not yet | Sullipalayam, Sittampoondi, Kondarasampalayam, Kallankattuputhur, Sathipalayam, Karundevam Palayam, Kandampalayam, Nallur, Pamagoundam Palayam, Zamin Elampalli, Kosavampalayam. | Moderately deep, well drained, gravelly loam soils on gently sloping lands, severely eroded; associated with: moderately drained, gravelly loam soils. | Loamy-skeleta , mixed Typic Rhodustalfs & Loamy-skeleta , mixed Typic Ustropepts | Hornblende Biotite gneiss, Agmatic gneiss, granitic gneiss, Migmatised gneiss & Gneiss - Granitoid Complex / Charnockite Khondalite Complex / Migmatite Complex | 23.8 | 32.2 | 193 | 195 | 200 | -0.57 |
| 27 | Pulikunda | Good luck exports | 78° 21' 8.88001" 12° 24' 59.42002" | 6.8 | 0.2 | 1.6 | 4% | No | Within 3 km, to the north and west, is Puligunda II R.F. | No | Not yet, active mine site | Mangalapatti, Puligunta, Moongampatti, Gangavaram, Pillaikottai, Perugobanapalli, Kannandahalli, Kadappasandampatti, Santhur, Thogarapalli, Samalpatti, Pasinayanapalli, Karadigollapatti, Gaddampalli, Vannyapuram. | Moderately shallow, well drained, gravelly clay soils on gently sloping lands, moderately eroded; associated with, shallow, well drained, gravelly clay soils with slight erosion. | Clayey-skeletal, mixed, Rhodic Paleustalfs & Fine, mixed. Rhodic Paleustalfs | Epidote - hornblende gneiss, Champion gneiss & Gneiss - Granitoid Complex / Charnockite Khondalite Complex / Migmatite Complex | 20.8 | 31.5 | 473 | 478 | 486 | -0.48 |

| | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 28 | Sandhanapalli | Karthik Ganesh | 77° 50' 28.41" 12° 27' 58.11001" | 9 | 0.9 | 1.6 | 6% | Yes | 1.6 km to the southeast, Aiyur Extension, Udedurgam R.F., Denkanikotta, and the Cauvery North Wildlife Sanctuary. | No | Not yet, active mine site | Kuppasandram, Santhanapalli, Thalsur, Jarakalatti, Balaguli Hanumanthapuram, Namrelli, Thalsur, Samadhur, Balaguli, Bilalam, | Deep, well drained, clayey soils on undulating lands, moderately eroded; associated with; shallow, well drained, gravelly clay soils. | Fine, mixed, Typic Paleustalfs & Clayey-skeletal, mixed, Lithic Haplustalfs | Epidote - hornblende gneiss, Champion gneiss & Gneiss - Granitoid Complex / Charnockite Khondalite Complex / Migmatite Complex | 20.8 | 31.5 | 868 | 880 | 889 | -0.49 |
| **Black granite** | | | | | | | | | | | | | | | | | | | | |
| 29 | Rendadi | TANMIN | 79° 22' 39.36" 13° 4' 24.71002" | 32.1 | 0.1 | 6.6 | 5% | Yes | Ammoor R.F. is 2.5 km to the south. / Perunkanci Lake is within 3 km. | Yes | Not yet | Rendadi, Mylarwada, Kodaikkal Mottur, Sekkadikuppam, Paivalasa, Chanurmallavaram, Ootheri, Meesarakandapuram, Manjankaranai, Chinnanagapodi, Peddaramapuram, Kodakkal, Perunkanchi, Venkatapuram, Kesavanakuppam, Jambukulam. | Moderately deep, moderately well drained, clayey soils on nearly level lowlands, slightly eroded; associated with; very deep, moderately well drained, loamy soils | Fine, mixed, Typic Ustropepts & Fine-loamy, mixed, Fluventic Ustropepts | Epidote - hornblende gneiss, Champion gneiss & Gneiss - Granitoid Complex / Charnockite Khondalite Complex / Migmatite Complex | 22.1 | 32.5 | 186 | 245 | 321 | -0.36 |
| 30 | Kodakal | | 79° 24' 55.90001" 13° 4' 59.76998" | 30.8 | 0.1 | 5 | 6% | Yes | Veeranathur Bit I R.F. is within 3 km. / Periya eri | Yes | It looks like some erosion is happening, but I'm not sure due to the low resolution. | Kodakkal, Padmapuram, Ootheri, Kodaikkal Mottur, Sholinhur, Pandiyanellore, Bodaparai, Narasingapuram, Kallankuppam, Aswaravanthapuram, Manjankaranai, Chanurmallavaram, Meesarakandapuram, Ariyur, Pulivalam, Nandimangalam, Bhavnapuram, Venkatapuram, Perunkanchi. | Moderately deep, well drained, loamy soils on undulating lands, severely eroded; associated with; shallow, well drained, loamy soils. | Fine-loamy, mixed, Typic Haplustalfs & Fine-loamy, mixed Typic Rhodustalfs | Epidote - hornblende gneiss, Champion gneiss & Gneiss - Granitoid Complex / Charnockite Khondalite Complex / Migmatite Complex | 22.1 | 32.5 | 194 | 266 | 340 | -0.36 |
| 31 | Pothuvai & pazhavala | Tamin /GOVT of Tamilnadu | 79° 15' 47.63999" 12° 8' 15.37001" | 4.6 | | 0.3 | 15% | No | The mine itself is located on Pothuvai Hill, and Pakkamalai R.F. is 1.3 km nearby. | | | Palavalam, Pothuvoy, Tadagam, Anukkumalai, Settavarai, Malarasankuppam, Pulijimalai R.F., Poomjimalai R.F., Ponnimedu, Neivanatham, Ulivampattu, Gudalur Z, Nagalampattu, Uthukuttai, Vettavallam, Kanjur. | Moderately deep, well drained, clayey soils on undulating lands, moderately eroded; associated with; rock outcrops. | Fine, mixed, Rhodic Paleustalfs & Rock outcrops | Hornblende Biotite gneiss, Agmatic gneiss, granitic gneiss, Migmatised gneiss & Gneiss - Granitoid Complex / Charnockite Khondalite Complex / Migmatite Complex | 23.1 | 33 | 172 | 189 | 195 | -0.33 |
| 32 | Melmalaiyanur | | 79° 19' 17.3114" 12° 20' 30.30349" | 10 | 1.6 | | | Yes | Siruvadi RF is located at 9 km south / Malayanur Lake | No | Not yet | Dasiripalli, Naduvanapalli, Madeppalli, Chinnakothur, Chennasandiram, Kathiripalli, Dasigowripalli, Budhimutlu, Thadatharai, Ponnappa Gownapalli, Chennasandiram, Verupasandiram, Thimmasandram, Avalnatham, Thotakanama, Ramasandiram, Madepalli, Nedsalai, Gunthapalli, Kuppachiparai, Avalnatham. | Deep, imperfectly drained, calcareous, clayey, soils on nearly level lowlands, slightly eroded | Fine, mixed, Typic Ustropepts | Hornblende Biotite gneiss, Agmatic gneiss, granitic gneiss, Migmatised gneiss & Gneiss - Granitoid Complex / Charnockite Khondalite Complex / Migmatite Complex | 23.1 | 33 | 136 | 139 | 141 | -0.34 |

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|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 33 | Kathiripalli village | A. Murugan | 78° 9' 56.40998" 12° 41' 31.42" | 5.3 | 0.5 | 1.3 | 4% | Yes | Veppanapalli Bit II RF / A River is present nearby | No | Not yet | Kuppasandram, Santhanapalli, Thalsur, Jarakalatti, Balaguli Hanumanthapuram, Namrelli, Thalsur, Samadhur, Balaguli, Bilalam, | Rock outcrops; associated with; moderately deep, well drained, clayey soils on moderately sloping hills, severely eroded. | Rock land Fine, mixed, Typic Ustropepts | Hornblende Biotite gneiss, Agmatic gneiss, granitic gneiss, Migmatised gneiss & Gneiss - Granitoid Complex / Charnockite Khondalite Complex / Migmatite Complex | 20.8 | 31.5 | 573 | 578 | 583 | -0.51 |
| 34 | Sandhanapalli | Ramachandra granites | 77° 50' 28.75999" 12° 27' 52.58999" | 18.5 | 0.7 | 2.2 | 8% | Very little | 1.6 km to the southeast are Aiyur Extension, Udedurgam R.F., Denkanikotta, and the Cauvery North Wildlife Sanctuary. | No | Not yet | Kuppasandram, Santhanapalli, Thalsur, Jarakalatti, Balaguli hanumanthapuram, Namrelli, Thalsur, Samadhur, Balaguli, Bilalam, | Deep, well drained, clayey soils on undulating lands, moderately eroded; associated with; shallow, well drained, gravelly clay soils. | Fine, mixed, Typic Paleustalfs & Clayey-skeletal, mixed, Lithic Haplustalfs | Epidote - hornblende gneiss, Champion gneiss & Gneiss - Granitoid Complex / Charnockite Khondalite Complex / Migmatite Complex | 20.8 | 31.5 | 874 | 883 | 892 | -0.49 |
| **Roughstone & (Roughstone & ) Gravel** | | | | | | | | | | | | | | | | | | | | | | |
| 35 | Sennampatti | Private/ KSS stone crusher company private | 77° 41' 22.24" 11° 41' 49.72999" | 24 | 2 | 1.4 | 17% | Yes | Palamali R.F. and Kannamoochi R.F., with another located 3.8 km away in Ennamangalam. | No | Not yet | Kannamoochi, Kittampatti, Pudur, Murali, Chennapatti, Palamalai R.F. | Very shallow, somewhat excessively drained, loamy soils on very steeply sloping hills, severely eroded; associated with; shallow, somewhat excessively drained, loamy soils. | Loamy, mixed, Lithic Ustorthents & Loamy, mixed, Lithic Haplustalfs | Charnockite & Gneiss - Granitoid Complex / Charnockite Khondalite Complex / Migmatite Complex | 20.1 | 30.4 | 276 | 307 | 336 | -0.52 |
| 36 | South avinashipalaya | Private/ Krishnamoorthy | 77° 28' 11.95176" 10° 57' 40.28918" | 11.4 | | | | No | | No | Not yet | Olappalayam, Thattaravalasu, Kaattupalayam, Kurukkapalayam, Kadalaikaatupudur, Veenampalayam, Kiraakkaattupudur, Koduvai, South Avanasipalayam, Kavundanpudur, Kadaiyur. | Moderately shallow, moderately well drained. calcareous, gravelly loam soils on gently sloping lands, moderately eroded. | Loamy-skeletal, mixed, Typic Ustropepts | Hornblende Biotite gneiss, Agmatic gneiss, granitic gneiss, Migmatised gneiss & Gneiss - Granitoid Complex / Charnockite Khondalite Complex / Migmatite Complex | 20.8 | 30.7 | 350 | 359 | 365 | -0.65 |
| 37 | Chittathur | Bluerock crusher | 79° 23' 47.77001" 12° 56' 14.21002" | 258 | 10.5 | 3.9 | 66% | Yes | Bagaveli RF / Within 5 km are Periya Lake, Chinna Lake, and Kaveripakkam Lake. | Yes | Not yet | Musiri, Anandalai, Chithathoor, Narasingapuram, Sengadu, Padiyampakkam, Valluvambakkam, Kuppathu Mottur, Thangal, Varadharajapuram, Bagaveli, Ammananthangal, Walajapet, Ozhugur. | Moderately shallow, well drained, gravelly clay soils on gently sloping lands, moderately eroded associated with; moderately shallow, well drained, gravelly loam soils. | Clayey-skeletal, mixed, Rhodic Paleustalfs & Loamy-skeletal, mixed, Typic Rhodustalfs | Epidote - hornblende gneiss, Champion gneiss & Gneiss - Granitoid Complex / Charnockite Khondalite Complex / Migmatite Complex | 22.1 | 32.5 | 171 | 214 | 235 | -0.37 |
| **Lignite** | | | | | | | | | | | | | | | | | | | | | | |
| 38 | Aladnderkoil | | 79° 29' 35.76794" 11° 32' 46.53668" | 9138 | 511 | 211.3 | 43% | Yes | Ammeri RF / Manimutharu river | Yes | Plantation is happening | Kilpathi, Melpappannapattu, Melpathy, Nevveli, Uyyakondaravi, Sepalanatham, Tenkuthu, Sengalpalayam, Rassipuram, Kottagam, Thoppalikuppam, Karuvetti, Vanadirayapuram | Very deep, well drained, loamy soils on gently sloping lands, moderately eroded; associated with, deep, well drained, loamy soils. | Fine-loamy, mixed. Oxic Ustropepts & Fine-loamy, mixed, Typic Ustropepts | Sandstone and shales, Clay and Sandstone & Semi - Consolidated Sediments | 23.9 | 33.1 | -50 and | 38 and | 79 and | -0.22 |

| | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Vermiculite** | | | | | | | | | | | | | | | | | | | | |
| 39 | Sevathur | TAMIN/Govt | 78°31'42.17999" 12°25'17.94" | 20.1 | 0.5 | 0.8 | 25% | Very little | 4 km to the south is K. Papparapatti R.F. | No | Not yet | Papparapatti, Kakangarai, Lakkinayakkampatti, Elavampatti, Kurichi, Koratti, Dhanduganor, Mathampatti, Errampatti, Mettu kottai, Kannalapatti, Kunnachi, Melagarampatti | Moderately shallow, well drained, gravelly clay soils on gently sloping lands, moderately eroded; associated with; moderately shallow, well drained, gravelly loam soils. | Clayey-skeletal , mixed, Typic Rhodustalfs & Loamy-skeletal mixed, Typic Rhodustalfs | Syenite, Carbonatites, Norite Gabbro,Basic and ultrabasics & Plutonic Rocks | 22.1 | 32.5 | 407 | 413 | 418 | -0.45 |
| **Fire Clay** | | | | | | | | | | | | | | | | | | | | |
| 40 | Panikkankuppam | TANCEM | 79°32'54.66998" 11°44'53.63999" | 4.8 | 0.03 | | | No | The mine is mostly surrounded by farm trees. | Yes | Not yet | Panikankuppam, Pudu pillaiyar kuppam, Nadupilliyarkuppam, A.Andikuppam, Karumaththampatti, Melmambattu, Maligampattu, Panruti, Eralkpum, Sathippattu, Muttharasankuppam, Nellithoppu, Kalmambattu, Sirunangaivadi, Thorapadi, Siruvathur, Anguchettipalayam, Kottambakkam | Very deep, well drained, clayey soils on gently sloping lands, moderately and severely eroded; associated with; moderately deep, well drained, loamy soils on nearly level lands with slig | Fine, kaolinitic, Kandic Paleustalfs & Fine-loamy, mixed, Kanhaplic Haplustalfs | Sandstone and shales, Clay and Sandstone & Semi - Consolidated Sediments | 23.9 | 33.1 | 57 | 60 | 67 | -0.27 |

*Moisture Index data is sourced from CitiesGOER (Globally Observed Environmental), obtained from a station near the mentioned mine site.

**A compilation of representative photographs from the sites visited/ground-truthed can be found in Annexure 1.**

## 2.4 Ground-truthing study results

| S.no | Village | Size approx (Ha) | Ownership | Location details (Lat & Lon) | Soil Quality and Composition | Vegetation and Plant Communities | Hydrology and Water Quality | Geomorphology and Landscape Structure | | Ecological Connectivity | Socio-Economic Considerations | Site Protection |
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| | | | | | | | | Overburden | Mining Area | | | |
| Limestone | | | | | | | | | | | | |
| 1 | Periyanagalur | 70 | Dalmia Cements/ Patta land/ Limestone/ Periyanagalur | 79° 8'23.13"E, 11° 7'43.29"N | · Laterite soil<br>· Coarse<br>· Top layer- laterite soil mixed with limes stone, Contact zone- sand stone<br>· loose soil<br>· Topsoil - Nil | · There was not much diversity in this area as the site had been completely cleared for mining activity. Only at the edges and in undisturbed areas could a few wild native trees be observed, such as Alangium salvifolium, Diospyros montana, Morinda coreia, Euphorbia antiquorum, Anisomelos malabarica, Dodonaea angustifolia, Lantana indica, and Toddalia asiatica.<br>·The regeneration of native species was minimal. Scattered instances of regeneration were found for species such as Azadirachta indica, Diospyros montana, Dodonaea angustifolia, Holoptelea integrifolia, and Morinda coreia.<br>·Trees like Acacia auriculiformis, Delonix regia, Holoptelea integrifolia, Mimusops elengi, Polyalthia longifolia, Pongamia pinnata, Thespesia populnea, Terminalia catappa, Syzygium cumini, Simarouba glauca, and Gmelina arborea had been planted in some parts of the site.<br>·Invasive species were found in certain areas, including Acacia auriculiformis, Conocarpus lancifolius, Prosopis juliflora, and Cassia siamea.<br>·The existing and planted trees appeared healthy.<br>·Grazing activity was observed at the site.<br>·No significant natural ecosystems were found around the mining site. | · Rainwater stagnation<br>· Low to medium<br>· ph- 7.96, TDS- 90 | · Half of the extent is flat terrrain and rest is a mining pit<br>· No erosion<br>· No potential for landform stabilisation.<br>·No overburden in site, mineral is from surface itself<br>· Stable | · Benches present- 5 nos<br>· Lime and stand stones<br>· No backfilling | · Nil | · Around 130 local people work in the mines.<br>·Infrastructure includes a bus stand, toilet blocks, and borewells.<br>·Key companies operating in the area are Ramco and TANCEM.<br>·There is no farming in the immediate vicinity.<br>·The area consists of mining zones and drylands.<br>·The Kallankurichi Perumal Temple is located nearby. | · 70% fences, rest soil bunds are made for protection<br>· 2030<br>· Operational |
| 2 | Anandavadi | 110 | TANCEM (TN Govt)/Govt and Patta land/Limestone/ Anandhavadi | 79°10'57.69"E, 11°11'20.31"N | · Black cotton soil<br>· loamy<br>· Top layer- Black cotton soil. Middle- Limestone<br>· Loose soil<br>· Less quantity available | · Acacia leucophloea, Albizia amara, Cassia fistula, Clausena dentata, Dodonaea angustifolia, Ficus amplissima, Morinda coreia, Pongamia pinnata, Senna auriculata, Ficus religiosa, Lannea coromandelica, Terminalia arjuna, and Ficus benghalensis are the main native species found at this mining site. Vegetation diversity is higher in the surrounding areas; however, the mining site has been primarily planted with Eucalyptus trees.<br>·Regeneration of native species is very limited on the site. Regeneration of species such as Azadirachta indica, Clausena dentata, Morinda coreia, Senna auriculata, and Cassia fistula was observed in some locations.<br>·Acacia colei is the main invasive and dominant species present throughout the site. Most areas are occupied by Acacia colei along with other invasive species such as Cassia siamea and Prosopis juliflora.<br>· Existing and planted trees growing well in that mining site, all the trees are in healthy condition.<br>· signs of grazing activities were found on this site even though the mining site is protected well by the fence. | · Water is available onsite. Water seeping is reported. But as mining is active water is being channelized to a nearby stream<br>· Low to medium<br>· ph- 6.93, TDS- 105, EC- 211 | · Flat land with a mining pit ocvering 30 hectare. Soil is dumped in areas spanning around 3 hectares<br>· Erosion evident. Gullets- Width- 15 cms, Height- 10 cms<br>· There is potential for landform stabilisation<br>· Landfrom Stable | · Benches present. 3 benches<br>· Liemstone<br>· No backfilling done yet | · Vannankurichi RF is near by.<br>· Deers, Leopard crossing has been reported in near by areas.<br>·Famous Karaivetti Bird Sanctuary is located on the south-west side of the mining area at 25 km distance. | · Local people are enaged in the mines<br>· Toilet buildings<br>· Rain fed, Millets, Pulses<br>· Agriculture, forestry<br>· Kallankurichi Perumal temple is present in the viscinity. | · 65% fenced<br>· 2050<br>· Operational |

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| 3 | Alathiyur | 57.12 | Ramco cements/Patta land & Govt land /Limestone/ Alathiyur | 79°14'40.61"E, 11°21'47.63"N | · Black cotton soil<br><br>· loamy<br><br>· Top layer- Black cotton soil, Middle layer- limestone, Contact zone- Cuddalore sand stone<br><br>· Humus present<br><br>· loose soil<br><br>· Topsoil not available | · The diversity of the mining site and surrounding areas is rich and dense. However, the population of native species on the site is very low, as the area is mostly planted with exotic species. A few native species, such as Cassine glauca, Clausena dentata, Ficus hispida, Glycosmis mauritiana, Holoptelea integrifolia, Morinda coreia, Senna auriculata, and Wrightia tinctoria, can be observed sporadically.<br><br>·Numerous trees have been planted around the site. The regeneration of planted trees is high in this area, and some naturally existing trees are also regenerating in many locations. Species such as Cassia siamea, Holoptelea integrifolia, Clausena dentata, Ficus hispida, Ziziphus mauritiana, Pongamia pinnata, Morinda coreia, and Wrightia tinctoria were the main species found with regeneration. The northwest side of the site has been extensively planted with Peltophorum pterocarpum trees. Other species, including Albizia lebbeck, Delonix regia, Pongamia pinnata, Samanea saman, Mangifera indica, and Psidium guajava, were also recorded during the survey.<br><br>·The presence of invasive species is very high in this area, as many hazardous invasive species have been introduced unknowingly. The main invasive species include Cassia siamea, Tecoma stans, Lantana camara, Eupatorium glandulosum, Parthenium hysterophorus, and Prosopis juliflora.<br><br>·The naturally existing and planted trees appeared to be in good health, but trees and shrubs planted within the mining area showed signs of poor health, including withering leaves.<br><br>·Grazing activity by local people was observed in parts of the mining site. | · Water is available onsite throughout the year. There are two mining pits, one holds water all year around and the other during monsoon.<br><br>· Low to medium.<br><br>· ph-7.87, TDS- 285, EC-391 | · Flat land with mining pits of approximately 32 hectares<br><br>· Erosion evident<br><br>· The company has stabilized landform to a certain extent, and plantation is also carried out in the reformed areas.<br><br>· Landform stable | · Total 7 benches present. 4 visible and 3 underneath water<br><br>· Sandstone<br><br>· 20 hectares backfilled | · Kuzhumur RF is located near the site.<br><br>· Monkey, Peacock reported onsite/in the area<br><br>· Ramco has bought lands for mining in the adjacent areas and that has connectivity to Mudhukulam RF | · Nil.<br><br>· Mines non operational<br><br>· RO water plant, School renovation<br><br>· India Cements Limited<br><br>· Rainfed/ Borewell. Maize, Cashew fields<br><br>· Mining/ Agriculture | · Fenced.<br>·As mining is not operational grazing is happening.<br><br>· 2030<br><br>· Non-operational since 2018 |
| 4 | Periyathirukonam | 106 | Dalmia cements/ Patta land/ Lime stone/ Periyathirukonam | 79° 9'59.89"E, 11° 3'0.99"N | · Black cotton soil<br><br>· Loamy<br><br>· Top layer- Black cotton soil, Middle layer- Lime stone, Contact Zone- Sand stone<br><br>· Loose soil<br><br>· Topsoil available | ·Rottboellia cochinchinensis grass is the dominant species on this site, growing extensively across a vast area around the mining site. Native species such as Acacia nilotica, Prosopis cineria, Dodonaea angustifolia, Morinda coreia, Pongamia pinnata, Flueggea leucopyrus, Jatropha glandulifera, Ficus amplissima, and Ziziphus mauritiana are present. Additionally, Senna siamea and Bambusa balcooa have been planted on a large scale near the mining site. Other planted species observed around the site include Acacia auriculiformis, Senna siamea, Delonix regia, Gmelina arborea, Leucaena leucocephala, Peltophorum pterocarpum, Tectona grandis, Holoptelea integrifolia, Terminalia bellirica, Terminalia catappa, and Conocarpus lancifolius.<br><br>·Regeneration of species such as Jatropha glandulifera, Acacia nilotica, Azadirachta indica, Calotropis gigantea, Dodonaea angustifolia, Morinda coreia, Conocarpus lancifolius, Senna siamea, Pongamia pinnata, Ziziphus mauritiana, and Peltophorum pterocarpum was observed in many areas. Conocarpus trees planted inside the mining site are being maintained by the management. | · Water available. Water is holding in around 10 hectares<br><br>· Low to medium<br><br>· Ph- 6.76, TDS- 982, | · Flat terrain with mining pits and soil dumps<br><br>· There is not much potential for landfor recontouring<br><br>· stable | · Benches present- 3<br><br>· Limestone<br><br>· Backfilling done in 50 hectares | · Wild boar | · Thousands of lcoal people work in the mines<br><br>· Water bodies restoration, School renovation<br><br>· Ultra tech cements, Chettinad cements<br><br>· Rainfed agriculture in the surrounding area. Maize, Cotton, Ground nut crops are grown.<br><br>· Agriculture | · Partially fenced<br><br>· 2030<br><br>· Operational |

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| 5 | Devarmalai | 200 | Chettinad Cements Limestoen quarry/ Patta land/ Devarmalai village | 78°10'4.71"E, 10°44'27.49"N | · Red laterite<br><br>· Coarse<br><br>· Top layer- top soil , middle- lime stone.<br><br>· loose soil<br><br>· Top soil not available | · Acacia leucophloea and Senna auriculata are the dominant native species recorded around the mine site. Other species, such as Alangium salvifolium, Ailanthus excelsa, Commiphora berryi, Dodonaea angustifolia, Holoptelea integrifolia, Canthium coromandelicum, and Wrightia tinctoria, can also be observed in this area.<br><br>·Natural regeneration of Senna auriculata, Ailanthus excelsa, Wrightia tinctoria, Ficus religiosa, and Dodonaea angustifolia was noted in some locations.<br><br>·Prosopis juliflora is the primary invasive species naturally occurring around the mine site, while the introduced alien species Conocarpus lancifolius was observed in the planted areas.<br><br>·The natural vegetation appears dry and withered due to drought conditions and the intensity of sunlight.<br><br>·Grazing activity is intensive in this area. Local grazers extensively use the site for cattle and goat grazing. | · Not available. Some rain water stagnation<br><br>· Permeability medium<br><br>· TDS- 126 ppm, pH- 5.42 | · Flat land with mining happening in around 15 hecatres with few waste dump mounds. Has potentially good space for planting.<br>Mining process has started in the recent years and it will be gradually extended<br><br>· There is good potential for landform reformation and stabilization<br><br>· Landform stable<br><br>· Flat | · 2 benches present. Mining has started recently.<br><br>· rock<br><br>· No backfilling has be done as minig has recenly started | · Thoppaisami Malai RF is located to the south of the study site, approximatel y 10 to 12 km from the mine area. | · Most of the labours are outsourced, very few locals working in the mine<br><br>· School furnitures, borewells, sintex tanks, and temple restoration are some of the CSR activities.<br><br>· Windmill plants nearby<br><br>· Seasonal farming, rain-fed. Maize, coconut<br><br>· Agricultural and dry lands | · Fencing present<br><br>· 2039<br><br>· Operational |
| 6 | Dhalipatti | 138 | | 78° 7'3.30"E, 10°42'58.08"N | · Red laterite soil<br><br>· Coarse<br><br>· Top layer- tops oil, middle- limestone<br><br>· loose soil<br><br>· No topsoil available for plantation | · Acacia leucophloea, Ailanthus excelsa, Borassus flabellifer, Combretum albidum, Senna auriculata, Dodonaea angustifolia, Wrightia tinctoria, and Ficus amplissima are the native species recorded in our survey. Additionally, some plots around the mine area have native tree species that were planted and are maintained by the mine management.<br><br>·Natural regeneration of Ailanthus excelsa, Dodonaea angustifolia, Senna auriculata, and Wrightia tinctoria was found around the mine site. Seedlings of Cassia fistula, Millingtonia hortensis, and Pongamia pinnata were observed in the planted areas.<br><br>·Prosopis juliflora is the main harmful invasive species affecting both the mine site and the planted areas.<br><br>·Both the natural vegetation and planted trees appeared healthy and in good condition. However, in some areas, planted trees were stunted due to a lack of water and the intensity of the sun.<br><br>·Signs of grazing were observed in many places. We found a herd of goats inside the study site. | · Rainwater stagnation<br><br>· Permeability high<br><br>· TDS- 238 ppm, Ph- 6.60 | · Flat land, mining happening in aorund 100 hectares with waste dumping mounds in around 2 hectares.<br><br>· Erosion evident, rills- 40 cms<br><br>· Potential for landform stability<br><br>· Landform stable<br><br>· stable | · Benches present- 7<br><br>· Rock<br><br>· No backfilling done, active mining is going on | · Thoppaisami RF is located to the south of the Chettinadu mine site. | · Around 100 workers from the local villages work in the mine<br><br>· CSR: Borewells, tanks, street lights, furniture for schools ect<br><br>· One more Chettinad limestone quarry nearby.<br><br>· Rainfed farming. Coconut, Drumstick etc<br><br>Agriculture and dryland surrounding site. | · Fenced<br><br>· 2039<br><br>· Operational |

