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MODEL PLAN

ELEPHANT CONSERVATION PLAN FOR NILGIRI ELEPHANT RESERVE (NER)

भारतीय वन्यजीव संस्थान
Wildlife Institute of India

हाथी परियोजना
भारत सरकार
PROJECT ELEPHANT
GOVT. OF INDIA

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MODEL PLAN

ELEPHANT CONSERVATION PLAN FOR NILGIRI ELEPHANT RESERVE (NER)

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It is hoped that this Model Elephant Conservation Plan for the Nilgiri Elephant Reserve will serve as a comprehensive framework for the long-term conservation and management of Asian elephants, strengthen landscape-level conservation not only across southern India, but will also act as a reference document for the preparation and implementation of Elephant Conservation Plans in other Elephant Reserves across the country.

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EXECUTIVE SUMMARY

The **Nilgiri Elephant Reserve (NER)**, with Nilgiris, Gudalur, Mudumalai & Sathyamangalam, Thanthai-Periyar, Erode, Cauvery North-South in Dharmapuri & Hosur divisions, represents one of the most important elephant landscapes in southern India. Located at the junction of the Western and Eastern Ghats, it forms a contiguous transboundary habitat connecting Tamil Nadu with Karnataka and Kerala, supporting one of the largest populations of Asian elephants.

Introduction to the Region

The landscape is physio-graphically diverse, ranging from low-elevation dry plains in Dharmapuri and Hosur to high-elevation plateaus and montane systems in the Nilgiris. Geologically dominated by ancient gneissic formations, the region has varied soils- from lateritic and red loams to gravelly dry soils- which influence forest composition. Climatically, it spans tropical dry to moist temperate conditions, with rainfall gradients shaped by both monsoons. Major river systems such as the Bhavani and Moyar sustain hydrological stability and provide critical water sources for elephants. Biologically, the reserve encompasses wet evergreen, moist and dry deciduous, thorn forests, and shola-grassland systems. It supports elephants as a keystone species along with tigers, gaurs and other megafauna, and holds high conservation value due to its biodiversity richness, watershed functions, ecosystem services, cultural associations with indigenous communities.

Land use within the NER includes protected forests, reserved forests, plantations, agriculture, settlements and infrastructure corridors. While core protected areas maintain relatively intact forest cover, fragmentation is evident in fringe divisions like Gudalur and eastern plains due to encroachments, plantations & linear infrastructure. These changes have altered traditional elephant movement patterns.

The reserve contains vital elephant corridors that ensure seasonal and long-distance movement across divisions and adjoining states. However, infrastructure development, highways and agricultural expansion have constricted some corridors, increasing the vulnerability of elephant populations and intensifying human-elephant interactions. The synergy among protected area notifications, eco-sensitive zones and forest diversion regulations provides a framework for habitat protection, corridor conservation and mitigation of developmental impacts.

Historically, parts of the landscape experienced timber extraction, plantation development and regulated forest use. Over time, management shifted toward conservation-oriented approaches, particularly after the declaration of tiger reserves. Efforts now include habitat restoration, invasive species control, soil and water conservation works, regulated Non-Timber Forest Produce (NTFP) collection, eco-development initiatives and strengthened protection infrastructure. The interface between forests and human-dominated landscapes has undergone significant transformation due to plantation expansion, settlement growth and infrastructure development. These historic land-use changes have directly contributed to increased human-elephant conflict (HEC), especially in Gudalur, Sathyamangalam fringes, Dharmapuri and Hosur divisions, where crop depredation and property damage are frequent. Production sectors such as agriculture, plantations, highways, railways and power infrastructure exert both direct and indirect impacts on elephant habitats. Direct impacts include habitat fragmentation and mortality risks, while indirect impacts arise from crop patterns that attract elephants and altered resource distribution. Effective elephant conservation therefore requires coordinated inputs from multiple line agencies alongside the Forest Department.

Context and Situation

Elephants in the NER are widely distributed across moist deciduous forests of Mudumalai and Sathyamangalam and extend eastward into the drier forests of Erode, Dharmapuri and Hosur. Their movement is seasonal and resource-driven, forming part of a larger southern Indian metapopulation. High densities occur in well-protected core habitats, while eastern divisions function as dispersal and corridor zones critical for landscape connectivity. Population estimation follows standardized All-India Elephant Estimation protocols using direct sightings, line transects and dung density methods. Monitoring is strengthened through camera trapping, radio-collaring, patrol records and systematic conflict documentation. Spatial databases developed using GIS integrate habitat, corridor, infrastructure and conflict hotspot layers to support evidence-based planning and risk assessment. Habitat quality varies across the reserve. Moist deciduous and riverine tracts provide high forage and water availability, whereas drier forests experience seasonal stress, prompting elephants to move toward agricultural fields. Invasive species, fragmentation and altered fire regimes influence habitat productivity and elephant utilization patterns.

Villages in fringes exhibit varying degrees of resource dependency on forests for fuelwood, grazing and non-timber forest produce. Agriculture- especially cultivation of crops attractive to elephants- forms the primary livelihood base in many conflict-prone areas. This close interface between subsistence needs and elephant movement intensifies interaction and vulnerability.

Human-Elephant Conflict (HEC) is a major challenge in Gudalur, Sathyamangalam fringes, Erode, Dharmapuri and Hosur. Conflict is largely seasonal, peaking during crop maturity and dry periods. Common characteristics include crop depredation, property damage and occasional human casualties. Causes include habitat fragmentation, obstruction of corridors, water scarcity, expansion of high-value crops and linear infrastructure barriers. Key drivers of HEC include land-use change, settlement expansion, invasive species reducing natural forage and increasing developmental pressures. Management responses involve solar fencing, elephant-proof trenches, anti-depredation squads, early warning systems, compensation schemes and community outreach. However, ensuring corridor integrity, timely compensation and long-term coexistence remain challenging. Threat assessment identifies habitat fragmentation, corridor bottlenecks, electrocution risks, road and railway mortality, water stress and climate variability as significant risks. Spatial and temporal mapping of conflict and habitat vulnerability enables prioritization of mitigation measures & targeted interventions.

The zone of influence surrounding protected areas comprises agriculture, plantations, settlements and expanding infrastructure. While core areas remain relatively secure, buffer and interface zones face mounting anthropogenic pressures, necessitating integrated land-use planning and interdepartmental coordination.

The proposed management framework articulates a vision of sustaining a viable, free-ranging and genetically connected elephant population while promoting coexistence with local communities. The goal focuses on habitat connectivity, HEC reduction and integration of conservation with sustainable development. Management objectives include strengthening corridors, enhancing habitat quality and water availability, improving scientific monitoring, reducing conflict and fostering inter-agency collaboration. Constraints include land tenure complexities, encroachments, funding limitations and socio-economic pressures.

A Strengths, Weaknesses, Opportunities, and Threats (SWOT) analysis highlights strengths such as contiguous habitat and legal backing; weaknesses like fragmented corridors and high HEC; opportunities in technology and interstate coordination; and threats from infrastructure expansion and climate variability. Strategies are aligned with existing wildlife and forest management plans, emphasizing adaptive, science-based and community-inclusive conservation.

Managing Drivers and Pressures

The plan proposes functional zonation within the NER to guide interventions. Elephant Conservation Zone focuses on core habitats where habitat protection and ecological integrity are paramount. Elephant-Human Coexistence Zone emphasizes regulated livelihood activities and participatory conflict mitigation in buffer areas. Elephant-Human Management Zone covers high-conflict and multiple-use landscapes where intensive mitigation, infrastructure regulation and coordinated planning are required. The Elephant-Habitat Relationship (EHR) framework explains how elephant distribution is shaped by forage, water, seasonality and corridor connectivity. Maintaining habitat integrity and contiguity across protected areas and reserved forests is central to sustaining viable populations. The strategy promotes ecosystem-based management to preserve ecological processes and landscape connectivity.

An integrated landscape management strategy is proposed through delineation of Landscape Management Areas (LMAs). This involves collecting ecological and socio-economic inventories, assessing trends and human use, setting multi-use conservation goals, evaluating alternative management options and finalizing time-bound strategies. A structured monitoring and evaluation system is recommended to ensure adaptive management. Landscape analysis integrates ecological, hydrological, spatial and socio-economic components to identify risks and opportunities. Ecosystem-based management emphasizes habitat connectivity, restoration of ecological structure and processes, incorporation of community resource use, integration of biological and governance perspectives and development of a shared conservation vision based on scientific and local knowledge. The chapter addresses disturbance regimes affecting elephant habitats, including invasive species spread, biotic pressures and overgrazing, forest fires, declining catchment capability and water scarcity, wetland degradation, NTFP extraction and impacts of linear infrastructure. It also integrates climate change adaptation and disaster risk reduction into habitat restoration and management planning.

Corridor protection and management of dispersing populations are prioritized. The plan recommends securing and restoring corridors, monitoring traditional migratory routes and addressing localized overpopulation or splinter groups through habitat improvement and scientific management. It also highlights regulating human spatial activities, such as crop patterns and settlement expansion, that intensify conflict. Reducing livelihood dependence on forest resources is emphasized through eco-development initiatives and alternative livelihood support. Safeguarding threatened biodiversity values alongside elephant conservation is considered essential to maintaining ecosystem balance.

Elephant protection measures include identifying vulnerable areas, documenting traditional migratory routes, strengthening anti-poaching mechanism. Strategies include enhancing anti-poaching camps, developing intelligence networks, coordinating with enforcement agencies, sustaining patrol operations and maintaining village-level crime records to deter wildlife crime.

Elephant health monitoring is addressed through systematic surveillance, veterinary care and disease monitoring. Improved veterinary infrastructure, management of government-owned and privately held captive elephants, and adoption of a One Health approach integrating wildlife, livestock and human health are key components.

Sustainable waste management and sanitation around elephant habitats to prevent unnatural attraction and reduce health risks. Effective solid waste management in fringe settlements is viewed as part of conflict mitigation.

Stakeholder involvement and sectoral coordination are highlighted as critical. The plan calls for convergence of development schemes, improved understanding of ecological impacts, institutional coordination and knowledge sharing among forest departments, communities and other line agencies to ensure long-term, landscape-scale elephant conservation.

Human Elephant Conflict (HEC) and Planning Mitigation Strategy

The chapter begins by outlining the specific conditions of conflict in the landscape, noting that HEC is often seasonal, crop-driven and spatially concentrated near corridors and forest fringes. Operational requirements include rapid mobilization of trained staff, availability of vehicles & equipment, coordination with local administration and real-time communication systems. Identification of individual conflict-prone elephants and precise mapping of hotspots are emphasized as the foundation for targeted intervention.

Mitigation approaches stress the establishment of a synergistic strategy combining technology, field response and community engagement. Early warning systems- such as SMS alerts, watchtowers and local informant networks- are to be deployed in conflict hotspots. Continuous monitoring of elephant behaviour and movement patterns helps in anticipating conflict escalation. Integrated mitigation strategies are recommended for habitual crop-raiding or aggressive individuals, including coordinated field operations & scientific decision-making.

The plan calls for strengthening anti-depredation squads and patrolling mechanisms to provide rapid response in vulnerable villages. Managing straying and dispersing elephants outside forest habitats requires site-specific strategies such as driving operations, temporary barriers or, where unavoidable, capture and translocation. Site-specific barriers- including solar or steel rope or hanging fencing, elephant-proof trenches & natural barriers- are to be scientifically evaluated and maintained. Community-based awareness, cooperation and participatory conflict management are highlighted as critical for long-term success, supported by regular training and capacity building of frontline staff and local volunteers. Institutional capacity development is identified as a key requirement. A structured support system for conflict management includes dedicated response teams, veterinary backup, communication infrastructure & coordination with district administration & police departments. Strengthening interdepartmental linkages enhances efficiency during emergencies.

The chapter elaborates on emergency response protocols. In pre-emergency situations, preparedness measures such as hotspot mapping, equipment readiness and awareness campaigns are prioritized. During emergencies, coordinated field control, crowd regulation and medical preparedness are essential. Post-emergency actions include compensation processing, counselling, damage assessment and review of response effectiveness.

Crowd management and media engagement receive special attention. Threat analysis and risk assessment help anticipate volatile situations. Preparedness frameworks include clear command structures, containment measures and stakeholder roles. Challenges in forest–media engagement are acknowledged, and guidelines are proposed to ensure responsible reporting, timely information dissemination and prevention of rumour escalation during conflict.

Reducing the impact of HEC on affected communities is addressed through compensation and welfare mechanisms. The plan details procedures for ex-gratia relief in cases of human death, support for injury treatment, compensation for property and crop damage, livestock loss and livelihood disruption. Insurance coverage and mechanisms to offset conflict costs are recommended to build community resilience and trust.

Attention is also given to minimizing the impact of conflict management on elephant health. Post-capture protocols include safe handling, housing & sanitation standards, rehabilitation measures and monitoring prior to release. Rescue and rearing of orphaned or severely strayed elephants are included. Use of radio collars or RFID tagging is proposed to track high-risk individuals and prevent repeated conflict.

Occupational Health and Safety (OHS) measures are detailed for frontline personnel. Hazard and risk assessments guide safe procedures during pre-capture, capture, handling and transport of elephants. Protocols are provided for addressing human health emergencies and veterinary crises. A One-Health approach integrates wildlife, livestock and human health surveillance to manage zoonotic risks. Continuous competency development of personnel responsible for health emergencies is emphasized.

The chapter evaluates the economics and efficacy of HEC mitigation measures. It assesses socio-economic impacts; maps affected areas and reviews the status and effectiveness of physical barriers. Cost-benefit analysis of mitigation structures helps prioritize investments & improve resource allocation. A robust monitoring and evaluation framework is proposed to assess mitigation effectiveness, track conflict trends and refine strategies over time. Adaptive management, data-driven decision-making and periodic review are central to ensuring that human-elephant conflict mitigation remains responsive, efficient and socially equitable.

Ecological Sustainable Development

The chapter begins with tribal considerations and the role of forest-dwelling Scheduled Tribes (STs) and Other Forest Dwellers (OFDs) within the reserve. It provides background on traditional habitation, cultural linkages and dependency on forest resources. Recognition of forest rights under applicable legislation is emphasized, along with delineation of Critical Wildlife Habitats (CWH) where conservation priorities may require regulated access. Voluntary relocation of tribal settlements from critical habitats is addressed through safeguards, fair compensation and livelihood rehabilitation. The plan promotes synergy between Forest Rights and Joint Forest Management (JFM) to ensure participatory governance. It identifies the need for collaboration with line departments, development agencies, research institutions and NGOs to build a strong support system. Periodic review and monitoring of programmes are proposed to ensure transparency and adaptive management.

Ecotourism, interpretation and conservation education are presented as tools for sustainable development and awareness creation. General principles stress low-impact tourism, conservation-first approaches and benefit-sharing with local communities. The goal of ecotourism is to generate livelihood opportunities while strengthening conservation values. Objectives include environmental education, community participation, revenue generation and enhancement of visitor experience without compromising ecological integrity. Key aspects of ecotourism include identification of ecotourism resources, assessment of ecological concerns and carrying capacity, and adherence to guiding principles such as conservation of natural and cultural diversity, development of community-based tourism, infrastructure support, multi-stakeholder partnerships, capacity building and establishment of standards and norms. Strategies include zonation of ecotourism areas, constitution of Ecotourism Management Committees, preparation of site-specific management plans, infrastructure and visitor facility development, interpretation centres, marketing strategies and structured training programmes. Participatory impact assessments are recommended to evaluate ecological and social outcomes.

Ecodevelopment and livelihood improvement form a core component of sustainable development. The chapter outlines the scope and purpose of reducing forest dependency through socio-economic surveys, identification of key issues and formation of Eco-Development Committees (EDCs). Participatory planning processes lead to preparation of micro-plans tailored to village needs. Implementation includes skill development for tribal youth, soil and moisture conservation, preservation of traditional knowledge, conservation of heritage sites and diversification of livelihood options. Integration of rural development schemes is emphasized to leverage existing government programmes. Monitoring and evaluation mechanisms ensure accountability and measurable outcomes.

Mainstreaming the Zonal Master Plan in Eco-Sensitive Zones (ESZ) is another key focus. The chapter provides background on ESZ notifications and calls for integration of zonal plans with elephant conservation objectives. It promotes eco-friendly development, regulation of activities near protected areas and establishment of monitoring frameworks for ESZ compliance. Mainstreaming zonal plans into district and regional development processes is highlighted to ensure coherence between conservation and development. Synergy among departments within the NER landscape is considered essential for long-term sustainability.

Management Capacity Development

The chapter emphasizes activation of research as a cornerstone of informed management. Short-term research is oriented toward immediate management needs such as conflict hotspots, corridor functionality and habitat restoration. Long-term research addresses population dynamics, genetic connectivity, climate impacts, landscape ecology. An indicative list of research themes includes elephant movement ecology, human-elephant conflict, habitat productivity, invasive species management, socio-economic linkages and One-health concerns. The outcomes of research are expected to directly inform policy decisions, mitigation strategies and adaptive planning. Collaboration with research institutions, universities, NGOs & technical agencies is encouraged to enhance expertise & participation.