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| 7 | Madukarai | 135 | ACC Cements | 76°57'8.75"E, 10°55'40.99"N | · Red calcareous soil<br><br>· Coarse<br><br>·Top soil on top, middle- lime stone, bottom-rock<br><br>· 6.86 ph<br><br>· Not much of top soil available | · Acacia leucophloea, Acacia nilotica, Dicrostachys cinerea, Morinda coreia, and Dodonaea angustifolia are the native species found along the edges of the mine area. The height of the trees ranges from 2 to 3 meters. Vegetation diversity is very low, with the alien species Leucaena leucocephala occupying most of the area.<br><br>·Regeneration of key species is minimal, with only a few species such as Morinda coreia, Acacia nilotica, and Dicrostachys cinerea regenerating in very small numbers.<br><br>·Leucaena leucocephala is a harmful invasive species to the ecosystem, and Prosopis juliflora and Tecoma stans are also spreading rapidly in many places. Typha latifolia has colonized the shallow areas of the waterbody.<br><br>·Due to heat stress, most of the trees appear unhealthy, with dry conditions. Almost all grasses and floor shrubs are dried out.<br><br>·No grazing activity was observed on this site, as the mine area is efficiently protected. | · Water is available in around 27 hectares of the site. Groundwater is available throughout the year.<br><br>· High Permeability<br><br>· TDS- 1051 ppm, Ph- 6.86. EC- 2120 | · Slopy terrain with minor overburden mounds and has considerable space for planting<br><br>· Erosion not evident<br><br>· Poor potential for land stabilization as overburden and topsoil dumping are not much on the site.<br><br>· Landfrom stable<br><br>· 30 degree | · Benches present<br><br>· Rock<br><br>· Back filling in around 17 hectares has been done | · The southwest part of the site is covered by Madukarai Reserve Forest, which has moderately diverse vegetation.<br><br>· Elephant movement recorded | · CSR: Classroom and Anganwadi construction, school renovation<br><br>· No nearby companies<br><br>· No farming around<br><br>· Dryland and forest in the surrounding area | · Partial fencing<br><br>· Active<br><br>· Operational |
| 8 | Walayar | 65.3 | Forest Land/ Leased by ACC | 76°50'39.29"E, 10°52'39.84"N | · Red calcareous soil mixed with lime stone<br><br>· Coarse<br><br>·Top layer- top soil, Middle layer- lime stone<br><br>· 4.36<br><br>· Top soil not available | · There is not much diversity in this area, as most places are invaded by alien species like Tecoma stans and Prosopis juliflora. However, Acacia catechu, Chloroxylon swietenia, Ailanthus excelsa, Albizia lebbeck, Ziziphus glabrata, Combretum albidum, Pongamia pinnata, Azadirachta indica, and Santalum album are a few native species found occasionally. The average canopy height of the natural vegetation is 4 to 6 meters. The study site is entirely surrounded by Walayar Reserve Forest, with the northern part bordered by a large mountain.<br><br>· A few regenerations were found on-site, such as Acacia catechu, Combretum albidum, and Dichrostachys cinerea. Invasive species like Prosopis juliflora and Tecoma stans are very prevalent throughout the site. The invasive species Conocarpus lancifolius has been planted along the unused vehicle path bund areas, which is detrimental to the natural ecosystem.<br><br>·Tecoma stans, Prosopis juliflora, and Conocarpus lancifolius are the main invasive species in the core area of the mine site.<br><br>·The trees and shrubs appear very healthy, but the floor vegetation seems dry, especially in open areas.<br><br>·Goat excreta found in some places, indicating that grazing activity is occurring intensively. Elephant excreta was also observed in many areas.<br><br>·The site is surrounded by Walayar Reserve Forest, which has a healthy vegetative ecosystem. Species such as Naringi crenulata, Acacia chundra, Alangium salvifolium, Mitragyna parvifolia, Hymenodictyon orixense, and Limonia acidissima were recorded in the reserve forest. The average canopy height is 6 to 10 meters. Cleistanthus collinus is the dominant species in this ecosystem. Additionally, along the roadside, some invasive species like Eupatorium odoratum and Lantana camara were found. | · Water is available in 40 hectares of the site.<br><br>Groundwater, depth of water around 50 mts, available throughout the year, water level increases to 3 meters during monsoons<br><br>· Permeability high<br><br>· TDS- 312 ppm, PH- 4.011, EC- 612 | · Mining area covering around 80% of the total extent, which acts as a water reservoir now, the remining area is almost a flat terrain with small overburden mounds. Around 4 hectares available for planting.<br><br>· Erosion evident in some places. Depth of rills- 8 to 10 cms<br><br>· Potential for landform stabilization is low as there is no much dumping of the overburden or topsoil on site<br><br>· Landform stable<br><br>· between 25-30 degree | · Benches present, 9 visible, 8 under water<br><br>· Rock<br><br>· Backfilling has happened around 6.18 hectares | · Site located in the middle of the Walayar RF<br><br>· Elephant, Deer, Monkey, porcupine, wild boar | · Mine not operational now and so no emplyoment of the local peope in the mine<br><br>· A check dam has been built by the company<br><br>· Malabar cement factory nearby<br><br>· Borewell and dam irrigation. Plantain, coconut are crops in the surrounding area.<br><br>· Forest and agriculture | · No fencing<br><br>· Closed<br><br>· Non operational |

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| 12 | Ottakoil | 74.38 | Ultra tech Cements/ Patta Land/ Limestone/ Ottakoil | 79° 6'34.21"E, 11°12'36.10"N | · Black cotton soil<br><br>· Loamy<br><br>· Top layer- Black cotton soil, Middle- Lime stone<br><br>· Loose soil<br><br>· Top soil dumped in site | · The vegetation diversity in the surrounding area of the mining site is high. Morinda coreia and Acacia leucophloea are the dominant species found on the site. Other native species such as Acacia nilotica, Alangium salvifolium, Azadirachta indica, Borassus flabellifer, Chloroxylon swietenia, Clausena dentata, Jatropha glandulifera, Prosopis cineraria, and Senna auriculata were also recorded on this site.<br><br>·Some plant species, including Acacia leucophloea, Azadirachta indica, Chloroxylon swietenia, Clausena dentata, Pongamia pinnata, Senna auriculata, Jatropha glandulifera, Dodonaea angustifolia, and Cassia siamea, were found regenerating in many places.<br><br>·Cassia siamea, Leucaena leucocephala, Prosopis juliflora, and Peltophorum pterocarpum are the main invasive species on this site.<br><br>·The general health of the existing and planted trees is good, with the trees appearing healthy and strong. Peltophorum pterocarpum, Pongamia pinnata, Nerium oleander, and Morinda coreia have been planted and are maintained by the management.<br><br>·Evidence of grazing activity can be observed at this site. | · Rain water stagnation.<br><br>· Low to medium<br><br>· Ph- 7.76, TDS- 316, EC- 387 | · Flat land with a mining pit. The limestone mined here is of second-grade nature and hence mining is happening at a slower pace.<br><br>· Erosion evident<br><br>· There is potential for landform stabilisation.<br><br>· Landform stable | · Benches present- 1. Mining has started recently<br><br>· Lime and sandstone mixed<br><br>· No backfilling. Mining going on at a slower pace | · Karaivetti Bird Sanctuary is located 25 km to the south of the mining site. | · Around 8 people from the local area work here<br><br>· CSR: Smart toilets, school renovation, Anganwadi renovation in Ottakoil village<br><br>· neighbours: Ramco, Dalmia<br><br>· Rain-fed farming. Maize and millets are major crops<br><br>· Agriculture and mining | · 70% fenced<br><br>· 2067<br><br>· Operational |
| | | | | | | | Limekankar | | | | | |
| 9 | Maravarperungudi | 198.15 | Ramco cements/Limekankar/ Patta land/Maravaperugudi village | 78°11'13.35"E, 9°21'23.02"N | · Black cotton soil<br><br>· loamy<br><br>· Top layer- Black cotton soil, Middle- Limekankar, contact zone- Gravel<br><br>· soil ph- 6.74<br><br>· loose soil<br><br>· Topsoil available for plantation. | · There is not much native vegetation diversity at this site, as the land has been disturbed for mining. Abutilon indicum and Morinda pubescens are the dominant native species occupying the entire site. Other native species, such as Acacia nilotica, Acacia leucophloea, Cadaba fruticosa, Anisomeles malabarica, Ziziphus mauritiana, and Calotropis gigantea, are also found in scattered areas.<br><br>· On the mined site, a few natural regenerations of Morinda pubescens and Abutilon indicum can be found, predominantly. Seedlings of Acacia nilotica and Anisomeles malabarica were also recorded in some places.<br><br>· Prosopis juliflora is the main invasive alien tree species found extensively around the site. Parthenium hysterophorus is rarely found in some places. Conocarpus lancifolius was unknowingly planted around the site area, which is detrimental to the natural ecosystem.<br><br>·The recently planted saplings and surrounding existing trees appear slightly withered, with dried leaves at the edges.<br><br>·No grazing evidence was recorded at this protected site.<br><br>·Pandalkudi Eco Park is located to the west of the site, approximately 10 km away from the study area. | · Water is not available. The mining does not go deep into the ground, only 2-3 meters below the surface.<br><br>· Permeability of soil: Low to medium | · The land is flat, with mining occurring area by area and being backfilled immediately. The mining does not go deep, only 2-3 meters from the ground level. There is good potential for planting. Reject soil dumps are present on the site.<br><br>· No erosion evident<br><br>· Landform stable<br><br>· stable | · flat<br><br>· no benches<br><br>· Mining areas are backfilled rightaway after the mining | · Wild boar | · Mine lands are eased to local farmers to do farming.<br><br>· CSR: Yes. Borewells, toilets for BPL families, school renovation works<br><br>· India Cements Limited has lands nearby but no mining activity yet.<br><br>· Agriculture: Rainfed. Maize, cotton<br><br>· Agriculture, dry land | · 2041<br><br>· Operational |

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| 10 | T.koppuchithampatti | 294 | Ramco cements/ Lime kankar/ T.Koppuchithampatti village/patta land | 78° 8'3.55"E, 9°24'35.74"N | · Black cotton soil<br>· Loamy<br>· Top layer- Black cotton soil<br>· Ph- 6.64<br>· Loose soil<br>· Top soil available for plantation. | · The native vegetations is present very less and in unmined areas. Also, the vegetation was cleared on this site. Only newly emerged plants like Abutilon indicum, Morinda coreia, Morinda pubescens, Jatropha glandulifera were seen majorly. The surrounding land can be seen with Borassus flabellifer, Balanites aegyptica, Acacia leucophloea, Acacia nilotica, Senna auriculata, Cadaba fruticosa and Ziziphus mauritiana.<br>· The presence of regeneration in and around the site is moderately high. Abutilon indicum, Acacia nilotica, Acacia leucophloea, Morinda pubescens, Jatropha glandulifera and Senna auriculata were seen in many places.<br>· Prosopis juliflora is the dominant invasive tree species found around the mine site. Parthenium hysterophorus were seen in fewer places.<br>· The general health of the existing plants in the site area was good, the surrounding area vegetation was slightly withering due to heat stress.<br>· Grazing signs were found around the site area. Some native vegetation was eaten by goats and the excreta of the cattle was found on uncultivated land.<br>· Pandalkudi Eco Park is situated on the southwest side of the site. It is located at a 6 km distance from the study site. | · No water in site. Mining has not been started yet.<br>· Low to medium | · A flat land. Mining has not started yet.<br>· Erosion not evident<br>· Flat land<br>· Landform stable | · Flat land<br>· no benches<br>· No mining yet | · Nil<br>· Wildboar<br>·Pandalkudi Eco Park is located to the west of the site, approximately 10 km away from the study area. | · Agriculture, Mine lands leased to farmers to do farming till mining starts.<br>· Bus stops, toilets<br>· Agriculture: Rainfed. Maize, cotton<br>· Dryland, Agricuture | · No fencing<br>· 2033<br>· Minig not yet started |
| 11 | Kurundamadam | 4.86 | RJV Chemicals/ LimeKankar mine/ patta land | 78° 2'31.07"E, 9°26'34.38"N | · Black cotton soil<br>· Loamy<br>· Top layer- Back soil, middle- limekankar, contact zone- gravel<br>· Ph- 6.96<br>· Loose soil<br>· Topsoil Not available for plantation | · In most areas of the abandoned mines, Prosopis juliflora dominates as the alien species. However, a few native species such as Acacia leucophloea, Acacia nilotica, Anisomeles malabarica, Morinda coreia, Cadaba fruticosa, Capparis decidua, Hibiscus micranthus, Jatropha glandulifera, and Senna auriculata were recorded during our survey.<br>· Regenerations of Acacia leucophloea, Morinda coreia, Senna auriculata, Jatropha glandulifera, Flueggea leucopyrus, Anisomeles malabarica, and Calotropis gigantea were found in and around the mine area.<br>· Prosopis juliflora is the main invasive tree species on this site. The immediate surrounding area of the abandoned mine is predominantly covered by invasive species and agricultural land.<br>· The general health of the existing natural vegetation is very good.<br>· The mine area is heavily browsed by local people for grazing. Signs of grazing were observed throughout the mine site. | · Water available onsite. Water is used by farmers nearby for irrigation in summer.<br>· Soil permeability: Low to medium<br>· TDS- 668 ppm, ph- 7.55 | · A flat land with the mining pit in the center holding water and a relatively small dumping mound is found on one side of the mining pit. Has good scope for planting.<br>· Erosion is evident.<br>· There is potential for landform recontouring.<br>· Landform stable | · No benches, a gentle slopy path<br>· No backfilling done. | · There is no significant ecosystem located near the abandoned mine.<br>· Deer, wild boar found onsite | · Locals not employed onsite<br>· Rainfed farming. Millets, maize<br>· Agriculture, drylands | · No fencing<br>· 2015<br>· Non operational |

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| Magnesite | | | | | | | | | | | | |
| 13 | Chettichavadi | | IMPL/ Govt land leased | 78° 9'57.31"E, 11°43'22.00"N | · Calcarious soil<br>· Coarse<br>· Mineral present from the top layer.<br>· Ph- 4.01<br>· Top soil not available | · Ailanthus excelsa, Albizia lebbeck, Dodonaea angustifolia, Ficus amplissima, Ficus religiosa, Holoptelea integrifolia, Morinda coreia, and Toddalia asiatica are the main native species recorded at this site. The land's diversity is very low as most of the floor vegetation was removed for excavating Magnesite. However, the surrounding hillocks and plains appear moderately thick and green.<br>· Regeneration is rarely observed at this mine site. Few species, such as Ailanthus excelsa, Azadirachta indica, Morinda coreia, and Toddalia asiatica, show sporadic regeneration. A few years ago, the management carried out plantation activities in some overburden areas, and small-scale planting continues to this day.<br>· Eupatorium odoratum and Prosopis juliflora are the invasive plant species found, though rarely.<br>· The western part of the mine site, an overburdened area moderately covered with planted vegetation, appears lush and healthy.<br>·No signs of cattle grazing were found in the area. | · Rain water staganation is present in the site.<br>· Soil permeability high<br>· Ph- 6.68, TDS- 360 ppm, EC- 727 | · Flat land with mining happening at about around 50% of the total extent and there is huge soil dumping from which the mineral has been extracted.<br>· Erosion evident. Rills and guillets height approx 1meter<br>· There is potential for landform stabilisation<br>· Landform stable | · Benches present<br>· soil<br>· Dump mining is going on and simulataneously backfilling is happening | · Nagarmalai Hillock is located to the west, Muyalkaradu is to the southeast, and the Servarayan Hill Range lies to the northeast of the study site.<br>· No wildlife movement<br>· No buffer or corridor zone, as agricultual fields is | · Around 50 people from the local villages work in the mine.<br>· CSR: Equipment for school and anganwadi center were donated.<br>· Nearby: Dalmia magnesite corporation<br>· Agriculture: borewell irirgation. Coconut and plantain<br>· Mining on three sides and in the south farming is | · Partially fenced<br>· 2036<br>· Operational |
| 14 | Periyasarogi | 6.18 | Govt land | 77°56'22.53"E, 11°44'3.95"N | · Calcarious soil<br>· Coarse<br>· On top red soil, middle soil mixed with magnesite stone veins<br>· Not available.<br>· N/A. But locals complain of kidney related disorders due to minute particles mixed with air during mining process | · Acacia chundra, Ailanthus excelsa, Chloroxylon swietenia, Ficus benghalensis, Holoptelea integrifolia, Wrightia tinctoria, and Ziziphus mauritiana are the native species found at this site. The surrounding areas are mostly residential colonies.<br>· Ailanthus excelsa, Ficus benghalensis, Wrightia tinctoria, and Ziziphus mauritiana regenerations were observed in some places.<br>· Eupatorium odoratum and Lantana camara are the main invasive species found at this site. Prosopis juliflora is rarely seen in some areas.<br>· The naturally existing plants show signs of stress, with dry leaves and stunted growth due to heat pressure.<br>· The surrounding lands are used by local grazers for grazing their cattle, and as a result, the mine's natural vegetation is also grazed by the cattle. | · No surface water available onsite. In monsoon water staganation is there for few weeks.<br>· Soil permeability high | · About 70% of the total extent is mined, with a mining pit of around 60 feet deep, and an undulated stretch of land covered with the mining dump.<br>· Rills and gullets are present<br>· There is no potential for land reforming as the dump will not even cover 5% of the mining pit.<br>· Landform unstable | · Stability low<br>· Benches present and looks damaged probably due to erosion.<br>· Soil<br>· No backfilling done | ·Chinnasoragai Reserve Forest is located to the northwest of the mine area.<br>· No buffer zones possible as there are villages surrounding the mine area | · Well and Rainfed agriculture. Pulses, grounnut, maize and coconut are the main crops<br>· A village in the immediate surroundings and agriculture is done on one side<br>· Tharamangalam Shivan temple. | · Fencing partially present but was made by the panchayat to cover an adjoining playground.<br>· Lease ended in 2018<br>· Non-operational |

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| 15 | Kurumambapatti | 96<br><br>hectare s total extent, 64 hectare s mining area, in that 40 hectare s is holding water now. | TANMAG/ Forest land | 78° 9'38.60"E, 11°45'12.53"N | · Red loam soil<br><br>· Coarse<br><br>· Top layer red soil and in middle magnesite mineral<br><br>· Loose soil<br><br>· Top soil not available<br><br>· A report form the company is available | · The entire mine site is located within the Kurumambatti Reserve Forest. Native tree species found in and around the study site include Acacia chundra, Acacia leucophloea, Soymida febrifuga, Atalantia monophylla, Ficus benghalensis, Morinda coreia, Syzygium cumini, and Ziziphus mauritiana.<br><br>· Acacia chundra, Ailanthus excelsa, Atalantia monophylla, Morinda coreia, and Ziziphus mauritiana regenerations were found in some places. Restoration has been carried out by the management to some extent, with 1,000 species planted per year, though this is not evident according to their records.<br><br>· The presence of invasive species is minimal at this site. Eupatorium odoratum and Acacia auriculiformis are rarely found in some areas.<br><br>·The growth of the existing species on this site appears green and healthy.<br><br>· No signs of grazing were found in the core area of the mine site, as it is protected by security forces. However, the surrounding reserve forest area has been browsed by Indian gaur and local cattle.<br><br>· Natural wildfires have occasionally occurred a few times due to natural causes. | · Water available in around 40 hectares. Rain water<br><br>· Permeability high<br><br>· Ph- 6.91, TDS- 602, EC- 1206 | · Flat land with mining areas and huge dumps of minig waste soil. Ig scope for plantation is available.<br><br>· Erosion evident<br><br>· Potential for landform recontouring is possible<br><br>· Landform stable | · Benches present<br><br>· Rock<br><br>· Backfilling of two hecatres has been done | · The mine site is surrounded by the Kurumambatti RF, and the Kurumambatti Zoological Zone is located on the southeast side.<br><br>· Bison, deer | · Around 300 local people are working in the mine<br><br>· A check dam has been constructed.<br><br>· No farming<br><br>· Reserve forest | · Partial fencing<br><br>· Active<br><br>· 2028. Will be renewed<br><br>· Operational |
| 16 | Puliyur | | Malco mines/ Govt land | 78°13'47.37"E, 11°50'22.75"N | · Red soil<br><br>· Coarse<br><br>· A thin top layer of red soil and mineral in the middle<br><br>· Leaf litter present<br><br>· soil<br><br>· No topsoil available | · The selected mine site is located on the Servarayan Hill. Native species found on the mine site include Ligustrum perotetti, Macaranga peltata, Daphniphyllum neilgherrense, Cipadessa baccifera, Cinnamomum tamala, Symplocos racemosa, Erythrina variegata, Rubus niveus, Dodonaea angustifolia, and Trema orientale.<br><br>· Few native plant species regenerations were found on-site, such as Macaranga peltata, Trema orientale, and Wendlandia thyrsoides. Invasive species regenerations were spreading massively across the area.<br><br>· Ageratina adenophora, Ageratum conyzoides, Pilosia bidentata, Stachytarpheta mutabilis, and Solanum chrysotrichum are detrimental invasive species to this particular mine site.<br><br>· The plants on the mining site appear dull, with withered leaves, due to a lack of nutrients. However, the naturally occurring vegetation around the mine site is lush and healthy.<br><br>· During our visit, we found excreta from the Indian gaur, indicating that the land has been browsed by this wild animal for grazing. | · Soil permeability is medium | · A generally sloped hill with mining occurring on one side of the slope..<br><br>· Erosion evident<br><br>· Potential for landform is not possible<br><br>· stable | · 45 degree<br><br>· No benches<br><br>· Backfiling has been done to a certain extent | · The study site is located within the Servarayan Hill Range and is surrounded by natural, thick vegetation and a coffee estate.<br><br>· Indian gaur<br><br>· Well connected to natural thickets around | · Balamady estate<br><br>· Plantation crops such as coffee is grown in the estates<br><br>· Agriculture, estate-type farming<br><br>· Chervarayan temple | · No fencing<br><br>· Non-active<br><br>· Lease ended<br><br>· Non-operational |

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| 17 | Selurnadu | 2 | Govt land leased/ Selurnadu Village/ Kolli hills | 11°13'44.49"N , 78°19'30.41" | · Red gravel soil<br>· Coarse<br>· Top layer- thin layer of red soil, middle- mineral<br>· Gravely soil | · Acacia torta, Cipadessa baccifera, Dodonaea angustifolia, Breynia vitis-idaea, Diospyros ferrea, Catunaregam spinosa, Memecylon umbellatum, Clausena dentata, and Macaranga peltata are the native species found on the site and in the surrounding areas. The entire site has been heavily planted with Eucalyptus, along with a few Silver oaks.<br>· Enormous regenerations of Impatiens balsamina can be found in many places, with Cipadessa baccifera, Acacia torta, and Dodonaea angustifolia present in some areas.<br>· The site is predominantly covered with invasive species like Stachytarpheta indica, Pennisetum purpureum, Bidens pilosa, Ageratum conyzoides, and Lantana camara.<br>·Most of the tall trees, such as Eucalyptus and Silver oak, have withered and dried leaves.<br>·No evidence of grazing activity was observed at the site.<br>·The site is located in the Kolli Hills, part of the Eastern Ghats, which are home to rich and diverse vegetation. Additionally, Jambuthu RF is located on the west side of the study site. | · No actual surface water source. Only rainwater stagnation<br>· Soil permeability is medium to high<br>· TDS- 5 ppm, Ph- 4.99 | · Undulated terrain on the top of a mound. No good access to the mine. A gently sloped path is full of bushes and eroded rills.<br>· Erosion evident on the pathways, rills- 20- 30 cms<br>· There is no potential for landform stabilsation<br>· Stable | · No benches<br>· No backfilling | The site is located in the Kolli Hills, part of the Eastern Ghats, which are home to rich and diverse vegetation. Additionally, Jambuthu RF is located on the west side of the study site. | · Small hills and hills. A private estate near by with no proper maintenance | · Non operational |
| | | | | | | **Granite** | | | | | | |
| 19 | Surampalayam | 2.86 | V .Punitha/ Patta land/ Nadanthai Village/Paramathivelur taluk | 77°58'9.76"E, 11°10'58.29"N | · Laterite soil<br>· Coarse<br>· Top layer- topsoil, middle- granite<br>· bedrock & loose soil<br>· Topsoil Not available | · The diversity of native vegetation around the mine site is moderately high. Acacia leucophloea, Wrightia tinctoria, Albizia amara, Borassus flabellifer, Diospyros montana, and Pongamia pinnata are the main native species recorded in and around the study site.<br>· Natural regeneration is very limited in this area, with only Wrightia tinctoria, Borassus flabellifer, and Azadirachta indica seedlings found in some places.<br>· Prosopis juliflora is the only detrimental alien tree species found in this site.<br>· Vegetation around the mine area is healthy, in good condition, and disease-free.<br>· Grazing activity is evident throughout the site, with herds of goats spotted during our visit.<br>· No significant ecosystem is located around the site area. | · Rain water stagnation<br>· Permeablilty medium to high<br>· TDS-206 ppm, pH- 7.57 | · Undulated terrain with mining pits, excavated granite blocks are stored on the mining site, denying space for plantation.<br>· Erosion evident in some places<br>· No potential for reforming<br>· Stable | · No bench/ a slopy path into the mining pit<br>· No backfilling | Nil | · Srivasa cements<br>· No farming in the immediate vicinity<br>· Mines, drylands | · Partial<br>· 2038<br>· Non operational |

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| | | | | | | Color Granite | | | | | | |
| 23 | Yalagiri hill | 6.19 | G. Achudhan/Patta land/Granite mine/Nilavur | 78°37'56.54"E, 12°33'20.08"N | · Red soil<br>· loamy<br>· Top layer- Red soil, Middle layer- Granite<br>· loose soil<br>· Not available | · The diversity of the native species were less in mining areas, species like Albizia amara, Butes monospera, Cassia fistula, Disospyros montana, Ficus amplissima, Ficus benghalensis, Gyrocarpus americanus, Terminalia chebula, Terminalia paniculata, Holoptelia integrifolia, Michelia champaca, and Wrightia tinctoria were recorded on the small hillock and surrounding areas. Butea monosperma, Terminalia paniculata and Terminalia chebula are the key species found on the site.<br>· Natural regeneration on the site is less, whereas on the hillock and surrounding areas can be seen with regenerations of few species like Butea monosperma, Holoptelia integrifolia, Pongamia pinnata, Wrightia tinctoria, and Phyllanthus reticulatus.<br>· Lantana camara is the main invasive species found in this mining site, also Bidens pilosa, Eupotorium glandulosum, Parthenium hysterophorus, and Muntingia calabura were seen while survey.<br>· Existing trees and shrubs at the site and surrounding area trees looked very healthy.<br>· Inside the mining area no signs of grazing activity found. The surrounding areas have been used by the local graziers for grazing their cattles and goat.<br>· Yelagiri is the part of Eastern ghats mountain range, it possess rich vegetative diversity. No other significant ecosystem situated nearby areas. | · Only rain water stagnation. No permanent source<br>· Medium<br>· Nil | · Located on top of the Yelagiri hills, the mine is a flat terrain with 3 hills on site. The hills are sliced for granite. There is also a waste dumping which eventually looks like a mini hill on the site<br>· Erosion evident<br>· There is not much potential to recontour the land<br>· Stable | · No benches. A gentle ramp is present<br>· Ramp is a mix of rocks and soil<br>· No backfilling done | · Hills nearby have vegetation<br>· As it is located on the Yelagiri hills, there are adjacent hills. | · Around 10 people form the local villages work in the mine<br>· CSR: During village festivals donations are given<br>· Agriculture is rainfed. Millets, Banana are the main crops.<br>· Hills nearby and minimal farming lands | · Fencing present<br>· 2025<br>· Operational |
| 25 | Thogamalai | 1.01 | Om Shakthi granites/ Patta land | 78°24'54.93"E, 10°43'46.96"N | · Thulukanur soil<br>· loamy<br>· Top layer- loamy soil, middle layer- rocks<br>· Rock<br>· Not available | · A few native species, such as Wrightia tinctoria, Holoptelea integrifolia, Ficus religiosa, Ficus mollis, and Calotropis gigantea, were recorded during our site visit.<br>·Natural regeneration is minimal in this area due to extensive excavation for granite, with Wrightia tinctoria and Catharanthus roseus seedlings observed rarely.<br>·Prosopis juliflora is the dominant invasive species threatening this site, along with Eupatorium glandulosum and Parthenium hysterophorus, which were sparsely present.<br>· Native tree diversity at the site is limited; however, vegetation in Thogamalai, located very close to the study site, appeared lush and healthy.<br>·The mine area and Thogamalai are easily accessible to local grazers, and signs of grazing are evident throughout the mines and forest area. | · Only rainwater stagnation<br>· Soil permeabiliy low<br>· TDS- 6 ppm, Ph- 6.92 | · The total extent is almost mined and site is with mining pits leaving very little scope for planting (area wise)<br>· No potential for landform recontouring<br>· stable | · No benches<br>· No backfiling done | · Veeramalai RF<br>·Thogamalai is located very close to the study site | · Agriculture: Tank irrigation; Paddy, maize<br>· Village, farming, Thogamalai small hillock<br>· Ponnar Sankar temple | · Partial fencing<br>· 2026<br>· Non operational |

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| 26 | Sithampoondi | 5 | MS Granite exports/ Sengottuvel lessee/ Sithamboondi Village/ Paramathi velur Taluk | 77°54'17.67"E, 11°14'47.22"N | · Clayey soil<br>· Loamy<br>· Top layer- Clayey soil and middle layer- granite<br>· clayey soil<br>· No topsoil available | · Found many native species in and around the mine area, including Albizia amara, Albizia lebbeck, Atalantia monophylla, Canthium coromandelicum, Catunaregam spinosa, Commiphora berryi, Commiphora caudata, Diospyros montana, and Wrightia tinctoria. Vegetation diversity is high in areas with minimal human intervention.<br>· Natural regeneration on the site is limited, with Azadirachta indica, Calotropis gigantea, and Peltophorum pterocarpum seedlings observed sporadically. Teak and Commiphora berryi have been planted along the boundary as a protective fence.<br>· The presence of invasive species is minimal, with only Prosopis juliflora and Eupatorium glandulosum recorded rarely.<br>· The trees and shrubs around the site appear lush, green, and healthy.<br>· Grazing activity by local grazers is occurring on the site due to the absence of fencing, posing a significant threat to ground vegetation and shrub species. | · No water available<br>· soil permeability low to medium | · Flat land with mining happening in around 2.5 hectares. Extracted graite slabs are stored on the site itself.<br>· No erosion evident<br>· The waste dump is outside the mining area, some 50 mts away. So recontouring the area will be little difficult.<br>· Stable | · Benches present- 4 benches<br>· rock<br>· No backfilling, active mining going on | Nil | · No local people working in the mines<br>· CSR: Local govt school renovation<br>· Neighbour: PKK granite exports<br>· Agriculture: river canals and borewells. Tapioca, Sugarcane<br>· Mining and agriculture | · Partial fencing<br>· 2036<br>· Operational |
| 27 | Pulikunda | 4.01 | Good luck exports/Patta land/Granite/Pulikunda | 78°21'8.88"E, 12°24'59.42"N | · Red laterite<br>· Coarse<br>· Top layer- laterite soil, Middle layer- Granite<br>· Bed rock and loose soil<br>· No pure top soil dumps available. Soil mixed with rocks is dumped in site. | · Acacia leucophloea, Ailanthus excelsa, Albizia amara, Borassus flabellifer, Cassia roxburghii, Streblus asper, Holoptelea integrifolia, Ficus religiosa, Dichrostachys cinerea, Ficus benghalensis, Phyllanthus reticulatus, Senna montana, Santalum album, and Wrightia tinctoria are the main native species found, especially along the edges of the mining areas and surrounding regions.<br>· Regenerations of Senna montana, Phyllanthus reticulatus, Azadirachta indica, Borassus flabellifer, Ficus benghalensis, and Wrightia tinctoria were noted in the site area. The entire site is surrounded by mango cultivation fields.<br>· Lantana camara is the main invasive species found in many places, with Eupatorium glandulosum also observed in some areas.<br>· The surrounding trees and shrubs were in healthy condition.<br>· No evidence of grazing was observed at the mining site, as it is surrounded by agricultural fields. | · Only rain water stagnation and that too is used for mining purposes.<br>· Soil permeability is medium | · Flat terrain with a large mining pit which composes major part of the mine and there are two waste dump mounts along the border of the site<br>· Erosion is evident<br>· Not much potential for recontouring<br>· Stable | · No benches, a gentle ramp is there<br>· Rocks mixes with soil<br>· No backfilling done | · Thogarapalli RF is situated to the northwest, 5 km away, and Thattakal RF is located to the southwest, 7 km away.<br>· Villages in between | · Around 10 people from the local villages work in the mine<br>· Agriculture: Rainfed. Mango orchards, Maize<br>· Agricultural lands | · No fencing by the mining company. The adjacent mango orchard has put up a fence. So partially fenced<br>· 2039<br>· Operational |

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| 28 | Sandhanapalli | 1.49 | Karthik Ganesh/Patta land/Black granite Sandhanapalli | 77°50'28.76"E, 12°27'52.59"N | · Laterite soil<br>· Coarse<br>· Top layer- Laterite soil, Middle layer- granite<br>· Rocks mixed with soil<br>· Top soil not available | · The density of tree species is lower in this area. A few native species, such as Acacia planiflorns, Albizia amara, Cipadessa baccifera, Lannea coromandelica, Mundulea seriacea, Ficus benghalensis, Pongamia pinnata, and Wrightia tinctoria, can be seen scattered across the site.<br>· The regeneration of Cipadessa baccifera, Wrightia tinctoria, Ficus benghalensis, Ipomoea staphylina, and Calotropis gigantea plant species has been observed at this mining site. No planted trees were noted in this area, but there is space around the mining site that can be utilized for plantations.<br>· Lantana camara, Eupatorium glandulosum, and Parthenium hysterophorus are the main invasive species found in many places.<br>· The growth and health of the trees are in good condition.<br>· The area is highly disturbed due to cattle grazing by the local population. | · Water available<br>· Soil permeability is medium<br>· Ph- 7.83, TDS- 170, EC- 223 | · Undulated land with a mining pit holding water and some hillocks in the site<br>· Erosion evident<br>· No potential for landform recontouring<br>· Stable | · Only a ramp present<br>· Rocks mixed with soil - ramp | · The Thenkanikotta RF is situated 5 km to the north, while the Gullaty RF is located 7 km to the south.<br>· Elephant movement in near by areas but not inside the mine.<br>· Nil | · Non operational.<br>· N/A<br>· Neighbours: Global granites<br>· Rainfed agriculture. Ragi and millets are the main crops in the area.<br>· Mining, agriculture | · There is no fencing, but granite blocks have been placed along the boundary for protection<br>· 2029<br>· Non-operational. |
| 29 | Rendadi | 75 | TAMIN/ Govt Land/Black granite/Rendadi | 79°22'39.36"E, 13° 4'24.71"N | · Red soil<br>· Loamy<br>· Top layer- Red soil, parent rock, Middle layer- Granite<br>· Bed rock | · The excavated mine on top of the small hillock exhibits moderate vegetative diversity. Acacia chundra is the dominant tree species, found almost everywhere. Other plant species recorded in the area include Acacia leucophloea, Albizia amara, Pongamia pinnata, Ficus religiosa, Cassia roxburghii, Dolichandrone falcata, Ficus hispida, Ficus racemosa, Morinda coreia, Syzygium cumini, Ziziphus mauritiana, and Wrightia tinctoria.<br>· Regeneration of plant species was observed in many areas. Species such as Acacia chundra, Acacia leucophloea, Azadirachta indica, Cassia roxburghii, Ficus benghalensis, Ficus hispida, Ficus racemosa, Morinda coreia, Wrightia tinctoria, and Ziziphus mauritiana were seen regenerating in the hillock terrain.<br>· Invasive species noted during the survey include Eupatorium odoratum, Prosopis juliflora, Lantana camara, and Cassia siamea.<br>· The forest's overall condition and growth are good.<br>· Footprints of cattle and goats were observed on the site, indicating that grazing has occurred in this mining area. | · No surface water<br>· Soil permeability: Low to medium | · Undulated. The site is a small chain of hillocks. Of the total extent about 5 hectares are mined and the rest is undisturbed hillocks<br>· No potential for recontouring<br>· Stable | · No benches. Gentle ramp<br>· Ramp is mix of soil and rocks<br>· No backfilling done | · The adjacent hills have vegetation<br>· No significant ecosystem/reserve forest is situated near this mining site. | · Agriculture: Rainfed and Lake irrigation. Crops: Paddy, Groundnut<br>· Neighbours: Agricultural lands<br>· Sholingur Narasimar temple | · One side is fenced and the other sides are feature the presence of hills.<br>· 2028<br>· Non-operational |

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| 30 | Kodakal | 24 | | 79°24'55.90"E, 13° 4'59.77"N | · Red laterite<br><br>· Coarse<br><br>· Top layer- Red laterite, Middle layer- granite<br><br>· Bed rock and loose soil<br><br>· No topsoil available | · The hillock is mostly covered with grasses and scattered shrub species, with only a few tree species present sporadically. Native species such as Acacia leucophloea, Acacia nilotica, Borassus flabellifer, Butea monosperma, Cassia roxburghii, Cordia domestica, Ficus gibbosa, Flacourtia indica, Ficus hispida, Morinda coreia, Ficus racemosa, Phoenix sylvestris, Wrightia tinctoria, and Ziziphus mauritiana were recorded in this area.<br><br>· Natural regeneration of species such as Acacia leucophloea, Azadirachta indica, Borassus flabellifer, Butea monosperma, Cassia roxburghii, Morinda coreia, Phyllanthus reticulatus, Pongamia pinnata, Wrightia tinctoria, and Ziziphus oenophloea was observed in some locations.<br><br>· Invasive species identified on this mining site include Eupatorium glandulosum, Lantana camara, and Prosopis juliflora.<br><br>· The vegetation on the hillock appeared green and healthy, with trees and shrubs in good condition.<br><br>· No signs of grazing activity were found on the hillock, although a herd of goats was observed on the plains during the survey. | · Only rainwater stagnation<br><br>· Soil permeability: Medium | · Undulated. A Chain of hills<br><br>· Erosion signs evident<br><br>· No potential for recontouring now. Active mining is going on.<br><br>· Stable | · Benches present- 3 nos<br><br>· Granite<br><br>· No backfilling | · Natural vegeratins in the hills nearby<br><br>· No wildlife movement<br><br>· It is connected to the hills nearby which has vegetation. However there is no significant/notable ecosystem located near this mining site. | · Around 10 workers from the local villages work on the site.<br><br>· CSR works: School renovation works<br><br>· TAMIN<br><br>· No farming nearby<br><br>· Surrounding area: Vast empty lands with trees and grasses<br><br>· Sholingur Lakshmi Narasimma temple | · Partial fencing. Hills on other sides.<br><br>· 2039<br><br>· Operational |
| 31 | Pothuvai & pazhavalum | 40.13 | Tamin /GOVT of Tamilnadu | 79°15'47.64"E, 12° 8'15.37"N | · Gravel soil mixed with pebbles<br><br>· Granular<br><br>· A thin layer of Gravel soil on top and rocks at the middle<br><br>· Bedrock<br><br>· Top soil not available | · The study site possesses moderately diverse vegetation. A few native species, such as Albizia amara, Wrightia tinctoria, Euphorbia antiquorum, Olax scandens, Combretum albidum, and Clausena dentata, can be found. Pongamia pinnata and Azadirachta indica (Neem) appear to have been planted in some areas.<br><br>· There was limited regeneration observed on-site, with species like Clausena dentata, Wrightia tinctoria, and Azadirachta indica present in certain locations.<br><br>· Prosopis juliflora was the primary invasive species, occupying nearly half of the site. Additionally, Lantana camara was found in a few areas.<br><br>· All shrubs and trees appeared healthy and green, while grasses and smaller shrubs were dried out due to the heat.<br><br>· Grazing activity is occurring intensively, with some trees being targeted for firewood. Evidence of anthropogenic activity was observed throughout the site.<br><br>· The nearest healthy ecosystems to the study site are the Pakkamalai Reserved Forest (RF) and the Genagvaram Reserved Forest (RF). | · Water is not available on the site, but two lakes are adjoining the area: Pazhavalam Lake to the east and Podhuvai Lake to the north. A small quantity of water was found in one of the pits on the site, likely rainwater. Thus, there is no proper source of irrigation within the site.<br><br>· The soil is highly permeable, with no evidence of runoff or erosion.<br><br>· Water analysis of the probable rainwater found on the site:<br>pH: 4.01 | · The site consists of an undulating rocky terrain with two undisturbed small hillocks and minor dumping of quarry waste rocks. The area suitable for planting is almost negligible.<br><br>· Erosion is not evident, probably because the site has reached its maximum erosion limit. No rills or gullies were observed.<br><br>· As no topsoil is present, the scope for recontouring and stabilization is minimal.<br><br>· The landform is stable due to the presence of heavy rocky stones. | No benches | · Pakkamalai RF and Gengavaram RF is in close proximity of the site.<br><br>· Monkeys and wildboar signs present<br><br>· Eventhough two RFs are present in close connectivity, there are agricultural lands in between. | · Irrigated farming is done. Lakes are the main source of irrigation and also rain-fed cutivation is carried out. Rice, Ground nut and millet are the main crops.<br><br>· Pazhavalam Fort remains is in the close proximity to the site. | · No fencing<br><br>· Non operational |

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| 33 | Kathiripalli | 1.94 | A. Murugan/ Patta land/ Black granite/Kathirapally | 78° 9'56.41"E, 12°41'31.42"N | · Red laterite<br><br>· Coarse<br><br>· Top layer- Red laterite, Midldle layer- granite<br><br>· loose soil<br><br>· No top soil available. | · Around the mining edges of the site and the nearby small hillock area, a few native tree species are present, including Albizia amara, Azadirachta indica, Canthium coromandelicum, Catunaregam spinosa, Dodonaea angustifolia, Pongamia pinnata, Senna auriculata, Syzygium cumini, Tarenna asiatica, Senna montana, Acacia leucophloea, Acacia nilotica, and Acacia planifrons.<br><br>· The regeneration of tree species was observed in many places around the mining area. Species such as Anisomelos malabarica, Azadirachta indica, Catunaregam spinosa, Canthium coromandelicum, Senna montana, Tarenna asiatica, and Calotropis gigantea were seen regenerating. The entire mining site is surrounded by agricultural fields, where crops like cotton and coconut are cultivated.<br><br>· Invasive species found on the site include Lantana camara, Eupatorium glandulosum, Cassia siamea, Prosopis juliflora, and Parthenium hysterophorus.<br><br>· The existing plants are healthy and in good condition.<br><br>· There is no evidence of grazing activity. | · Water available in the mining pit which is used for farming.<br><br>· Soil permeability: Medium<br><br>· ph- 6.79, TDS- 283, EC- 482 | · A flat terrain with a minig pit that holds water. The rest of the land has been leveled and farming is happening<br><br>· Not much erosion<br><br>· landform already recontoured<br><br>· Stable | · Flat<br><br>· No Benches<br><br>· Except for the mining pit, the other areas are leveled and used for farming | · The Naralapalli Reserved Forest (RF) is located southeast of the site, at a distance of 9 km.<br><br>· There are hillocks nearby with natural vegetation<br><br>· Wild boar | · Neighbours: Suguna poultry farm<br><br>· Agriculture: Rain-fed and Borewell irrigation. Crops: Paddy, Coconut, Cotton<br><br>· Surrounding area: Hillocks and Agriculture | · Partially fenced, has a trench surrounding the mine.<br><br>· Non-operational |
| 34 | Sandhanapalli | 2 | Ramachandra granites/Patta land/Black granite/Sandhanapalli | 77°50'28.41"E, 12°27'58.11"N | · Red soil<br><br>· Loamy<br><br>· Top layer- Red soil, Middle layer- Granite<br><br>· Loose soil | · The density of tree species in this area is low. A few native species, such as Acacia planifrons, Albizia amara, Cipadessa baccifera, Lannea coromandelica, Mundulea seriacea, Ficus benghalensis, Pongamia pinnata, and Wrightia tinctoria, are present but scattered.<br><br>· Regeneration of plant species like Cipadessa baccifera, Wrightia tinctoria, Ficus benghalensis, Ipomoea staphylina, and Calotropis gigantea was observed on this mining site.<br><br>· No planted trees were noted in the area, but there is space around the mining site that could be used for plantations.<br><br>· The main invasive species found in many locations are Lantana camara, Eupatorium glandulosum, and Parthenium hysterophorus.<br><br>· The trees in the area are in good health and show satisfactory growth.<br><br>· The site is highly disturbed due to cattle grazing by the local population. | · Surface water available<br><br>· Soil permeability: medium | · Undulated terrain with mining pits and waste dump mounts<br><br>· Erosion evident<br><br>· No potential | · Stable<br><br>· Gentle ramp<br><br>· No Backfilling done | · The Thenkanikotta Reserved Forest (RF) is situated 5 km to the north, and the Gullaty Reserved Forest (RF) is located 7 km to the south. | · Neighbours: Global granites<br><br>· Agriculture: Rainfed. Millets<br><br>· Surrounding area: Mining agriculture | · No fencing. Surrounded by mines<br><br>· 2028<br><br>· Non operational |

| Rough Stone | | | | | | | | | | | | |
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| 18 | Vadugapatti | 11.94 | Govt land/ Rough stone quarry/ Leased/ Mondipatty village, Manaparai Taluk | 78°25'28.27"E, 10°40'6.04"N | · Laterite soil ( surrounding the mining area)<br>· Coarse<br>· Top layer- rocks. Kallanguthu<br>· Bed rock<br>· Topsoil Not available | · The diversity of tree species in this site is very low, as the entire mine area is surrounded by residential areas and agricultural fields. Holoptelea integrifolia, Calotropis gigantea, and Moringa oleifera are among the few native species found in some places.<br>· There was limited regeneration observed in the study site. Only seedlings of Calotropis gigantea, Jatropha gossypifolia, and Prosopis juliflora were recorded in a few areas.<br>· Prosopis juliflora and Parthenium hysterophorus are the main invasive species present in some parts of the site.<br>· The existing tree and shrub species in the surrounding area appear healthy and disease-free.<br>· Local villagers are using this mine site and its surroundings for grazing their cattle and goats. | · Surface water available onsite<br>· (Soil) Permeability low<br>· TDS- 430 PPM, Ph- 7.41 | · The land is with several mining pits holding water with no scope for planting within the land boundary | · No benches<br>· No backfilling | · To the northwest of the study site, Veeramalai Reserved Forest (RF) is located at a distance of 5 km, while Poigai Malai is situated to the south at a distance of 8 km. | · Neighbour: Tamilnadu paper limited<br>· Agriculture: Well irrigation. Paddy, maize<br>· Surrounding: Village nearby, agriculture<br>· Veerapur Ponnar sankar temple | · No fencing<br>· Lease ended 15 years ago<br>· Non operational |
| 21 | Alathur | 5 | Private/ Shivakumar | 77°11'3.74"E, 11°17'48.87"N | · Laterite soil<br>· Coarse<br>· Top layer- topsoil, middle layer- rough granite<br>· 3.26<br>· Loose soil<br>· No topsoil available | · Wrightia tinctoria, Azadirachta indica, Ziziphus mauritiana, Chloroxylon swietenia, Borassus flabellifer, Albizia lebbeck, and Catunaregam spinosa are the main native species recorded around the site. The average height of the vegetation is between 2 to 4 meters. The diversity of the vegetation is very low. Some species, such as Neem and Morinda coreia, appeared sparsely around the site.<br>· There was little natural regeneration observed in and around the site. Only regeneration of Ziziphus mauritiana, Wrightia tinctoria, Borassus flabellifer, and Azadirachta indica was noted, and it was rare. This site has good potential for plantation efforts to recreate the original ecosystem, as it has a potential water source and suitable space for planting.<br>· The only invasive species observed on the site were Lantana camara and Eupatorium odoratum.<br>· The condition of the trees and shrubs looks healthy, except for the lower-floor vegetation. The grasses and small herbs appeared wilted and dry.<br>· Goat excreta was spotted in many places, indicating grazing activity on the site. | · Very little water available on site, rainwater stagnation<br>· Permeablility high-Soil<br>· TDS- 83 ppm, Ph- 6.86, EC- 156 | · Flat terrain with mining happening at the center of the plot. The site has space available for plantation.<br>· No erosion evident<br>· Not required<br>· Stable<br>· No angle | · No benches present<br>· No back filling | · There are no significant ecosystems or reserved forests around the site. | · Neighbours: Chenniappa yarn spinners<br>· Agriculture: Rainfed farming. Crops: Groundnut, Coconut<br>· Surrounding: Dry land and agriculture | · No fencing<br>· Operational |

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| 22 | Mangarasa valaya palayam | 17 | Private | 77°12'2.32"E, 11°18'41.77"N | · Laterite<br>· Coarse<br>· Top layer- laterite soil,fully leveled already.<br>· Loose soil<br>· No topsoil available | · The mined area contains a few native trees, such as Wrightia tinctoria, Ziziphus glabrata, Holoptelea integrifolia, Senna montana, Canthium coromandelicum, and Benakara malabarica. Recently emerged tree species are found on this site, with an average height of 2 to 3 meters. There is no dense vegetation, and no significant ecosystem is found around the site due to active agricultural activity.<br>· Only a few regenerations can be found here and there, such as Wrightia tinctoria, Senna montana, and Flacourtia indica. There are no water facilities for plantation work, and the mine pits were completely backfilled a few years ago.<br>· Prosopis juliflora and Lantana camara were seen in a few places, but their invasion is minimal. Waltheria indica and Leucas aspera have completely covered vast areas around the site.<br>· All the trees and shrubs are in good condition and lush green, except for the ground covers.<br>· Grazing activity is occurring extensively as the site is not protected by a | · No water available at site<br>· Permeability high (soil) | · Flat terrain and mining area has been backfilled already. Vast areas available for plantation<br>· No erosion evident<br>· Not required<br>· Stable<br>· No angle | · No benches<br>· Backfilled already | There is no significant ecosystem or any protected forest in the surrounding area. | · Neighbour: Sreedhara textiles pvt ltd<br>· Agriculture: Rainfed and borewell farming. Crop: Coconut and groundnut<br>· Surrounding: Farming and dry land | · No fencing<br>· Non operational for last 10 years<br>· Non operational |
| 35 | Sennampatti | | Govt land/ Leased/ KSS Crusher | 77°41'22.24"E, 11°41'49.73"N | · Laterite<br>· Coarse<br>· Top layer- laterite soil for 2 feet, middle-rocks<br>· 5.3<br>· Rock<br>· Top soil Not available | · The presence of native species is relatively high at this site. Wrightia tinctoria, Senna montana, Holoptelea integrifolia, Chloroxylon swietenia, Albizia amara, Lannea coromandelica, Senna auriculata, Tarenna asiatica, Borassus flabellifer, and Acacia caesia are the main native species found around the mine site. The average canopy height is between 3 to 5 meters. Restoration efforts are feasible at this particular site.<br>· Regeneration of Senna montana, Wrightia tinctoria, Senna auriculata, Borassus flabellifer, Albizia amara, Chloroxylon swietenia, and Lannea coromandelica was found at this site.<br>· The presence of invasive species is minimal. Prosopis juliflora and Lantana camara were hardly seen in the lower terrain of the site. Hyptis suaveolens has spread across the lower plain terrain.<br>· The existing trees and shrubs in the foothills look very healthy. However, the area around the mine excavation site has very little vegetation.<br>· A herd of goats were spotted during the survey, which indicates grazing activity at this site. | · Surface water is available on site. Rainwater stagnation<br>· Permeability high<br>· TDS- 202, Ph -7.144, EC- 402 | · Undulated terrain with small hills on site with mining pits covering nearly 60% of the area. Mostly rocky surface.<br>· No obvious erosion possible given rocky surface<br>· Stable | · Benches present.<br>· Rock<br>·Halfway backfilling done in a very smaller area with rock waste | · Palamalai Reserved Forest (RF) is located very close to this mine site.<br>· No wildlife movement<br>· Agricultural lands in between the RF and the mine | · Neighbour: Rough granite quarries near by<br>· Agriculture: Borewell/ Rainfed/ river water pumping from 15 kms<br>· Surrounding: Agriculture, mining | · Partial fencing<br>· Non-active<br>· Penalty levied by government and sealed for irregularities<br>· Non-operational. Under Jurisdiction |

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| 37 | Chittathur | 2 | Bluerock crusher/Govt land/Rough stone /Chitathur | 79°23'47.77"E, 12°56'14.21"N | · Red laterite soil<br><br>· Coarse<br><br>· Top layer- Red laterite, Middle - black soil and Rough stone<br><br>· Bed rock and loose soil | · Native species such as Flueggea leucopyrus, Gmelina asiatica, Acacia chundara, Acacia leucophloea, Acacia nilotica, Albizia lebbeck, Borassus flabellifer, Cassia roxburghi, Combretum albidum, Lannea coromandelica, Morinda coreia, Santalum album, and Ziziphus mauritiana were found in this mining area and the surrounding places.<br><br>· The regeneration of native species is limited in this area. Albizia lebbeck, Azadirachta indica, Borassus flabellifer, Calotropis gigantea, Cassia roxburghi, Combretum albidum, Lannea coromandelica, and Morinda coreia were recorded during the survey.<br><br>· Eupatorium glandulosum, Lantana camara, and Prosopis juliflora are the main invasive species found in and around the mining site.<br><br>· Some of the lower shrubs and grasses are dried due to heat intensity. The tree species are in good condition and thriving well in the area.<br><br>· Local graziers have been using this area to graze their cattle and goats. The excreta of the cattle indicates grazing activity at this site. | · Surface water available at site<br><br>· Low to medium<br><br>· ph- 6.67, TDS- 124, EC- 188 | · Undulating terrain with hills that have been broken for rough stone. A chain of mines is located nearby.<br><br>· Erosion evident<br><br>· No potentail for recontouring. Active mining going on.<br><br>Stable | · Ramps present<br><br>· Rocks mixes with soil<br><br>· no backfilling | · There is no significant ecosystem located near this mining site. | · Around 30 people from the local villages work in the mine<br><br>· Neighbour: Omshakthi mines<br><br>· Agriculture: Not at immediate vicinity<br><br>Surroundings: Mining | · No fencing. There are mines very closeby<br><br>· 2033<br><br>· Operational |
| 41 | Mayilamabadi | 1 | Vijayalakshmi/ Private land | 77°39'36.39"E, 11°31'36.80"N | · Laterite soil<br><br>· Coarse<br><br>· Top layer- laterite soil, middle layer- rock<br><br>· 6.86<br><br>· Top Soil: not available | · There is not much native vegetation in and around the site, as the entire area is surrounded by agricultural land. A few species, such as Wrightia tinctoria, Ficus amplissima, Ficus benghalensis, and Holoptelia integrifolia, are found on the edges of the mine site. The average height of the trees is 3 to 4 meters. No significant ecosystem exists near this particular mine area.<br><br>· Regeneration of key species is very poor onsite; only Wrightia tinctoria and Ficus amplissima were found, and they are sparse. There is no space to implement a restoration in this site, as the area around the mine is very limited, and there is a scarcity of water for irrigation. Plantation was carried out around the edges of the mine by the management a few years ago. Species such as Thespesia populnea, Ficus racemosa, Madhuca longifolia, Pongamia pinnata, Dalbergia sissoo, Terminalia arjuna, Terminalia catappa, and Ficus religiosa were planted.<br><br>· Very few invasive plant species were found at this site, including Leucaena leucocephala, Prosopis juliflora, and Eupatorium odoratum. Hyptis suaveolens is the dominant invasive species, spotted in a wide range.<br><br>· The trees and shrubs look very healthy, except for the ground cover. The floor vegetation is mostly dried due to the heat impact.<br><br>· There is no evidence of grazing activity, as the mine site is entirely surrounded by agricultural fields and protected by a live fence. | · No surface water available at site. Some rainwater stagnation<br><br>· Permeability high- soil<br><br>· TDS- 1431 ppm, Ph- 6.86, EC- 2910 | · Flat terrain with mining happening in almost 90% of the site, very minimal space available for plantation<br><br>· No erosion evident<br><br>· Not possible for land recontouring<br><br>· Stable<br><br>· Flat | · One bench present<br><br>· Rock<br><br>· No backfilling has happened | No significant ecological zone or green patches are present around the study site. | · Village people working in the mine<br><br>· CSR: Some furniture for local schools<br><br>· Agriculture: Rainfed/ Borewell. Maize, Pulses, Tapioca<br><br>· Surrounding: Agriculture | · Fenced<br><br>· Active<br><br>· Operational |

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| 42 | Rakkipalayam | 1.15 | Government land/ Abandonded | 77°17'56.65"E, 11° 8'58.87"N | · Laterite soil<br>· Coarse<br>· Toplayer- laterite, middle-- rough granite<br>· 5.11<br>· Bed rock | · The vegetation diversity is moderately high outside the mine area. Wrightia tinctoria, Albizia amara, Acacia leucophloea, Commiphora berryi, Catunaregam spinosa, and Diospyros montana are the native tree species found around the site area. The average canopy height of the vegetation is 4 to 6 meters.<br>· Few tree species' regenerations were found in some places, such as Wrightia tinctoria, Dichrostachys cineria, Holoptelia integrifolia, and Azadirachta indica. There is only limited space to carry out a plantation drive along the edges of the mine and the southern part.<br>· Prosopis juliflora is the main invasive species found at this site. The shrub species Sesamum alatum can be found in almost all the open areas. Typha latifolia is growing around the water body inside the mine.<br>· The vegetation around the site looks very dry and is in the withering stage. Only a few species, like Commiphora berryi and Acacia leucophloea, appear healthy.<br>· Grazing and anthropogenic activities are occurring extensively in this vegetation area. | · Surface water available on site. Groundwater, 30 feet depth<br>· Permeability high- Soil<br>· TDS- 244 ppm, Ph- 6.86, EC- 484 | · Almost 95% of the area is mined, leaving almost nil space for plantation<br>· No erosion evident<br>· Not possible<br>· landform stable | · Benches present- 1 nos<br>· rock | · There is no significant ecosystem nearby the study site; the entire area is surrounded by residential colonies. | · Agriculture: Borewell and rainfed farming. Coconut and plantain<br>· Surroundings: Agriculture, houses adjacent | · Fencing present but broken at some places<br>· Abandonded<br>· Non operational |
| 39 | Sevathur | 23.7 | TAMIN/Govt land/Vermiculite/Sevathur | 78°31'42.18"E, 12°25'17.94"N | · Black cotton soil<br>· Loamy<br>· Top layer- Black cotton soil, Middle layer- Vermiculite<br>· Few top soil dumps are there | · The mining site is mostly invaded by the invasive species Eupatorium glandulosum and other mixed shrub species, such as Senna auriculata, Calotropis gigantea, and Sida cordifolia, with an average canopy height of 2 meters. The emergent scattered trees Acacia nilotica, Ailanthus excelsa, Albizia lebbeck, Ficus amplissima, Borassus flabellifer, Dalbergia paniculata, Ficus benghalensis, Holoptelia integrifolia, Morinda coreia, and Wrightia tinctoria can be seen in a scattered manner.<br>· It is a very good site to carry out a plantation drive, as it has a vast area around the mining site with a good amount of water. Additionally, we found regeneration seedlings such as Acacia nilotica, Ailanthus excelsa, Albizia amara, Albizia lebbeck, Dalbergia paniculata, Holoptelia integrifolia, Morinda coreia, Pongamia pinnata, and Senna auriculata during our survey.<br>· Eupatorium glandulosum is the dominant invasive species found almost everywhere. Lantana camara and Prosopis juliflora are also present in a few places.<br>· All the trees and shrubs on the mining site are in good health, except for the lower shrubs. A few open exposed shrubs appear dry due to the heat.<br>· Browsing and grazing activities are happening intensively at this mining site. We spotted a herd of goats inside the study site during the survey. | · Surface water available.<br>· Soil permeability: low to medium<br>· ph- 8.51, TDS- 51, EC- 66 | · Flat terrain with 5 mining pits here and there. Two big mine pits and 3 are small pits.<br>· Erosion evident<br>· There is potential for landform recontouring<br>· Stable | · Benches present- 5<br>· Sandstone<br>· No backfilling | · There is no significant ecosystem located nearby this mining site. | · Agriculture: Rainfed and Borewells. Crops: Groudnut, cotton, Paddy<br>· Surrounding area: Agriculture<br>· Sevathur perumal temple and Koratti Shivan temple | · Fencing present. Soil mounds on one side<br>· 2040<br>· Non operational |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 40 | Panikkankuppam | 5 | TANCEM/Govt Land/ Fireclay/ Pannikankuppam | 79°32'54.67"E, 11°44'53.64"N | · Red soil<br>· Loamy<br>· Top layer- Red soil, Middle layer- Clay, Contact zone- Gravel<br>· Loose soil<br>· Not available | · The mined land is surrounded by cashew plantations, with native species growing in between the plantations and along the edges of the abandoned mine area. The diversity of vegetation is moderate. Hyptis suaveolens has occupied almost all areas. Azadirachta indica (Neem) and Wrightia tinctoria can be seen occasionally. Other native species like Albizia lebbeck, Benkara malabarica, Wrightia tinctoria, Borassus flabellifer, Morinda coreia, Catunaregam spinosa, Flueggea leucopyrus, and Phoenix sylvestris were recorded during our survey. Planted trees such as Anacardium occidentale (Cashew), Cassia fistula, Mangifera indica (Mango), Psidium guajava (Guava), and Tectona grandis (Teak) were also found.<br>· The regeneration of native species was minimal. A few species such as Albizia lebbeck, Azadirachta indica, Wrightia tinctoria, Borassus flabellifer, Catunaregam spinosa, and Calotropis gigantea were spotted regenerating in some places.<br>· Hyptis suaveolens covered nearly one-third of the mining site. Additionally, Acacia colei, Eupatorium glandulosum, Lantana camara, and Muntingia calabura have invaded the site.<br>· The existing wild trees were in good condition and healthy. However, some shrubs and ground cover appeared dry due to the heat.<br>· Local graziers have been using this land for grazing their cattle and goats. Evidence of grazing is visible throughout the site. | · No surface water onsite.<br>· Soil permeability: low to Medium | · The area is in divided into almost 3 equal parts, the first and second areas are flat terrains and the third one is a pit<br>· Erosion evident<br>· No potential for recontouring<br>· Stable | · No benches<br>· Nil<br>· No bakcfilling | · Nil | · Agriculture: rainfed. Crops: Cashew fields<br>· Surrounding area: Agriculture | · No fencing<br>· 2014<br>· Non operational |

*****The QGIS study and information from the TN mining department indicated certain mine types; however, ground truthing revealed discrepancies in the mine type:

- Mine No. 12, identified as *Limekankar*, was confirmed as Limestone.
- Mine No. 18, labelled as *Quartz & Feldspar*, turned out to be Roughstone.
- Mine No. 19, categorized as *White Granite*, was verified as Granite.
- Mine Nos. 21 and 22, classified as *Colour Granite/Multicolour Granite*, were actually Roughstone.
- Mine No. 28, also marked as *Colour Granite/Multicolour Granite*, was found to be Black Granite.