Preparation and updating of spatial maps form an essential component of management capacity. This includes habitat maps, corridor maps, conflict hotspot maps, land-use layers and infrastructure overlays to support planning and monitoring. GIS enhancement and strengthening of Management Information Systems (MIS) are proposed to integrate real-time data, field inputs and analytical outputs into a unified decision-support framework.

Infrastructure and mobility improvements are highlighted to enhance field effectiveness. This includes upgrading equipment for monitoring and protection, procurement of vehicles for rapid response and patrol duties, development of anti-poaching camps & staff quarters, strengthening office & field buildings. Adequate infrastructure ensures timely response to conflict situations and improved protection coverage.

Training and human resource development are central to capacity enhancement. On-the-job training strengthens practical skills in conflict mitigation, wildlife handling and community engagement. Formal and customized training courses are proposed through specialized institutions. Establishing a dedicated learning centre within the NER landscape is envisioned to facilitate continuous skill development, knowledge exchange & exposure to best practices.

A comprehensive monitoring and evaluation (M&E) framework is proposed to track management effectiveness. This includes developing standardized M&E protocols, identifying operational and outcome indicators, conducting regular field-based evaluations, and using scientific spatial monitoring tools. Concurrent evaluation and adaptive application of findings are emphasized, along with periodic review meetings and workshops. Pilot studies, thematic documentation and publication of findings are encouraged to build institutional knowledge. Information dissemination through websites and communication platforms is recommended to enhance transparency and public awareness.

The chapter advocates the use of innovative techniques and technologies such as radio-collaring, drones, camera traps, early warning systems and digital data platforms to improve monitoring and response. Compliance with Management Effectiveness Evaluation (MEE) standards ensures accountability and benchmarking against national conservation criteria.

Organizational strengthening includes clearly defined structures and responsibilities within forest divisions. Staff adequacy, improved amenities and welfare measures are recognized as critical to maintaining morale and operational efficiency. Human resource development (HRD) initiatives & performance-linked incentives are suggested to motivate personnel. Mechanisms for complaint monitoring and grievance redressal are also included to improve governance.

Financial planning forms a key component of management capacity. The chapter outlines the Plan budget for developmental activities and operational costs for day-to-day management. It also highlights the need for resource mobilization beyond the Plan, including convergence with other schemes, externally aided projects and partnerships.

Finally, the implementation schedule provides a structured timeline for activities, supported by a Schedule of Operations and regulatory framework. Mechanisms for maintaining records of deviations and tracking implemented targets are proposed to ensure accountability, and adaptive course correction.

Conclusion

The Elephant Conservation Plan for the Nilgiri Elephant Reserve (NER) presents a comprehensive, science-based and socially inclusive framework to secure one of India’s most critical elephant landscapes. Across chapters, the plan integrates landscape ecology, habitat connectivity, corridor protection, HEC mitigation, community participation, ecologically sustainable development and institutional capacity strengthening. It recognizes that long-term elephant conservation in NER depends not only on protecting core habitats, but also on managing interfaces, aligning development with ecological priorities, empowering local communities, and building robust research, monitoring and governance systems. By combining adaptive management, interdepartmental coordination and stakeholder partnerships, the plan lays a strategic roadmap to ensure viable elephant populations, reduced conflict and resilient ecosystems across the Nilgiri landscape.

PLANNING PROCESS

The preparation of the Model Elephant Conservation Plan (ECP) for the Nilgiri Elephant Reserve (NER) followed a structured, participatory and science-based planning process aligned with Project Elephant guidelines and ECP framework. The process integrated ecological assessment, field-level consultations, spatial analysis and institutional strengthening to ensure a comprehensive landscape-level strategy.

Constitution of the Planning Team

The planning began with the constitution of a core planning team comprising wildlife planning experts and nodal officer, elephant cell, WII. The core team was supported by the controlling officers and field officers from Nilgiris, Gudalur, Mudumalai Tiger Reserve (MTR), Sathyamangalam Tiger Reserve (STR), Erode, Dharmapuri and Hosur Forest Divisions.

Review of the Literature

Existing tiger conservation plans of tiger reserves, management plans of the wildlife sanctuaries, working plans of the forest divisions, eco-sensitive zone notifications and Project Elephant advisories were reviewed to ensure alignment and avoid duplication.

Project Initiation Meeting

In response to D/WII letter WII/Elephant-Cell/2024-25/Model-ECP-Plan dt 13-12-2024, Project Initiation meeting was held on 29th Jan 2025 with the Chief Wildlife Warden, Tamil Nadu and Director, WII, along with Wildlife Planning Experts, Nodal Officer, Elephant Cell and all field officers.

Pre-MCP Field Visit

The first field visit to the NER was undertaken by the Wildlife Planning Experts and Nodal Officer, Elephant Cell from 26th to 30th Sept 2023 as part of the pilot-testing of the MEE of the NER, in which all the divisions were inspected and basic information was collected

MCP related First Field Visit

The visit was conducted as part of the Model ECP preparation to Nilgiris and Gudalur divisions (in Western Ghats) from 13th to 16th Aug 2025, and discussions were held with the Field Director, MTR and his team members at Udhagamandalam and Gudalur.

Data Collection, Map Preparation and Drafting of Chapters

The visit to WII was undertaken from 8th to 12th Sept 2025. in which discussions were held on various chapters of the MCP. The list of data required was communicated to the field controlling officers; besides, GIS data was collected and preparation of draft chapters commenced as per the ECP framework.

MCP related Second Field Visit

Another visit was conducted in the STR (Eastern Ghat sector) from 27th to 30th Jan 2026 and discussions were held with the Field Director, STR and his team members at Hassanur and with the CCF Dharmapuri and his team at Erode.

Formation of the Discussion Forum

A Whatsapp Group 'NER Model ECP' was created on 5th Feb 2026 along with the field officers and situation analysis was undertaken to compile ecological, demographic and socio-economic data as per the information and data related to structured interactions and data received from the field officers.

Finalisation of the Draft Chapters of the MCP

The preparation of the Model ECP for the Nilgiri Elephant Reserve followed a consultative, data-driven and multi-sectoral planning process, ensuring that elephant conservation is integrated with landscape management, community welfare and long-term ecological sustainability.

CHAPTER 1: INTRODUCTION

India supports an estimated 60% of the global Asian elephant population and harbours nearly 29,964 Asian elephants spread over an area of 110,000 km^2 of which 65,000 km^2 is constituted as Elephant Reserves (ER). There are 33 ERs across 23 states, covering 11 elephant landscapes in four distinct regions, connected regionally by 150 corridors. The ERs cover approximately 30% of Protected Areas (PA), 40% of Reserved Forests (RF) and another 30% of private lands.

The Asian elephant (*Elephas maximus*) is the largest terrestrial herbivore species, whose population and areas of occupancy has significantly declined over the years. Elephants are recognized as flagship species and continue to face significant challenges including habitat loss and fragmentation, human elephant conflict, anthropogenic pressures such as grazing, non-timber forest produce collection and development pressures. In this context, the landscape approach to conservation is the most appropriate strategy for integration of area development, while maintaining biodiversity values and ensuring ecological integrity.

The Project Elephant has identified four Regions viz North Western, Eastern, North Eastern and Southern with 33 Elephant Reserves, which are the basic management units for elephant conservation in the country. The Reserves are delineated state wise though the ecological boundaries of a reserve extend into adjoining reserves of adjacent states which needs to be harmonised. The Elephant Reserve covers Tiger Reserves, Protected Areas (National Parks, Wildlife Sanctuaries, Community Reserves, Conservation Reserves), Reserved Forests, Forestry plantations and areas under Eco-sensitive Zones.

1.1 DESCRIPTION OF THE REGION / LANDSCAPE WITH ATTRIBUTES

Located in the Western Ghats and Eastern Ghats, the Nilgiri Elephant Reserve (NER) is a large, complex, heterogeneous land area, an embodiment of ecological patterns and processes, consisting of a mosaic of 'patches', or landscape elements and the key units include Mudumalai & Sathyamangalam Tiger Reserves; Cauvery & Periyar Thanthai Wildlife Sanctuaries; and territorial forest divisions of Nilgiri, Gudalur, Erode, Dharmapuri & Hosur divisions.

NER requires a comprehensive and multi-scale approach that includes PAs, TRs and the surrounding buffer area (RFs, ESZ) 'matrix'. The matrix contains a variety of land uses and ownerships, not necessarily the biodiversity rich entities only. The landscape encompasses biodiversity rich areas (global hotspots, unique endemic species, wetlands, marshes, etc) with PAs lying at the core, the buffer with managed forests and lands, extending to agricultural rural landscape along with urban settings and network of linear infrastructures.

The legal status of various administrative units in the ER landscape (PAs, TRs. RFs & ESZ) is notified under the relevant Acts (Wildlife Protection Act, Indian Forest Act or State Forest Acts & Environment Protection Act etc).

1.1.1 Boundary description

Nilgiri Elephant Reserve (NER) was notified on 19/09/2003 vide No. G.O.(Ms)No.151 by the Tamil Nadu Forest Department in pursuance to the guidelines issued by the Project Elephant Division, MoEF&CC, Govt. of India. It includes erstwhile Reserved Forests and Protected Areas; now reconstituted in Mudumalai Tiger Reserve (MTR), Sathyamanagalam Tiger Reserve (STR), Cauvery North & South Wildlife Sanctuaries (CWLS) and Forest divisions of Nilgiris, Gudalur, Erode, Dharmapuri and Hosur.

There are 3 important zones with relatively intact habitat and with large elephant populations within this elephant reserve (Fig-1.1). They are as follows:

1. Western Ghat portion of MTR, Nilgiris & Gudalur forest divisions.
2. Eastern Ghat portion of STR & Erode division.
3. Eastern Ghat along the Cauvery River in CWLS and Dharmapuri & Hosur forest divisions.

Nilgiri Elephant Reserve spreads over an area of 4662.45 km^2 and is located in the North-Eastern edge of the state bordering Mysuru Elephant Reserve of Karnataka in the North along with Wayanad and Nilambur Elephant Reserves of Kerala in the West and Coimbatore Elephant Reserve in the South.

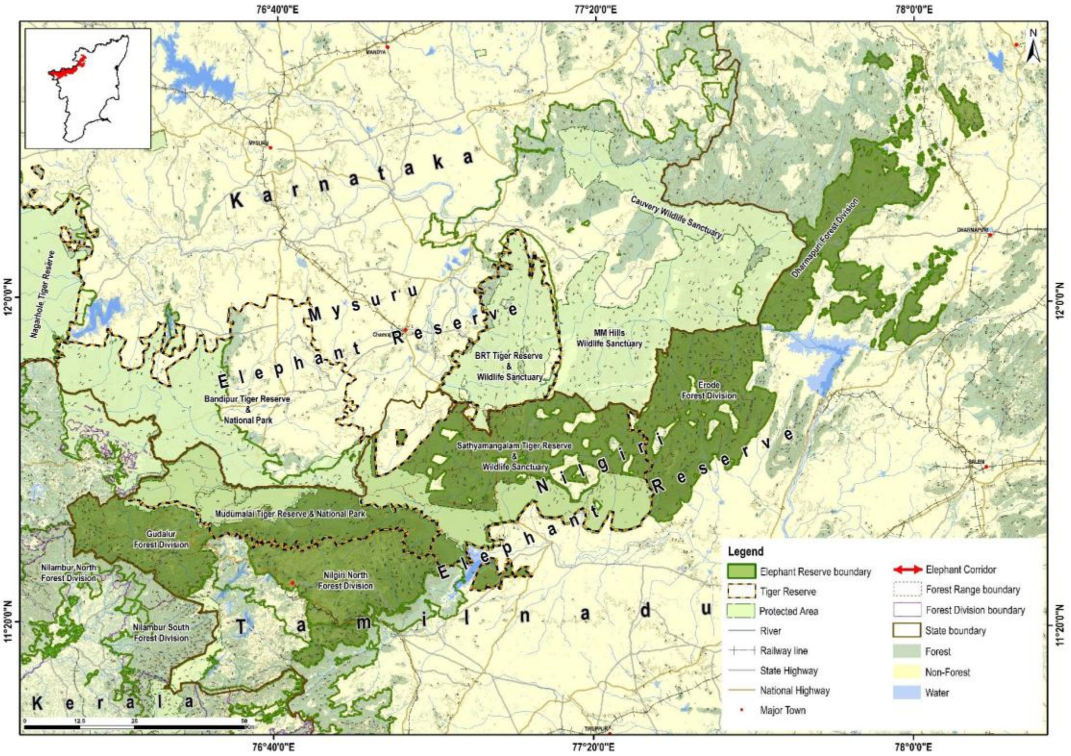


Fig-1.1: Map showing the Nilgiri Elephant Reserve boundary and area

1.1.2 Topographic attributes

The topographical attributes of an Nilgiri Elephant Reserve contribute significantly to the overall habitat and ecological dynamics within the region, which exhibits an alignment from south west (Western Ghats) to north east (Eastern Ghats). The key topographical features in NER include: mountainous terrain; valleys and ravines; plateaus and tablelands; rivers and waterways; caves and caverns etc.

- The **south-west region** is constituted with Nilgiris & Gudalur forest divisions and Mudumalai Tiger Reserve (MTR). Towards southern portion of the NER, is an extensive Nilgiris plateau with an average elevation of 2000m. The plateau consists of a series of undulating hills and valleys which rarely rise/ fall much above/ below the average elevation of the table land. The network of streams rising from the Nilgiris plateau leads into the river systems viz. Sigur river and Kedar-halla, flowing into the Moyar. The terrain in Gudalur consists of the Nilgiris - Wayanad tract and is undulating with low hills and valleys. A characteristic feature of this tract is the frequent occurrences of swamps of varying sizes at the foot of the hills and in the more accessible localities, many of these swamps are cultivated for paddy. The average elevation of the tract is about 1000m which closely corresponds to that of the Mysore Plateau having the highest peak (Needle Rock) with an altitude of 1526m. The MTR, which represents the faulted and eroded edge of the deccan plateau, has a gentle slope with undulations and peaks. The elevation ranges from 792m-1266m (Morganbetta peak) and has a 100-300m steep 'gorge' in Moyar river along the northern side of the reserve. The area also has various special features such as overhangs, caves (Karadibetta) etc.

- The **central region** is constituted with Sathyamangalam Tiger Reserve (STR) and erstwhile Erode Forest division (now Thanthai Periyar Wildlife Sanctuary). The terrain of STR is undulating having elevation ranging from 960m to 1494m with the northern part being almost flat in nature. The terrain of Erode division exhibits a wide range of altitude and diversity in general configuration comprising mostly from north Coimbatore plateau, hillocks and plain forests, and foot hills. The eastern part of the plateau drains into the Cauvery River and the northern part drains into the Palar River which ultimately joins the Cauvery. Bargur and Kathirimalai forms the major forested hills of this division falling in Anthiyur taluk.
- The **north-east region** is constituted with Dharmapuri forest division and erstwhile Hosur forest division (now Cauvery North & South wildlife sanctuaries). The tract of Dharmapuri forest division has Hudedurgam hills (extreme bouldery terrain with huge rocky outcrops) and Woddapatty hills of 'Melagiris' (succession of hill ranges between the Chinnar and Cauvery Rivers). The western part between Pennagaram and Denkanikottai also has hill ranges of Mysore Plateau. The Hosur plateau dominates the division with large tracts of forests, many villages and extensive areas of cultivation, some of which constitutes as enclosures in the forests. The major portion of the CNWLS in the north lies in the Hosur plateau which is at an average altitude of around 900m, and is part of the 'Melagiris'. The terrain is hilly with valleys and ravines generally running north to south in the direction of the Cauvery River. The Chinnar in its course from near Thalli to Hogenakkal, where it falls in the Cauvery, describes a crescent the hours of which point westwards. A chord to this area is formed by a massive ridge of mountains, running north east by north and south west by south which culminate in the Guthirayan (1402m). The southern portion descends suddenly towards Anchetty where the altitude drops to around 500m. Beyond the southern boundary of the sanctuary, the forests of Melagiris continue to descend towards the Cauvery River to around 250m. Two major valleys namely the Hebbahalla or Kovaipallam in Denkanikotta range and Panai Kovai in Jawalagiri range are noteworthy. Also, the average elevation of the CSWLS is about 400 to 500m, but a few of the rocky hills are over 1,000m. The area is a large contiguous forest having common boundary with Cauvery Wildlife Sanctuary of Karnataka on its western and southern sides and CNWLS on the northern side.

Topographic features also provide unique habitats like the deep valleys and gorges home to endangered species. Terrain together with other environmental and physical factors strongly influence the distribution and density of vegetation communities; also, habitat use by wild animals. The combination of these topographical attributes creates a mosaic of habitats within the NER, supporting the complex web of life that includes elephants and a diverse range of plant and animal species.

1.1.3 Geological attributes

Understanding the geological attributes is integral to ensuring the health and sustainability of the entire ecosystem and conservation efforts must take into account the geological intricacies to maintain the balance and resilience of the landscape. The key geological features in NER include: rock formations (Fig-1.2); granite outcrops; caves and riverbeds; mineral deposits; aquifers and water sources; etc.