Therefore, the numbers in the report are not in ascending order or continuous (as the numbers were assigned during the study/section stage) but are instead sorted according to the mine type.

**Limitation (Ground Truthing):**

During the ground-truthing phase, a few selected mines (20, 24, 32, 36, and 38) were not accessible for direct observation due to permission-related considerations or site-specific circumstances such as water inundation. To maintain the robustness and comprehensiveness of the study, alternate mine sites (41 and 42) were subsequently included for detailed assessment. Moreover, ground inspections provided updated insights, leading to the reclassification of certain mines, thereby refining the accuracy of mine-type representation within the study. This adaptive approach ensured overall data reliability and enhanced the depth of the findings.

## 2.5 Summary of results

The field survey component of the study successfully covered 37 out of the initially identified 40 mine sites. Each mine visited showcased unique characteristics, reflecting considerable diversity in both landscape features and vegetation types. This variability highlights the complexity and richness of mining landscapes across Tamil Nadu, offering valuable insights for site-specific assessment and restoration planning.

**Limestone mines:** The limestone mines, predominantly owned by cement industry such as Ramco, Dalmia, UltraTech, Chettinad, and ACC, showcase diverse topographies and varying mineral depths. For instance, the limestone mines of Dalmia in Periyanagalur, Ariyalur, have minimal overburden, with the mineral present at ground level. Of the 70 hectares leased for mining, approximately 44 hectares are currently being mined, with the remaining areas slated for future operations. Backfilling these mines is unlikely unless the company undertakes extreme and costly measures, as there is little overburden and significant reject soil. Consequently, the mining site will likely evolve into a massive 70-hectare pit. However, this could provide substantial space for plantations, potentially supporting low-lying forests instead. Diverting rainfall into a pond, to be excavated later, can minimize water stagnation.

Certain limestone mines, such as the ACC mine in Walayar, Coimbatore, function as water reservoirs, indicating that the mineral lies at sufficient depth to reach groundwater levels. As a result, backfilling such mines is improbable, with restoration efforts limited to surrounding areas. Nevertheless, the presence of water on-site is a positive indicator for restoration activities.

The limestone mine of Ramco in Alathiyur, Ariyalur district, ceased operations in 2018 and features two mining pits—one containing water and the other dry. These pits are relatively shallow compared to other sites, offering greater potential for restoration efforts.

**Lime Kankar mines:** Ramco Cements' Lime Kankar mines in the Virudhunagar area follow a distinct pattern, with the mineral located just one to two meters below the surface. Mining is conducted in plots, where straight trenches are excavated and backfilled immediately before moving to the adjacent plot. This simultaneous process of backfilling and mining ensures minimal disruption.

A particularly noteworthy practice is that the land is leased to local farmers for cultivation both before mining begins and after the mined plots are backfilled. Since the mining does not extend to significant depths, natural water availability on-site is generally absent, though exceptions may exist. Despite this, the Kankar mines offer considerable potential for restoration due to the ample space available.

**Granite & Rough stone mines:** The mines are typically located on hills or in landscapes where a rocky bed forms the upper surface. Generally, granite and rough stone mines are smaller in size compared to Kankar and limestone mines. As the name suggests, nearly all material extracted from rough stone mines is utilized, with granite debris being the primary waste product.

Granite is mined either by cutting through hills or by drilling deeper into the earth to extract granite slabs. Interestingly, in granite mining, while one hill is gradually ground down, a new hill is simultaneously formed nearby using the leftover rocks, creating a unique reshaping of the landscape. Planting on this surface will be hard.

**Magnesite mining:** Most magnesite mining occurs on level ground using surface excavation methods. Since the mineral is present in the soil as veins, there is a higher likelihood of backfilling due to the large amount of rejected waste, which primarily consists of soil. At the IMBL magnesite mine in Chettichavady, Salem district, we observed dump mining, where the earth is excavated and disposed of in massive piles, and the mineral is later filtered from these dumps. The rejected soil from this process is then used to backfill the mining pits.

The Tanmag (Tamil Nadu Magnesite Board) mine in Kurumambadi, Salem district, is located within a reserve forest, and mining activity is still ongoing. There is significant potential for restoration in this area. Even without active restoration efforts, the surrounding reserve forest ecosystem is likely to naturally assist in reestablishing vegetation cover over the mining sites if they are left undisturbed for a period of time. However, considering the wildlife safety, taking up appropriate restoration measures soon after the closure of this mines remains critical.

**Bauxite mining:** Bauxite mines are predominantly located on hilltops, including the two mines that was surveyed in Kollimalai and Yercaud. Over time, vegetation—primarily bushes and weeds, with some trees—has gradually concealed the mining traces at these locations, as both mines have been out of operation for an extended period. Reaching these hilltop mines requires trekking, the paths are in poor condition due to a lack of maintenance. A restoration plan for these mines can be specially drafted to ensure sustainable restoration.

**Vermiculite mining:** Vermiculite is mined by excavating the ground, with mining extending deeper than in limestone mines. In terms of available space, there is significant potential for plantations. An irrigation water supply can be established through proper rainwater collection and channelling. Unlike larger-scale mining operations, vermiculite mining does not involve digging extensive trenches. Instead, it is conducted in specific locations, leaving a substantial portion of the land undisturbed.

## 2.6 Scope for restoration

Usually large in size, **limestone mines** offer ample room for restoration. Furthermore, a favorable base for plantations is available as the mineral is generally found mixed with soil and layers of sandstone, whereas in granite mines, the base is mostly hard rocks leaving less opportunity for massive greening. Backfilling or landform stabilization in limestone mines is also more feasible compared to granite mines because the ground medium in the former is soil, while in the latter, it is hard rock.

**Lime kankar mines**, as a type of limestone mine, have considerable area for restoration, but the primary drawback is the lack of water on-site due to the shallow depth of mining. However, exceptions exist where mining goes deep enough to reach the level of water seepage. Borewells can

serve as an alternative to irrigate vegetation during the initial stages in mines without natural water reserves.

In general, **granite and rough stone mines** do not provide suitable space for plantations, as most of the area is fully mined. The rate of backfilling is very low due to the high cost of returning rubble to the pits. Even where virgin lands exist within the mines, most are rocky beds. Some mines have areas along their boundaries suitable for plantations, and certain mines allow restoration activities in their office premises. Another significant hurdle in granite mines is the storage of huge blocks of granite slabs, which occupy considerable space.

**Magnesite mines** have good potential for plantations due to the availability of land and the high potential for backfilling. The mineral is found in veins running through soil, and the reject waste provides ample material for recontouring and stabilization. However, the probable drawback is the lack of a permanent water supply. Rainwater harvesting and channeling are necessary to store water. Vegetation-covered hillocks near the magnesite mines studied could encourage vegetation growth within the mining sites.

**Vermiculite mines** offer significant potential for planting, thanks to their friendly terrain with flat, loose soil suitable for restoration activities. The primary water source on-site is rainwater stagnation, which necessitates proper rainwater harvesting methods.

**Fire clay mines** have good potential for plantations due to their terrain, as they are not deeply excavated. The mine that was visited had three distinct levels: the first was very close to ground level, the second was excavated about one meter deep, and the third was excavated about three to four meters deep. The first two levels are relatively flat and almost barren, while the third, a shallow pit, is uneven and has some vegetation growing naturally.

(Only one fire clay mine near Panruti in the Cuddalore district was visited, so this observation is specific to that site and may not reflect the general pattern of such mines.)

The main challenge is the lack of water, as there is no water source available on-site. Additionally, any mine without fencing poses challenge of cattle grazing challenging any plantation drive.

**Table summarizing the general restoration potential of each mine type:**

| Mineral type | Size of the mine | Available area for planting | Planting substrate | Water available (onsite) | Collaboration feasibility | Restoration Potential | Notes |
|---|---|---|---|---|---|---|---|
| Limestone | Large | Large | Loose | ✓ | Easy | High | |
| Limekankar | Large | Large | Loose | ✗ | Easy | High/medium | * Irrigation water could be groundwater or nearby sources. |
| Magnesite | Large | Large | Loose | ✓ | Easy | High | |
| Bauxite | Small | Less | Semi-hard | ✗ | Not easy | Low | |
| Vermiculite | Large | Large | Loose | ✓ | Easy | High | |
| Granite | Small | Less | Hard | ✗ | Not easy | Low | |
| Black granite | Medium | Less | Hard | ✓ | Not easy | Low | |
| Colour granite | Medium | Less | Hard | ✗ | Not easy | Low | |
| Rough stone | Small | Less | Hard | ✗ | Not easy | Low | |
| Fireclay | Medium | Large | Loose | ✗ | Not easy | Medium/low | *Must be assessed case by case depending on Collaboration feasibility |

*** Ranking and results displayed are mainly based on the sites that have been ground-truthed.**

**Mine Sites with High Restoration Potential (among the ground assessed 37 sites)**

1. **Walayar Limestone Mine - ACC Cements, Mine No. 8**
   Good source of water, healthy ecosystem in the surroundings, and space available for planting.
2. **Periyathirukonam Limestone Mine - Dalmia, Mine No. 4**
   Good source of water, good-sized and suitable terrain. The company has already initiated a significant amount of planting.
3. **Dholipatti Limestone Mine - Chettinad Cements, Mine No. 6**
   Good-sized mine (area for planting is available) and suitable terrain (for planting); the source of water will be a borewell.
4. **Maravaperungudi Limekankar Mine - Ramco, Mine No. 9**
   Suitable terrain; the source of water will be a borewell. Top soil available. The company has already initiated planting activities.
5. **Ottakoil Limestone Mine - Ultratech Cements, Mine No. 12**
   Suitable terrain; the source of water is a borewell and rain water. The company has already initiated planting activities.
6. **Alathiyur Limestone Mine - Ramco, Mine No. 3**
   Good source of water (surface water), has good planting substrate and top soil available, and the company has already undertaken a significant amount of planting.

**Mine Sites with Moderate Restoration Potential (among the ground assessed 37 sites)**

1. **Sevathur Vermiculite Mine - TAMIN, Mine No. 39**
   Good-sized and suitable terrain for plantation. Water is available on-site.
2. **Periyanagalur Limestone Mine - Dalmia, Mine No. 1**
   Half of the mine is flat, and the rest is a mining pit. The mining pit is a flat terrain at its own level. Planting can be done both at ground zero and within the mining pit. Surface water/rainwater is available for irrigation.
3. **Ananthavadi Limestone Mine - TANCEM, Mine No. Mine No. 2**
   Good-sized and suitable terrain for plantation. A water spring is on-site, and a stream flows nearby. Not much topsoil available though.
4. **Kurumambatty Magnesite Mine - TANMAG, Mine No. 15**
   Good-sized and suitable terrain, with water available on-site. A healthy ecosystem exists nearby.
5. **Devarmalai Limestone Mine - Chettinad Cements, Master List No. 5**
   Good-sized and suitable terrain available. No surface water. The source of water is a borewell.
6. **Chettichavadi Magnesite Mine - IMPL, Mine No. 13**
   Good-sized and suitable terrain. Surface water available. The substrate is medium level challenging for plantation and not much top soil.
7. **Mangarasavalapalayam Granite Mine - Private, Mine No. 22**
   Good-sized terrain available for planting. No water is available; a borewell needs to be dug.

***All of the above listed mine are either corporate owned or government owned which offers high collaborative feasibility for undertaking restoration.**

**Annexure 2** presents a detailed analysis and interpretation of the data provided by the Tamil Nadu mining department, integrating expert knowledge, ground-truthing observations, and additional supporting data.

# 3. Framework methodology for assessing mines and their restoration potential

## 3.1 Potential Restoration Objectives for Post-Mining Sites

**Introduction:** The completion of mining marks a critical shift in land use. Historically, post-mining lands were viewed as exhausted and unproductive. Restoration often involved costly refilling, minimal tree planting, and basic fencing—efforts that typically failed due to poor survival rates and grazing pressures.

Today, this mindset is evolving. In light of climate goals and sustainability commitments, the value of post-mining landscapes is being reassessed. At least five distinct restoration objectives are now recognized, to be pursued individually or in combination:

- Biodiversity
- Water security
- Agroforestry
- Recreation
- Solar power generation

Additionally, the default practice of refilling mines warrants re-evaluation, considering the energy costs and potential missed opportunities in realizing other restoration goals.

**1. Biodiversity:** Tamil Nadu boasts rich biodiversity that provides critical ecosystem services—pollination, pest control, carcass scavenging, and seed dispersal. Restoring post-mining sites with native species can create ecological hotspots across the region and support biodiversity corridors. These sites also serve as valuable educational and recreational resources.

*Key Actions:*

- Conduct a baseline biodiversity survey
- Analyze soil for physical and chemical properties
- Engage local communities
- Secure land with fencing
- Plant suitable native species
- Provide aftercare and maintenance
- Monitor and evaluate ecological development
- Establish long-term protection agreements

*Note:* Without lasting stakeholder agreements, investments in site restoration remain vulnerable.

**2. Water Security:** Many hard rock mines (granite, limestone) naturally collect rainwater and runoff, creating reliable water bodies. These can become vital resources in Tamil Nadu's dry landscape.

During active mining, water is typically diverted to settling tanks and used for irrigation. Post-closure, abandoned mines can be formalized as reservoirs.

*Key Actions:*

- Maximize surface runoff capture
- Stabilize adjacent slopes with vegetation
- Fence sites to prevent accidents
- Establish local water user committees for governance

**3. Agroforestry:** Post-mining lands with levelled or terraced areas and viable soil can support agroforestry or orchard systems. However, much of the post-mining substrate is rocky or nutrient-poor.

If topsoil was saved prior to mining, reapplication will improve success. Mines with water storage also offer irrigation potential to aid early establishment.

*Species Selection:* (based on soil fertility)

- **High fertility:** Banana, papaya, mango, jackfruit, cashew, coconut
- **Moderate fertility:** Lemon, guava, pomegranate
- **Low fertility/degraded soils:** Bael, jamun, drumstick, wood apple, tamarind, sesbania, pongamia, red sanders, vengai, hardwickia

Irrigation may be required during the first 3 years of establishment.

**4. Recreation:** In peri-urban regions, restored mines can serve as much-needed recreational spaces—walking trails, birdwatching zones, fitness parks, and environmental education sites.

These uses are best paired with biodiversity objectives. CSR funding can support staffing and upkeep.

*Infrastructure Possibilities:*

- Toilets
- Visitor centres and interpretation hubs
- Amphitheatres
- Cafeterias
- Paved pathways

*Pre-requisites:*

- Fencing, irrigation, security
- Detailed planning and DPR development based on end-user needs

**5. Solar Power Generation:** Large, barren mine pits with minimal soil may be suited for solar PV installations. Systems can be ground-mounted or floating, depending on site conditions.

*Considerations:*

- Avoid *rockfall-prone areas and shaded zones near quarry walls*
- *Floating solar offers 1–22% higher efficiency due to water-cooling effect and reduced evaporation*

*Limitations:*

- *Structural stability of quarry edges*
- *Installation and maintenance costs (higher for floating systems)*

**Conclusion:** Post-mining landscapes offer diverse opportunities for ecological, social, and economic revitalization. With thoughtful planning and multi-stakeholder collaboration, these once-extractive lands can contribute meaningfully to regional sustainability goals.

## 3.2 Criteria/Indicators for site assessment

**A. Ownership:**
With respect to **ownership**, the study examines stability and the scope for long-term land protection. Understanding this factor helps to determine the anticipated level of commitment towards land restoration and further enables the projection of potential risks associated with achieving each restoration objective.

There are 4 main categories that are pertinent, each with its positive and negative aspects which can influence the potential restoration objective.

- **Government – State:** Long term, unlikely to sell, subject to whims of political leadership, but relatively stable, as policy changes are cumbersome to enact.
- **Government – Local:** Much less stable than State, each areas will be at whim of local political vested interests – therefore the objective needs to address general local needs amongst the population that will sustain through local changes in the political hierarchy.
- **Corporate:** This will be generally mining companies, and be associated with the larger mines. There will be company policy – which is generally stable, but investment in certain projects will be very dependent on the economic climate, with down turns reducing potential investment in the projects. In the current climate of buy outs and take overs there is a danger of the new management making dramatic u-turns in investment.
- **Private individuals:** Unless they are highly motivated individuals it unlikely that they will have the vision to invest unless the returns are guaranteed.

**B. Size:**
This parameter assesses the overall dimensions of the land holding, mine area, depth, and the availability of surrounding land, including areas covered with extracted overburden or left undisturbed. Each of these elements significantly impacts the restoration opportunities, influencing the choice and scale of restoration activities.

**C. Level of Protection:**
Ownership characteristics and legal frameworks, including statutory regulations related to proximity to forests or natural reserves, directly affect site stability and long-term restoration potential. Presence of physical or social boundaries enhances the viability of restoration, particularly for plantation activities or other infrastructure development. If these boundaries are absent, their establishment must be accounted for in restoration planning and budgeting.

**D. Water Availability and Quality:**
Water is a pivotal factor, crucial for certain restoration objectives such as plantations or agriculture, though less critical for others. Both the availability and quality of water determine its suitability for various restoration uses—domestic, agricultural, or ecological. Increased salinity (high TDS values exceeding 2,200–2,500) restricts water usability, limiting the choice of restoration activities and plant species. High TDS water, if used, must be carefully managed in the initial years to avoid detrimental impacts on soil health.

**E. Availability of Soil:**
Successful restoration, especially involving revegetation or plantations, depends significantly on soil availability. Mining operations typically involve removal and relocation of topsoil, sometimes stored as perimeter bunds or abandoned piles around the site. Identifying potential soil reserves during site visits is therefore essential for determining realistic restoration possibilities and enhancing project feasibility.

**F. Lease maturity & status of mining activity:**
The status of mining operations—including lease maturity and the likelihood of mining resumption—strongly influences long-term restoration plans. Some sites might temporarily halt operations due to market dynamics or technological constraints. This factor should be carefully considered, particularly when selecting restoration strategies designed for long-term ecological or socio-economic outcomes.

**G. Ecological Connectivity:**
Proximity to intact native vegetation significantly enhances biodiversity-focused restoration objectives by promoting gene flow of flora and fauna, thus contributing to regional ecological resilience. Restoration outcomes are strengthened when linked to broader landscape-level conservation efforts, potentially facilitating reintroduction of rare or locally extinct species and creating interconnected ecological networks.

**H. Social Consideration:**
Restoration projects succeed **Community** best when they resonate with local community aspirations and relationships with the land. Understanding community perceptions—such as feelings of ownership, involvement, and long-term aspirations—helps identify suitable restoration objectives that generate strong local support and meaningful socio-economic outcomes.

**I. Contact Zone:**
The geological interface between extracted minerals and underlying bedrock defines conditions such as water accumulation and root penetration potential. Impermeable bedrock layers can lead to significant water pooling, limiting vegetation growth without costly interventions like reintroduction of overburden material. Restoration methods involving substantial substrate transfer should thus be prioritized primarily when supporting productive agriculture or agroforestry systems is economically and environmentally viable.

**J. Slope Stability:**
Overburden accumulations from mining activities often create steep and unstable slopes, posing challenges for restoration. Effective restoration planning must address slope stability through methods like slope regrading, vegetation cover, or combinations thereof. Stable slopes facilitate successful revegetation and reduce erosion risks, directly enhancing the overall effectiveness and sustainability of restoration efforts.

## 3.3 Comparative Assessment of Restoration Objectives Against Site-Specific Criteria

To guide effective decision-making for post-mining land use, this section presents a comparative evaluation of five potential restoration objectives—Biodiversity, Water Security, Agroforestry, Recreation, and Solar Power Generation—against twelve critical site-specific criteria. The analysis helps identify which objectives are most suitable for different portions of the mine area, based on ecological feasibility, physical conditions, and social acceptability. This structured approach ensures that restoration planning is both context-sensitive and strategically aligned with long-term sustainability goals.

### 3.3.a Biodiversity Restoration Feasibility Assessment

**A. Ownership:**

As biodiversity restoration will have minimal direct monetary benefits to the owners there needs to be a larger vision or policy-driven deliverable that frames the project. In other words there needs to be a passion – either personal or institutional, that recognizes the value of biodiversity at the landscape level, or for the owner's image/profile.

| | | | |
|---|---|---|---|
| 1 | Positive | Corporate | Corporate can have easy access to funding if they are motivated. |
| 2 | Ambivalent | State | Funding can be an issue at large scale. |
| 3 | Negative | Panchyat, Private | Funding will difficult and more vulnerable to changes in leadership. |

**B. Size:**

Not a critical factor, as small havens can have a positive impact on the wider goals of biodiversity conservation, however the larger the size the more potential there will be for the creation of a diverse landscape mosaic, which will increase the resilience of the area in the long term.

| | | | |
|---|---|---|---|
| 1 | Positive | Greater than 10 hectares | At this scale the impacts can be easily discerned and appreciated. |
| 2 | Ambivalent | 2 to 10 hectares | Less easy to motivate for larger organizations. |
| 3 | Negative | Less than 2 hectares | Possible, but only with the special conditions and motivated owner. |

**C. Level of protection:**

As biodiversity restoration is a long term commitment, statutory regulation to protect the project investments from the whims of future owners who might seek to change the trajectory of the project is a positive contribution to the viability of the restoration objective. Additional an appropriate fence – physical or social needs to be establish to prevent over exploitation of the site – particularly in the establishment phase.

Statutory

| | | |
|---|---|---|
| 1 | Positive | Clear ordinance in place for the long term protection of the area. |
| 2 | Ambivalent | Nothing in place but willingness from owners. |
| 3 | Negative | No interest from owners and local community, or ordinance in place |

Boundaries

| | | |
|---|---|---|
| 1 | Positive | Existing fence in good condition or clear agreement with local community. |
| 2 | Ambivalent | Old fence existing – but porous, some community engagement. |
| 3 | Negative | No clear boundaries – and clear over utilization of land |

**D. Water availability & Water quality:**

A huge advantage to have a useable and easily accessible source of water, assuming that the TDS is within reasonable limits (less that 2200 for most resilient species of trees). Establishment of planted saplings through the extend dry season which is common in the majority of areas that mines are located, is greatly enhance by the ability to water the plants for one or two years. It also enables faster growth of the seedlings – which can be beneficial when there are other threats to establishment such a grazing from domestic or wild animals or presence of invasive species that will smother small seedlings if given the chance – such as Lantana, Chromolaena or Prosopis.

| | | |
|---|---|---|
| 1 | Positive | Perennial water sources in place with reasonable quality. |
| 2 | Ambivalent | Significant annual storage that lasts into the dry season. |
| 3 | Negative | No presence of water post monsoon. |

**E. Soil availability:**

Trees and shrubs general establish well on loose planting medium where the roots can move easily to search for soil moisture and nutrients. If good soils are present then the alternative restoration objective of Agroforestry should be considered, but where soils are skeletal or nutrient poor there are a large number of native species that establish well and contribute to the biodiversity restoration objective.

| | | |
|---|---|---|
| 1 | Positive | Soil available either in-situ or accessible on site. |
| 2 | Ambivalent | Some planting substrate available that is not compacted. |
| 3 | Negative | No soil available |

**F. Lease maturity & status of mining activity:**

Unless there is a clearly defined mine plan that has been followed and is consistent with setting aside areas for the long term, this restoration objective only should be considered, once the lease is completed or close to the end – where the final position of soil dumps and other defining landscape features are clear and unchanging.

| | | |
|---|---|---|
| 1 | Positive | Mining activities ceased. |
| 2 | Ambivalent | Mining activities close to cessation. |
| 3 | Negative | Mining activities in dynamic phase |

**G. Ecological connectivity:**

Good connectivity to other natural areas will certainly give more value to the site, and should be seen as a positive contributing factor in the decision making process, but contrarily poor connectivity should not be negative factor, as an isolated patch can have a major impact on the surrounding area.

| | | |
|---|---|---|
| 1 | Positive | Adjacent to forest area or other natural resource |
| 2 | Ambivalent | Within 20 km of forest area or other natural resource. |
| 3 | Negative | Great than 20 km from forest area or other natural resource |

**H. Social consideration:**

Protection of biodiversity areas will be greatly enhance if the local community feels benefits from the project's long term goals or commitments – thus to couple the restoration objective of biodiversity conservation to other goals such as recreation and education will give the local community more reason to value the project for the social and economic benefits these activities can bring.

| | | |
|---|---|---|
| 1 | Positive | Local community engaged with and aware of importance of biodiversity conservation. |
| 2 | Ambivalent | Local community organized and ready to listen. |
| 3 | Negative | No organized structure in the local community open to listen. |

**I. Contact zone:**

Biodiversity conservation can happen in any environment, however the presence of a large open area at the bottom of the mined area, which has no water or soil present to enable life to establish would give other objectives a prior claim to be considered.

| | | |
|---|---|---|
| 1 | Positive | Either with permeable soil – or had perennial water body. |
| 2 | Ambivalent | Has seasonal water into dry season, or available soil to use. |
| 3 | Negative | Hard rock, no perennial water, no available soil. |

**J. Slope stability:**

This is something that can be enhanced with effective planning and interventions, and local native species of grass, shrubs or trees can be used to great effect to stabilize the slopes - thus it should not be considered as a negative factor – assuming that slope stability is something required as a regulatory condition of decommissioning a mine.

| | | |
|---|---|---|
| 1 | Positive | Slopes well graded or benched – no discernible erosion. |
| 2 | Ambivalent | Slope with signs of rill erosion – but possible rectify with minimal intervention. |
| 3 | Negative | Highly eroded, with significant effort required to rectify. |

## 3.3.b Water Security Integration Potential

**A. Ownership:**

So long as there are clear agreements signed between the owners and the water users association, that define the terms and conditions for the use of the water, then ownership is not a limiting consideration for this restoration objective

| | | | |
|---|---|---|---|
| 1 | Positive | Corporate | Corporate will be motivated to support local communities to show benefit of mining. |
| 2 | Ambivalent | State and Panchayat | A willingness will be there, but funds and organization capacity can be low.. |
| 3 | Negative | Private | Reticence to give user rights might be a negative aspect. |

**B. Size:**

Not a limiting factor – so long as water is present.

| | | |
|---|---|---|
| 1 | Positive | All sizes have potential for this – it simply dependant on water availability. |

**C. Level of protection:**

As above for ownership – so long as the agreement is clear in terms of user rights and longevity of access. Unwanted intrusion into the site which could lead to pollution of the water body needs to be in place.