- In the **south-west region** of the NER in **Nilgiris**, in several places, escarpments may be traced which, though now partly cut up into ravines and rounded spurs by the denudation resulting from the heavy rainfall, were apparently formed by oceans washing their bases. The Nilgiris plateau consists mainly of Archean gneiss and chondolites and schist comprising of grandoid gneiss. the huge hill masses are mainly made up of charnockites, leptynites and other gneissic rocks profusely intruded by pegmatite veins. The subtropical climate has facilitated the leaching out of silica from the (leptynite) charnockite in the process of alteration and has given rise to bauxite and clay deposits. The deposits of iron ore and bauxite are confined to the hill tops in a few places. The charnockite masses are altered into ferruginous clays. In **Gudalur**, Biotite-Gneiss forms the dominant country rock throughout the area. Other types include hornblende-biotite gneiss, pyroxene granulite, ferruginous quartzite, charnockite, gabbro etc., which have been profusely intruded by later pegmatites and quartz veins. The presence of amphibolite in the form of dykes is also noticed at places. The later intrusive such as amphibolite, pegmatite and quartz veins are of economic importance as they contain mica and gold respectively. A number of mica bearing pegmatites (muscovite) can be seen around Pandalur, Devala and Kolapally. The division also abounds in hard rocks such as ferruginous quartzite, charnockite and gneisses which are found at many places for road and building construction. In **Mudumalai TR**, the mountain ranges comprise of Achaean metamorphic rock which include charnokite, biotitic, magnetite, quartzite, hornblende, granulite, pegmatite, dolerite and quartz veins. Small enclave schistose rocks such as talc chloride schist occur in areas bordering Gudalur. Laterite is prevalent extensively in Mudumalai occurring as mantle over country rock including Lithomarge. Mineral resource like mica is present in Masinagudi range of MTR.

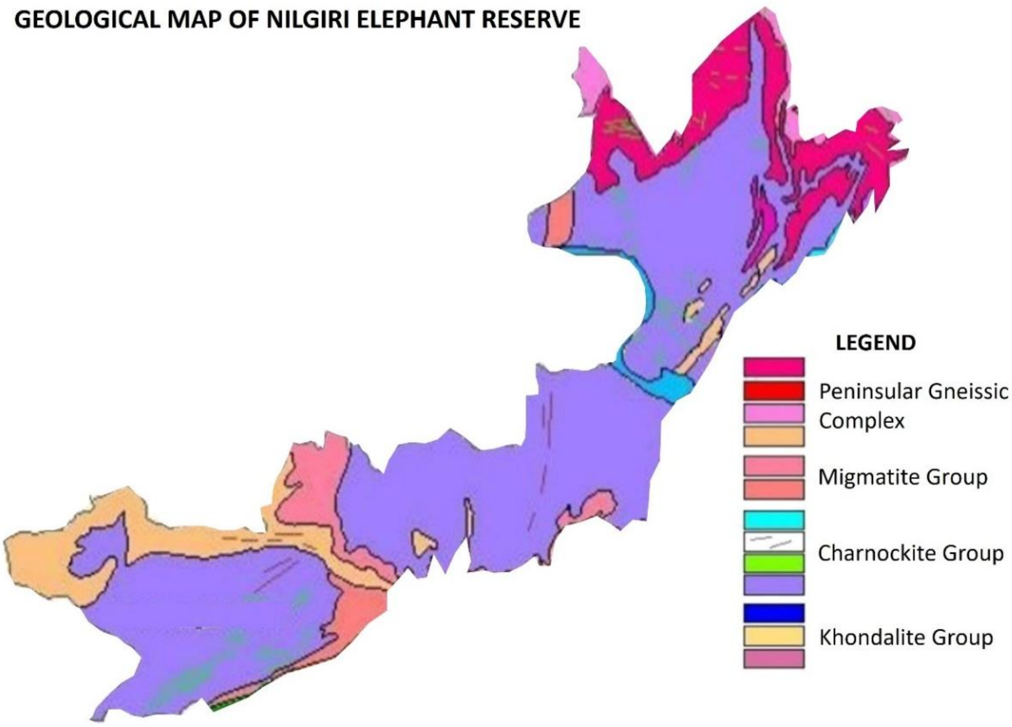


Fig-1.2: Geological Map of Nilgiri Elephant Reserve (as adapted from Geological Map of Tamilnadu: Source District Mineral Survey Report for Granite-Erode District, 2019)

- In **central region** of NER, especially in **Sathyamanagalam TR**, the rock types of the core area mainly belong to the great gneissic Pre-Cambrian age. The common metamorphic derivatives found in the reserve are metamorphosed sedimentary rocks such as quartzite, hornblende, amphibolites, pyroxenite etc. The rocks acquire reddish tinge (east of the reserve). Metamorphic igneous rock types such as charnockites and granite gneiss have widespread occurrence. The charnockites have bluish-green look and the most widespread in the hilly forests. The minerals found in the core area are feldspar, quartzite, magnetite, garnet, and kyanite. In **Thanthai-Periyar WLS, Erode**, the rock types mainly belong to the great gneissic series of Archaean and Precambrian ages. They are the granulite group of rocks consisting of the dark coloured charnockite, basic granulite, magnetite, quartzite etc., and the light coloured garnetiferous, sillimanite gneiss and pink felspathic pegmatite gneisses. These are mainly seen on the plateau in Bargur range. The leucocratic to mesocratic gneissic group of rocks with a number of enclaves of the other schistose, micaceous and amphibolitic rocks, fuchsite and kyanite bearing schists, quartzites-calc-granulites etc, intruded by a number of ultramafic/basic rocks, are encountered in foot hills and plain areas. The economic minerals occurring in the area are magnesite, charnockite, magnetite (quartzite) corundum, sillimanite, kyanite, garnet and road metals.

- In **north-east region** of NER, in **Dharmapuri**, the underlying rock for the most part of the division is a gneissic or metamorphic series of crystalline peninsular complex traversed by irruptive rocks in the form of trap dykes and granite veins. A few unimportant sub serial deposits and alluvia of different rivers occupy the remaining part. The formation of gneiss belongs to the oldest group of rocks in the Archaen system. Despite the age and the great amount of metamorphism they have undergone, their truly sedimentary origin may be seen generally. Five important trap dykes are noted and they run in as south east to north-west direction in the southern part of the division. They consist generally of rather coarse grained but exceedingly hard and tough black - basalt like mass. Their age is pre-cretaceous. Black granite stone is quarried from these rocks for exporting as building stone. High quality black granite is present in this district. Another high value mineral available in this district is Molybdenum. In the region, crystalline rock formations of Archaean metamorphic complex are exposed. The southern part mainly consists of charnockite with minor intercalations of granite gneiss while northern portion is made up of only granite gneiss with discontinuous patches of schistose rocks. In **Hosur** area, underlying rock of the plateau is granulite gneissic formation of Archean origin belonging to the group known as "Sathyamangalams" consisting of quartzite ± fuchsite ± kyanite ± sillimanite and banded iron stone. The carbonate and ferruginous beds at many places show high proportion of manganese. The rocks of Sathyamangalam group generally occur as dismembered bands and lenses within the Peninsular Gneissic Complex. Granite is abundant and quarried in many areas of Krishnagiri district. In **Cauvery North & South WLS**, the underlying rock is a gneissic formation of Archean origin traversed by trap dykes. A remarkable five quartz reef exists near Gummalapuram to the north-west of Thalli. Iron ore was worked in the past around Anchetty area and magnetite seams traverse several hills in many areas. In general, granite is abundant and quarried in many areas of Krishnagiri district.

1.1.4 Edaphic attributes

The edaphic attributes of the NER refer to the soil-related characteristics that influence the types of vegetation, nutrient availability, and overall habitat suitability for elephants and other wildlife in the reserve. The key edaphic attributes include: soil composition (Fig-1.3); organic matter (litter); water retention capacity; soil structure; and soil moisture levels etc

- In the **south-west region** of NER, the soil of the **Nilgiris plateau** is classified as Ootacamund soil series and is predominantly red lateritic mainly derived from igneous and metamorphic rocks. Moderately high precipitation, abundance of grass or other vegetation and good drainage have combined to furnish ideal conditions for deep and extensive weathering of the rocks and also for accumulation of a considerable amount of organic matter. The soils have layers of solum and a degree of horizontal differentiation and vary considerably in depth from a few cms to several metres. The soils may be roughly classified under four varieties, namely - black soil; brown soil; yellow soil; and the red soil. There is absence of lime in the soil. The PH value of the soils range mostly from 5.0 to 6.5 although in some localities higher or lower values may prevail. In **Gudalur** area, the soils are derived from charnockite, gneiss and pyroxene granulite rocks. The area receives a relatively higher amount of rainfall causing an aquic moisture regime and hyperthermic temperature regime. The undulating topography has shallow soils on the crest of the hillocks and moderately deep soils on the hill slopes. Soils on gentle to moderate hill slopes are extensively used for tea plantations whereas valley soils are mostly used for cultivation of paddy. There are 12 soils series falling under 4 soil orders viz. Mollisols, Alfisols, Inceptisols and Entisols. Generally, Inceptisols occur under evergreen forests whereas Alfisols and Mollisols occur under moist deciduous forest types. Due to high rainfall on the southern part of the division, soils are shallower than those in the northern part. The adjoining **Mudumalai TR** is having broadly two types of soil - black sandy loam containing over 50 percent of sand and gravel; and red heavy loam soil. The red soil is generally confined to the southern part of the reserve, where rainfall is high and carries much better growth (height) of trees and plants than the black soil. The northern part of the reserve has blackish soil, which does not favour better retention of moisture, and possibly has more infertile mineral content and thereby show poor growth. The eastern part of the reserve has gravely soil, with very poor rainfall and poor soil moisture content resulting in stunted growth of plant cover, especially trees. The soils of MTR are mostly derived from granite and granite gneiss. The soils are slightly acidic to neutral in soil reaction (pH 6.0 to 7.2). High soil organic–C was recorded in these forest soils ranging from 1.5 per cent in scrub forests to 3.42 percent in moist deciduous forests. Available nutrients for vegetation increased with increase in soil organic-C and recyclable biomass-C. Seasonal litter fall associated with fire damage, especially in dry deciduous and moist deciduous forests, is likely to cause huge nutrient losses from the system in run-off and leaching water.

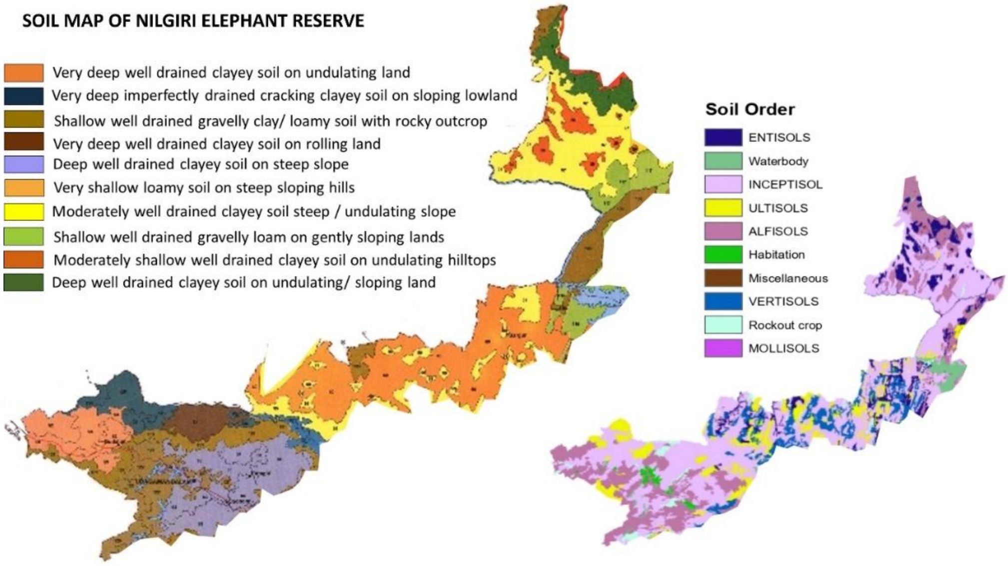


Fig-1.3: Soil Map of Nilgiri Elephant Reserve (as adapted from Tamil Nadu Soils Sheet-1&3. Source: National Bureau of Soil Survey (NBSS) and Land Use Planning (LUP) 1996)

- In the **central region**, especially in **Sathyamangalam TR** and **Thanthai Periyar WLS**, the common soil types are red soils, laterite soils, black cotton soils, and alluvial soils. Soils vary rapidly with altitude and slope. Major variations in types are due to disintegration of charnockites, granite and gneiss. Most of the soils are residual. Charnockite soils support good forest growth while granite gneisses are shallow to a depth of 10 to 30 cm and least fertile. In some parts, the soil varies from patches of black clayey soil to shallow reddish loam. In the plain forests the soil is shallow and bouldery and is mostly devoid of humus due to long dry spell and periodic fires in the dry season and is washed away by the initial rains.

- In the **north-eastern region** of NER, the most common soil type is red sandy loam varying in depth and fertility. Such red soils are derived from the decomposition and weathering of underlying rocks which are ferruginous, especially the hornblendic varieties. There is generally a deficiency of lime in soils that supports sandal forests. The soil has low nitrogen and phosphate content with marked variations in **Dharmapuri** area. In Krishnagiri, Hosur and Rayakotta ranges of **Cauvery WLS**, the red soil is mixed with gravel and boulders. Black soils are seldom found in the forests. Alluvium is very rare; and Kaolin, as well as samples of laterite, are found in Jawalagiri and Thali areas. The Kaolin soils are subject to gully erosion and are deficient in tree growth. Parts of Thali RF contains fertile but shallow soil resting on impenetrable rock, because of which the forest supports a mixture of dwarfed tree species.

1.1.5 Climatic attributes

The climatic attributes of an NER significantly influence the overall ecosystem, including the types of vegetation, availability of water, and the behaviour of elephants and other wildlife. The key climatic attributes in NER include: temperature range; seasonal variations; rainfall patterns; monsoons; humidity levels; wind patterns; and altitude effects etc. Landscape can also help define regional climate; a region's elevation, proximity to the water, and land-use patterns, can all impact climate.

a) Rainfall

- **South-west region**: The **Nilgiris** plateau enjoys both the monsoons. The rainfall is more than 2000mm in the upper reaches which gradually diminishes towards the interior plateau. The rainy season in **Gudalur** starts with the pre monsoon showers by the end of May and reaches its peak during July and continues up to December. By the time the south west monsoon retreats in September, the north-east monsoon becomes active and continues up to the end of December contributing a significant rainfall, averaging 2286.64mm. The western part of the landscape receives rainfall from both southwest and northeast monsoons. The **Mudumalai TR's** eastern side lies on the leeward side of the Nilgiris and hence receives a poor rainfall of 886.25 mm /year and there is a gradual increase in rainfall towards the western part of the reserve. The western most part of the reserve abutting Gudalur division and Wayanad WLS receives an average of 2491.12 mm/year of rainfall.

- **Central region**: The northern slopes and eastwards towards the **Sathyamangalam TR** across the Segur plateau, the area lies in the rain-shadow region, and the bulk of rain fall is derived (70%) from the north east monsoon during October and November. Average annual rainfall in STR is about 824mm. The period from January to April is usually dry, though from May onwards, intermittent rains may occur till August. However, variation could be noticed from east to west. In the eastern part of the landscape comprising of **STR & Thanthai-Periyar WLS**, in some areas, both the monsoons are active and make more or less equal contribution of the rainfall to the division.

- **North-east region**: In **Dharmapuri** division, the average annual rainfall is 719mm. There is remarkable uniformity in the amounts of rainfall which is received practically all over the division. It may be because the places are sheltered by hills practically all round and function somewhat like rain shadow areas in respect of both the monsoons. The south west monsoon contributes 35 percent of the annual rainfall while the north east monsoon and the thunder storms (that occur in April and May) contribute about 39 and 10 percent respectively. The mean annual rainfall of **Hosur** division is 882mm, of which 706mm is during monsoon. The **Cauvery North & South WLS** receive rainfall during both south west monsoon (36%) and north east monsoons (64%); however, south west is less effective due to the series of hills to the south of the sanctuary. Parts of Denkanikotta range experience the highest rainfall close of 1000mm and the rainfall varies from 500 to 1100mm. The bulk of precipitation is received from August to November averaging around 100mm a month. December to March is dry period with January being the driest month.

b) Temperature

- **South-west region**: By virtue of its altitude, although situated in the tropical zone, the **Nilgiri** plateau enjoys a sub-tropical to temperate and equable climate with the maximum mean temperature generally as 23^{0}C which occurs in April and the minimum temperature 7^{0}C. In **Gudalur** area, the average monthly temperature in a year varies between 32^{0}C and 16^{0}C average with the monthly maximum temperature going up to 30.8^{0}C (in March) and the minimum temperature falling down to 13.8^{0}C (Dec-Jan). Frost is unknown while mist is very common. The **Mudumalai TR** experiences cold weather during the month of December or beginning of January and hot weather is experienced during the months of March and April.

- **Central region**: In the eastern side of the landscape the average minimum and maximum temperatures are 21.54^{0}C and 27.02^{0}C in the plateau and the average minimum and maximum temperatures are 26.24^{0}C and 32.84^{0}C in the plains respectively. Thus, the climate of the eastern landscape around **Sathyamangalam TR** is moderate. The plateau enjoys a mild and equable climate favourable to vegetation. Lower slopes of the hills and other plain forests are subject to a very hot and dry climate. In **Thanthai-Periyar WLS**, the hot months are March, April and May with maximum temperature ranging from 35.5^{0}C to

36.8°C. The cool months are November, December and January with the minimum temperature ranging from 23.9°C to 24.1°C.

- **North-east region**: **Dharmapuri** district is situated in the western agro-climatic zone and is generally warm. The district has hot and dry weather in summer during March to May with the mean daily maximum temperature of about 37°C and the mean daily minimum temperature of about 25°C in the plains. The climate becomes cool in December and continues up to February, touching a minimum of 17°C in January. In the northern portion of the **Hosur** plateau (Shoolagiri) where the average elevation is about 1,000 metres, the climate is generally salubrious and pleasantly cool for about 9 months in the year. The south-western portion comprising mostly of the **Cauvery** valley (altitude below 300m), climate is too hot in summer when temperature shoots up to 38°C. It is comparatively cool and pleasant during November and February.

c) Relative Humidity

- The annual mean relative humidity of in the south-western region of the NER especially in Gudalur and Mudumalai, ranges from 64% to 70.58% and eastwards the humidity increases as the rainfall is much more with both the south west and north east monsoon contributing equally. In the north-eastern region of the NER, in Hosur division and Cauvery WLS, the maximum relative humidity of about 78% occurs during December and minimum relative humidity of about 31% occurs during March. This also coincides with the peak fire season.

d) Wind

- The south west monsoon between June and September brings strong winds which cause a desiccating effect if rains are poor. The maximum wind velocity on the western part of the landscape is 4 kmph during the month of June and the minimum wind speed is recorded as 1 kmph during the month of April. Eastwards the wind speed increases and the winds measured in Dharmapuri division indicates the maximum and minimum normal wind speed as 10.3 kmph and 4.6 kmph during the months of June and October respectively. The mean annual wind speed observed during the above period is 6.7 kmph.

e) Drought

- Drought is defined as *"temporal deficiency"* of water. In Mudumalai Tiger Reserve, it receives rainfall both from southwest and northeast monsoons and water is available in all seasonal waterholes during monsoon seasons and after monsoon season, water accumulates in seasonal waterholes for animals until February. During the months of March and April, water is available only in perennial waterholes like Game Hut, Ombetta and some of the streams. All seasonal waterholes and streams dry up. The drought period also coincides with the accumulation of dry leaf litter and fire.

1.1.6 Hydrological attributes

The hydrological attributes refer to the characteristics of water-related features within the NER, including rivers, lakes, wetlands, and other water bodies. These attributes play a crucial role in shaping the habitat, supporting biodiversity, and influencing the behaviour of elephants and other wildlife. Conservation efforts aim to preserve the natural flow of water, maintain water quality, and address any anthropogenic impacts on the hydrological systems within the reserve.

The key hydrological attributes in NER include: aquatic habitats; rivers and streams; lakes and reservoirs; wetlands and marshes; water quality and water availability; water table levels; seasonal fluctuations; water temperature; water flow dynamics; erosion and sedimentation; and water management practices etc. Besides, there are many other features of hydrology such as perennial and non-perennial streams, stream width and depth, discharge, substratum size, which affect the species composition and productivity.

- **South-west region**: The Pykara river which rises as the Mukurti stream in the upper reaches of the Nilgiris, drains in the extreme west of the plateau plunges down a steep valley by a series of falls, into the low-lying area near Gudalur. Thence, the river (thereafter known as Moyar) winds placidly to Theppakadu, turns sharply eastwards, drops over a considerable fall, passes through a narrow gorge, known as the 'Mysore ditch' and finally falls into the Bhavani. Moyar River is the major water source for wildlife and people living in and around the reserve. Avarhalla (9km long) is another perennial water source in the eastern part of MTR. Several seasonal streams in MTR include Mavinhalla, Bidharhalla, Sigur River, Doddakatti halla, Hebhalla, Imberhalla, Bennahole, Kakkanhalla, and Mukkatti hole, where water flows only during rainy season but is available for wildlife in puddles throughout the year. Many perennial waterholes like Ombetta, Game hut, C3, Nardhi check dam exist in MTR but retain less water during the end of dry season. Though this area is in low rainfall zone, it is blessed with presence of perennial water sources like Moyar river, Sigurallah river, Kedarallah river and many other semi perennial streams. The Kedar halla, flows past Anaikatti in Sigur Range to fall into the Moyar.
- **Central region**: There are 2 catchments, 5 sub catchments and 15 watersheds, out of which 8 watersheds lie in STR. The core zone of STR plateau in general has northerly aspect and is drained by Moyar river and to certain extent by river Bhavani. Most of the streams from the eastern half of the plateau drain into the Suvaranavathy and Palar watershed while, the streams from west and south-west join Moyar. Palar flows northwards along the common boundary of STR and Erode division and joins Cauvery. River Bhavani, enters into the area from upper Bhavani through Bhavanisagar Range in south-west region. Bhavani river originates from the Nilgiris (217km long) as a perennial river and courses majorly through Coimbatore and Erode districts. About 90 per cent of the river's water is used for irrigation (agriculture). Moyar is a major tributary of river Bhavani. The central and north-western parts of the STR plateau are drained by numerous torrents, streams which flow only during the rainy days and join river Bhavani. These water bodies serve as a critical water source to wild animals during the dry spell between January and May. About 30 kilometres downstream, Moyar river drains into Bhavanisagar reservoir (Lower Bhavani) located at the periphery of the core zone of STR and serves as a perennial source of water for wild animals. Swarnavathi and Halibidha halla are the other major streams of the reserve. Besides, there are many other minor streams and number of ponds which also meet the water requirements of both wildlife and domestic cattle in the area.
- **North-east region**: Cauvery and its tributaries Chinnar and Thoppaiyar flows for the most part amidst forested hills in the western side of the region. River Ponnaiyar, a perennial river originating in Karnataka, flows past many of the ex-panchayat forests of Morappur and is well utilized for irrigation purposes throughout its course. Pambar river, which originates from Penugondapuram passes through Uthangarai and joins Cauvery at Hogenakkal. The forest area forms catchment for semi perennial rivers like South Pennaiar, Pambar, Chinnar, Barur etc. Generally during monsoons, flow of water is moderate in the above rivers. There are many tanks and check-dams inside Hosur division, which are mostly seasonal and act as a water source for wildlife (Battalmadugu check-dam). Numerous seasonal streams and rivulets flow in an easterly or southerly direction. The most important river is the Chinnar or Sanathkumara Nadhi which rises at Thali Lake and is fed by the streams from around Devarbetta within the CNWLS. The Sanathkumara Nadhi feed the Panjapalli reservoir. Doddahalla and Annaebidahalla are some of the other important seasonal streams that pass through the sanctuary.

1.1.7 Biological attributes

The biological attributes encompass the diverse array of flora and fauna that inhabit the region. These attributes contribute to the overall biodiversity, ecological balance, and the well-being of elephants and other wildlife. Conserving the biological attributes, is fundamental to ensuring the long-term health and sustainability of the ecosystem. Elephant reserves are critically important habitats in terms of the biological diversity they contain and in terms of the ecological functions they serve.

The key biological attributes in NER include: forest types; vegetation zones; floral diversity; keystone plant species; faunal diversity; mammalian diversity; avian diversity; reptiles and amphibians; insect life;

microbial communities; endangered and threatened species; plant-animal interactions; ecological interconnectedness; and genetic diversity etc.

a) Plants

- **Biogeographic Classification**: The NER lies in the 2 biogeographic zones as under:

  - Western Ghats (Zone-5): includes Nilgiri & Gudalur forest divisions and Mudumali Tiger Reserve (MTR). The varied climate and diverse topography create a wide array of habitats that support unique sets of plant and animal species. The Western Ghats are amongst the 25-biodiversity hot-spots recognized globally. These hills are known for their high levels of endemism expressed at both higher and lower taxonomic levels. Most of the Western Ghat endemic plants are associated with evergreen forests. The region also shares several plant species with Sri Lanka.

  - Deccan Plateau (Zone-6): includes divisions in Eastern Ghats viz. Sathyamanagalam Tiger Reserve (STR), Thanthai Periyar Wildlife Sanctuary, Erode, Dharmapuri forest division (part), Hosur forest division (part), Cauvery North & South Wildlife Sanctuaries. Beyond the Western Ghats, is Eastern Ghats, a semi-arid region lying in the rain shadow area, broken into small hill ranges by river coming from the western ghats and the highlands of the plateau are covered with different types of forests, which provide a large variety of forest products.

- **Champion & Seth's Vegetation Types**: The Western Ghats has nearly 4000 species (27% of the total) of flowering plants of which 1500 species are endemic (Nayar, 1996). The gymnosperm flora is represented by Cycadales, Coniferales and Gnetales. Amongst the lower plants, around 150 species of pteridophytes, 200 species of bryophytes, 200-300 species of algae, 800 species of lichens and 600 species of fungi known from the Western Ghats (Nair and Daniel, 1986). The high level of diversity and endemism in Western Ghats has given it the status of one of the biodiversity hot spots (Myers, 1988). The Nilgiris are considered as the most important centre of speciation of flowering plants in the Western Ghats (Blasco, 1970). About 3,200 species of flowering plants can be seen here of which 132 are endemic to the biosphere reserve. Of the 175 species of orchids found in the NBR, 8 are endemic.

  A wide variety of forest types can be seen as we transgress from south-west region (Western ghats) to north-east region (Eastern ghats) (Table-1.1) as under:

Table-1.1: Region-wise Forest Types and Dominant Plant Species

S.No.	Forest Type	Region / Division	Dominant Plant Species
1	8A/C1 Southern tropical Hill forests	MTR, Nilgiris, Gudalur, STR	*Syzygium densiflorum, Michelia nilagirica, Rhododendron nilagiricum, Ilex denticulata, Vaccinium neilgherrense,*
2	Tropical dry evergreen forest (7/C1)	Cauvery WLS	*Acacia pinnata, Albizia lebbek, Alseodaphne semecarpifolia, Anogeissus latifolia, Benkara malabarica, Ixora arborea, Canthium coromandelicum, Memecylon bremeri M. edule*
3	Southern tropical dry thorn forest (6A/C1 & C2)	MTR, STR, Erode, Dharmapuri, Hosur, Cauvery WLS	*Acacia leucophloea, Acacia sundra, Acacia suma, Albizia amara, Chloroxylon swietenia, Hardwickia binata, Euphorbia antiquorum, Zizyphus mauritiana, Euphorbia antiquorum, Carissa spinarum,*

			Sapindus emarginatus, Phyllanthus emblica, Erythroxylon monogynum, Canthium parviflorum
4	Southern tropical dry mixed deciduous forest (5A/C1 & C3)	MTR, STR, Erode, Dharmapuri, Hosur, Cauvery WLS	*Anogeissus latifolia, Hardwickia binata, Albizia amara, Boswellia serrata, Terminalia crenulata, Terminalia chebula, Wrightia tinctoria, Grewia tilifolia, Terminalia tomentosa, Tectona grandis, Dalbergia latifolia, Kydia calycina*
5	West coast topical evergreen forest (3A/C2)	Gudalur	*Dipterocarpus indicus, Cullenia exarillata, Palaquium ellipticum, Mesua ferrea*
6	Southern Tropical moist mixed deciduous forest (3B/C1 & C2)	MTR, Nilgiris, Gudalur, STR, Erode, Dharmapuri, Hosur, Cauvery WLS	*Tectona grandis, Terminalia crenulata, Dalbergia latifolia, Lagerstroemia microcarpa, Terminalia crenulata, Terminalia arjuna, Dalbergia latifolia, Pterocarpus marsupium, Butea monosperma, Kydia calycina*
7	Southern Tropical semi evergreen (2A/C2)	Gudalur, MTR	*Cullenia exarillata, Terminalia paniculata, Palaquium ellipticum, Hopea parviflora, Litsea mysorensis, Casseria ovoides*
8	Riparian forest (4E/RS1)	MTR, Nilgiris, Gudalur, STR, Erode, Dharmapuri, Hosur, CWLS	*Terminalia arjuna, Ficus benghalensis, Ficus racemosa, Syzygium cumini, Mangifera indica, Pongamia pinnata, Ficus spp.*
9	Moist Bamboo brakes (2E3)	MTR	*Bambusa arundinacea and Dendrocalamus strictus*
10	Dry Bamboo brakes (5E9)	Cauvery WLS	*Bambusa bambos and Dendrocalamus strictus*

The Nilgiri - Eastern Ghats belt is significant in terms of elephant and tiger corridor, and the vegetation ranges from thorny scrub to moist deciduous, riparian, and hill forests (Box-1.1).

Box-1.1: Division-wise Vegetation Changes

- *Nilgiri Division*: higher altitude shola-grassland mosaics with montane endemics, alongside deciduous belts.
- *Gudalur Division*: wetter, more evergreen & semi-evergreen forests, acting as a transition zone towards Wayanad.
- *Mudumalai TR*: dominated by dry & moist deciduous forests and thorn scrub, making it excellent elephant & carnivore habitat.
- *Sathyamangalam TR*: has the fullest range of vegetation (thorn - dry deciduous - moist deciduous - riparian - montane shola).
- *Erode & Dharmapuri Divisions*: are drier, dominated by thorn & dry deciduous types.
- *Hosur Division:* acts as a transition zone with patches of moist deciduous in valleys.
- *Cauvery WLS*: is strongly shaped by the riverine system (riparian strips are critical for elephant corridors).

- **Preferred Plant Species**: Elephants in the Nilgiri Elephant Reserve primarily feed on a mix of native grasses with *Themeda cymbaria*, *Heteropogon contortus*, *Themeda triandra*, *Bothriochloa spp, Curcuma spp, Cyrtococcum patens etc* being especially prominent; while also relying on key browse and fruiting species such as *Acacia intsia*, *Kydia calycina, Helicteres isora, Dioscorea spp, Grewia hirsuta, Grewia tillifolia, Bauhinia racemosa, Zizyphus mauritiana, and Bamboo*; and seasonal fruits like jackfruit, tamarind, and wild mango. Their feeding strategy varies by habitat type and season, reflecting adaptive foraging behavior and ecological flexibility. Grasses dominate elephant diets across all habitats, especially in wet seasons and grass-rich areas; browse becomes more important during dry seasons, particularly in drier habitats like thorn forests. Feeding adjustments accordingly align with availability- for instance, grass consumption drops in dry seasons when grasses are scarce; browse intake rises to compensate. Seed dispersal by elephants supports regeneration of key fruiting species, particularly during lean seasons.

b) Animals

- The Nilgiri Elephant Reserve is a biodiversity hotspot, harbouring substantial Asian elephant population alongside tigers, dholes, gaurs, ungulates, birds, amphibians, reptiles, butterflies and other species. It is one of India's most critical landscapes for large mammal conservation and ecological connectivity. The fauna of the NER is quite similar to that of NBR which includes over 100 species of mammals, 350 species of birds, 80 species of reptiles and amphibians, 300 species of butterflies and innumerable invertebrates (Daniel 1996). Key faunal species in the NER (Table-1.2), include:

Table-1.2: Distribution and Preferred Habitat of Major Faunal Species in the NER

Common Name	Scientific Name	IUCN Status	Distribution	Preferred Habitat
• **Large Mammals**				
Asian Elephant	*Elephas maximus*	Endangered	Widespread throughout reserve	Moist & dry deciduous forests, bamboo brakes, grasslands
Bengal Tiger	*Panthera tigris tigris*	Endangered	MTR & STR and adjoining areas	Dense deciduous forests, riverine areas
Indian Leopard	*Panthera pardus fusca*	Vulnerable	Throughout reserve	Deciduous, scrub forests, edges near villages
Dhole (Wild Dog)	*Cuon alpinus*	Endangered	PAs across NER	Moist & dry deciduous forests with prey
Sloth Bear	*Melursus ursinus*	Vulnerable	MTR, STR, Nilgiris	Dry deciduous, scrub, rocky areas
Gaur (Indian Bison)	*Bos gaurus*	Vulnerable	MTR, Nilgiris	Deciduous forests, open grasslands
Sambar Deer	*Rusa unicolor*	Vulnerable	Common across NER	Forest edges, riverine forests, grasslands
Spotted Deer	*Axis axis*	Least Concern	Abundant in deciduous forests	Dry & moist deciduous forests, glades
Barking Deer	*Muntiacus muntjak*	Least Concern	Patchy across Nilgiris, Gudalur	Understory of moist deciduous forests
Four-horned Antelope	*Tetracerus quadricornis*	Vulnerable	Dry thorn & scrub forests (STR, Hosur)	Open dry deciduous, thorn scrub
• **Primates and Small Mammals**				
Nilgiri Langur	*Semnopithecus johnii*	Vulnerable	Nilgiris	Evergreen & moist deciduous forests