Statutory

| | | |
|---|---|---|
| 1 | Positive | Clear ordinance in place for the long term protection of the area. |
| 2 | Ambivalent | Nothing in place but willingness from owners. |
| 3 | Negative | No interest from owners and local community, or ordinance in place |

Boundaries

| | | |
|---|---|---|
| 1 | Positive | Existing fence in good condition or clear agreement with local community. |
| 2 | Ambivalent | Old fence existing – but porous, some community engagement. |
| 3 | Negative | No clear boundaries – and clear over utilization of land |

**D. Water availability & Water quality:**

Essential to be present, and of suitable quality for this restoration objective. Additionally, there should be a clarity on the amount of water available for sustainable extraction that does not impact the surrounding water table.

| | | |
|---|---|---|
| 1 | Positive | Perennial water sources in place with reasonable quality. |
| 2 | Ambivalent | Significant annual storage that lasts into the dry season. |
| 3 | Negative | No presence of water post monsoon. |

**E. Soil availability:**

Not a limiting factor

| | | |
|---|---|---|
| 1 | Positive | All situations are fine. |

**F. Lease maturity & status of mining activity:**

Not a limiting factor

| | | |
|---|---|---|
| 1 | Positive | All situations are fine. |

**G. Ecological connectivity:**

| | | |
|---|---|---|
| 1 | Positive | All situations are fine. |

**H. Social consideration:**

A clearly defined water users group with good governance will enhance the success of this restoration activity

| | | |
|---|---|---|
| 1 | Positive | Local community engaged. |
| 2 | Ambivalent | Local community organized and ready to listen. |
| 3 | Negative | No organized structure in the local community open to listen. |

**I. Contact zone:**

Should be non-porous

| | | |
|---|---|---|
| 1 | Positive | All situations are fine so long as water is present. |

**J. Slope stability:**

If the slopes are not stable and have the potential to erode down into the water reservoir, then this should be consider as a negative factor if there is no clear and realistic strategy to mitigate the threat.

| | | |
|---|---|---|
| 1 | Positive | Slopes well graded or benched – no discernible erosion. |
| 2 | Ambivalent | Slope with signs of rill erosion – but possible rectify with minimal intervention. |
| 3 | Negative | Highly eroded, with significant effort required to rectify. |

## 3.3.c Recreation and Community Access Potential

**A. Ownership:**

Generally for this kind of project, if the investment in infrastructure is to be considered, a stable and committed ownership is required – this would need to be considered on a case by case basis – profiling the owners – if investment is coming from outside sources.

| | | | |
|---|---|---|---|
| 1 | Positive | Corporate | Corporate can have easy access to funding if they are motivated. |
| 2 | Ambivalent | State | Funding can be an issue at large scale. |
| 3 | Negative | Panchyat, Private | Funding will difficult and more vulnerable to changes in leadership. |

**B. Size:**

If the design is good, access is not a problem, and there is a coherent circulation plan size is not an issue – as adventure activities such as rock climbing can be confined to a small area.

| | | |
|---|---|---|
| 1 | Positive | All sizes have potential for this – it simply depends on the appropriate design and usage – an interest from visitors |

**C. Level of protection:**

This is of least concern – except for change of direction from the owners as mentioned above. Security of the site needs to be in place, either through social or physical fences, for the protection of the assets from theft or for the visitors.

Statutory

| | | |
|---|---|---|
| 1 | Positive | Clear ordinance in place for the long term protection of the area. |
| 2 | Ambivalent | Nothing in place but willingness from owners. |
| 3 | Negative | No interest from owners and local community, or ordinance in place |

Boundaries

| | | |
|---|---|---|
| 1 | Positive | Existing fence in good condition or clear agreement with local community. |
| 2 | Ambivalent | Old fence existing – but porous, some community engagement. |
| 3 | Negative | No clear boundaries – and clear over utilization of land |

**D. Water availability & Water quality:**

Not an issue – save for basic requirements for toilets and other amenities if they are required.

| | | |
|---|---|---|
| 1 | Positive | All situations have potential – it simply depends on the appropriate design and usage. |

**E. Soil availability:**

Not an issue

| | | |
|---|---|---|
| 1 | Positive | All situations have potential – it simply depends on the appropriate design and usage – an interest from visitors |

**F. Lease maturity & status of mining activity:**

If mining activities are continuing, then clear demarcations of access etc are a requirement, but if the interest is there, the mining activity can be a part of the attraction for visitors.

| | | |
|---|---|---|
| 1 | Positive | All situations have potential – it simply depends on the appropriate design and usage – an interest from visitors |

**G. Ecological connectivity:**

Not an issue.

| | | |
|---|---|---|
| 1 | Positive | All situations have potential |

**H. Social consideration:**

Locally community involvement is preferable, but not essential for this kind of objective.

| | | |
|---|---|---|
| 1 | Positive | Local community engaged with and aware of importance of biodiversity conservation. |
| 2 | Ambivalent | Local community organized and ready to listen. |
| 3 | Negative | No organized structure in the local community open to listen. |

**I. Contact zone:**

Not an issue

| | | |
|---|---|---|
| 1 | Positive | All situations have potential – it simply depends on the appropriate design and usage – an interest from visitors |

**J. Slope stability:**

Not an issue assuming the circulation plan does not allow visitors any where near the unstable slopes. But something to be considered.

| | | |
|---|---|---|
| 1 | Positive | Slopes well graded or benched – no discernible erosion. |
| 2 | Ambivalent | Slope with signs of rill erosion – but possible rectify with minimal intervention. |
| 3 | Negative | Highly eroded, with significant effort required to rectify. |

## 3.3.d Agroforestry Viability Mapping

**A. Ownership:**

Not an issue, as the economic aspects of this restoration objective will be a motiving and deciding factor in the owners investment plan.

| | | |
|---|---|---|
| 1 | Positive | All situations have potential – it simply depends on the interest from the owners |

**B. Size:**

Not an issue - more to do with availability of suitable topography that lends it self to the designed system of agroforestry to be implemented – trees can easily be grown on terraced slopes and so long as harvesting of products is safe an economically viable this activity can be considered.

| | | |
|---|---|---|
| 1 | Positive | All situations have potential – it simply depends on the interest from the owners |

**C. Level of protection:**

Fencing – physical or social will be the key to success of the project, and clear user rights for the harvesting of the products need to be defined in any agreements with third parties.

Statutory

| | | |
|---|---|---|
| 1 | Positive | Clear ordinance in place for the long term protection of the area. |
| 2 | Ambivalent | Nothing in place but willingness from owners. |
| 3 | Negative | No interest from owners and local community, or ordinance in place |

Boundaries

| | | |
|---|---|---|
| 1 | Positive | Existing fence in good condition or clear agreement with local community. |
| 2 | Ambivalent | Old fence existing – but porous, some community engagement. |
| 3 | Negative | No clear boundaries – and clear over utilization of land |

**D. Water availability & Water quality:**

Certainly advantageous for the projects economic viability.

| | | |
|---|---|---|
| 1 | Positive | Perennial water sources in place with reasonable quality. |
| 2 | Ambivalent | Significant annual storage that lasts into the dry season. |
| 3 | Negative | No presence of water post monsoon. |

**E. Soil availability:**

Essential for most potential agroforestry systems.

| | | |
|---|---|---|
| 1 | Positive | Soil available either in-situ or accessible on site. |
| 2 | Ambivalent | Some planting substrate available that is not compacted. |
| 3 | Negative | No soil available |

**F. Lease maturity & status of mining activity:**

Not an issue of if the designated zones are clearly demarcated.

| | | |
|---|---|---|
| 1 | Positive | All situations have potential – it simply depends on the interest from the owners |

**G. Ecological connectivity:**

Not an issue

| | | |
|---|---|---|
| 1 | Positive | All situations have potential |

**H. Social consideration:**

Not an issue – but if there is a plan to involve the local communities in receiving the benefits from the harvest – a clear agreement will need to be in place from the outset.

| | | |
|---|---|---|
| 1 | Positive | All situations have potential |

I. **Contact zone:**

If the contact zone is permeable – as can be the case in soil mining – then agroforestry can be an excellent choice for the restoration objective. If not then the impermeable surface either needs to accumulate water or have the potential for amelioration through the import of soil.

| | | |
|---|---|---|
| 1 | Positive | Either with permeable soil – or has perennial water body. |
| 2 | Ambivalent | Has seasonal water into dry season, or available soil to use. |
| 3 | Negative | Hard rock, no perennial water, no available soil. |

J. **Slope stability:**

Important if the agroforestry is implemented on the mounds or slopes, otherwise not a limiting factor.

| | | |
|---|---|---|
| 1 | Positive | Slopes well graded or benched – no discernible erosion. |
| 2 | Ambivalent | Slope with signs of rill erosion – but possible rectify with minimal intervention. |
| 3 | Negative | Highly eroded, with significant effort required to rectify. |

## 3.3.e Solar Infrastructure Compatibility Assessment

A. **Ownership:**

Not a limiting factor

| | | |
|---|---|---|
| 1 | Positive | All situations have potential – it simply depends on the interest from the owners |

B. **Size:**

The larger the better, but under certain conditions small sites can also be productive assuming the energy generated can be connected to the grid or a defined user. One factor for panels installed at the bottom of mines – floating panels or otherwise will be the depth of the mine – as shadows cast by the walls of the quarry will limit productivity – this is a factor in the smaller sites.

| | | |
|---|---|---|
| 1 | Positive | All situations have potential – it simply depends on the interest from the owners |

C. **Level of protection:**

Assets such as solar panels need protection – thus this needs to be considered – both in the physical and at the statutory level.

Statutory

| | | |
|---|---|---|
| 1 | Positive | Clear ordinance in place for the long term protection of the area. |
| 2 | Ambivalent | Nothing in place but willingness from owners. |
| 3 | Negative | No interest from owners and local community, or ordinance in place |

Boundaries

| | | |
|---|---|---|
| 1 | Positive | Existing fence in good condition or clear agreement with local community. |
| 2 | Ambivalent | Old fence existing – but porous, some community engagement. |
| 3 | Negative | No clear boundaries – and clear over utilization of land |

**D. Water availability & Water quality:**

Not essential – but cleaning of the panels from dust is an important consideration – especially if there is loose soil present onsite from unstable overburden dumps.

| | | |
|---|---|---|
| 1 | Positive | Perennial water sources in place with reasonable quality. |
| 2 | Ambivalent | Significant annual storage that lasts into the dry season. |
| 3 | Negative | No presence of water post monsoon. |

**E. Soil availability:**

Not an issue

| | | |
|---|---|---|
| 1 | Positive | All situations have potential – it simply depends on the interest from the owners |

**F. Lease maturity & status of mining activity:**

Not an issue

| | | |
|---|---|---|
| 1 | Positive | All situations have potential – it simply depends on the interest from the owners |

**G. Ecological connectivity:**

Not an issue

| | | |
|---|---|---|
| 1 | Positive | All situations have potential – it simply depends on the interest from the owners |

**H. Social consideration:**

Not an issue

| | | |
|---|---|---|
| 1 | Positive | All situations have potential – it simply depends on the interest from the owners |

**I. Contact zone:**

Not an issue – so long as there are no flooding issues if the terrestrial panels are being considered.

| | | |
|---|---|---|
| 1 | Positive | All situations have potential – it simply depends on the interest from the owners |

**J. Slope stability:**

This will be a limiting factor if there is a chance of rocks falling or landslips occurring close to where the panels are located – for example floating panels will need to be kept well away from the sides of the quarry, or terrestrial panels away from the unstable slopes of overburden dumps.

| | | |
|---|---|---|
| 1 | Positive | Slopes well graded or benched – no discernible erosion. |
| 2 | Ambivalent | Slope with signs of rill erosion – but possible to rectify with minimal intervention. |
| 3 | Negative | Highly eroded, with significant effort required to rectify. |

## 3.4 Testing of Framework methodology using data from 39 (out 41 studied) sites

**Using the Framework methodology to score the restoration potential of the 39 mines that were visited and assessed:**

For each mine a scoring table was filled to assess the potential of the mine across the 5 Restoration Objectives: Biodiversity, Water Security, Recreation/Education, Agroforestry, Solar power generation.

| 0 | Mine name | | | | | | |
|---|---|---|---|---|---|---|---|
| | Criteria/Indicators | Biodiversity | Water security | Recreation education | Agro forestry | Solar power | Comment |
| | Potential score | 30 | 20 | 18 | 20 | 16 | |
| | Actual score | 0 | 0 | 0 | 0 | 0 | |
| | Average score | - | - | - | - | - | |
| 1 | Ownership | 1 to 3 | 1 to 3 | 1 to 3 | 1 | 1 | |
| 2 | Size, % mine vs. overburden | 1 to 3 | 1 | 1 | 1 | 1 | |
| 3 | Level of protection | | | | | | |
| | Statutory | 1 to 3 | 1 to 3 | 1 to 3 | 1 to 3 | 1 to 3 | Consistent across categories |
| | Boundaries | 1 to 3 | 1 to 3 | 1 to 3 | 1 to 3 | 1 to 3 | Consistent across categories |
| 4 | Water availability & Water quality | 1 to 3 | 1 to 3 | 1 | 1 to 3 | 1 to 3 | Varies across catergories |
| 5 | Soil availability | 1 to 3 | 1 | 1 | 1 to 3 | 1 | |
| 6 | Lease maturity & status of mining activity | 1 to 3 | 1 | 1 | 1 | 1 | |
| 7 | Ecological connectivity | 1 to 3 | 1 | 1 | 1 | 1 | |
| 8 | Social consideration | 1 to 3 | 1 to 3 | 1 to 3 | 1 | 1 | |
| 9 | Contact zone | 1 to 3 | 1 | 1 | 1 to 3 | 1 | |
| 10 | Slope stability | 1 to 3 | 1 to 3 | 1 to 3 | 1 to 3 | 1 to 3 | Consistent across categories |

| | |
|---|---|
| 1 to 3 | Score of 1 to 3 to be enter |
| 1 to 3 | Score of 1 to 3 to be enter, will affect adjacent cells |
| 1 to 3 | Filled with same value as blue cell |
| 1 | No value to be filled as this criterea does no affect the Restoration Objective |

Example of scoring for the first mine:

| 1 | Periyanagular | | | | | |
|---|---|---|---|---|---|---|
| | Criteria/Indicators | Biodiversity | Water security | Recreation education | Agro forestry | Solar power |
| | Potential score | 33 | 23 | 21 | 23 | 19 |
| | Actual score | 21 | 16 | 16 | 19 | 15 |
| | Factored score | 0.29 | 0.40 | 0.34 | 0.19 | 0.37 |
| | Average score | 0.32 | | | | |
| 1 | Ownership | 1 | 1 | 1 | 1 | 1 |
| 2 | Size, % mine vs. overburden | 1 | 1 | 1 | 1 | 1 |
| 3 | Level of protection | | | | | |
| | Statutory | 2 | 2 | 2 | 2 | 2 |
| | Boundaries | 2 | 2 | 2 | 2 | 2 |
| 4 | Water availability & Water quality | 1 | 1 | 1 | 1 | 1 |
| 5 | Soil availability | 2 | 1 | 1 | 3 | 1 |
| 6 | Lease maturity & status of mining activity | 2 | 1 | 1 | 1 | 1 |
| 7 | Ecological connectivity | 2 | 1 | 1 | 1 | 1 |
| 8 | Social consideration | 2 | 2 | 2 | 1 | 1 |
| 9 | Contact zone | 3 | 1 | 1 | 3 | 1 |
| 10 | Slope stability | 3 | 3 | 3 | 3 | 3 |

Factored score is calculated by as:

((Potential Score/Actual Score)-1)/((Potential score/Minimum score)-1) which gives a relative value of the potential for the site for each of the Restoration Objectives:
The higher the number the more suitable the mine is for undergoing restoration– but it is important to note that this is a value that can be compared within the specific Restoration Objective across the mine types, – but not between different Restoration Objectives.

These results were then tabulated for better comparative understanding between the mine types.

| S. No. | Village | Type | Biodiversity | Water security | Recreation education | Agro forestry | Solar power | Average |
|---|---|---|---|---|---|---|---|---|
| 1 | Periyanagalur | Limestone | 0.29 | 0.40 | 0.34 | 0.19 | 0.37 | 0.32 |
| 2 | Anandavadi | Limestone | 0.16 | 0.19 | 0.26 | 0.14 | 0.26 | 0.20 |
| 3 | Alathiyur | Limestone | 0.37 | 0.40 | 0.44 | 0.25 | 0.49 | 0.39 |
| 4 | Periyathirukonam | Limestone | 0.42 | 0.49 | 0.44 | 0.32 | 0.63 | 0.46 |
| 5 | Devarmalai | Limestone | 0.33 | 0.49 | 0.44 | 0.25 | 0.49 | 0.40 |
| 6 | Dholipatti | Limestone | 0.29 | 0.49 | 0.44 | 0.32 | 0.49 | 0.41 |
| 7 | Madukarai | Limestone | 0.42 | 0.49 | 0.44 | 0.32 | 0.49 | 0.43 |
| 8 | Walayar | Limestone | 0.42 | 0.49 | 0.44 | 0.32 | 0.49 | 0.43 |
| | | | **0.33** | **0.43** | **0.41** | **0.27** | **0.46** | **0.38** |
| 9 | Maravarperungudi | Lime kankar | 0.33 | 0.32 | 0.44 | 0.32 | 0.26 | 0.33 |
| 10 | T.koppuchithampatti | Lime kankar | 0.33 | 0.25 | 0.34 | 0.40 | 0.26 | 0.32 |
| 11 | Kurundamadam | Lime kankar | 0.42 | 0.40 | 0.34 | 0.59 | 0.49 | 0.45 |
| 12 | Ottakoil | Lime kankar | 0.42 | 0.40 | 0.34 | 0.59 | 0.49 | 0.45 |
| | | | **0.37** | **0.35** | **0.37** | **0.48** | **0.37** | **0.39** |
| 13 | Chettichavadi | Magnesite | 0.25 | 0.32 | 0.26 | 0.25 | 0.37 | 0.29 |
| 14 | Periyasoragai | Magnesite | 0.16 | 0.19 | 0.26 | 0.14 | 0.16 | 0.18 |
| 15 | Kurumambapatti | Magnesite | 0.29 | 0.32 | 0.26 | 0.25 | 0.37 | 0.30 |
| | | | **0.23** | **0.28** | **0.26** | **0.22** | **0.30** | **0.26** |
| 16 | Puliyur | Bauxite | 0.29 | 0.19 | 0.26 | 0.14 | 0.16 | 0.21 |
| 17 | Selurnadu | Bauxite | 0.25 | 0.19 | 0.26 | 0.14 | 0.16 | 0.20 |
| | | | **0.27** | **0.19** | **0.26** | **0.14** | **0.16** | **0.20** |
| 18 | Vadugapatti | Quartz and Feldspar | 0.19 | 0.25 | 0.18 | 0.19 | 0.37 | 0.24 |
| | | | **0.19** | **0.25** | **0.18** | **0.19** | **0.37** | **0.24** |
| 19 | Surampalayam | White granite | 0.11 | 0.19 | 0.12 | 0.19 | 0.37 | 0.20 |
| 20 | Sariprakad | White granite | 0.07 | 0.09 | 0.12 | 0.09 | 0.16 | 0.10 |
| 21 | Alathur | Coloured granite | 0.11 | 0.19 | 0.12 | 0.19 | 0.37 | 0.20 |
| 22 | Mangarasa valaya palayam | Coloured granite | 0.05 | 0.09 | 0.12 | 0.09 | 0.16 | 0.10 |
| 23 | Triupattur | Coloured granite | 0.11 | 0.09 | 0.12 | 0.14 | 0.16 | 0.12 |
| 24 | Murugapadi | Coloured granite | 0.19 | 0.25 | 0.18 | 0.32 | 0.49 | 0.29 |
| 25 | Thogamalai | Coloured granite | 0.13 | 0.19 | 0.12 | 0.25 | 0.37 | 0.21 |
| 26 | Sithampoondi | Coloured granite | 0.11 | 0.14 | 0.12 | 0.19 | 0.26 | 0.16 |
| 27 | Pulikunda | Coloured granite | 0.13 | 0.19 | 0.12 | 0.25 | 0.37 | 0.21 |
| 28 | Sandhanapalli | Coloured granite | 0.09 | 0.19 | 0.12 | 0.25 | 0.37 | 0.20 |
| 29 | Rendadi | Black granite | 0.07 | 0.14 | 0.18 | 0.14 | 0.16 | 0.14 |
| 30 | Kodakal | Black granite | 0.07 | 0.09 | 0.12 | 0.09 | 0.16 | 0.10 |
| 31 | Pothuvai & pazhavalam | Black granite | 0.05 | 0.09 | 0.12 | 0.09 | 0.16 | 0.10 |
| 32 | Melmalaiyanur | Black granite | 0.09 | 0.19 | 0.12 | 0.19 | 0.37 | 0.19 |
| 33 | Kathiripalli village | Black granite | 0.11 | 0.19 | 0.12 | 0.25 | 0.37 | 0.21 |
| 34 | Sandhanapalli | Black granite | 0.13 | 0.19 | 0.12 | 0.25 | 0.37 | 0.21 |
| 35 | Sennampatti | Rough stone | 0.16 | 0.19 | 0.12 | 0.19 | 0.37 | 0.21 |
| 36 | South avinashipalayam | Rough stone | 0.07 | 0.14 | 0.12 | 0.14 | 0.26 | 0.14 |
| 37 | Chittathur | Rough stone | 0.05 | 0.09 | 0.12 | 0.09 | 0.16 | 0.10 |
| | | | **0.10** | **0.15** | **0.12** | **0.18** | **0.29** | **0.17** |
| 38 | Sevathur | Vermiculite | 0.11 | 0.19 | 0.12 | 0.25 | 0.37 | 0.21 |
| | | | **0.11** | **0.19** | **0.12** | **0.25** | **0.37** | **0.21** |
| 39 | Panikkankuppam | Fireclay | 0.16 | 0.14 | 0.18 | 0.25 | 0.16 | 0.18 |
| | | | **0.16** | **0.14** | **0.18** | **0.25** | **0.16** | **0.18** |

It was further summarized into a table to give a broad overview of Mine types with respect to the Restoration Objectives.

## 3.5 Summary of the Restoration potential assessment

**8 Mine Types**: Limestone, Lime kankar, Magnesite, Bauxite, Quartz and feldspar, Granite and Rough Stone, Vermiculite and Fireclay

with respect to the

**5 Restoration Objectives**: Biodiversity, Water Security, Recreation/Education, Agroforestry, Solar power generation.

is summarised below.

| Type | Average rank | Biodiversity | | Water security | | Recreation education | | Agro forestry | | Solar power | | Average | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | factor | rank | factor | rank | factor | rank | factor | rank | factor | rank | factor | rank |
| Limestone | 1.40 | 0.33 | 2 | 0.43 | 1 | 0.41 | 1 | 0.27 | 2 | 0.46 | 1 | 0.38 | 2 |
| Lime kankar | 1.60 | 0.37 | 1 | 0.35 | 2 | 0.37 | 2 | 0.48 | 1 | 0.37 | 2 | 0.39 | 1 |
| Magnesite | 4.00 | 0.23 | 4 | 0.28 | 3 | 0.26 | 3 | 0.22 | 5 | 0.30 | 5 | 0.26 | 3 |
| Quartz and Feldspar | 4.80 | 0.19 | 5 | 0.25 | 4 | 0.18 | 5 | 0.19 | 6 | 0.37 | 4 | 0.24 | 4 |
| Bauxite | 5.60 | 0.27 | 3 | 0.19 | 5 | 0.26 | 4 | 0.14 | 8 | 0.16 | 8 | 0.20 | 6 |
| Vermiculite | 5.60 | 0.11 | 7 | 0.19 | 6 | 0.12 | 8 | 0.25 | 4 | 0.37 | 3 | 0.21 | 5 |
| Fireclay | 6.00 | 0.16 | 6 | 0.14 | 8 | 0.18 | 6 | 0.25 | 3 | 0.16 | 7 | 0.18 | 7 |
| Granite and Rough stone | 7.00 | 0.10 | 8 | 0.15 | 7 | 0.12 | 7 | 0.18 | 7 | 0.29 | 6 | 0.17 | 8 |

As can be clearly seen both Limestone mines and Lime kankar mines top the ranking for each of the 5 restoration objectives, with Magnesite, Quartz and Feldspar and Bauxite in the next category. Granite consistently ranks at the bottom.

Analysis of the four major mine types - Limestone, Lime Kanker, Magnesite, and Granite/Rough stone is described below.

**Limestone mines: - Good for all the 5 Restoration Objectives.**

1. Ownership: The limestones mines consistently scored high as they are generally owned by corporates which had been identified as the most likely owner type to support restoration as they are concerned about branding and company image, with respect to the large carbon footprint of cement manufacturing.
2. Size, % mine vs. overburden: The mines are of a large size, and in most cases there is a significant amount of overburden removed and stored.
3. Level of protection – Statutory: The mines are well regulated and consequently the land use clearly defined, which is good for long term requirements of restoration.
4. Level of protection – Boundary: These are clearly defined often with perimeter bunds created from the initial scrapping of the site, and there are also boundary fences which in the case of active mines they are well maintained, but a number of years after activities cease they tend to degenerate as the wires corrode and are not replaced.
5. Water availability & Water quality. Water is often present at the bottom of the mines which is useful for the restoration objective – which is benefical for all the restoration objectives.
6. Soil availability: Sometimes to be found in mines – which leads to higher scores for biodiversity and agroforestry objectives.
7. Lease maturity & status of mining activity: The leases are generally active, although in some places mines are approaching the last few years of production – which is good for all the objectives.
8. Ecological connectivity: A number of the mines are adjacent, or close to reserve forests, which is beneficial for the biodiversity objective.

9. Social consideration: The large cement companies are very aware of their image within the local communities, and have active CSR programs that support community initiatives.
10. Contact zone: In the majority of cases, the contact zone is hard and impermeable which supports the water security objective.
11. Slope stability: In some areas, where the overburden is soft, there is considerable erosion on the slopes, so this is one area where this mine type was scoring lower.

**Lime Kankar mines: Good for Agroforestry, and Solar power, with varying potential for biodiversity and water security, less for recreation and education.**

1. Ownership: Again this lies with the large corporates which scores highly
2. Size, % mine vs. overburden: The mines are large, and so the scores high.
3. Level of protection – Statutory: Same as for the Limestone mines
4. Level of protection – Boundary: Where the canker is extracted from shallow beds – the boundaries are not strongly enforced as they are not deep and dangerous.
5. Water availability & Water quality: In the shallow mines there is no water holding capacity, and in some areas, the TDS becomes high due to the calcareous leeching.
6. Soil availability: In the shallow beds it is readily available, however pH can be high
7. Lease maturity & status of mining activity: Most leases are shorter terms and the kankar beds are shallow, and thus there are large areas of land available for restoration -
8. Ecological connectivity: Not so significant for these mine types, as they often occur in agricultural zones.
9. Social consideration: Less formed that an around the limestone factories, but still significant as the corporates are active in the CSR activities with respect to restoration of water tanks and provision of toilets.
10. Contact zone: Often soft and permeable – which reduces the water hold capacity for the water security objective.
11. Slope stability: Normally not an issue as the mines are shallow.

**Magnesite mining: Significantly less potential than the top two, but has potential for Solar panels, Water security and Biodiversity.**

1. Ownership: Either with Government or large companies – thus scores in the middle range for most restoration objectives.
2. Size, % mine vs. overburden: They are large mines, so scores well on this level where it is important such as with Biodiversity.
3. Level of protection – Statutory: Generally well defined, so scores well.
4. Level of protection – Boundary: Similar to the limestone mines – when mines are active well maintained
5. Water availability & Water quality: Good reservoirs so good for Water security.
6. Soil availability: Generally poor
7. Lease maturity & status of mining activity: Ge
8. Ecological connectivity: High as a number are found close to the reserve forests.
9. Social consideration: As with limestone the companies are aware of the need for CSR activities,
10. Contact zone: General hard and impervious, so good for water storage, poor for planation.
11. Slope stability. There is a large amount of waste material generated, so there significant areas of dumping, with eroding slopes.

**Granite & Rough stone mines: Have potential for small scale water security, but generally ownership is with local political connections, so difficult to deal with it on a planning level.**

1. Ownership: Generally held in private hands – so potential is restoration is dependant on individual owners discretion.
2. Size, % mine vs. overburden: Normally small in size, and the extraction area is significant portion of the land area, so relatively small areas for any activities aside to the mine.
3. Level of protection – Statutory. Private lands, with lease for mining – thus longer term commitments are potentially less forth coming.
4. Level of protection – Boundary – Often porous – particularly if mining activity is low.
5. Water availability & Water quality. Around 50% of the mines have water – so this has potential for restoration as water resources. So are already used by the local agricultural communities but there is more potential to collect information and assess the storage potentials at a wider level.
6. Soil availability: Often poor, as mines are cut directly into exposed rock – either excavating hills or deep holes in the ground.
7. Lease maturity & status of mining activity: No clear data on this was forthcoming from the sources available for this study.
8. Ecological connectivity. In some areas, there are reserve forest in the vinicinity, but planting potential is often low, due to lack of space or soil, and thus the biodiversity obejective regularly scored low.
9. Social consideration: Local partisan political interests often control the mining areas, so general broad community support is not engaged in these areas.
10. Contact zone: always hard and impermeable – so little scope for Agroforestry etc.
11. Slope stability: Normally waste rock is the only debris – so slopes are relatively stable.

**Conclusions of the Framework analysis with respect to the 5 Restoration Objectives:**

**Biodiversity:**

Given the need to protect Biodiversity in the context of species conservation, ecosystem services, and creation of resilient carbon sequestration sinks with native species, the aim to restore mines for this objective is valid at the societal level. However it requires investment and long term support, which means the owners of the need to see the benefits for their brand or image or be passionate about the environment. The examples of what can be achieved, but the general mind set prevalent within the mining industry is that any green tree is enough – there is little understanding of ecology and the associated benefits of ecosystem services. It will require clear regulatory guidance from above, and a dynamic educative program to build capacity within the industry to understand the nuances of ecological restoration. The materials are there (see the blue print for mine restoration) but trainings need to be organized and companies need to buy into the idea and support it within the companies sustainability programs.