Slender Loris	*Loris lydekkerianus*	Near Threatened	MTR, STR, Hosur	Dry thorn & scrub forests
Malabar Giant Squirrel	*Ratufa indica*	Least Concern	Common in Nilgiris, MTR	Tall evergreen & moist deciduous forests
Indian Pangolin	*Manis crassicaudata*	Endangered	Patchy across NER	Scrub, deciduous forests, burrowed terrain
• **Birds**				
Great Hornbill	*Buceros bicornis*	Vulnerable	MTR, Nilgiris	Tall evergreen & moist deciduous forests
Nilgiri Flycatcher	*Eumyias albicaudatus*	Least Concern (Endemic)	High-altitude Nilgiris	Sholas, montane forests
White-bellied Blue Robin	*Sholicola albiventris*	Endangered (Endemic)	Nilgiri high ranges	Montane shola forests
Malabar Whistling Thrush	*Myophonus horsfieldii*	Least Concern	Nilgiris	Moist forests, riverine
Painted Stork	*Mycteria leucocephala*	Near Threatened	Wetlands in foothills	Wetlands, rivers
Indian Peafowl	*Pavo cristatus*	Least Concern	Widespread	Deciduous forests, scrub, villages
• **Reptiles**				
King Cobra	*Ophiophagus hannah*	Vulnerable	Nilgiris	Moist evergreen forests, streams
Indian Rock Python	*Python molurus*	Near Threatened	MTR, STR, CNWLS	Riverine, moist forests
Spectacled Cobra	*Naja naja*	Least Concern	Throughout	Dry deciduous, scrub, agriculture edges
Russell's Viper	*Daboia russelii*	Least Concern	Throughout	Grasslands, scrub
Malabar Pit Viper	*Trimeresurus malabaricus*	Least Concern (Endemic)	Nilgiris	Moist evergreen forests, leaf litter
• **Amphibians**				
Malabar Gliding Frog	*Rhacophorus malabaricus*	Least Concern	Nilgiris	Tree canopies, water bodies
Bush Frogs	*Raorchestes* spp. (several)	Endangered–CR (varies)	Nilgiri sholas	Montane evergreen forests
Fungoid Frog	*Hydrophylax malabaricus*	Least Concern	Wet forests	Leaf litter, forest floor
• **Butterflies**				
Southern Birdwing	*Troides minos*	Schedule-I (WPA)	Nilgiris	Evergreen, moist forests
Malabar Banded Peacock	*Papilio buddha*	Schedule-I (WPA)	Nilgiris	Evergreen forests
Tamil Lacewing	*Cethosia nietneri mahratta*	Endemic	Nilgiri slopes	Moist deciduous, forest edges
Grass Jewel	*Freyeria trochylus*	Widespread	Common in grasslands	Grasslands, scrub

1.2 LAND USE LAND COVER (LULC) CLASSIFICATION

LULC classification in an Elephant Reserve is an integral part of evidence-based conservation efforts. It provides a comprehensive understanding of the landscape, enabling conservationists to make informed decisions to protect and sustain the diverse ecosystems within the reserve. Land use/land cover and human/natural modifications have largely resulted in deforestation, biodiversity loss, and human elephant conflict in the forest agriculture interface.

Land use land cover (LULC) classification involves mapping and categorizing different types of land cover and land use within the designated area (Fig-1.4 & 1.5). This classification is essential for effective conservation and management strategies.

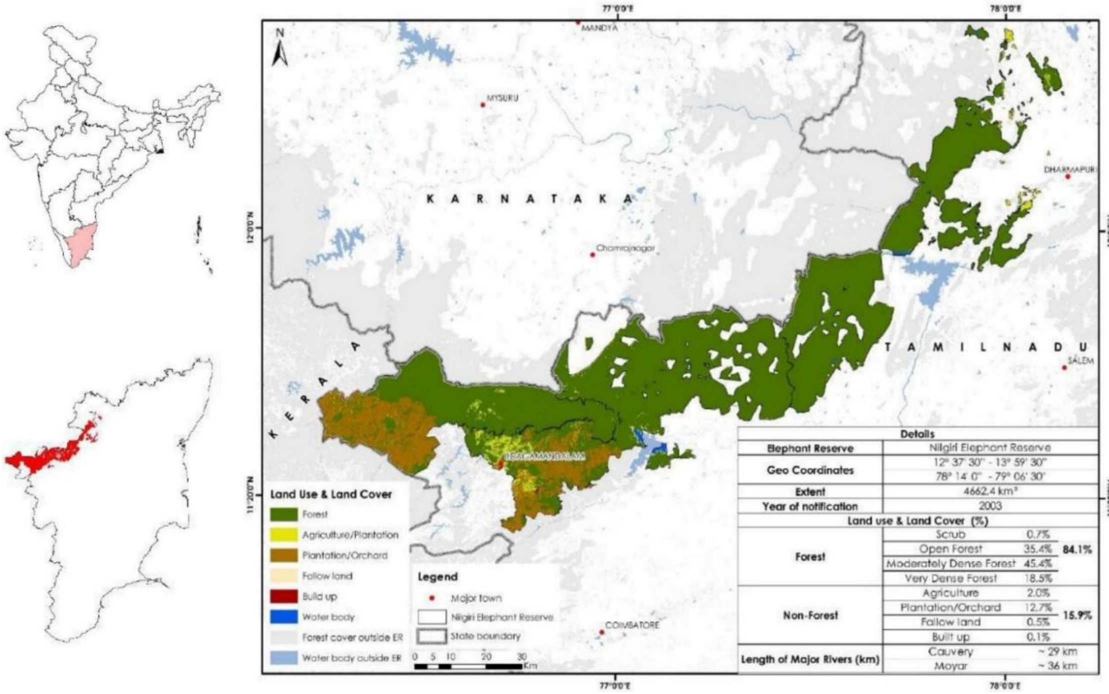


Fig-1.4: Land Use and Land Cover (LULC) Map of Nilgiri Elephant Reserve (NER)

Fig-1.5: 3-Dimensional view of Nilgiri Elephant Reserve (NER)

While direct studies focusing exclusively on the Nilgiris Elephant Reserve (NER) are limited, Development activities and linear infrastructure development occurring both inside the forests and in the immediate vicinity outside the forests can potentially affect elephant habitats as well as populations due to increasing isolation of habitats, edge effects, and site-specific insidious threats. Major roads and other linear infrastructure could act as barriers to elephant movement if the developmental activities do not adequately consider elephant habitat needs. An understanding of the present land-use land-cover (LULC) describing the proportion of different land-use categories within the ERs would be essential for planning. Further, a broad comparison assessing whether the LULC of the ERs has drastically changed or remained static would be essential for decision-making.

LULC Trends in NER

The land use and land cover (LULC) classification products at 100-m resolution for NER at decadal intervals for 1985, 1995, and 2005 was developed by Roy et, al. (2016) (Fig-1.6). The data were derived from Landsat 4 & 5 Thematic Mapper (TM), Enhanced Thematic Mapper Plus (ETM+), and Multispectral (MSS) data, India Remote Sensing satellites (IRS) Resourceat Linear Imaging Self-Scanning Sensor-1 or III (LISS-I, LISS-III) data, ground truth surveys, and visual interpretation. An overall mapping accuracy of all the three decadal data was found to be 94.46% and the Kappa accuracy of 0.9445.

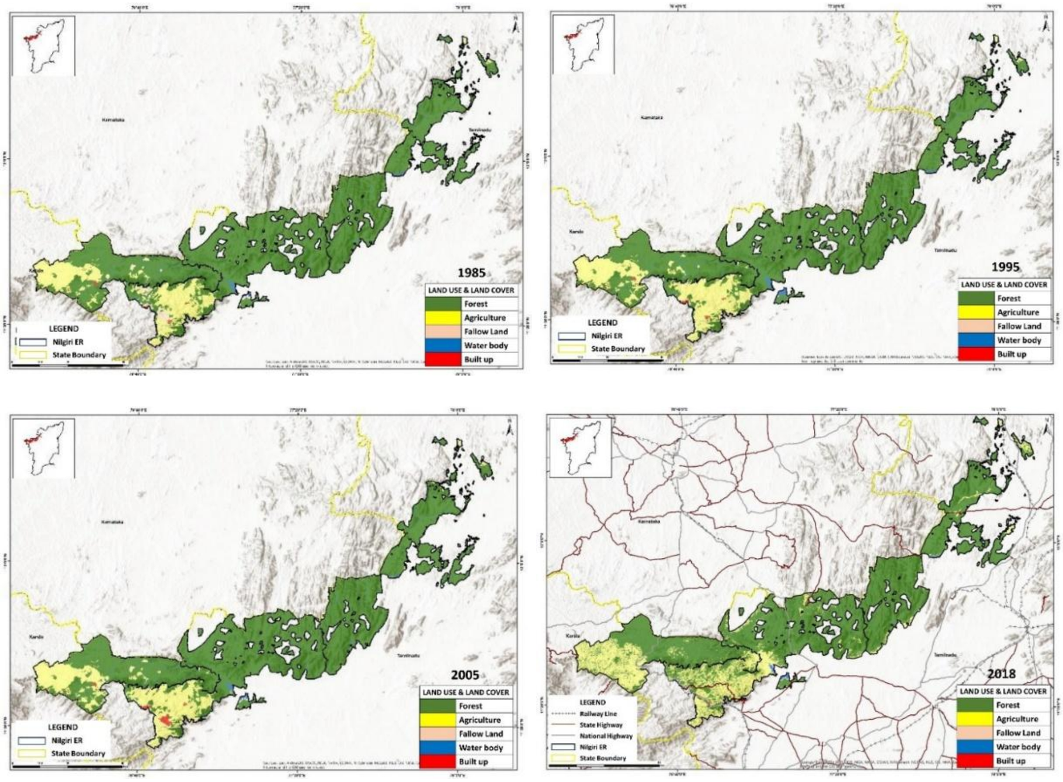


Fig-1.6: LULC Map of NER 1985/ 1995/ 2005 (Roy et.al 2016) & 2018 with linear infra. (Bhuvan, NRSC)

Table-1.3: Change in the Land use and Land cover (LULC) Map

YEAR	Forest	Agriculture	Fallow Land	Built up	Water body
1985	82.55	14.25	1.92	0.17	1.09
1995	80.98	16.86	0.70	0.23	1.20
2005	80.36	17.35	0.67	0.52	1.07
2018	75.32	23.63	0.50	0.05	0.47

There was a significant decrease in the forest cover and increase in the agriculture between the periods 2005 and 2018 (Table-1.3). These shifts indicate a pronounced conversion of natural habitats into agricultural or mixed-use zones—especially in buffer areas, signifying intensifying anthropogenic influence. Studies have also noted that deforestation and land-use change are closely tied to escalating human-elephant conflict and conflict events (like crop raids and attacks) are strongly correlated with zones experiencing severe deforestation.

Critical implications for elephant conservation and corridor management (Box-1.2), envisages:

Box-1.2: Implications for Elephant Conservation and Corridor Management

- Shrinking grasslands and savannas reduce essential feeding grounds for elephants, potentially pushing them into croplands and increasing conflict.
- Expansion of agriculture and settlements fragments habitat and encroaches on corridors vital for elephant movement.
- Forest gain (especially mixed forests) may benefit biodiversity overall but alignment with elephant habitat preferences (such as open grassland corridors) needs careful consideration.

1.2.1 Extent and condition of forests and tree cover

Assessing the extent and condition of forests and tree cover in NER requires a combination of remote sensing technologies, field surveys, and community participation. This holistic approach helps conservationists develop effective strategies to protect and enhance the habitat for elephants and other species within the reserve. The division-wise assessment of forest cover (Table-1.4) is as under:

Table-1.4: Division-wise assessment of forest cover in the NER

Division	Area	2023 Assessment				% of Digitized Area	Change with respect to 2021	Scrub
		Very Dense Forest	Moderately Dense Forest	Open Forest	Total			
Nilgiris	315.88	76.24	55.40	25.01	156.65	49.59	0.35	0.26
MTR	688.59	108.39	190.45	188.50	487.33	70.77	-0.84	3.12
Gudalur	149.97	23.49	35.29	57.11	115.89	77.28	-0.08	0.70
STR	1411.61	47.29	176.42	184.74	408.45	28.93	3.47	13.38
Erode	805.67	67.28	125.15	57.58	250.00	31.03	3.64	0.97
Dharmapuri	319.98	8.19	61.47	58.81	128.46	40.15	-0.44	0.76
Hosur	970.75	17.52	154.84	131.19	303.55	31.27	1.89	6.66
Total	**4662.45**	**348.40**	**799.01**	**702.93**	**1850.34**	**39.69**	**7.98**	**25.86**

Decadal Change in Forest Cover of Tiger Reserves

The decadal assessment of change in forest cover within Mudumalai Tiger Reserve (MTR) and Sathyamangalam Tiger Reserve (STR) falling in NER by Forest Survey of India, Dehradun during the period between IFSR 2011 (2008-09 satellite data) and IFSR 2021 (2019-20 satellite data) was carried out primarily to assess the impact of various conservation measures and management interventions during the period (Table-1.5).

Table-1.5: Decadal Change in Forest Cover of Tiger Reserves

Division	Area	2011 Assessment				2021 Assessment				Change
		VDF	MDF	Open	Total	VDF	MDF	Open	Total	
MTR	750.81	62.73	382.65	255.19	700.57	143.29	260.98	285.61	689.88	-10.69
STR	1581.77	198.34	853.69	278.57	1330.60	161.23	658.09	540.98	1360.30	+29.70

As per the change analysis matrix, it is observed that the decadal change in the forest cover in 2021 with respect to IFSR 2011 as -10.69 km^2 and +29.70 in respect of MTR and STR respectively.

As per the above data, without going into the details of the areas of change in the canopy class (>10%), there is urgent need to verify the locations, where loss of 10.69 km^2 has been reported by acquisition of the data from FSI and analysing the same in spatial domain and taking corrective measures.

1.3 STATEMENT OF CONSERVATION SIGNIFICANCE

Established to safeguard the habitat of the Asian elephant and promote biodiversity conservation, a statement of conservation significance in respect of NER plays a crucial role in maintaining ecological processes and supporting sustainable utilization and serves as a foundational document for guiding conservation efforts and informing stakeholders about the significance of the reserve.

- *Ecological Importance:* The reserve encompasses diverse ecosystems, including dense, open and scrub forests, grasslands, wetlands and water bodies in NER, and the habitat supports rich flora and fauna, contributing to the overall biological diversity of the region.
- *Role in Elephant Conservation:* The reserve is a stronghold for the elephants, providing essential habitats for breeding, foraging, and social interactions and the reserve serves as a critical corridor, facilitating the movement of elephants and ensuring genetic diversity within the species between Western Ghats and Eastern Ghats.
- *Biodiversity Hotspot:* The reserve is recognized as a biodiversity hotspot, hosting a wide array of mammalian, avian, reptilian, and amphibian species and is a home to numerous endangered and endemic species, underscoring its global significance for biodiversity conservation.
- *Cultural and Heritage Significance:* The reserve holds cultural and heritage significance for local communities and the traditional coexistence of humans and elephants has shaped unique cultural practices and fosters a harmonious relationship between communities and wildlife.
- *International Importance:* The reserve contributes to global conservation efforts and aligns with international commitments to biodiversity conservation, climate change mitigation, and sustainable development goals and is part of UNESCO's World Heritage Site.

The list of values and their conservation attributes in the statement of significance includes-

1.3.1 Categorisation of different values

The values of NER can be categorized into various dimensions, including ecological, cultural, economic, aesthetic and recreational values (Box-1.3). The different values within these categories, include:

Box-1.3: Categorisation of different values in NER

- *Ecological value* - related to biodiversity conservation, ecosystem diversity, habitat suitability, endangered species, ecosystem services, genetic diversity and carbon sequestration etc.
- *Cultural value* - covers various aspects of cultural heritage, coexistence traditions, cultural events and festivals, sacred sites and traditional knowledge.
- *Economic value* - includes revenue from tourism, livelihood and NTFP etc
- *Recreational & Aesthetic value* - envisages recreational opportunities and scenic beauty.
- *Educational & Interpretive value* - includes opportunities for learning.
- *Existence & Intrinsic value* - envisages intrinsic value of nature along with existence value.
- *Educational & Scientific value* - is mainly towards research and education.
- *Spiritual and Inspirational value* is towards spiritual connection and inspiration for conservation.

In respect of NER, different values can be conceptualized for Western Ghats & Eastern Ghats as under:

Value	Western Ghats	Eastern Ghats
Ecological	Core of the Nilgiri Biosphere Reserve; tropical evergreen, shola-grassland, moist & dry deciduous forests; high endemism (Nilgiri tahr, Nilgiri langur).	Outlying spurs toward Dharmapuri & Erode; mostly dry deciduous, scrub & riparian patches; supports elephants, bear, four-horned antelope; fewer endemics; important corridor with Western Ghats.
Economic	Tea, coffee, spices, floriculture, forest produce (honey, wax); eco-tourism in Nigiris/ MTR; sustainable timber.	Minor agriculture (millets, pulses), fuelwood, medicinal plants, honey; potential for eco-tourism (STR, CNWLS).
Hydrological	Major watershed: Bhavani, Moyar, Pykara; perennial streams; drinking water, irrigation & hydel projects.	Small seasonal streams draining to Cauvery & Bhavani; moderate role in groundwater recharge.
Cultural	Sacred groves of Todas, Badagas, Kotas; tribal traditions (Kurumbas, Irulas); pilgrimage spots.	Sacred sites & shrines in Sathyamangalam forests; folk traditions of hill tribes (Sholagars, Ooralis and Irulas).
Historic	British-era tea estates, UNESCO site; Toda settlements & stone temples; colonial bungalows.	History of ancient trade routes linking Kongu region; hunting traditions; forts and watch posts in Sathy-Dharmapuri belt.
Recreational	Trekking (Nilgiris), wildlife safaris in (MTR), Gene Pool Garden (Gudalur).	Trekking in Sathyamangalam, viewpoints (Hasanur), birdwatching, rustic camping.
Educational	Field stations of BSI, SACON; training hubs for forestry & wildlife.	Local forest schools for eco-awareness; potential for community-based education.
Scientific	Long-term research on shola ecology, grassland dynamics, elephant corridors, climate studies.	Studies on dry forest ecology, elephant migration corridors, human–wildlife coexistence.
Global	UNESCO-designated Biosphere Reserve & World Heritage Site (as part of Western Ghats serial sites).	Not globally listed, but ecologically linked to Ghats connectivity (Eastern–Western corridor).
National	Key tiger & elephant landscapes (MTR, STR); source of water & biodiversity for southern India.	Integral to STR, India's largest contiguous tiger habitat; corridor between Western & Eastern Ghats.
Regional	Regulates climate of Coimbatore-Nilgiris- Wayanad region; perennial flow for Bhavani & Moyar basins.	Supports farming & grazing communities in Erode, Dharmapuri; protects Cauvery sub-basin catchments.
Local	Provides fuelwood, grazing, NTFPs, honey, medicinal herbs, eco-tourism jobs; spiritual significance for Todas, Badagas, Irulas, Kurumbas.	Supports shifting agriculture, honey collection, herbal medicine, local crafts; wildlife tourism benefits villages near Sathyamangalam.

- Western Ghats sector (Nilgiris, Mudumalai, Mukurthi) is richer in biodiversity, perennial water sources, global heritage value, and recreational infrastructure.
- Eastern Ghats sector (Sathyamangalam, Dharmapuri fringes) is drier, but vital as a wildlife corridor, cultural landscape, and resource base for local communities.

1.4 ELEPHANT SPECIES RANGE AND CORRIDORS

Elephants in NER inhabit a variety of ecosystems, including tropical forests, grasslands, and swampy areas. They have a distinct range and utilize corridors for movement within the reserve. Populations in this region move across Western - Eastern ghat network and use multiple protected areas and reserve forests for seasonal movements and dispersal. The fragmentation and shrinkage of forests, degradation of habitat and scarcity of water resources, affect the ranging pattern of elephants.

Elephants' movement is conditioned by a range of climatic and environmental variables, like temperature, rainfall, drought, and water availability to embark on their migratory journey through corridors. The distribution of food and water is not uniform and the elephants seasonally migrate and move over a large area and return utilizing a large habitat to meet its food and water requirements.

The home range size in the landscape varies depending on factors such as habitat type, food availability, water sources, population density, and human disturbances and typically ranges from about 50 to 300 km^2 for males and 20 to 150 km^2 for females; however, in some fragmented or degraded habitats, home ranges may be even smaller.

The species distribution, ranging behaviour, major linkages and major threats in the Western and Eastern Ghat region of the reserve is as under:

	Western Ghats	**Eastern Ghats**
Species Distribution	***Nilgiris Division:*** Elephants use Nilgiris north and central ranges (Segur, Segur–Bhavani foothills), with seasonal movements across plateaus and into lower valleys. ***Gudalur Division***: Elephants move through Gudalur ranges and use its riparian corridors to access Nilgiri highlands and the plains. ***MTR:*** Occur throughout MTR and its buffer; family groups and bull movements are well documented (along Masinagudi -Moyar, Kargudi & Theppakadu areas).	***STR:*** STR forms an eastern sink/source and is a major conduit between Western Ghats elephants and more easterly populations. ***Erode forests:*** host seasonal/ transit elephant movements; some RFs are used as stopovers and for grazing. ***Dharmapuri Division***: its ranges (towards Hosur and Krishnagiri) have patchy elephant use - partly seasonal and partly resident in some blocks; historical connectivity to larger landscapes exists. ***Cauvery WLS & Hosur Division***: nearby ranges contain multiple elephant-inhabited blocks and are important for dispersal and conflict hotspots.
Home Range & Ranging Behaviour	Family groups and females in the Nilgiri landscape show home-ranges that can vary widely (up to several hundred km²) depending on resource distribution; low for groups, and males ranging widely.	Elephants in STR landscape use large tracts; home ranges again vary widely by sex and season but the reserve forms core habitat for resident herds and for migrants using the Nilgiri–Sathyamangalam network.
Major linkages	Singara -Mavinhalla; Masinagudi - Moyar; Segur Plateau; Avarahalla - Segur; Mudumalai – Bandipur etc	Sathyamangalam - Segur / Nilgiris linkage; Sathyamangalam - Bhavanisagar/ Erode foothills;
Major Threats	Road kills on Masinagudi -Theppakadu roads; resort/ settlement developments in Segur plateau (court-directed actions)	Mitigation of highway impacts (e.g., NH stretches) and land-use regulation around corridors are priority actions.

Threats common across all divisions are:

- *Habitat fragmentation and linear infrastructure*: roads, flumes, power lines, plantations and resorts breaking continuity of corridors.
- *Human-elephant conflict (HEC)*: crop raiding, retaliatory incidents in corridor margins and agricultural matrices.
- *Unregulated development in corridor lands*: private resorts/structures in Segur plateau and other corridor lands.

Elephant Corridors in the NER

Corridors in the reserve, which are linear, narrow, natural habitat linkages between two otherwise disconnected forest habitats, are crucial for ensuring larger extent of habitats, maintenance of genetic diversity, allowing for seasonal movements, and promoting connectivity between fragmented habitats. The migratory/ movement paths of the elephants away from forest habitats into the human domain without connecting to viable habitat patches may not be considered as elephant corridors.

These corridors play a crucial role in sustaining healthy and resilient elephant populations in fragmented landscapes. To address the fragmentation of elephant corridors and mitigate its impacts, efforts may envisage ensuring protected corridors to facilitate elephant movement between habitat patches and implementing land-use planning and zoning regulations to minimize habitat fragmentation and maintain connectivity between key elephant habitats.

As per the report of Elephant Corridors of India (Project Elephant, MoEF&CC, Govt of India (2023), nearly 11 elephant corridors (Fig-1.7) have been documented in the Nilgiri Elephant Reserve as under:

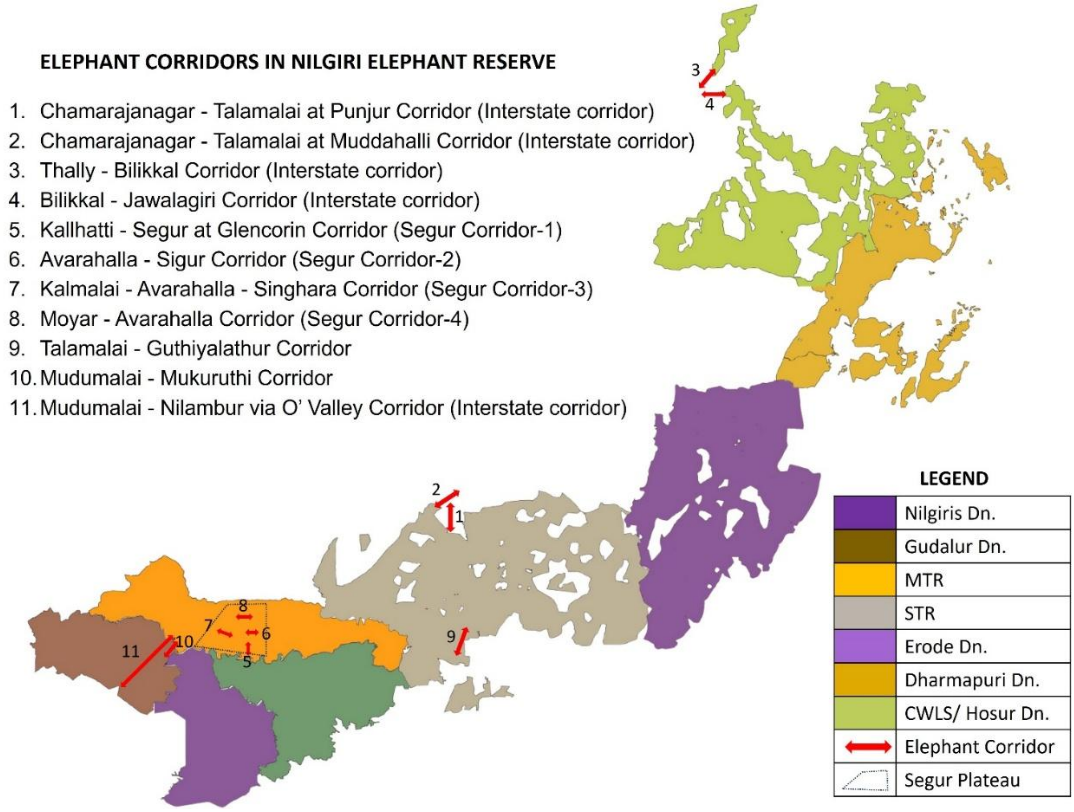
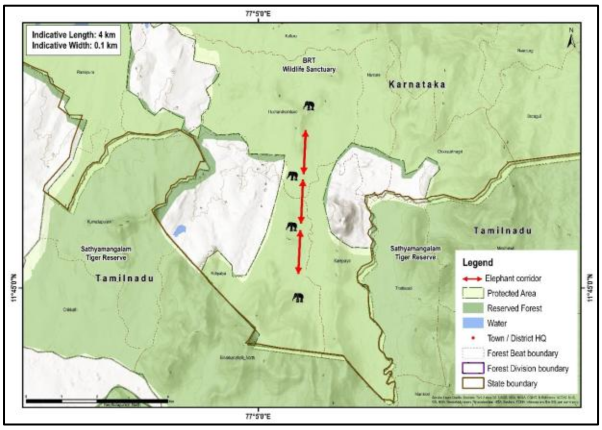
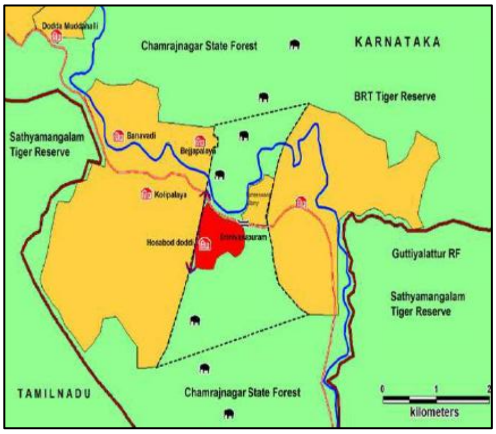


Fig-1.7: Elephant Corridors in Nigiri Elephant Reserve

1. Chamarajanagar - Talamalai at Punjur Corridor (Interstate corridor)

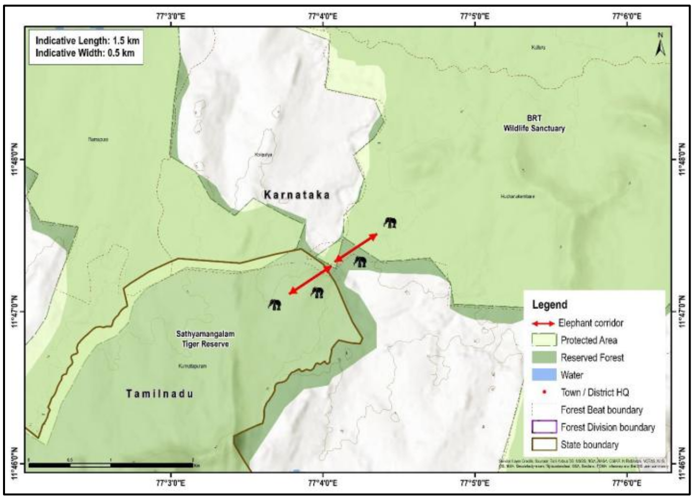


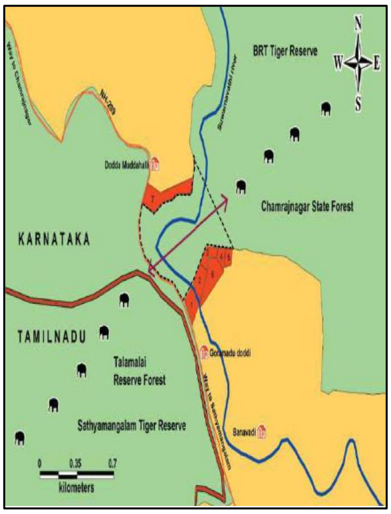


Connectivity	This corridor connects the K Gudi Range of Chamarajanagar Wildlife Division (BRT Tiger Reserve) with the Thalavadi Range of Sathyamangalam Tiger Reserve through the Punjur Range.
State	Karnataka and TN
Corridor Dimensions	Length = 4 km, width = 0.1 km
Geo coordinates	11° 46' - 11° 47' N; 77° 05'- 77° 06' E
Forest ranges	K Gudi and Thalavadi Range
Revenue villages	3 Revenue villages fall in the corridor
Habitat type	Tropical thorn and deciduous forest
Habitat status	The ground cover in the corridor area is dominated by grasses (60%) with shrubs (22%), herbs (16%) and barren ground (2%). Of the 29 plant species recorded, 15 were elephant food species like *Erythroxylum monogynum, Chloroxylon swietenia* and *Ixora pavetta*. Eucalyptus was extensively debarked in this corridor besides bamboo patches and natural salt licks available in plenty. Livestock grazing pressure was evidenced from low proportion of herbs/ shrubs but grass cover was not overly affected.
Major land use	Human habitation
Elephant movement	Regular
Linear infrastructure	National highway 209 and the associated vehicular traffic
Corridor status	Impaired
Bottlenecks & Threats	• Human settlements: Hosaboddoddi, Srinivasapuram and Muneeshwara Colony located inside the corridor have severely hindered the movement of elephants and other wild animals. • Traffic on NH 209: About 2800 to 3000 vehicles ply every day and the movement of 6-wheel vehicles was high with peak movement of 6-wheelers between 8 pm and 4 am. Vehicular traffic increase during Kundam festival (Mar-Apr) at Bannari Amman temple. • Roadside hotels are located about 300 metres from the Punjur forest check-post. The movement of vehicles/ people and thrown food waste impact wildlife including elephants.
Human-Elephant Conflict	• Conflict is reasonably high. There is an increasing trend of HEC (electrocution/ crop damage) from the year 2006 onwards. • Land use has changed drastically along the corridor and in fringe areas over the last two decades. Corridor width has shrunk from 1000 metres to less than 100 metres which has forced elephants to venture into agricultural lands and human habitations, resulting in increased crop depredation and economic losses to farmers.

Recommendations	1. The corridor should be notified and legally protected and action should be taken to prevent encroachment and developmental activities in the area. 2. About 126 acres of the corridor land belonging to 86 families in the Hosaboddoddi and Srinivasapuram settlements needs to be secured on a priority basis. Efforts should also be made to secure land from Muneeshwara Colony in the second stage. 3. No construction should be allowed on either side of NH 209 in the area passing through the corridor. 4. Vehicular speeds on the NH 209 stretch that passes through the corridor should be regulated with speed breakers. A flyover could also be constructed with under-passes for elephants.