- In general, larger mines have greater restoration potential as they provide more extensive areas for plantation, habitat creation, and ecological rehabilitation.
- The presence of water in the mine pit further enhances this potential.
- The presence of a hinterland within the lease area—an undisturbed area that has not been excavated, with or without overburden dumps—also enhances restoration potential.
- Refilled mines often have less stability compared to overburden slopes; however, this largely depends on the gradient of the slope.

- Mines such as granite mines and roughstone, with rocks as their planting substrate and limited area available for plantations due to their small size, have lower potential for restoration. In contrast, limestone, magnesite, and vermiculite mines seem to have high potential for restoration, as they typically offer ample space for plantations and often feature pits that can serve as water reservoirs.

**Key Considerations for Successful Restoration**

- **Diverse Plantations:** Using a wider variety of (native) species in plantations enhances resilience to changing climate conditions.
- **Nursery Development:** Establish nurseries with the recommended species to ensure the availability of planting material.
- **Biodiversity Focus:** When planting for biodiversity, include species that provide resources for wildlife, such as nectar and fruit-bearing plants.
- **Basic Infrastructure Needs:** Restoration efforts require essential infrastructure, including water supply, fencing, and a commitment to aftercare.
- **Temporary Fencing:** Fencing should be maintained for at least three years and can then be reused in other areas.
- **Reusable Irrigation Systems:** Irrigation pipelines and similar infrastructure should be designed for reuse to optimize resources.
- **Capacity Building**: Training onsite teams to develop expertise in restoration techniques is important to ensure long-term maintenance. Helping create a horticulture team onsite goes a long way to ensuring the longevity of the effort and invites more such efforts in the future.

**Water Security:**

The potential for organizing the mines into a network of reservoirs can be studied at the next level – district or block wise, with particular attention paid to the drought prone areas – which have been identified in Annexure 1. Local agreements will always be made between small mines and the adjacent agriculturists as it is mutually beneficial – the mines need dewatering and the farmers are normally happy to have water for irrigation. However at a wider level it will require more planning when mines are exhausted and their primary function is as water reservoir. Targeted design for each mine to maximise the water captured by the mine, and understanding of water flow patterns for when mines become full and overflow to the next water channel. Additionally measures can be taken to secure any erosion into the water areas, which might in the longer term compromise the water holding capacity.

**Recreation/Education:**

This objective requires specialized knowledge, and is something the segues neatly with other restoration activities where the environment is enhanced in a educative or aesthetically interesting manner. It is a great chance for a corporate to add value to a restoration project, build their profile locally or nationally, as education activities are important ways to give energy back to the future.

**Agroforestry:**

The critical factors for this restoration objective are soil, water and space. Given the agricultural heritage of Tamil Nadu, there is always enthusiasm for the plantation of fruit trees, and many mines have shown in the good lands mango orchards can be established, with reasonable productivity. The additional research is require in the other areas, where the lands are more marginal and it required hardier species to be used to taken on the more challenging conditions. A particular study of tree plantation within mine leased areas would formed a good basis to understand what has already been achieved and which innovated practices have been developed to push the boundaries of productive land use in the mining areas.

**Solar power generation:**

A clear potentiality for this, which will surely develop rapidly if the right incentives are on offer, the larger infrastructure is developed, and regulations encourage the selling of self-generated power back to the grid. There are many specialized groups that are working on this issue. It would be important as a next step to understand from their perspective what are the limiting factors and critical steps that need to be taken to unleash this potential. Land holdings are there, and it is also apparent that once the conditions are right, people and companies are ready to invest their own finances. The parameters need to be defined and then it would be relatively simple to set up a couple of prototypic areas to test and provide proof of concept.

## 3.6 Recommendations

- Profiling, and data organization for all mines of Tamil Nadu should be undertaken urgently, to facilitate large-scale land-use planning. This process can begin with mines exceeding a certain threshold size. Essential details to collect include latitude and longitude (for location), shapefiles of the lease area, and basic information such as lease duration, ownership, and the type of mineral mined. These should align with the format of the original Excel sheet that was previously shared.

- Drone images are reportedly available with the Central Bureau of Mines for each mine (as companies are required to take drone images every year). Are these also accessible at the state level? Furthermore, for which types of mines are these images available? These drone images should be incorporated into the mine profiles. Having detailed and up-to-date information about the mines will streamline the study and planning process for restoration and land-use planning at the state level.

- Though this study was able to map the locations of numerous mines across Tamil Nadu accurately, currently, the specific types of each mine remain undetermined. This highlights the potential for AI-driven support to aid in mine-type identification. The next phase of the study should look to develop this further.

## 3.7 Closing remarks

Clear and well-coordinated data will facilitate systematic planning and utilization of this resource, which is increasingly accumulating in Tamil Nadu as numerous mines complete their productive mineral extraction phases. Funding will continue to serve as the fundamental determining factor regarding the prioritization of restoration activities. Creating a carbon-neutral economy requires informed decision-making and a willingness to reconsider conventional practices—such as mine refilling—through the perspective of the five defined restoration objectives. Identifying the optimal combination of these objectives will enhance the efficiency and effectiveness of restorative actions, thereby contributing positively to lands that have supported the economic growth and prosperity of the state. Strategically directing available resources towards restoration efforts, guided by a clear vision of the desired outcomes 10 to 15 years ahead, will ensure progress aligns with future knowledge, expertise, and sustainability goals.

**Annexure 4: Outline of Mine Restoration Manual prepared by Auroville Botanical Garden**
**Annexure 5: The list of species profiles of key trees and shrubs recommended for mine restoration plantations.**

# Annexures

# Annexure 1

## Mine site visit report

# 1- Periyanagalur Mines

*Confirmed Mineral:* Limestone

*Date:* 06.11.2024

*Ownership:* Dalmia Cements/ Patta land/ Limestone/ Periyanagalur *Size*: 70 hectares/ Full area will be mined/ Plantation possible in pit only *Local contact:* Gopi Rajeshkumar mines manager- 9865170056

## Key Criteria

### 1. Soil Quality and Composition:

| **Attributes/factors to look out for** | **Observation Notes** |
|---|---|
| Soil Type (Black cotton soil, red soil…) | Laterite soil |
| Soil texture (Clay, sand, silt, loamy, coarse, granular) | Coarse |
| Soil Profile (top layer, middle layer) | Top layer- laterite soil mixed with limes stone, Contact zone- sand stone |
| Soil pH | |
| Potential planting substrate (bed rock, loose soil, etc) | loose soil |
| Availability/quantity of topsoil for plantation | Nil |
| Presence of toxic substances such as heavy metals or acid. – Mine report/pollution control board/mine company | Nil |

## 2.Vegetation and Plant Communities:

| | |
|---|---|
| Presence of native species, key species and their diversity on the site and in the immediate surrounding area (5 km radius) | There was not much diversity in this area as the site completely cleared for mining activity. Only on the edges and undisturbed area can be seen with few wild native trees like Alangium salvifolium, Diospyros montana, Morinda coreia, Euphorbia antiquarum, Anisomelos malabarica, Dodonaea angustifolia, Lantana indica and Toddalia asiatica. |
| Presence of assisted natural regeneration onsite. Restoration plans/existing planting activity if any | The regeneration of the native species was very less, some species Azadirachta indica, Diospyros montana, Dodonaea angustifolia, Holoptelea integrifolia, and Morinda coreia regenerations were found here and there. Trees like Acacia auriculiformis, Delonix regia, Holoptelea integrifolia, Mimusops elengi, Polyalthia longifolia, Pongamia pinnata, Thespesia populnea, Terminalia catappa, Syzygium cumini, Simarouba glauca, and Gmelina arborea has been planted in some places in the site area. |
| Presence of invasive species (onsite and surrounding area) | The presence of the invasive species found in some places. Acacia auriculiformis, Conocarpus lancifolius, Prosopis juliflora and Cassia siamea can appear in this site. |
| General health (indication of plant stress presence/absence) of vegetation onsite and /or in the area | The existing trees and planted trees looked healthy. |
| Evidence of grazing either domestic or natural or other threats to vegetation | Grazing activity were noticed in this site. |
| Evidence of fire or natural hazards (natural/unnatural) | Nil |
| Reference site(s) in the region | No significant nature ecosystem found around the mining site. |

## 3.Hydrology and Water Quality:

| | |
|---|---|
| Water availability for irrigation purposes, source of water (rainwater/surface or groundwater), depth of water source/standing water level pre-and post- monsoon. Ground water level pre- and post-monsoon | Rainwater stagnation |
| Permeability of soil, surface runoff and erosion | Low to medium |
| Water quality parameters such as temperature, pH and TDS | ph- 7.96, TDS- 90 |
| The presence of contaminants such as heavy metals or salts in the water. – mine water test report/ pollution control board/mine company | Nil |

## 4. Geomorphology and Landscape Structure: 4a. Overburden C 4b. Mining areas:

| | |
|---|---|
| General topography of the landscape | Half of the extent is flat terrain and rest is a mining pit |
| Erosion potential and sediment transport processes. Depth of rills and gullets | No erosion |
| Potential for landform recontouring and stabilization | No potential for landform stabilisation. No overburden in site, mineral is from surface itself |
| Landform stability | Stable |
| Slope angle and stability | |
| Benches present or absent | Benches present- 5 nos |
| Kind of substrate for benches (rock or granite or sandstone) | Lime and stand stones |
| Presence of backfilling and current state of it | No backfilling |

## 5. Ecological Connectivity:

| | |
|---|---|
| Proximity of the site to interesting/sensitive ecosystems | Nil |
| Potential for wildlife movement and habitat connectivity | Nil |
| Potential for corridors and buffer zones in promoting ecological connectivity with other interesting ecological areas in the immediate surrounding | Nil |

## 6. Socio-Economic Considerations:

| | |
|---|---|
| Local communities in the surrounding region (livelihood/employment details (directly employed or indirectly employed in the mine) | Around 130 local people work in the mines |
| Is there any CSR activities undertaken by the company in the surrounding area ? | Bus stand construction, toilet blocks, Borewells |
| Other potential stakeholders (other neighbours such as other mines or factories or companies, schools, environmental organization close by) | Ramco, TANCEM |
| Farming in the surrounding region (what type, what crop, how many crops in a year) | No farming at immediate vicinity |
| Land use in the surrounding region | Mining, Drylands |
| Historical significance of the area (and the mine site if any) for cultural context | Kallankurichi Perumal temple |

## 7. Site Protection:

| | |
|---|---|
| Fencing (non-existent, present but broken (broken but reparable or broken and not reparable), present and functioning) | 70% fences, rest soil bunds are made as protection |
| Regulatory status of the site | |
| Lease maturity | 2030 |
| Activity level of the mine | Operational |

*Highlight in Grey: Information can also come from other sources such as remote sensing and test reports.

Note: The above is an example of a ground-truthing report. Similar detailed reports have been prepared for all other 36 sites visited.

## 2. Anandavadi – Limestone

## 3. Alathiyur – Limestone

## 4. Periyathirukonam – Limestone

## 5. Devarmalai– Limestone

## 6. Dholipatti- Limestone

## 7. Madukarai ACC mine- Limestone

## 8. Walayar ACC mine- Limestone

## 9. Ottakoil - Limestone

## 10. Maravarperungudi Lime kankar

## 11. T.Koppuchithampatti- Lime kankar

## 12. Kurundamadam Lime kankar

## 13. Chettichavadi- Magnesite

## 14. Periyasoragai- Magnesite

## 15. Kurumbapatti- Magnesite

## 16. Puliyur-Bauxite

## 17. Selurnadu- Bauxite

## 18. Surampalayam- Granite

## 19. Yelagiri-Colour granite

## 20. Thogamalai- Colour Granite

## 21. Sithampoondi–Colour granite

## 22. Pulikunda- Grey granite (Colour granite)

## 23. Sandhanapalli- Granite

## 24. Rendadi- Black granite

## 25. Kodakal- Black granite

## 26. Pothuvai-Pazhavalam- Black granite

## 27. Kathiripalli- Black granite

## 28. Sandhanapalli- Black granite

## 29. Vadugapatti–Rough stone

## 30. Alathur-Rough stone

## 31. Mangrasavalayapalayam- Rough stone

## 32. Sennampatti - Rough stone

## 33. Chittathur- Rough stone

## 34. Rakkipalayam- Rough stone

## 35. Mylambadi - Rough stone

## 36.Panikkankuppam - Fire clay

*The mine site visit photos have been organised by mine type rather than their original numbering, so the site numbers may appear out of sequence.

*A total of 42 mines were selected for the study. However, site visits were completed for only 37; the reasons for not visiting some of the listed mines are detailed in the main report.

# Annexure 2

## Data analysis and interpretation

# Data Analysis and Interpretation (Data from the Mining Department)

**Data Extraction**

Extracted the name/type, district, and total extent of the 5,051 mines from the datasheet provided by the Tamil Nadu Mining Department.

## Analysis

**District Ranking Calculations:**

District rankings were calculated based on three primary parameters:

1. **Drought Index** (Source: Calculated by Auroville Consulting using Indian Meteorological Department data, IMD 2023)
2. **Percentage of Forest Cover** (Source: ISFR, India State of Forest Report, 2021)
3. **Actual Rainfall** (Source: TNSMART: https://beta-tnsmart.rimes.int/index.php/Rainfall)

The rankings for each parameter were categorized as follows:

| Forest Cover | Category | Numerical Rank |
|---|---|---|
| 0 ≤ % of Forest cover ≤ 10 | Low | 3 |
| 10 ≤ % of Forest cover ≤ 23 | Medium | 2 |
| 23 ≤ % of Forest cover | High | 1 |
| | | |
| **Rainfall (mm)** | | |
| 0 ≤ Whole Year – Actual ≤ 850 | Low | 3 |
| 850 ≤ Whole Year – Actual ≤ 1500 | Medium | 2 |
| 1500 ≤ Whole Year - Actual | High | 1 |
| | | |
| **Drought** | | |
| -2 ≤ SPI ≤ -1 | High | 3 |
| -1 ≤ SPI ≤ 1 | Medium | 2 |
| 1 ≤ SPI | Low | 1 |

*SPI: Drought vulnerability is evaluated using the Standardized Precipitation Index (SPI), calculated with a GitHub-based SPI Utility tool and 30 years of rainfall data (1993–2023) from the Indian Meteorological Department (IMD) at a 27 km spatial resolution. The SPI measures deviations in rainfall from the long-term average to classify meteorological conditions.

The numerical rankings for each district were totaled and averaged (divided by 3, as three parameters were used). This is referred to as the averaged district ranking.

To ensure consistency and provide a range-based ranking for the districts, the following ranges were established: 2.67 and 2.33 = High, 2 = Medium and 1.67 and 1.33 = Low.

These final averaged district rankings (numerical values) calculations are summarized in the accompanying table.

| S.No | Districts | Drought Index (SPI-Value) | Drought range | Numerical value/rank | % of Forest cover | Forest Cover range | Numerical value/rank | Actual Rainfall | Rainfall range | Numerical value/rank | Total | Avg of District-Ranking | According to district Ranking (range) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Ariyalur | 1.13 | Low | 1 | 20.86 | Medium | 2 | 989.2 | Medium | 2 | 5 | 1.67 | Low |
| 2 | Chengalpattu | 0.59 | Medium | 2 | 7.06 | Low | 3 | 1144.4 | Medium | 2 | 7 | 2.33 | High |
| 3 | Chennai | 0.28 | Medium | 2 | 7.24 | Low | 3 | 1466.6 | Medium | 2 | 7 | 2.33 | High |
| 4 | Coimbatore | -0.8 | Medium | 2 | 41.95 | High | 1 | 2231.9 | High | 1 | 4 | 1.33 | High |
| 5 | Cuddalore | 1.3 | Low | 1 | 10.54 | Medium | 2 | 1330.3 | Medium | 2 | 5 | 1.67 | Low |
| 6 | Dharmapuri | -1.4 | High | 3 | 37.86 | High | 1 | 1176.2 | Medium | 2 | 6 | 2.00 | Medium |
| 7 | Dindigul | 1.8 | Low | 1 | 31.11 | High | 1 | 1368.6 | Medium | 2 | 4 | 1.33 | Low |
| 8 | Erode | -1.6 | High | 3 | 39.86 | High | 1 | 1148.5 | Medium | 2 | 6 | 2.00 | Medium |
| 9 | Kallakurichchi | -0.78 | Medium | 2 | 11.6 | Medium | 2 | 877.9 | Medium | 2 | 6 | 2.00 | Medium |
| 10 | Kancheepuram | 0.7 | Medium | 2 | 7.26 | Low | 3 | 1343.9 | Medium | 2 | 7 | 2.33 | High |
| 11 | Kanyakumari | -0.83 | Medium | 2 | 59.6 | High | 1 | 1095.9 | Medium | 2 | 5 | 1.67 | Low |
| 12 | Karur | -0.67 | Medium | 2 | 4.09 | Low | 3 | 734.3 | Low | 3 | 8 | 2.67 | Low |
| 13 | Krishnagiri | -1.59 | High | 3 | 31.55 | High | 1 | 1210.3 | Medium | 2 | 6 | 2.00 | Medium |
| 14 | Madurai | 0.38 | Medium | 2 | 14.91 | Medium | 2 | 1123 | Medium | 2 | 6 | 2.00 | Medium |
| 15 | Mayiladuthurai | 0.63 | Medium | 2 | 6.1 | Low | 3 | 1430.9 | Medium | 2 | 7 | 2.33 | High |
| 16 | Nagapattinam | 3.2 | Low | 1 | 6.1 | Low | 3 | 1344.2 | Medium | 2 | 6 | 2.00 | Medium |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 17 | Namakkal | 0.26 | Medium | 2 | 16.99 | Medium | 2 | 1069.2 | Medium | 2 | 6 | 2.00 | Medium |
| 18 | Perambalur | 0.72 | Medium | 2 | 8.1 | Low | 3 | 1059.8 | Medium | 2 | 7 | 2.33 | High |
| 19 | Pudukkottai | 1.1 | High | 3 | 8.12 | Low | 3 | 899.3 | Medium | 2 | 8 | 2.67 | High |
| 20 | Ramanathapuram | 0.74 | Low | 1 | 6.13 | Low | 3 | 770.5 | Low | 3 | 7 | 2.33 | Low |
| 21 | Ranipet | -0.12 | Medium | 2 | 30.04 | High | 1 | 1338.4 | Medium | 2 | 5 | 1.67 | Low |
| 22 | Salem | -1.09 | High | 3 | 28.09 | High | 1 | 1078.5 | Medium | 2 | 6 | 2.00 | Medium |
| 23 | Sivagangai | 1.2 | Low | 1 | 7.82 | Low | 3 | 1207.1 | Medium | 2 | 6 | 2.00 | Medium |
| 24 | Tenkasi | 1.06 | Low | 1 | 19.46 | Medium | 2 | 836.2 | Low | 3 | 6 | 2.00 | Medium |
| 25 | Thanjavur | 0.89 | Medium | 2 | 10.27 | Medium | 2 | 1177.3 | Medium | 2 | 6 | 2.00 | Medium |
| 26 | The Nilgiris | -1.16 | High | 3 | 67.5 | High | 1 | 2613.6 | High | 1 | 5 | 1.67 | High |
| 27 | Theni | -0.3 | Medium | 2 | 41.28 | High | 1 | 1267 | Medium | 2 | 5 | 1.67 | Low |
| 28 | Thirupattur | -1.5 | High | 3 | 30.04 | High | 1 | 1183 | Medium | 2 | 6 | 2.00 | Medium |
| 29 | Thiruvallur | 1.76 | Low | 1 | 8.71 | Low | 3 | 1347.6 | Medium | 2 | 6 | 2.00 | Medium |
| 30 | Thoothukudi | -0.9 | Medium | 2 | 5.31 | Low | 3 | 570.1 | Low | 3 | 8 | 2.67 | Low |
| 31 | Tiruchirapalli | 0.37 | Medium | 2 | 10.55 | Medium | 2 | 867 | Medium | 2 | 6 | 2.00 | Medium |
| 32 | Tirunelveli | 0.28 | Low | 1 | 19.46 | Medium | 2 | 763.9 | Low | 3 | 6 | 2.00 | Medium |
| 33 | Tirupur | 0.25 | Medium | 2 | 16.31 | Medium | 2 | 823.2 | Low | 3 | 7 | 2.33 | Low |
| 34 | Tiruvannamalai | -1.4 | High | 3 | 21.21 | Medium | 2 | 1310.9 | Medium | 2 | 7 | 2.33 | High |
| 35 | Tiruvarur | 2.8 | Low | 1 | 3.08 | Low | 3 | 1276.3 | Medium | 2 | 6 | 2.00 | Medium |
| 36 | Vellore | 1.2 | High | 3 | 30.04 | High | 1 | 1004.4 | Medium | 2 | 6 | 2.00 | Medium |
| 37 | Villupuram | -0.31 | Medium | 2 | 11.6 | Medium | 2 | 1019.4 | Medium | 2 | 6 | 2.00 | Medium |
| 38 | Virudhunagar | -0.14 | Medium | 2 | 8.06 | Low | 3 | 985 | Medium | 2 | 7 | 2.33 | High |

*Forest cover ( values extracted from (Source: ISFR, India State of Forest Report, 2021)– Notes: Kallakurichi district was separated from Viluppuram district in 2019, Chengalpattu district from Kancheepuram district in 2019, and Mayiladuthurai district from Nagapattinam district in 2020. Similarly, Ranipet district was separated from Vellore district in 2019, Tenkasi district from Tirunelveli district in 2019, and Tirupattur district from Vellore district in 2019. For the forest cover analysis of these newly formed districts, we have used the data from their respective origin districts. For example, as mentioned in the report, "*Recently, Vellore district was divided to create Tirupattur and Ranipet districts. However, the ISFR 2021 considers only the erstwhile combined area of Vellore district for the forest cover assessment.”*

## Mine Ranking Calculations:

Mines (each of the 5,051) were ranked across multiple dimensions/elements/parameters namely: Size, Type of mine, and District Ranking (averaged district ranking).

1. **Size**

| Size (ha) | Category | Rank |
|---|---|---|
| 0 ≤ Size ≤ 10 | Low | 1 |
| 10 < Size ≤ 50 | Medium | 2 |
| 50 < Size | High | 3 |

2. **Type of Mine**

| Type of Mine | Category | Rank |
|---|---|---|
| Limestone, Vermiculite, Magnesite | High | 3 |
| Limekankar, Fireclay | Medium | 2 |
| Bauxite, Rough Stone, Granite, Quartz | Low | 1 |
| Other types (e.g., Lignite, Gypsum, red soil, Savudu, Silica sand, Oil C gas, Soapstone, Dolomite, Steatite, etc | Low (default) | 1 |

*Note:* The ranking of certain **mine types** (e.g., Lignite, Gypsum, red soil, Savudu, Silica sand, Oil C gas, Soapstone, Dolomite, Steatite, etc) was not applicable in this analysis as we did not have a sufficient number of sites to include in our ground-truthing or study. Therefore, mine types with insufficient site data for ground truthing were given a low rank by default for this analysis under the **mine type** category.

3. ## District Ranking (averaged district ranking)

   Each district's rank (averaged district ranking), calculated as explained earlier, is assigned to each mine (regardless of mine type) located in that district under the 'Averaged District Ranking' parameter/heading.

## Final Mine Rankings:

Each ranking dimension was assigned a numerical value:

- **Size**: High = 3, Medium = 2, Low = 1
- **Type**: High = 3, Medium = 2, Low = 1
- **District ranking**: The actual averaged district ranking (numerical value) derived from district calculations for each mine (explained in the previous section).

The numerical values derived from the rankings were summed/totaled to produce an overall rank for each of the 5051 mines. This final score is recorded in the last column of the analysis table and reflects the overall ranking of each mine. These final scores/ranks for each of the mines were used to further analyse the data and interpret it.

The results of the analysis, including rankings (both range-based and numerical) and total, are detailed in the table that can be accessed through the given link: https://docs.google.com/spreadsheets/d/1GqVWl94kqV5DKTbduZ2pVwqTa0zKQdlh/edit?usp=sharingCouid=110541182502112762905Crtpof=trueCsd=true or can be found in the attachment.

## Final ranking of the districts based on restoration potential:

**Calculations:**

The final ranking of each mine (calculated as explained earlier) was clubbed/summed together based on their locations (district-wise), and a total value for each district was calculated, as presented in the table below. This total value for each district was then averaged by the number of mines present in that district, producing an average score per mine, which was used to create the graph following the table.

| Ranking of the Districts based on restoration potential | | | | |
|---|---|---|---|---|
| **S.no** | **Districts** | **Total** | **No. of mines** | **Average score per mine** |
| 1 | Ariyalur | 561.33 | 101 | 5.8548 |
| 2 | Thoothukudi | 788.00 | 156 | 5.0513 |
| 3 | Perambalur | 728.67 | 146 | 4.8604 |
| 4 | Karur | 1,878.00 | 387 | 4.8527 |
| 5 | Tirunelveli | 763.00 | 163 | 4.6810 |
| 6 | Pudukkottai | 586.00 | 126 | 4.6746 |
| 7 | Salem | 1,266.00 | 274 | 4.6204 |
| 8 | Tiruchirappalli | 426.00 | 64 | 4.5638 |
| 6 | Tenkasi | 355.00 | 78 | 4.5513 |
| 10 | Virudhunagar | 1,227.00 | 270 | 4.5444 |
| 11 | Mayiladuthurai | 301.67 | 68 | 4.4363 |

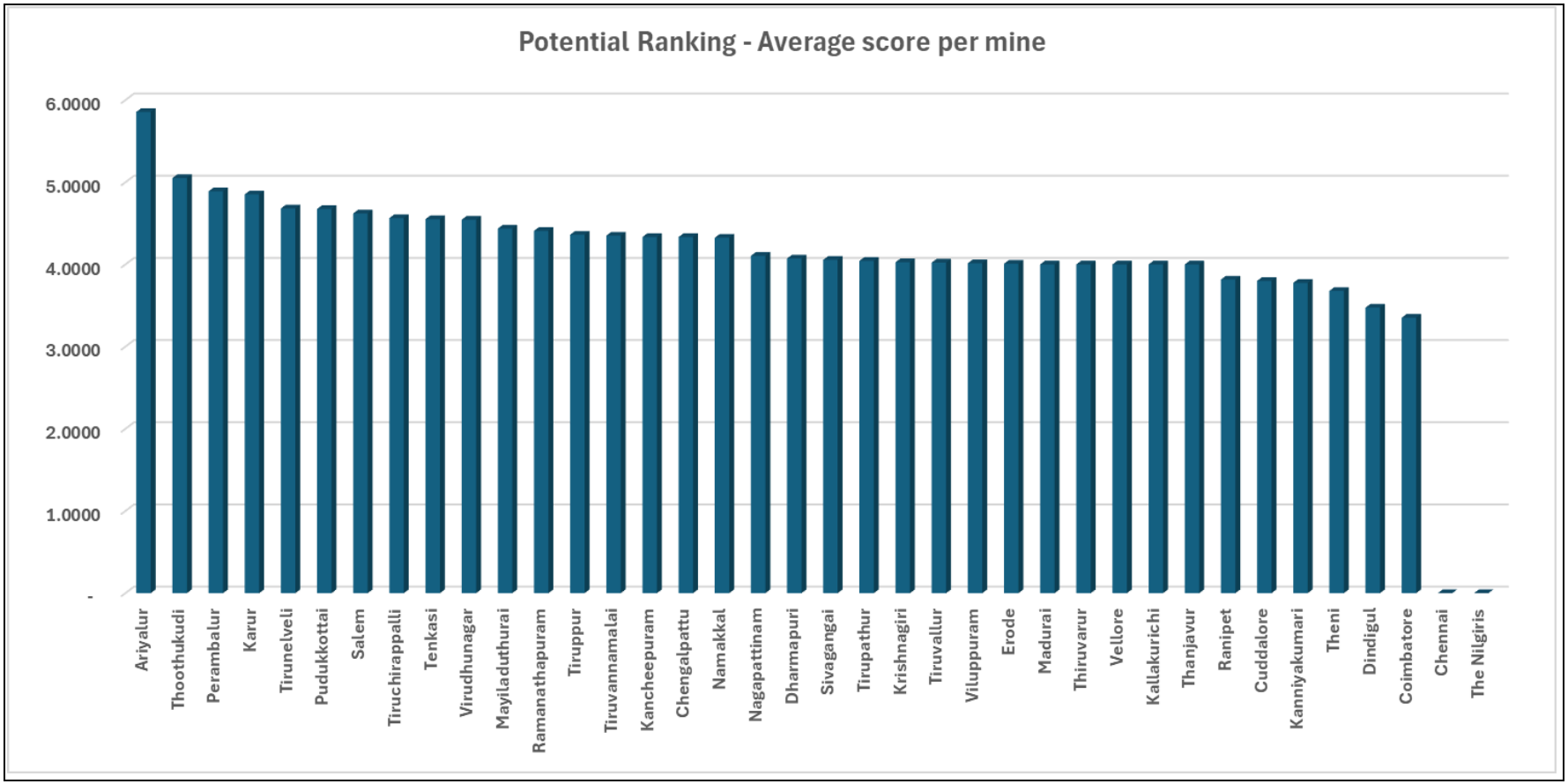
| | | | | |
|---|---|---|---|---|
| 12 | Ramanathapuram | 176.33 | 40 | 4.4083 |
| 13 | Tiruppur | 1,060.33 | 250 | 4.3613 |
| 14 | Tiruvannamalai | 2,083.67 | 476 | 4.3500 |
| 15 | Kancheepuram | 208.00 | 48 | 4.3333 |
| 16 | Chengalpattu | 173.33 | 40 | 4.3333 |
| 17 | Namakkal | 1,172.00 | 271 | 4.3247 |
| 18 | Nagapattinam | 234.00 | 57 | 4.1053 |
| 16 | Dharmapuri | 562.00 | 138 | 4.0725 |
| 20 | Sivagangai | 146.00 | 36 | 4.0556 |
| 21 | Tirupathur | 276.00 | 66 | 4.0435 |
| 22 | Krishnagiri | 1,647.00 | 406 | 4.0266 |
| 23 | Tiruvallur | 181.00 | 45 | 4.0222 |
| 24 | Viluppuram | 542.00 | 135 | 4.0148 |
| 25 | Erode | 486.00 | 122 | 4.0082 |
| 26 | Madurai | 864.00 | 216 | 4.0000 |
| 27 | Thiruvarur | 24.00 | 6 | 4.0000 |
| 28 | Vellore | 252.00 | 63 | 4.0000 |

| | | | | |
|---|---|---|---|---|
| 29 | Kallakurichi | 148.00 | 37 | 4.0000 |
| 30 | Thanjavur | 64.00 | 16 | 4.0000 |
| 31 | Ranipet | 176.33 | 47 | 3.8156 |
| 32 | Cuddalore | 372.33 | 68 | 3.7663 |
| 33 | Kanniyakumari | 173.67 | 46 | 3.7754 |
| 34 | Theni | 327.33 | 86 | 3.6776 |
| 35 | Dindigul | 344.00 | 66 | 3.4747 |
| 36 | Coimbatore | 1,102.67 | 326 | 3.3516 |
| 37 | Chennai | - | 0 | - |
| 38 | The Nilgiris | - | 0 | - |
| | | 21,751.67 | 5,051 | |

The high-potential restoration districts, based on the high-potential mineral types (limestone, magnesite, and vermiculite), are Salem and Ariyalur districts.