2. Chamarajanagar - Talamalai at Muddahalli Corridor (Interstate corridor)

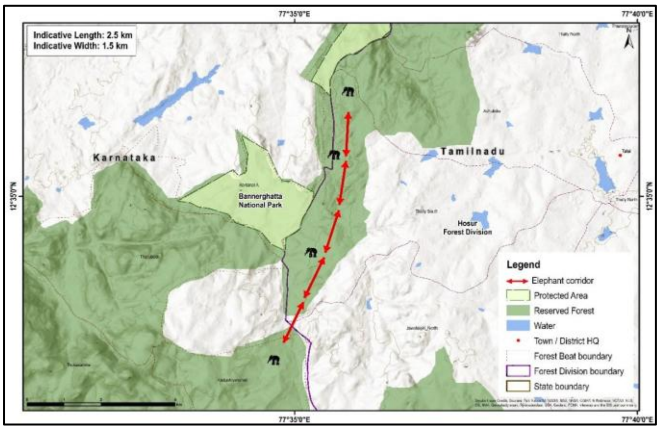


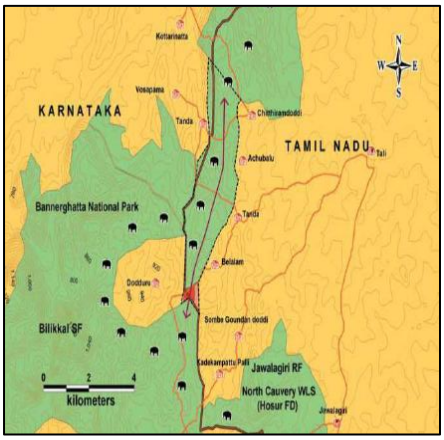


Connectivity	Connects the Punjur Range of Chamarajanagar Wildlife Division (BRT Tiger Reserve) with Thalavadi Range of Sathyamangalam TR
State	Karnataka and TN
Corridor Dimensions	Length = 4 km, width = 0.1 km
Geo coordinates	11° 46' - 11° 47' N; 77° 05'- 77° 06' E
Forest ranges	K Gudi and Thalavadi Range
Revenue villages	3 Revenue villages fall in the corridor
Habitat type	Tropical thorn and deciduous forest
Habitat status	The ground cover in the corridor area is dominated by grasses (50%) with shrubs (20%), herbs (16%) and barren ground (15%). Of the 35 plant species recorded, 25 were elephant food species like *Acorus calamus, Erythroxylon monogynum, Ixora pavetta, Decalepis hamiltonii* and *Somida fabrifuga*. Signs of lopping and wood cutting were seen on all trees.
Major land use	Human habitation
Elephant movement	Regular
Linear infrastructure	National highway 209 and the associated vehicular traffic
Corridor status	Active. Intensity of use by elephants increased
Bottlenecks & Threats	• *Settlements*: Expansion of villages such as Dodda Muddahalli, Goramadu Doddi and Mookanpalya along the corridor fringes has decreased the width of the corridor. • Traffic on NH 209: About 2800 to 3000 vehicles ply every day and the movement of 6-wheel vehicles was high with peak movement

	of 6-wheelers between 8 pm and 4 am. Vehicular traffic increase during Kundam festival (Mar-Apr) at Bannari Amman temple.
Human Elephant Conflict	• Increasing trend of HEC (electrocution/ crop damage) from the year 2006 onwards. This area is known for the high influx of elephants during the dry season, mainly because of the perennial Suwarnavathi reservoir which is near the corridor.
Recommendations	1. The corridor should be notified and legally protected. 2. About 27.39 acres of land belonging to six families from Goramadu Doddi, and 10 acres of forest leased land from the Muddahalli Joint Farming Cooperative Society, should be secured as a priority to increase the width of the corridor. 3. No construction should be allowed on either side of NH 209 in the area passing through the corridor. 4. Vehicular speeds on the NH 209 stretch that passes through the corridor should be regulated with speed breakers. A flyover could also be constructed with under-passes for elephants.

3. Thally - Bilikkal Corridor (Interstate corridor)

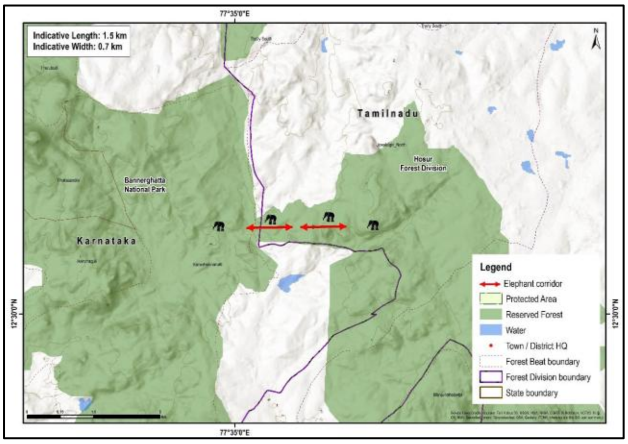


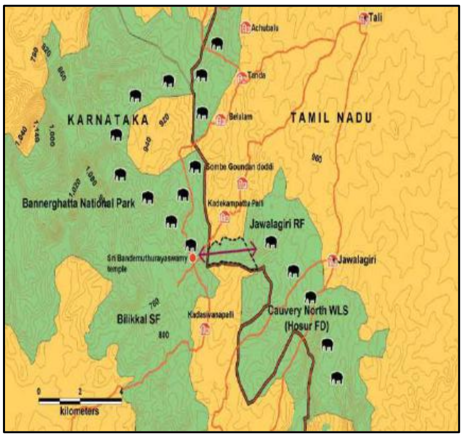


Connectivity	Connects the Bannerghatta National Park of Karnataka with the North Cauvery Wildlife Sanctuary of Tamil Nadu.
State	Tamil Nadu and Karnataka
Corridor Dimensions	Length = 2.50 km, width = 1 km
Geo coordinates	12.577567° N, 77.591290° E; 12.535615° N, 77.579358° E.
Forest ranges	Jawalagiri and Kodihalli ranges
Revenue villages	7 Chennangibayyailthoddi, Alappanthoddi, Belalam & Dodduru
Habitat type	Southern Tropical Dry Mixed Deciduous Forest
Habitat status	The ground cover in the corridor area has shrubs (45%), grasses (30%), herbs (15%) and barren ground (10%). Of the 34 plant species recorded, 22 were elephant food species with dominant trees like *Vitex altissima, Cochlospermum religiosum,* and *Ficus benghalensis*. Signs of lopping and wood cutting were seen on almost all tree species.
Major land use	Forest = 3302.35 ha / Agriculture = 500 ha / Habitation = 250 ha
Elephant movement	Regular (100 to 200 nos)
Corridor status	Active. Intensity of use by elephants increased
Linear Infrastructure	a) Road from Thally to Maralavadi via Belalam and Therubidhi b) Road from Elavanathe to Hosadoddi c) Road from Therbidi to Kadusivanapalli d) 765 kV S/C Line from Dharmapuri - Madhugiri through Thally RF

	e) 3 km EPT in Thally RF and 3 km in Bannerghatta NP
Bottlenecks & Threats	• Revenue land along the Dodduru - Belalam road (ca. 300-m gap) • Elephant-proof barriers • Encroachment of revenue land by six families for many years. • About 1500 cattle cause threat to the habitat, followed by wood cutting and fodder collection.
Human Elephant Conflict	• Elephants invade agriculture areas due to their nutritional value and taste, mostly in Dec and Jan. Records of HEC in Hosur forest division reveal a total of 49 human deaths within a period of 12 years especially in Tali Forest Range.
Recommendations	1. The corridor should be notified and legally protected with the eviction of encroachments and rehabilitation in revenue land 2. Habitat improvement works like removal of Invasive alien species, creation of waterholes and fodder plots inside the area will help the elephant movement within the corridor. 3. About 28 acres of revenue encroachment land (Survey Numbers 252 to 267), consisting of six houses and agriculture land in Channangibayilthoddi and Alappanthoddi villages and about 39 acres of lands may be secured to establish a width of about 700m 4. Villages are protected by EPTs/ steel rope fencing, which also hinders the free movement of elephants and therefore, have to be strategically placed. 5. Vehicular traffic needs to be regulated in mornings and evening

4. Bilikkal - Jawalagiri Corridor (Interstate corridor)

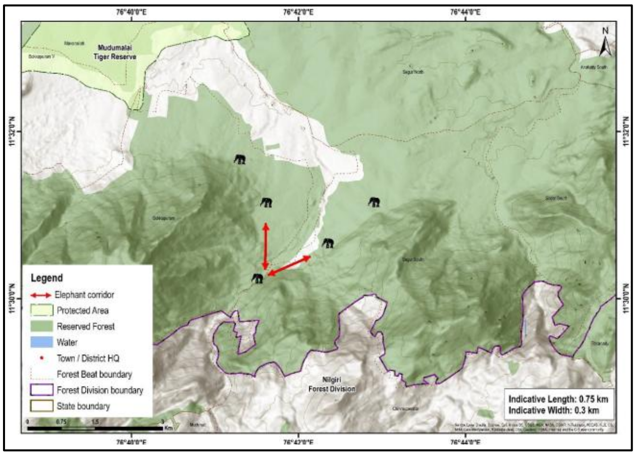


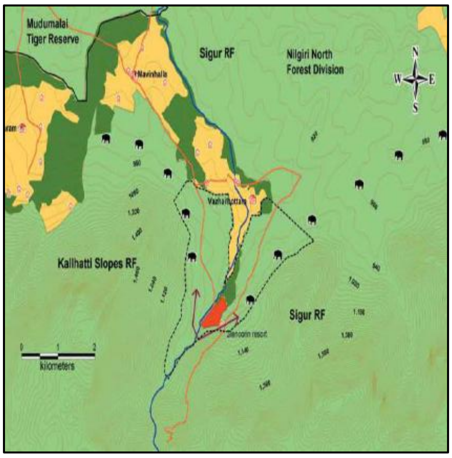


Connectivity	Connects Bilikkal State Forest of Bannerghatta NP, Karnataka with Jawalagiri RF of Cauvery North WLS, Tamil Nadu.
State	Tamil Nadu & Karnataka
Corridor Dimensions	Length = 1.5 km, width = 0.7 km
Geo coordinates	12.516164° N, 77.579524° E; 12.524220° N, 77.608672° E.
Forest ranges	Jawalagiri (CNWLS), Kodihalli & Harohalli ranges (Bannerghatta NP)
Revenue villages	Nil
Habitat type	Southern Tropical Dry Mixed Deciduous Forest
Habitat status	Ground cover is dominated by grasses (48%), shrubs (12%), herbs (15%) and barren ground (25%). Bamboo patches and mixed dry deciduous vegetation are commonly found and the dominant tree cover is *Acacia sp*.
Major land use	Forests: Jawalagiri RF (3141.58 ha) & Bilikkal State Forest (3500 ha)

Elephant movement	Regular (around 200 nos); seasonal movement seen in Oct-Apr mainly of small herds to more than 80 elephants.
Linear infrastructure	• Road from Belalam and Kadusivanapalli • Road from Elavanathe to Kadukempathpalli
Corridor status	Active. Intensity of use by elephants increased
Bottlenecks & Threats	• *Human Settlements*: Kadakampattupalli and Kadasivanapalli villages are located on the northern and southern sides of the corridor respectively with the combined population of 250 families and on the forest for cattle grazing and fuelwood. Malliandoddi (20-30families) and Gurusullappandoddi (15-20 families) are other settlements near the corridor • *Temple*: Sri Bandemuthurayaswamy temple is located at the entrance of the corridor. Pilgrim activity during festivals exerts tremendous pressure on elephant movement and degrades the quality of the corridor forest. • *Biotic pressure*: Cattle grazing affects the quality of the corridor habitat, followed by wood cutting and fodder collection.
Human Elephant Conflict	• Elephants invade agriculture areas mostly in Dec & Jan. Records of HEC in Hosur forest division reveal a total of 49 human deaths within a period of 12 years especially in Tali Forest Range.
Recommendations	1. Habitat improvement works like removal of Invasive alien species, creation of waterholes and fodder plots inside the area. 2. The corridor should be notified and legally protected.

5. Kallhatti - Segur at Glencorin Corridor (Segur Corridor-1)

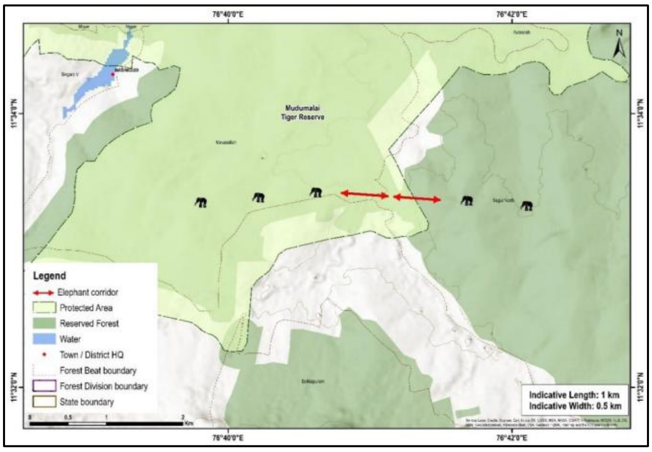


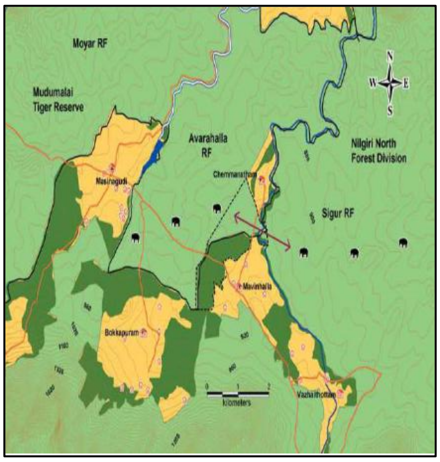


Connectivity	Connects Kalhatti RF with Singara RF and is part of Segur corridor (3413.73 ha) covering four corridors declared as Segur Plateau Elephant Corridor (G.O. Ms No 125 E&F (FR.5) Dept dt 31.08.2010)
State	Tamil Nadu
Corridor Dimensions	Length = 23.5 km, width = 1.5 km
Geo coordinates	1**) N- 11.521750°, E- 76.53937°** 2) N- 11.539190°, E- 76.64606° 3) N- 11.523191°, E- 76.73430° 4) N- 11.559855°, E- 76.68879°
Forest ranges	Segur, Singara and Masinagudi Ranges
Revenue villages	8 Revenue villages fall in the corridor
Habitat type	Tropical thorn and deciduous forest
Habitat status	Of the 18 tree species identified in the corridor, predominant species is *Cantheum parviflorum*. Other palatable species include *Acacia chundra, Erythroxylon monogynum, Gardenia sp.*

Major land use	Forest = 61,392 ha, Agriculture = 1,193 ha, Habitation = 195.40 ha
Elephant movement	Regular; 61 nos (for 4 Segur corridors as estimated in 2023).
Linear infrastructure	• State highway stretch-I (4.77 km), stretch-II (1.71 km) & traffic • 7 km of concrete flume channel from Masinagudi to Moyar • 2.09 km of Northern Hay and 3.27 km of Singara HT power lines • Schools, settlement, resorts and tourism infrastructure
Corridor status	Active. Intensity of use by elephants stable. (Segur corridors are critical in facilitating elephant movement in the Mudumalai - Bandipur - Wayanand - Sathyamangalam complex of Western Ghats)
Bottlenecks & Threats	• *Developmental activities*: Conversion of land in Kalhatti-Sigur area for resort development and tourism in the corridor by them. • *Habitations*: at Mavanallah, Bokkapuram and flume channel running across the corridor from Masinagudi to Moyar. • *Vehicular traffic*: Mudumalai - Ooty SH passes close to corridor; open from 6am - 8pm & elephant movement is affected by traffic
Human Elephant Conflict	• Conflict is low in this area due to the fact that most of the land is being used by tourist resorts and there is little cultivation of crops.
Recommendations	1. Acquiring land at crucial bottle neck points. 2. Reengineering of canal and flume channel to facilitate wildlife movement. 3. *Regulation of tourism*: The Supreme Court in 2022 upheld the Madras High Court's 2011 order, reinforcing the State's power to notify elephant corridors, protect elephants' movement, and directed demolition of illegal resorts and other structures. 4. Cattle grazing should not be allowed in the corridor areas; cattle should be vaccinated against FMD, anthrax, rinderpest. 5. *Awareness programs*: targeting villagers, tourists, guides, local drivers about criticality of the corridor, increased HEC etc.