A few of the low-potential restoration districts include Dindigual and Coimbatore based on the types of mines they host.

Potential ranking of the districts based on each mine's total ranking located in that district (presented in ascending order of rankings, i.e., average score per mine):



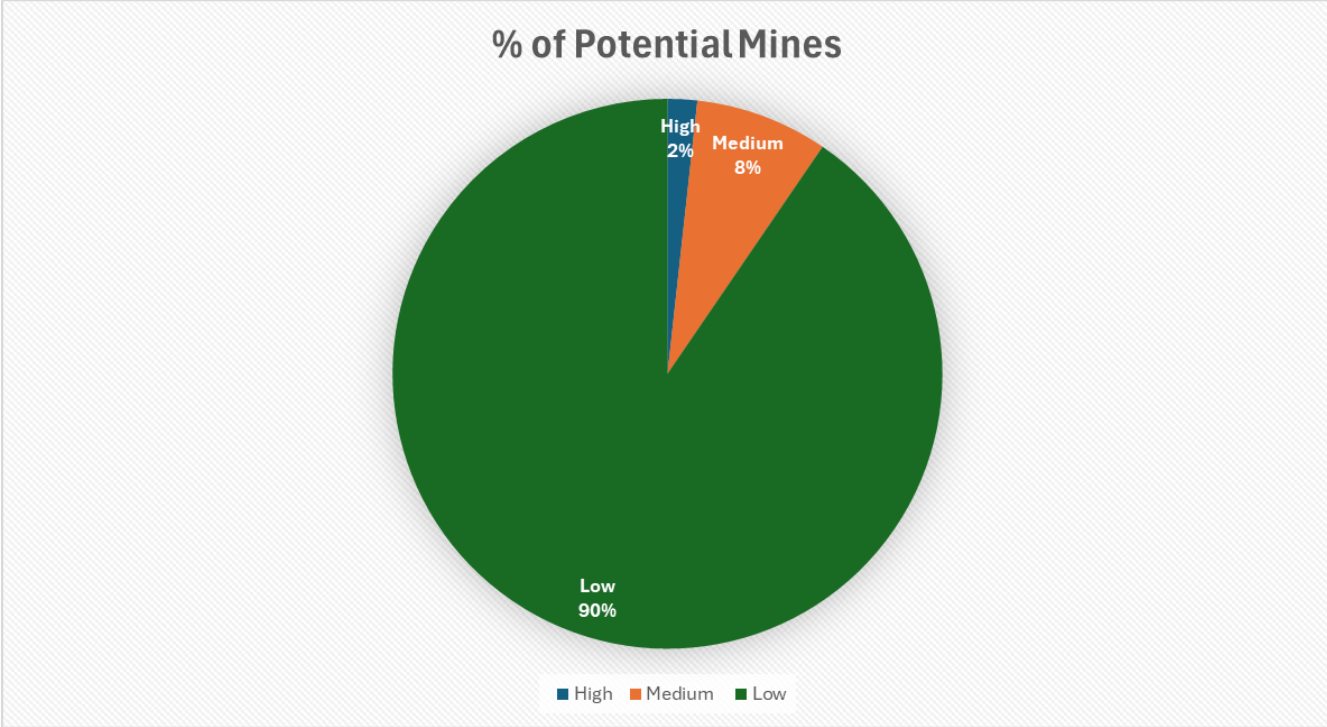
## High Potential Mines

Calculations:

Each mine's ranking total value (calculated as explained earlier) was divided into ranges of: 7.00 to 8.67 = high, 5.00 to 6.67 to = medium, and 3.33 to 4.67 = high and based on the number of mines that fell into the above mentioned ranges, the following the graph was produced:

| Ranking Value | Potential | No. of Mines |
|---|---|---|
| 8.67 | High | 4 |
| 8.33 | High | 4 |
| 8.00 | High | 10 |
| 7.67 | High | 23 |
| 7.33 | High | 9 |
| 7.00 | High | 38 |
| 6.67 | Medium | 63 |
| 6.33 | Medium | 47 |
| 6.00 | Medium | 154 |
| 5.67 | Medium | 53 |
| 5.33 | Medium | 38 |
| 5.00 | Medium | 39 |
| 4.67 | Low | 642 |
| 4.33 | Low | 1256 |
| 4.00 | Low | 1988 |
| 3.67 | Low | 265 |
| 3.33 | Low | 418 |

| Potential | No. of Mines |
|---|---|
| High | 88 |
| Medium | 394 |
| Low | 4569 |




In this 2% of high-potential mines, Limestone, Magnesite, and Vermiculite (with only one mine existing in Tamil Nadu) had the highest number of mines. These mines are mostly located in the Ariyalur and Salem districts, while the Vermiculite mine is located in the Tirupathur district.

# Annexure 3

## Case studies

# Case Studies

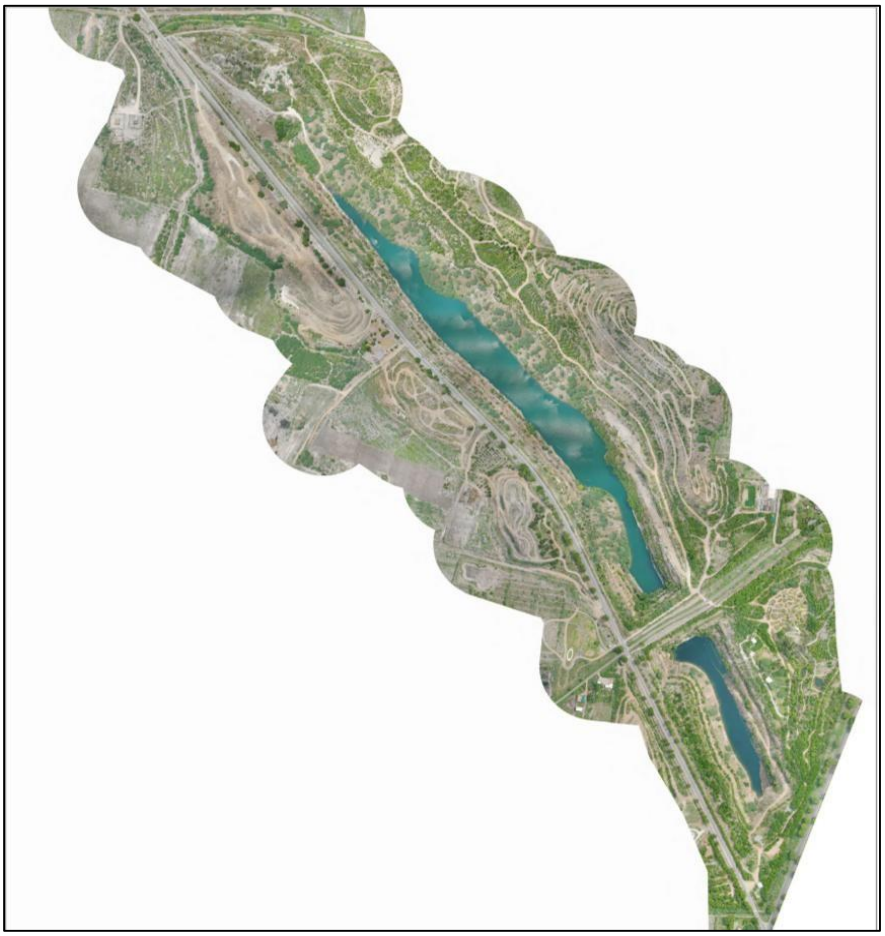
A strategic framework for identifying mines with high potential, demonstrated through practical case studies.

## Framework


| | Criteria |
|---|---|
| 1 | Ownership |
| 2 | Size, % mine vs. overburden |
| 3 | Level of protection |
| 4 | Water availability |
| 5 | Soil availability |
| 6 | Lease maturity |
| 7 | Ecological connectivity |
| 8 | Social engagement |
| 9 | Contact zone |
| 10 | Slope stability |

## Case Study 1: Report of restored mine – Pandalgudi, Tamil Nadu

| | Criteria | Pandalgudi (Ramco) |
|---|---|---|
| 1 | Ownership | Corporate |
| 2 | Size, % mine vs. overburden | 800 acres |
| 3 | Level of protection | Was porous but improved |
| 4 | Water availability | good |
| 5 | Soil availability | Recovered topsoil available |
| 6 | Lease maturity | Towards the end of mining |
| 7 | Ecological connectivity | Poor |
| 8 | Social engagement | Good CSR work, good connection with local communities |
| G | Contact zone | Hard rock |
| 10 | Slope stability | Good |

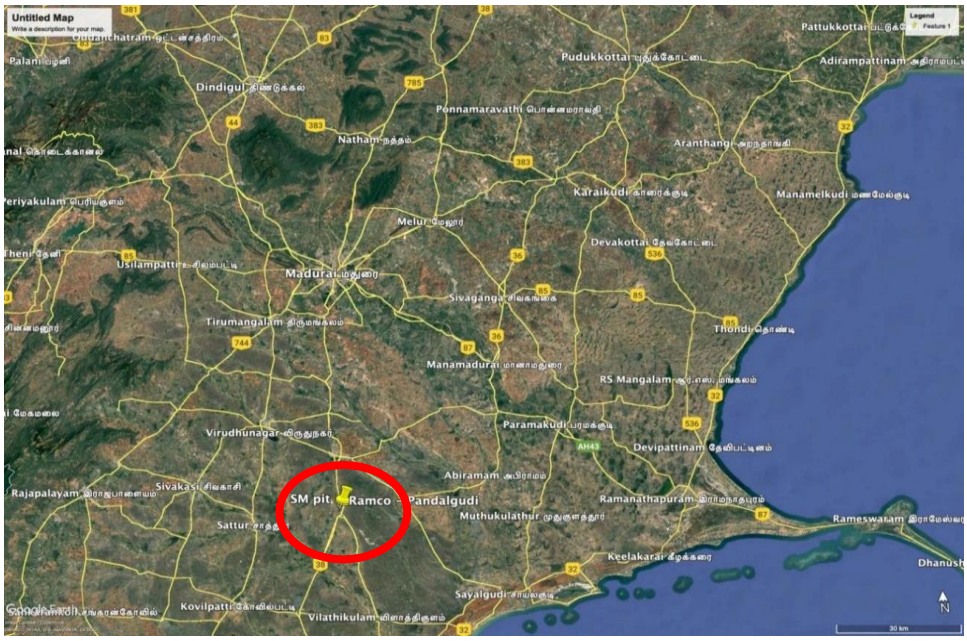


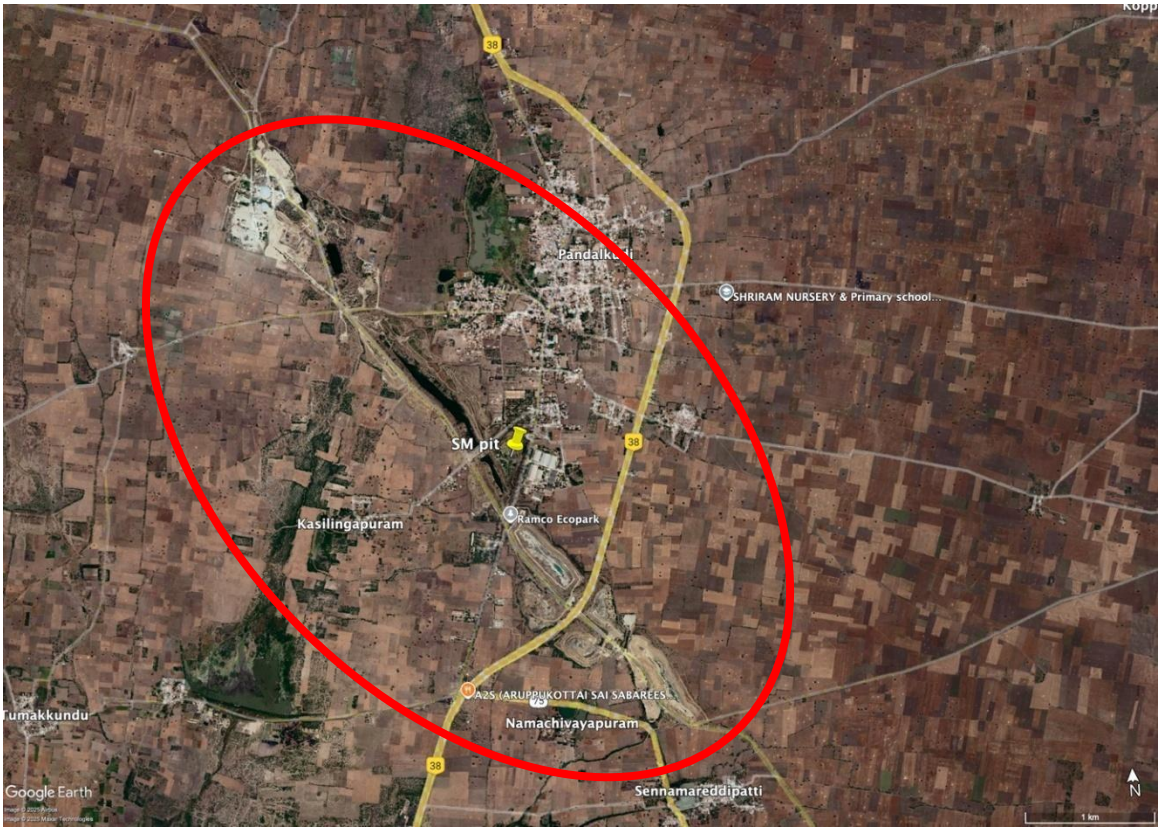
# Ecological Restoration of a Limestone Mine in Pandalgudi, Tamil Nadu: A case study of Ecological Restoration of a Former Mining Site

This case study presents a successful eco-restoration project aimed at revitalizing an 800- acre degraded post-mining landscape in Pandalgudi, Tamil Nadu. The restoration strategy involved implementing phased restoration to optimize resource allocation and promote sustainable rehabilitation. The restoration plan was developed through environmental assessments, ecological surveys, and expert consultations. Priority restoration zones, representing depleted reserves, were identified, forming the foundation for the phased implementation strategy. The restoration efforts involved the implementation of various strategies, including the establishment of an onsite nursery, staff training initiatives, and a multi-layered spatial mosaic of habitats. The project focused on establishing a self-sustaining, biodiverse ecosystem, while also creating an environmental educational center and recreational space for the local community. The successful implementation of Phases 1, 2, and 3 showcased substantial biodiversity recovery, reaffirming the project's commitment to sustainable land rehabilitation and ecological health. The paper explores the historical context of the site, the methodology employed, the unique factors contributing to success, and future monitoring plans.

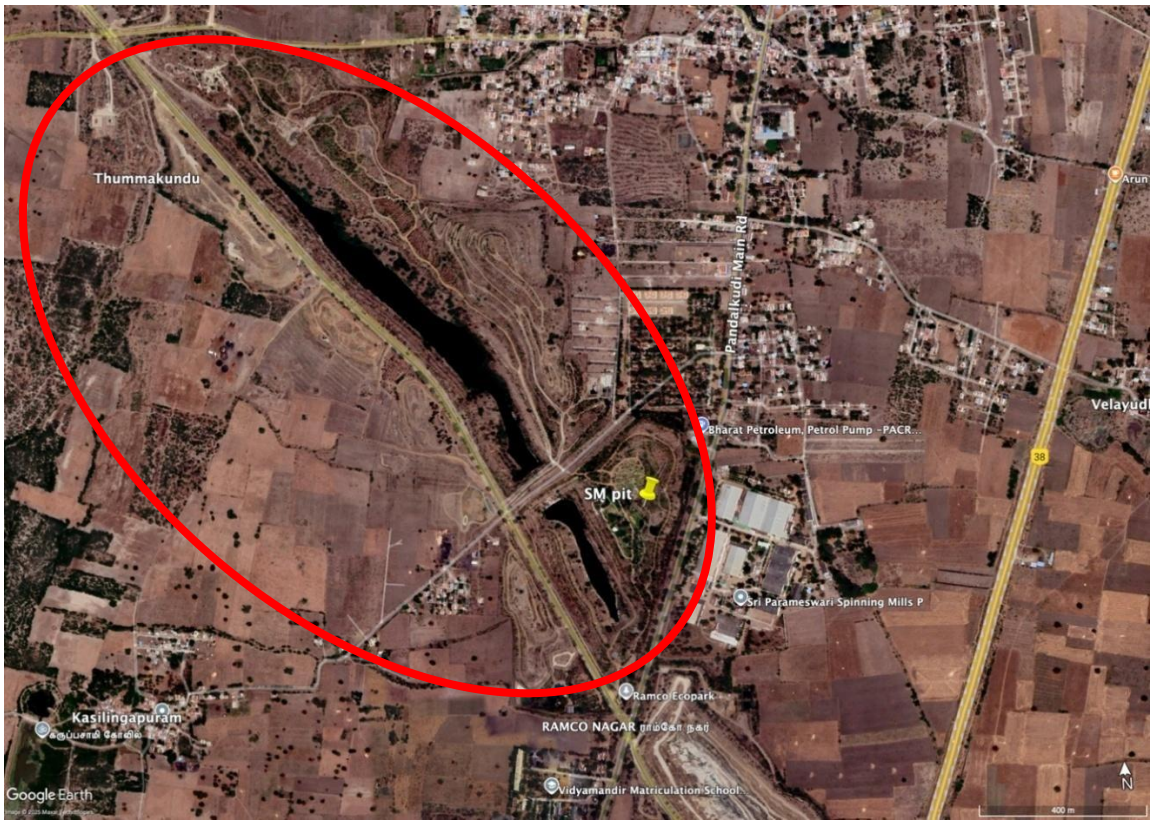
## Eco-restoration of Pandalgudi Mines

Site: The Pandalgudi area has been a site of limestone mining operations since the 1970s. The mining activities involved extracting limestone from a vertical seam 15 -20m in width, The extraction process adopted an open-cast approach, involving the excavation of benches measuring nine meters in height and nine meters in width on either side. This stepwise excavation proceeded gradually to reach a depth of around 60 meters. The extracted rock from these benches is predominantly comprised weathered gneiss, strategically deposited in spoil heaps on either side of the mined areas.






Full extent of mining operations – around 6.5 km in length



Over the years, certain areas of the mines have been back filled as per government requirements, however, as will be shown in this case study, in restoration projects such as this it would be better not to back fill the mines as the benches provide stable grounds for wildlife. However steep slopes might require backfilling considering the safety of the wildlife to avoid accidental falls.

The site is situated amidst a flat and monotonous landscape dedicated to dryland farming, predominantly sorghum millet, with smaller patches of chili and coriander near the villages, where cultivation takes place for three months annually. Subsequently, it would be left fallow for the remaining months, providing grazing grounds for a substantial herd of goats, sheep, and cattle. The original forest in this region likely belonged to the southern thorn forest category. Unfortunately, no undisturbed remnants of this vegetation type exist on the black

cotton soil. The nearest intact forest areas, though disturbed, are located on hillocks approximately 60 km away, with the largest one being at Kurumalai. Nevertheless, due to

multiple clearances for charcoal during the colonial period, and the soil's different composition – this area has more of a red sandy loam, resulting in a different plant community than what would have thrived at the mine site.

Situated in the rain shadow area between the Western Ghats to the west and Sri Lanka to the east, the region experiences high rainfall variability during summer months. Annual rainfall fluctuates between 450mm and 900mm, averaging around 600mm. Some years witness a concentration of the majority of rainfall in intense events over 2 or 3 days. Groundwater quality declines eastwards, with the SM pit site borewell water at 20m showing a Total Dissolved Solids (TDS) of 1500, escalating to a high of 25,000 over a 15km distance. This degradation is attributed to the leaching of salts from the canker layer situated approximately 1 meter beneath the black cotton soil.

## Restoration methodology

The restoration strategy was designed to be implemented in phases, focusing on areas where mining activities have concluded, thereby optimizing resource allocation and promoting sustainable rehabilitation. The eco-restoration plan was developed, incorporating environmental assessments, ecological surveys, and expert consultations. Priority restoration zones, representing depleted reserves, were identified, forming the foundation for the phased implementation strategy. Concentrating efforts on these regions enables the recovery of the ecosystem and the reintroduction of native flora, ensuring the reclamation of the entire post-mining landscape.

The primary objective of the Pandalgudi restoration initiative was to establish a self-sustaining, natural ecosystem that nurtures local flora and fauna biodiversity. Additionally, the endeavour aimed to create an environmental educational centre and recreational space to cater to the needs of the local community.

## Phased Restoration Approach:

The restoration was executed in three main phases, each targeting specific areas where mining operations had ceased. Phased implementation allowed progressive rehabilitation, knowledge accumulation, and refinement of techniques.

- Phase 1 (October 2019–March 2021): Focused on 65 acres, this phase prioritized site stabilization and preparation. Initial interventions included the removal of Prosopis juliflora (an invasive species), contouring and reshaping spoil heaps to create stable topography, and designing ornamental gardens using native drought-tolerant species. This phase laid the groundwork for plantation efforts and established the Environmental Education Centre as a central hub.

- Phase 2 (January 2021–January 2022): Restoration expanded to 190 acres with an emphasis on ecological function. The site was developed with an extensive 18-km trail network and further landform modifications to support recreational use. Plantation focused on regionally appropriate native species, specifically selected for their resilience in arid conditions and contribution to biodiversity.

- Phase 3 (December 2021–November 2024): Covering an additional 100 acres, this phase enhanced landscape connectivity through habitat corridors and introduced new native vegetation patches. It also focused on creating integrated habitat networks between restored areas separated by roads and fences, with plans to use underpasses for wildlife movement.

## Reference Ecosystem Development:

In the absence of an intact reference ecosystem, localized field surveys were conducted to identify resilient native species from nearby shrines, ponds, and agricultural boundaries. Species such as Vachellia leucopholea, Balanites roxburghii, Albizia lebbeck, and Salvadora persica were identified as appropriate models for restoration. These were used to build a species palette suited to local soil, moisture, and climatic conditions.

## Species Selection and Plantation Techniques:

A total of over 400,000 plants were introduced across the three phases, including more than 200 drought-tolerant species. Around 140 of these are native to the region. Restoration methodology included:

- Soil and Substrate Preparation: Mining removed large volumes of topsoil, so potential stockpiles of soil were identified and redistributed strategically. Where necessary, spoil heaps were modified to improve planting success.
- Species Matching to Microhabitats: Tree and shrub species were matched to the micro-topography and soil moisture conditions. This technique ensured higher survival and better ecological integration.

- Establishment of Onsite Nursery: A dedicated nursery enabled the collection and propagation of native seeds. It gradually increased the availability of native species, allowing a transition from non-native to native-dominant plantation strategies.
- Adaptive Management of Species Mix: Initial phases used a mix of native and proven non-native species due to availability constraints. As nursery capacity improved, the proportion of native plants increased to over 90%, aligning with long-term restoration goals.
- Topographical Enhancement: Spoil mounds were creatively reshaped to form hillocks, ridges, water bodies, and microhabitats. This created a structurally diverse terrain, conducive to ecosystem establishment.
- Themed Gardens and Landscape Integration: The site includes rock gardens, xerophytic gardens, and pondside plantings designed with ecological and educational intent. Water features such as ponds and cascades were integrated into the design to support hydrological and aesthetic functions.

## Training and Capacity Building:

A major component of the methodology was building local capacity through training programs in ecological horticulture. Partnering with Auroville Botanical Gardens, over 60 individuals were trained in native plant propagation, soil management, ecological design, and restoration principles. Several graduates now lead restoration efforts at the site, ensuring continuity and adaptive learning.

## Monitoring and Evaluation:

Baseline surveys and periodic monitoring were incorporated into the restoration methodology. These include:

- Faunal surveys (birds, mammals, butterflies, reptiles, odonates)
- Vegetation monitoring (survival rate, recruitment, and regeneration)
- Soil and water testing (quality and suitability for restoration objectives)
- Grazing management to protect young plantations

This evidence-based approach supports continuous refinement and ensures ecological functionality is progressively restored.

## Outcomes post-restoration

The Pandalgudi mine site has been successfully transformed into a resilient ecological landscape. Around 400 acres have been rehabilitated to date, with plans to complete the remaining 400 acres as mining concludes. The restored site now supports diverse habitats, from forests and grasslands to wetlands and rocky outcrops, enhancing ecological connectivity and regional biodiversity.

Community benefits include employment, environmental education programs, and recreational spaces. Over 30 local workers have been consistently employed, and hundreds of school children have participated in onsite educational activities. The environmental education center functions as a model for youth engagement in ecological stewardship.

This initiative demonstrates that mine sites can evolve into biodiversity sanctuaries and community assets, serving as a replicable model for post-mining restoration across India. It also underscores the potential of integrating ecological science, community participation, and design thinking in transforming degraded landscapes into multifunctional ecosystems.

**Before and after images from 2019 and 2020**

## Case Study 2: Preliminary study of limestone mine, before concept development, Wayalar,Tamil Nadu

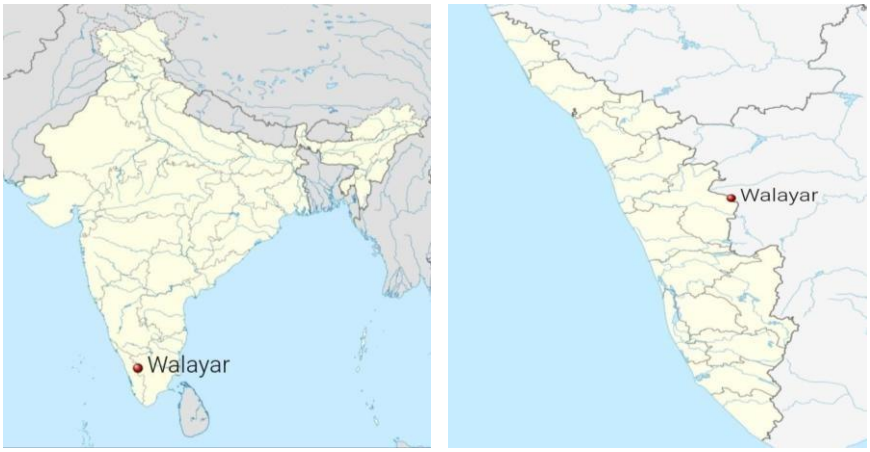
| | Criteria | Wayalar (ACC cements) |
|---|---|---|
| 1 | Ownership | corporate |
| 2 | Size, % mine vs. overburden | 66 ha |
| 3 | Level of protection | Porous (broken fence) |
| 4 | Water availability | Good |
| 5 | Soil availability | Poor |
| 6 | Lease maturity | End of mining |
| 7 | Ecological connectivity | Very good |
| 8 | Social engagement | minimum |
| 9 | Contact zone | Hard rock |
| 10 | Slope stability | Good |
| | | |

# Preliminary study of the mining site at Walyar, Tamil Nadu

## Location details

Walayar ACC mine is located in Pudhupathy, near Madukkarai city in Coimbatore district. It is the gateway to Coimbatore city from Kerala State and is located around 25 km from the Coimbatore Airport. The limestone mine is situated at 10.87954°, 76.84583° nearby Walayar reserve forest. The total area of the mine is 65.3 hectares. It is a non-operational site. The limestones have been excavated, and the groundwater remains at the bottom of the core mine. Water available in 40 hectares of the site, source ground water, depth of water around 50 metres available throughout the year, water level increases to 3 meters during monsoons. A part of the Western Ghats surrounds the northern part of the limestone mine. The other three sides are covered with Walayar RF.

**Map showing ACC mine location details in Tamil Nadu Walayar ACC mine at Puthupathy**




## Objectives of the visit:

The visit was made to check the feasibility and potential components of restoration in the mine site area, where the natural resources like topsoil and microclimate were ruined due to mining activity. Other factors were examined onsite that are responsible for recreating the original ecosystem.

- Restore the ecosystem: Re-establish the ecosystem that existed before mining operations began.
- Prevent or minimise environmental impacts: Prevent or reduce the long-term environmental impact of mine.
- Restore the land: Restore the land's topography, stability, and aesthetic value.
- Prepare for other uses: Prepare the site for other beneficial uses, such as eco-tourism, an interpretation centre, an ecological park and conservation.
- Restore biodiversity: Restore biodiversity and minimize interference with sensitive ecosystems.

## Observations and recommendations:

Restoration of a mining site can be a difficult and time intensive goal. Some common changes that occur from mining operations include - Diverting waterways, creating or levelling hills, and altering the composition of the topsoil. During our survey we observed and examined the following features to rehabilitate the land.

- **Soil quality and composition:**
  The soil of the site was examined onsite, red calcareous soil with coarse texture was present in most of the places. The existense of topsoil in the immediate surroundings of the core mining area is very low. Some distance from the mine, the level of the top soil slowly increasing and favouring for driving a plantation. The pH of the soil is 4.36, which indicates the strong acid nature.

- **Vegetation and plant communities:**
  There is not much diversity in this area, as most of the places are invaded by alien species like *Tecoma stans* and *Prosopis juliflora*. However, *Acacia catechu, Chloroxylon swietenia, Ailanthus excelsa, Albizia lebbeck, Ziziphus glabrata, Combretum albidum, Pongamia pinnata, Azadirachta indica* and *Santalum album* are the few native species found very occasionally. The average canopy of the natural vegetation is 4 to 6 m. Few regenerations were found onsite, such as *Acacia catechu, Combretum albidum* and *Dichrostachys cineria*. The invasive species *Conocarpus lancifolius* has been planted along the unused vehicle path bund areas, which is detrimental to the natural ecosystem.

- **Hydrology and water quality:**
  Water available in 40 hectares of the site, source ground water, depth of water around 50 meters, available throughout the year, water level increases to 3 meters during monsoons, the ability of soil to allow the water is high, the TDS of water is 312 ppm, pH of the water is 4.01, and electrical conductivity is 612.

- **Geomorphology and Landscape Structure:**
  Mining areas covering around 80% of the total extent, which acts as a water reservoir now, balance almost a flat terrain with small overburden mounts. Around 4 hectares are available to carry out a plantation, erosion evident in some places. Potential for landform stabilization is low as there is not much dumping of the overburden of topsoil in site, The landform is stable, the angle of the slope landform is between 25 to 30 degrees, Benches of the pits were present, 9 visible, 8 under water, the substrate benches are rock, backfilling has done around 6.18 hectares.

- **Ecological connectivity:**
  Walayar reserve forest is the important, significant ecosystem nearby the ACC mine. Three-fourths of the site is surrounded by the Walayar reserve forest. The reserve forest owns a healthy vegetative ecosystem. The reserve forest has rich diversity. *Naringi crenulata, Acacia chundra, Alangium slvifolium, Mitragyna parvifolia, Hymenodictyon orixense* and *Limonia acidissima* are

the main species recorded in this RF. The canopy height is 6 to 10 meters average. *Cleistanthus collinus* is the dominant species found in this ecosystem. Also, along the roadside, we found some invasive species, such as *Eupatorium odoratum* and *Lanatana camera*.

- **Site protection:**

The mine site is not protected by a fence. After completing mining activity, it is essential to protect it with fence materials.

## Recommendation for the restoration of mine:

1. **Removal of invasive plant species:**

Invasive species can have a significant negative impact on the natural biodiversity of the ecosystem. Also, invasive species can permanently alter habitats and bioregions. We recorded alien plant species *Tecoma stans* and *Prosopis juliflora* invaded almost all over the mining area, such detrimental invasive plant species have to be removed from the ecoregion before planting the native plants. Also, previously planted Conocarpus lancifolius needs to be replaced with native tree species.

*Tecoma stans*

*Conocarpus lancifolius*

2. **Levelling the soil:**

Levelling the soil in mine areas for planting is help to improve the soil fertility, reduce water runoff, prevent soil erosion, promote efficient water management and, support sustainable land use practices. In some places, south parts and west part of the mine site are dumped with rocks and a small pile of overburden soil. The uneven pits and overburden areas need to be levelled and the land prepared for plantation.

3. **Water irrigation for the plants from pit water:**

   Perennial ground water can be used for plantation. Submersible pumps pull out the water from the pit and water irrigates the plants through the pipe irrigation system. Using drip irrigation, the water would reach every nook and corner of the plantation areas.

4. **Fencing for mine areas:**

   65.3 hectares of mine area is not fenced. For security, enhancement of the fencing of the mine site is very important. To attain good survivability of the plant saplings in planting areas and protect them from other hazardous circumstances, the entire site is necessarily protected with a fence.

5. **Protect from grazing:**

   Excreta of the goats were found in many places, which indicates the grazing activity happening in this site intensively, the grazing activity can be stopped by making a fence around the mine site and giving awareness to the local community.

6. **Planting native species:**

   Planting native species in restoration areas is extremely important as it allows for the most effective re-establishment of a healthy ecosystem by supporting local biodiversity. Native plants have evolved to thrive in the local climate, soil type, and water availability, requiring less maintenance compared to non-native species.

7. **Control of soil erosion:**

   To control the soil erosion in mine areas through recontouring, the primary strategy is to reshape the disturbed land by creating gentle slopes, grading the terrain to promote water runoff diversion, and establishing terraces where necessary, allowing for better vegetation establishment and minimizing the erosive force of rainwater runoff on steep slopes.

## Case Study 3: Restoration proposal for limestone mine – Ariyalur, Tamil Nadu

| | Criteria | PPMn, Ariyalur (Ramco) |
|---|---|---|
| 1 | Ownership | Corporate |
| 2 | Size, % mine vs. overburden | 64 acres |
| 3 | Level of protection | good |
| 4 | Water availability | Good |
| 5 | Soil availability | Poor |
| 6 | Lease maturity | Towards the end of mining |
| 7 | Ecological connectivity | Poor |
| 8 | Social engagement | Good CSR work, good relationship with local communities |
| 9 | Contact zone | Hard rock |
| 10 | Slope stability | Not good, highly eroded |

## Restoration proposal for limestone mine at Ariyalur

As limestone mining operations draw to a close in Pudupalayam North (PPMn) of Ariyalur district, the focus shifts toward transforming these impacted landscapes into stable, biodiverse, and ecologically functional ecosystems. The primary aim of this restoration initiative is to implement a clear, phased action plan that addresses critical aspects such as slope stability, soil fertility, water management, and biodiversity recovery. The strategy is designed to align with land availability and restoration timelines, with initial efforts centered on physical stabilization, followed by the reintroduction of native flora to reestablish ecological processes. The long-term objective is to create self-sustaining systems that support natural recolonization by native fauna and deliver essential ecosystem services for local communities. By integrating ecological best practices, stakeholder participation, and phased implementation, the project seeks to ensure that post-mining areas transition into safe, regenerative, and resilient landscapes.

**Project Background and Objectives**

The Ariyalur district in Tamil Nadu, a key hub for limestone mining, presents an opportunity for ecological restoration at the Pudupalayam North (PPMn) mine, where mining operations have ceased over an area of 64 acres. The project aims to develop a phased, science-based restoration plan to stabilize the landscape, promote native biodiversity, and deliver ecosystem services. The initiative is guided by the principles of the Society for Ecological Restoration (SER), emphasizing native species rehabilitation, ecological function recovery, and community participation.

**Site Conditions and Challenges**

The site comprises black cotton soil overlaying micaceous sandstone and fossiliferous limestone. With a semi-arid climate, average annual rainfall of 954 mm, and groundwater levels ranging from 20 to 30 meters, the project must address challenges related to soil fertility, erosion, and water retention. Seasonal rainfall patterns, poor organic matter content, and steep excavation benches contribute to surface instability and low water-holding capacity. A phased action plan was designed to address these constraints while building ecological resilience. The first phase focuses on soil stabilization and plantation, supported by baseline ecological studies and stakeholder consultations.

**Soil Stabilization and Erosion Control**

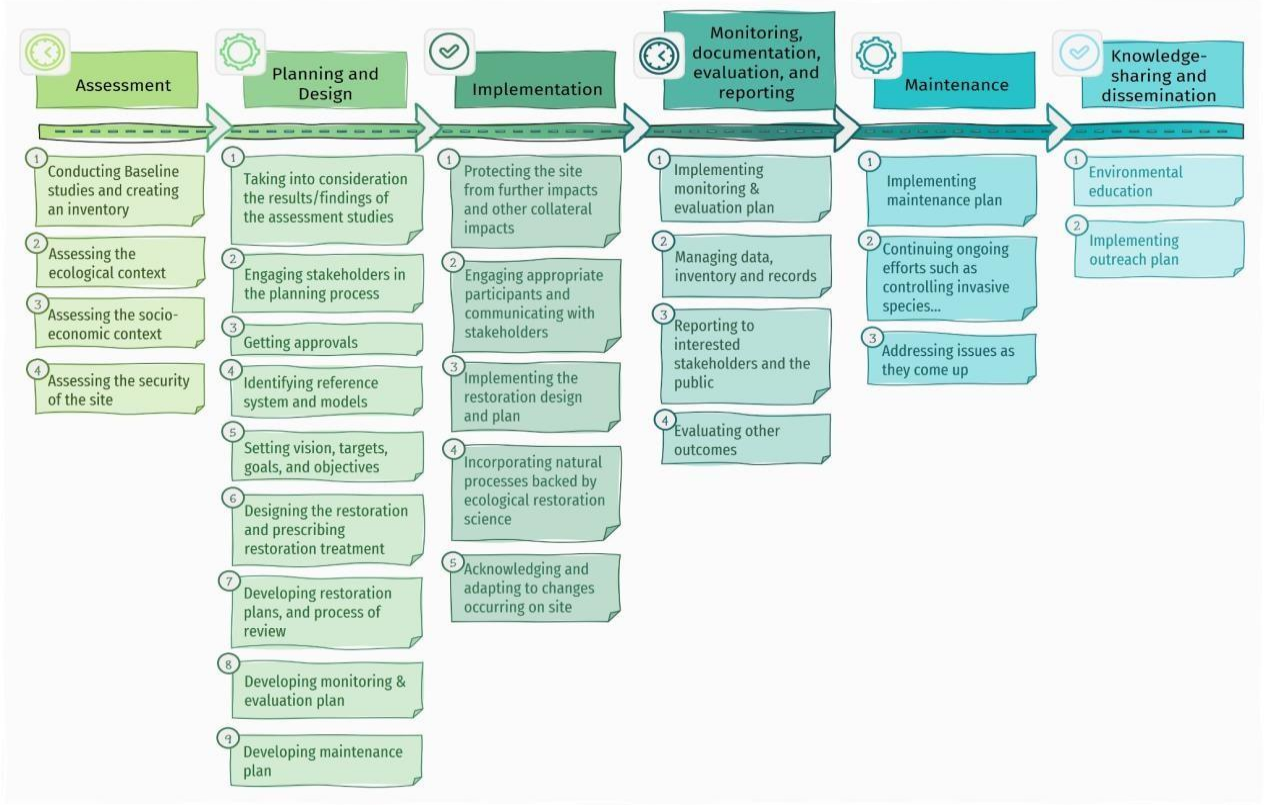
The restoration strategy begins with the preparation and grading of benches to prevent erosion. Benches will be reshaped with a backward tilt to direct surface runoff away from mine walls. Designated runoff zones will be constructed using placed rocks and contour bunds to manage heavy rains. Areas prone to sheet or rill erosion will be vegetated with fast-rooting grasses like Vetiver (Chrysopogon zizanioides) and Naanal (Saccharum spontaneum), which have proven efficacy in anchoring loose soils and slowing runoff.

Topsoil, which may have been stored along the mine perimeter during excavation, will be reclaimed and redistributed. This topsoil will be enriched with compost or organic additives to improve fertility before use in planting pits. In areas where topsoil is insufficient, subsoil or overburden material will be mechanically

amended to improve texture and drainage. The goal is to achieve sufficient rooting depth, moisture retention, and nutrient availability to support diverse vegetation across the site.

### Ecological Restoration Strategy

The approach to the restoration of the mine is guided by the recommendations, pathways, and principles set forth by the Society for Ecological Restoration.




Key steps in the restoration process

### Species Selection and Planting Plan

A zone-specific planting plan was developed based on topography, substrate conditions, and water availability. The landscape has been divided into four distinct zones:

- **Zone A (Top-level rims):** Highly exposed, fast-draining zones where hardy, drought-tolerant, and thorny species will be introduced. These include Acacia chundra, Balanites roxburghii, and Prosopis spicigera, which provide windbreaks and soil anchorage.

- **Zone B (Upper benches):** Slightly more sheltered zones suitable for nitrogen-fixing trees and species offering shade or leaf litter. Species include Albizia lebbeck, Pongamia pinnata, and Bauhinia racemosa.

- **Zone C (Mid-level benches):** Zones with increased soil moisture and potential seepage, offering better establishment conditions for a wider range of native species, including Diospyros chloroxylon and Holoptelia integrifolia.
- **Zone D (Lower benches and pit base):** Areas closer to the water table where deep-rooted and moisture-loving species will be planted. These include Aegle marmelos, Mimusops elengi, and Syzygium cumini.

Phase 1 will rehabilitate 16 acres with approximately 14,000 saplings representing over 40 native species. Planting density is set at 900 saplings per acre, and planting techniques include pit planting, line planting, and staggered groupings based on microtopography.

**Nursery Development and Community Participation**

An onsite nursery is being developed to support the propagation of native species. This facility will facilitate local seed collection, germination trials, and seedling hardening. It will also act as a center for training local community members in nursery management and propagation techniques. Community engagement is embedded in the project through employment opportunities in planting, nursery care, monitoring, and seed collection.

Workshops will be organized to raise awareness about the importance of native species, their ecological functions, and potential benefits for agroforestry. This effort will foster long-term stewardship of the restored areas and enhance livelihood opportunities for local stakeholders.

**Monitoring and Evaluation Framework**

A robust monitoring protocol is integral to the project. In the first year, quarterly monitoring will assess plantation survival rates, average height, species-specific performance, and any signs of stress or mortality. Permanent sample plots will be established in each zone to enable consistent, repeatable observations. In subsequent years, monitoring will be conducted biannually.

Soil health will be assessed through tests for pH, organic matter content, nutrient availability, and texture. Water quality monitoring will include TDS, pH, biological oxygen demand, and indicators of aquatic ecosystem health. Faunal surveys (birds, butterflies, odonates) will track biodiversity recovery. Monitoring data will guide adaptive interventions such as supplementary planting, enrichment, or regrading.

Indicators for evaluating success include canopy cover development, survival rate (>75%), reduction in bare patches, presence of regenerating seedlings, and increase in biodiversity indices. The evaluation approach is aligned with the Global Biodiversity Standard (GBS) and the Society for Ecological Restoration's (SER) evaluation principles.

### Evaluation of restoration efforts

Evaluation of restorative efforts involves the critical examination of project outcomes, measuring their effectiveness in achieving ecological and societal objectives/goals. This process enables

adaptive management, ensuring that restoration initiatives continuously evolve to meet the dynamic challenges of environmental conservation and community engagement.

The following indicators (socio-economic or ecological attributes/indicators) will be used for evaluating the success of ecological restoration. These indicators (per time stage) have been inspired, derived and adapted from De Oliveira et al., (2021).

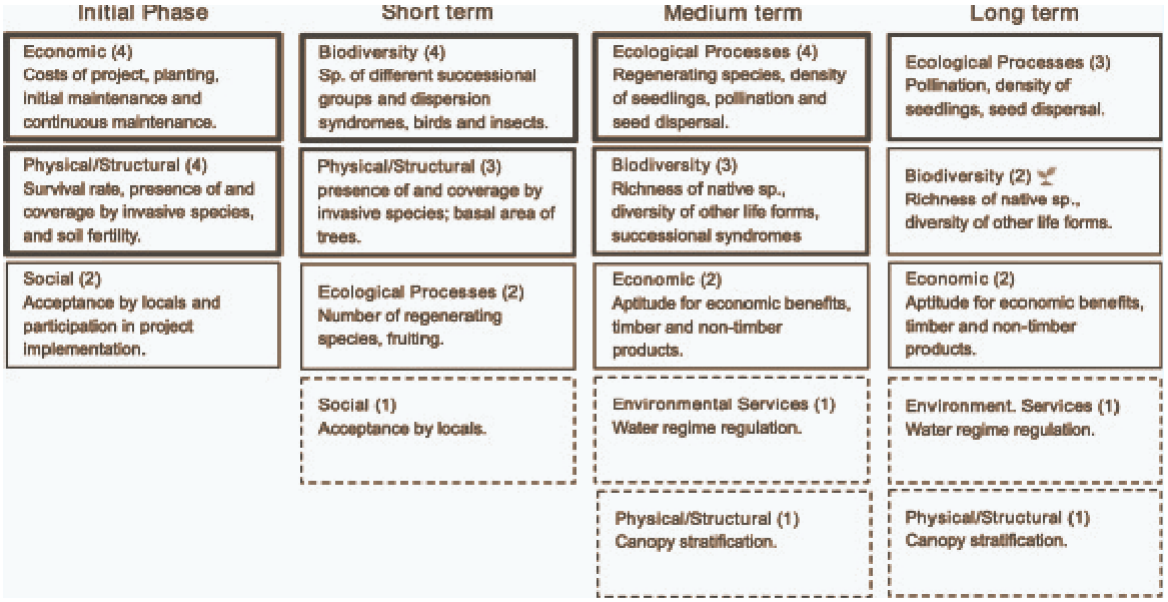
**Ecological indicators:**

1. **Physical and Structural:** Canopy or vegetation cover (percent), survival rate of planted species, tree height, tree basal area, above ground and below ground biomass, canopy stratification, presence of invasive or undesirable species, soil surface conditions, soil structure, soil fertility, water retention capacity, organic matter content, C/N ratio in litter.
2. **Composition/Biodiversity:** Diversity and richness of native species (both flora (plants, trees, shrubs etc) and fauna (birds, mammals, insects, soil microfauna, reptiles, soil microfauna etc), richness of habitat and functional groups, presence of plant species from different successional groups.
3. **Environmental Services:** Carbon stock/carbon sequestration, arresting soil erosion, regulation of water regimes (groundwater recharge etc).
4. **Ecological Processes:** Presence of regenerating native species, density of native seedlings, presence of herbivory, occurrence of pollination, prevalence of seed dispersal by fauna, occurrence of fruiting.

**Socio-economic Indicators:**

**Socio-economic** (Livelihoods and well-being): Employment/livelihood/ jobs created aptitude for economic benefit from ecosystem services (Timber, carbon stock, etc).

**Social (IP)**: Project orientation, awareness creation and acceptance by local community, collaborative, participation in restoration processes, ethnobotanical value of species used.



Indicators for evaluation per time-stage sourced from De Oliveira et al., 2021.

**Expected Outcomes**

The expected outcomes include the physical stabilization of the post-mining landscape, restoration of ecological functions such as infiltration and pollination, and the creation of microhabitats supporting native biodiversity. Long-term vegetation establishment will reduce erosion, improve groundwater recharge, and offer carbon sequestration benefits. Socially, the project will support employment, build ecological knowledge among local communities, and promote inclusive participation in environmental restoration.

> By integrating ecological science, participatory planning, and adaptive implementation, the Ariyalur mine restoration project aims to demonstrate a replicable model for sustainable landscape recovery in limestone mining regions of Tamil Nadu. Its zone-based restoration strategy, supported by local nursery development and rigorous monitoring, makes it a scalable and locally grounded ecological solution.

# Annexure 4

## Brief Outline of the Mine Restoration Manual

## Overview

The restoration of post-mining landscapes is a complex undertaking that involves not only physical rehabilitation but also the re-establishment of ecological functions and the integration of restored areas into the broader landscape. This effort is increasingly urgent, as the global consequences of environmental degradation become ever more apparent. Restoration, therefore, is not solely a technical process but a responsibility to sustain the balance between human activity and the natural world.

Mine restoration presents a unique opportunity to redefine human interaction with the land, addressing past imbalances and establishing pathways toward long-term sustainability. Each decision made during this process carries ecological implications, necessitating a careful consideration of long-term outcomes and potential ripple effects across ecosystems. Restoration requires patience, as ecological processes unfold over extended timeframes, often spanning generations.

Ecological restoration is inherently collaborative. Its success depends on the active participation of diverse stakeholders—including local communities, government bodies, environmental organizations, and industry actors. The process benefits significantly from inclusive dialogue and the integration of traditional knowledge, particularly that held by indigenous communities with long-standing relationships to the land. A shared commitment to ecological recovery fosters collective responsibility and long-term stewardship.

This manual offers a flexible framework designed to support adaptive management and continuous learning. It is grounded in a systems-based understanding of ecological dynamics, recognizing the interconnectedness of ecosystem components and the cascading impacts of interventions. Each restoration effort is context-specific, shaped by the site's unique characteristics and the surrounding community's aspirations.

Drawing from current best practices and the latest available knowledge in the field of ecological restoration, this manual aims to serve both as a practical guide and a living document. As restoration science continues to evolve, the content herein is open to revision and enrichment through ongoing feedback and collaboration.

The approach and strategies presented are intended to serve as a model for future restoration efforts across India and beyond. By combining scientific rigor, participatory planning, and adaptive management, the manual provides a foundation for addressing ecological degradation at scale. It emphasizes replicable methods that can be adapted to other degraded landscapes facing similar challenges.

The experiences and lessons documented here offer guidance for future initiatives—from ecological assessment and species selection to long-term monitoring and community

engagement. By sharing both achievements and challenges encountered during implementation, this manual aims to support and inspire future restoration projects.

This document stands as a call to action for all stakeholders committed to environmental stewardship. The restoration of post-mining landscapes is both an ecological necessity and a vital step toward a sustainable future. The hope is that this work contributes to a broader movement of restoration—restoring not only ecosystems, but also the connection between people and nature.

The Mine Restoration Manual contains the following chapters, along with related information and recommendations.

# Annexure 5

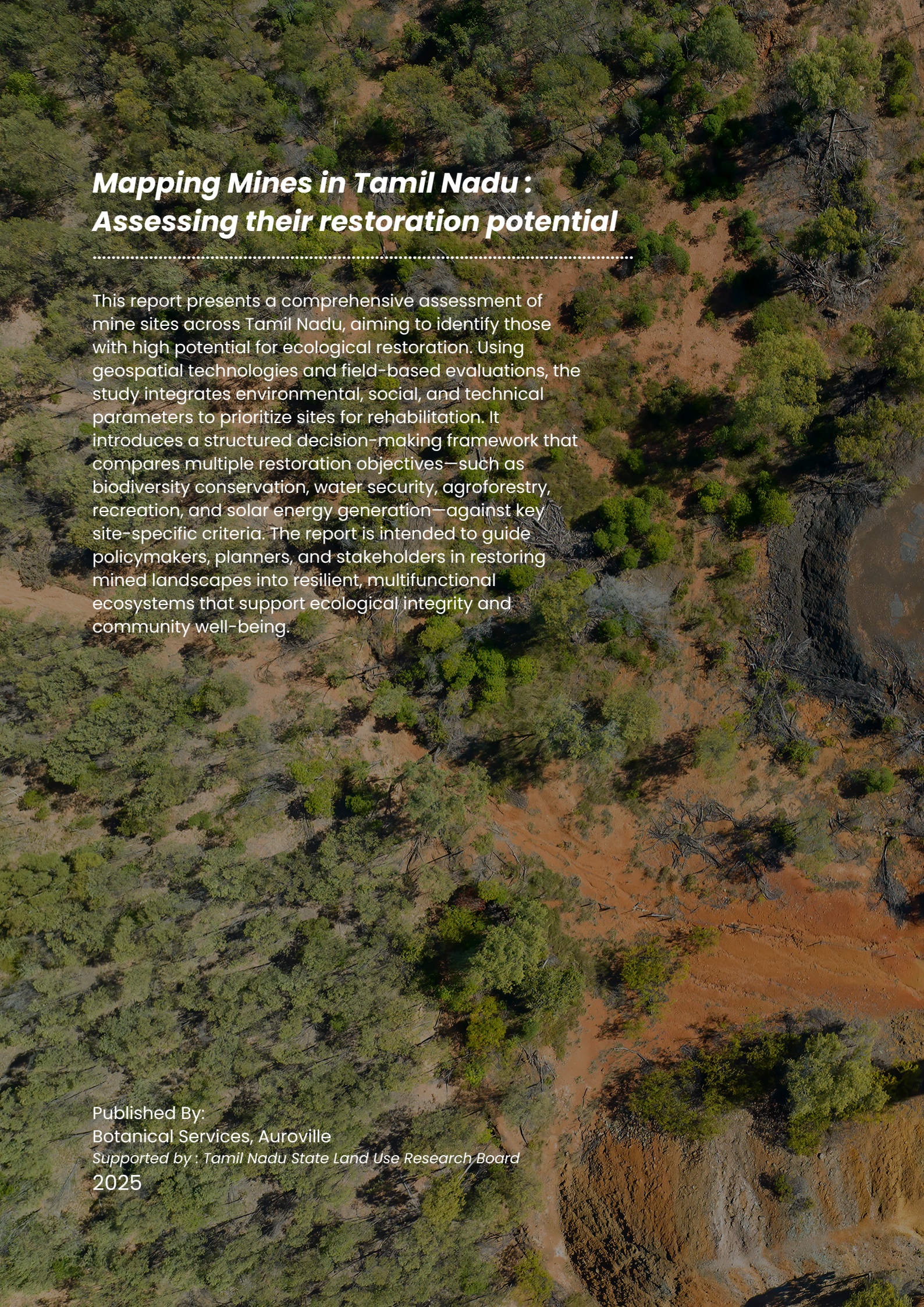
## Species Profiles of Key Trees and Shrubs Recommended for Mine Restoration Plantations

Species profiles have been developed for 50 key tree and shrub species recommended for mine restoration plantations.

The list of species is as follows:

| Sl. no. | Species | Type | Family |
|---|---|---|---|
| 1 | Acacia chundra | Tree | Fabaceae |
| 2 | Acacia leucophloea | Tree | Fabaceae |
| 3 | Acacia nilotica | Tree | Fabaceae |
| 4 | Albizia amara | Tree | Fabaceae |
| 5 | Albizia lebbeck | Tree | Fabaceae |
| 6 | Azadirachta indica | Tree | Meliaceae |
| 7 | Balanites roxburghii | Tree | Zygophyllaceae |
| 8 | Bauhinia racemosa | Tree | Fabaceae |
| 9 | Caesalpinia coriaria | Tree | Fabaceae |
| 10 | Cassia fistula | Tree | Fabaceae |
| 11 | Commiphora berryi | Tree | Burseraceae |
| 12 | Commiphora caudata | Tree | Burseraceae |
| 13 | Cordia domestica | Tree | Boraginaceae |
| 14 | Crataeva adansonii ssp. Odora | Tree | Capparaceae |
| 15 | Dolichandrone falcata | Tree | Bignoniaceae |
| 16 | Ficus amplissima | Tree | Moraceae |
| 17 | Ficus benghalensis | Tree | Moraceae |
| 18 | Ficus glomerata | Tree | Moraceae |
| 19 | Ficus microcarpa | Tree | Moraceae |
| 20 | Ficus religiosa | Tree | Moraceae |
| 21 | Hardwickia binata | Tree | Fabaceae |
| 22 | Hibiscus tiliaceus | Tree | Malvaceae |
| 23 | Holoptelea integrifolia | Tree | Ulmaceae |
| 24 | Limonia acidissima | Tree | Rutaceae |
| 25 | Madhuca indica | Tree | Sapotaceae |
| 26 | Mimusops elengi | Tree | Sapotaceae |
| 27 | Morinda tinctoria | Tree | Rubiaceae |
| 28 | Mundulea sericea | Tree | Fabaceae |
| 29 | Pithecellobium dulce | Tree | Fabaceae |
| 30 | Pongamia pinnata | Tree | Fabaceae |
| 31 | Pterocarpus marsupium | Tree | Fabaceae |
| 32 | Pterocarpus santalinus | Tree | Fabaceae |
| 33 | Salvadora persica | Tree | Salvadoraceae |
| 34 | Syzygium cumini | Tree | Myrtaceae |
| 35 | Terminalia arjuna | Tree | Combretaceae |
| 36 | Terminalia bellirica | Tree | Combretaceae |

| | | | |
|---|---|---|---|
| 37 | Wrightia tinctoria | Tree | Apocynaceae |
| 38 | Ziziphus mauritiana | Tree | Rhamnaceae |
| 39 | Cadaba fruticosa | Shrub | Capparaceae |
| 40 | Dodonaea viscosa | Shrub | Sapindaceae |
| 41 | Gardenia resinifera | Shrub | Rubiaceae |
| 42 | Ixora pavetta | Shrub | Rubiaceae |
| 43 | Premna serratifolia | Shrub | Lamiaceae |
| 44 | Rhinacanthus nasutus | Shrub | Acanthaceae |
| 45 | Senna auriculata | Shrub | Fabaceae |
| 46 | Suregada angustifolia | Shrub | Euphorbiaceae |
| 47 | Vitex negundo | Shrub | Lamiaceae |
| 48 | Dalbergia paniculata | Tree | Fabaceae |
| 49 | Dichrostachys cinerea | Tree | Fabaceae |
| 50 | Ziziphus xylopyrus | Tree | Rhamnaceae |



# *Mapping Mines in Tamil Nadu : Assessing their restoration potential*

This report presents a comprehensive assessment of mine sites across Tamil Nadu, aiming to identify those with high potential for ecological restoration. Using geospatial technologies and field-based evaluations, the study integrates environmental, social, and technical parameters to prioritize sites for rehabilitation. It introduces a structured decision-making framework that compares multiple restoration objectives—such as biodiversity conservation, water security, agroforestry, recreation, and solar energy generation—against key site-specific criteria. The report is intended to guide policymakers, planners, and stakeholders in restoring mined landscapes into resilient, multifunctional ecosystems that support ecological integrity and community well-being.

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