6. Avarahalla - Sigur Corridor (Segur Corridor-2)

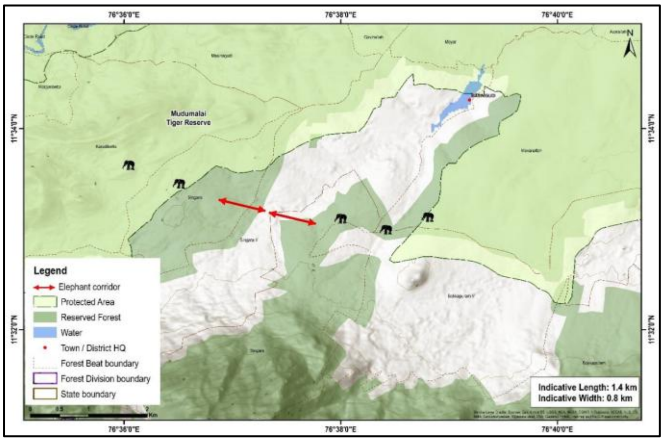


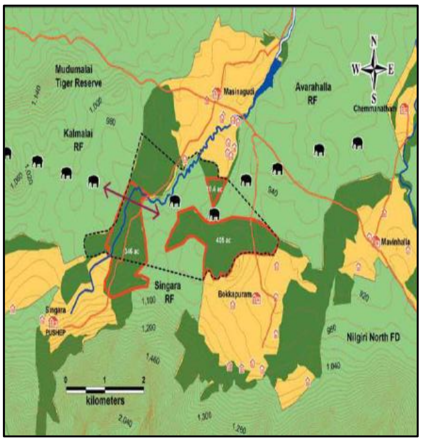


Connectivity	Connects Avarahalla RF with Segur RF and is part of four corridors declared as Segur Plateau Elephant Corridor (3413.73 ha)
State	Tamil Nadu
Corridor Dimensions	Length = 23.5 km, width = 1.5 km
Geo coordinates	1) N- 11.521750°, E- 76.53937° 2) **N- 11.539190°, E- 76.64606°** 3) N- 11.523191°, E- 76.73430° 4) N- 11.559855°, E- 76.68879°
Forest ranges	Segur, Singara and Masinagudi Ranges
Revenue villages	8 Revenue villages fall in the corridor

Habitat type	Tropical thorn and deciduous forest
Habitat status	Of the 10 tree species identified in the corridor, four palatable species include *Randia dumetorum, Diospyros montana, Cordia gharf* and *Zyziphus sp*. with bamboo patches. Ground cover is represented by shrubs (15%), grasses (25%), herbs (20%) and barren ground (40%).
Major land use	Forest = 61,392 ha, Agriculture = 1,193 ha, Habitation = 195.40 ha
Elephant movement	Regular; 61 nos (for 4 Segur corridors as estimated in 2023).
Linear infrastructure	• State highway stretch-I (4.77 km), stretch-II (1.71 km) & traffic • 7 km of concrete flume channel from Masinagudi to Moyar • 2.09 km of Northern Hay and 3.27 km of Singara HT power lines • Schools, settlement, resorts and tourism infrastructure
Corridor status	Active. Intensity of use by elephants stable. (Segur corridors are critical in facilitating elephant movement in the Mudumalai - Bandipur - Wayanand - Sathyamangalam complex of Western Ghats)
Bottlenecks & Threats	• *Habitations*: The corridor's width has been considerably reduced by Mavinhalla and Chemmanatham villages. • *Resort Development:* Resort owners take their guests to view wildlife in the late evenings and early mornings, and even at night. • *Cattle grazing*: Cattle use the corridor frequently and branches of elephant fodder trees are cut for livestock.
Human Elephant Conflict	• Conflict has increased recently due to biotic pressure, human population growth, vehicular traffic & changed cropping patterns.
Recommendations	1. Acquiring land at crucial bottle neck points and re-engineering of canal and flume channel to facilitate wildlife movement. 2. Regulation of tourism as per the Supreme Court Order in 2022. Tourism, disposal of garbage etc should be strictly controlled. 3. Cattle grazing should not be allowed in the corridor areas; cattle should be vaccinated against FMD, anthrax, rinderpest etc.

7. Kalmalai - Avarahalla - Singhara Corridor (Segur Corridor-3)

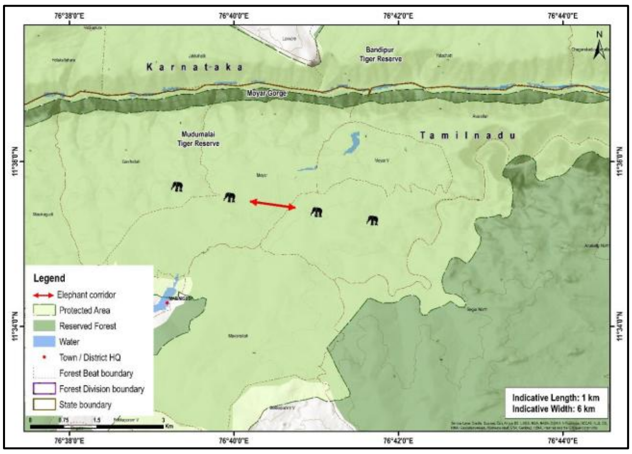


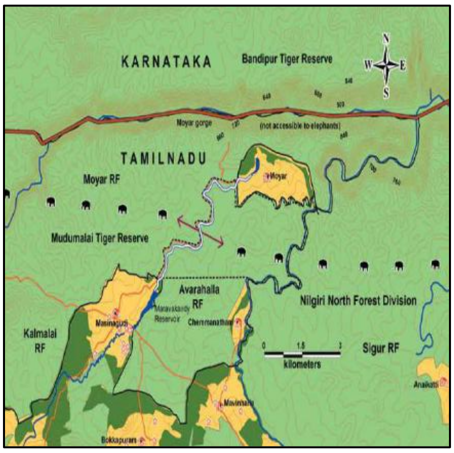


Connectivity	Connects Kalmalai RF with Singara RF & Avarahalla RF and is part of 4 corridors declared as Segur Plateau Elephant Corridor (3413.73 ha)
State	Tamil Nadu
Corridor Dimensions	Length = 23.5 km, width = 1.5 km
Geo coordinates	1) N- 11.521750°, E- 76.53937° 2) N- 11.539190°, E- 76.64606° 3) **N- 11.523191°, E- 76.73430°** 4) N- 11.559855°, E- 76.68879°
Forest ranges	Segur, Singara and Masinagudi Ranges
Revenue villages	8 Revenue villages fall in the corridor

Habitat type	Tropical thorn and deciduous forest
Habitat status	Of the 42 tree species identified in the corridor, predominant tree species are *Anogeissus latifolia, Randia dumetorum, Zyziphus xylopyrus* and *Erythroxylon monogynum* with the overall tree density as 327/ha along with availability of perennial water and salt licks.
Major land use	Forest = 61,392 ha, Agriculture = 1,193 ha, Habitation = 195.40 ha
Elephant movement	Regular; 61 nos (for 4 Segur corridors as estimated in 2023).
Linear infrastructure	• State highway stretch-I (4.77 km), stretch-II (1.71 km) & traffic • 7 km of concrete flume channel from Masinagudi to Moyar • 2.09 km of Northern Hay and 3.27 km of Singara HT power lines
Corridor status	Active. Intensity of use by elephants stable. (Segur corridors are critical in facilitating elephant movement in the Mudumalai - Bandipur - Wayanand - Sathyamangalam complex of Western Ghats)
Bottlenecks & Threats	• *Developmental activities*: Activities related to the Pykara Ultimate Stage Hydroelectric Project (PUSHEP), and human settlements. • *Vehicular traffic*: The Singara-Masinagudi road passes through the corridor for about 3 kilometres; actively used by the resorts. • *Unregulated Tourism*: Tourist resorts in the area organise vehicle safaris & trekking for their guests into the nearby private forests. • *Pollution*: Vehicles from Masinagudi are cleaned near Kalhalla bridge; this pollutes the water used by wildlife downstream. • *Cattle grazing*: Cattle compete with elephants & other wildlife for fodder resources (cattle dung encounter rate - 1176 piles/ sq km)
Human Elephant Conflict	• Conflict is low due to the fact that most of the land is coffee plantation or patta land has forest cover; no agriculture.
Recommendations	1. Acquiring land at crucial bottle neck points. Some 761.4 acres of private and revenue forest land needs to be secured. 2. *Regulation of tourism*: The Supreme Court in 2022 upheld the Madras High Court's 2011 order, reinforcing the State's power to notify elephant corridors, protect elephants' movement, and directed demolition of illegal resorts and other structures. 3. Jeep safaris, trekking and other wildlife viewing activities, whether on the Masinagudi - Singara road or inside private and revenue forests, need to be controlled. 4. Cattle grazing should not be allowed in the corridor areas; cattle should be vaccinated against FMD, anthrax, rinderpest etc.

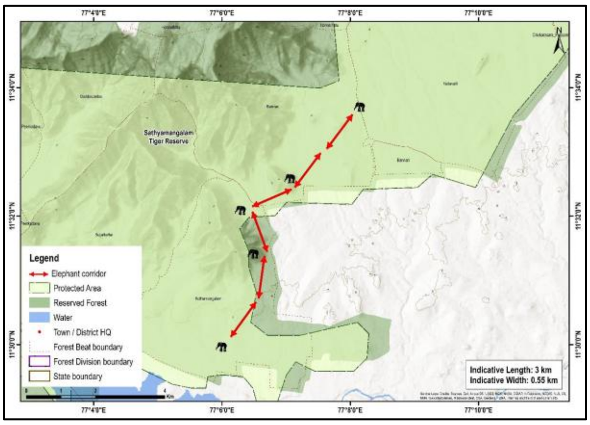
8. Moyar - Avarahalla Corridor (Segur Corridor-4)

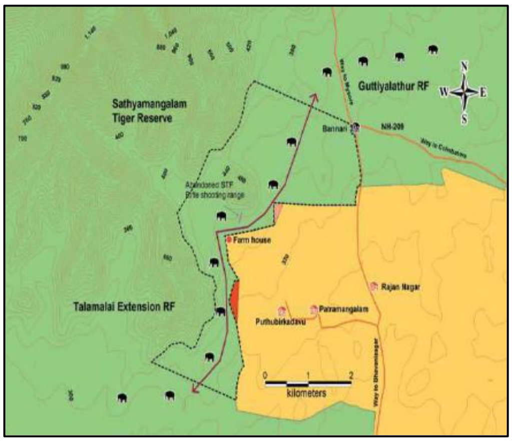




Connectivity	Connects Moyar RF with Avarahalla RF and is a part of 4 corridors declared as Segur Plateau Elephant Corridor (3413.73 ha)
State	Tamil Nadu
Corridor Dimensions	Length = 23.5 km, width = 1.5 km
Geo coordinates	1) N- 11.521750°, E- 76.53937° 2) N- 11.539190°, E- 76.64606° 3) N- 11.523191°, E- 76.73430° 4) **N- 11.559855°, E- 76.68879°**
Forest ranges	Segur, Singara and Masinagudi Ranges
Revenue villages	8 Revenue villages fall in the corridor
Habitat type	Tropical thorn and deciduous forest
Habitat status	Of the 37 tree species identified in the corridor, predominant palatable species are *Randia dumatorum (40%), Cantheum parviflorum (12%), Acacia chundra (5%), Erithroxylon monogynum and Gardenia sp (5%)* and 3 species of palatable shrubs. Area has abundant water bodies.
Major land use	Forest = 61,392 ha, Agriculture = 1,193 ha, Habitation = 195.40 ha
Elephant movement	Regular; 61 nos (for 4 Segur corridors as estimated in 2023).
Linear infrastructure	• State highway stretch-I (4.77 km), stretch-II (1.71 km) & traffic • 7 km of concrete flume channel from Masinagudi to Moyar • 2.09 km of Northern Hay and 3.27 km of Singara HT power lines • Schools, settlement, resorts and tourism infrastructure
Corridor status	Active. Intensity of use by elephants stable.
Bottlenecks & Threats	• *Developmental activities*: The major development activity in this area is the Moyar hydro-electric power project. • *Vehicular traffic*: Jeep safaris organised by resorts and local jeep drivers for wildlife viewing pose a severe threat to the free movement of wildlife including elephants. • *Cattle grazing*: Cattle compete with elephants & other wildlife for fodder resources (cattle dung encounter rate - 919 piles/ sq km)
Human Elephant Conflict	• Conflict is low in this area due to the fact that most of the land is being used by tourist resorts and there is little cultivation of crops.
Recommendations	1. Acquiring land at crucial bottle neck points and reengineering of canal and flume channel to facilitate wildlife movement. 2. No developmental activities to be allowed between Masinagudi, Moyar, Boothanatham and Chemmanatham villages. 3. Jeep safaris need to be regulated between Masinagudi-Moyar, in dry season when elephants access the flume channel for water. 4. Cattle grazing should not be allowed in the corridor areas cattle should be vaccinated against FMD, anthrax, rinderpest etc.

9. Talamalai - Guthiyalathur Corridor

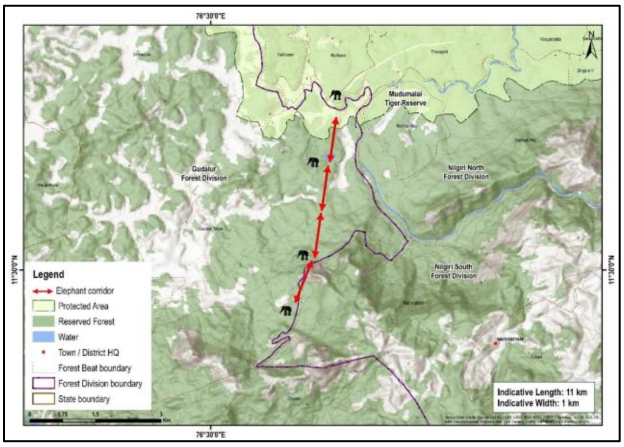




Connectivity	Connects Talamalai RF (upper plateau) to the Guthiyalathur RF (lower plateau) near 1st bend of the NH 209 from Bannari to Chamrajnagar.
State	Tamil Nadu
Corridor Dimensions	Length = 3 km, width = 0.5 km
Geo coordinates	N 11°30'31" - E 77°5'4"; N 11°33'37" - E 77°8'26"
Forest ranges	Sathyamangalam, Bhavani Sagar, and Talamalai Ranges
Ecological Importance	This is a very important corridor used by large number of elephants and other wildlife. The corridor is located along the foothills of the Talamalai hills, where the habitat is narrow and surrounded by agricultural areas. Elephant movement from Bhavanisagar range into Sathyamangalam range is particularly facilitated by this corridor.
Habitat type	Tropical thorn and deciduous forest
Major land use	Forest
Elephant movement	Regular; movement is high during Oct to Dec; around 770 elephants occur in the park and many of them use this corridor
Linear infrastructure	Sathyamangalam Chamrajnagar National Highway (NH 209)
Corridor status	Active. Intensity of use by elephants stable
Bottlenecks & Threats	• *Obstructions*: The shooting range of STF near Puthubeerkadavu and few resorts and ashrams located near the forest boundary. • *Settlements*: Expansion of Puthubirkadavu & Patramangalam villages has considerably decreased the width of the corridor. • *Intensive agricultural activities* have reached the foothills of Talamalai RF, obstructing elephant movement. People from nearby areas are also purchasing land. • *High vehicular traffic* on NH 209 (Sathyamangalam-Mysore), which passes through the corridor (2800-3000 vehicles/ day). • *Fuelwood collection* for commercial uses and selective felling of elephant food species has degraded the corridor. • *Livestock grazing* has reduced the availability of regeneration and recruitment saplings of elephant food species. • *Potential linear infrastructure threats*: Proposed railway line between Mettupalayam - Chamrajanagar, and a highway between Siriyur - Bhavanisagar (projects presently shelved).
Human Elephant Conflict	• The trend in and around the Talamalai - Guttiyalattur corridor reveals that HEC has increased during the past few years.
Recommendations	1. Taking over the ashram land near Puthubeerkadavu and increasing the width of the natural habitats.

	2. The corridor should be notified and legally protected and acquisition of land at crucial bottle neck points including closure of farm house close to the corridor. 3. Vehicular speeds should be regulated by barriers on NH-209 including mitigation measures for any road expansion. 4. EPT and/or fencing obstructing elephant movement should be removed and not be encouraged to mitigate HEC.

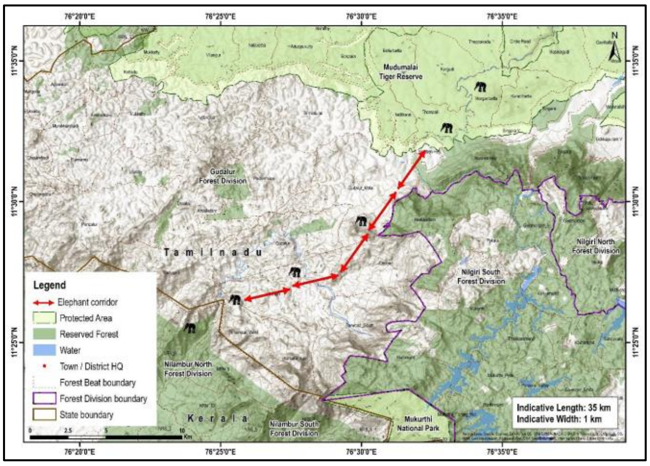
10. Mudumalai - Mukuruthi Corridor

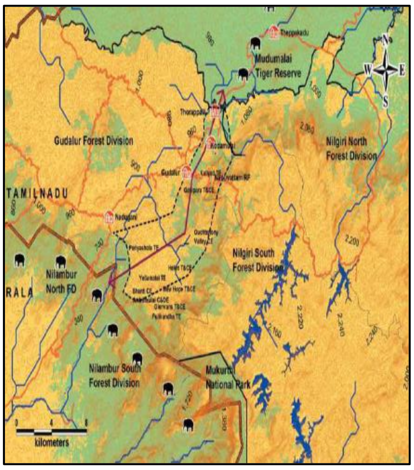


Connectivity	Connects Mudumalai Tiger Reserve to Mukuruthi National Park
State	Tamil Nadu
Corridor Dimensions	Length = 11 km, width = 1 km
Geo coordinates	76 31'31.07 E, 11 31' 3204 N; 76 30' 5973 E, 11 29' 34.25 N
Forest ranges	Gudalur, Naduvattam and Northern Hay Ranges
Revenue villages	7 Revenue villages fall in the corridor
Ecological Importance	This corridor connects Mudumalai TR and Mukurthi NP providing permeability for elephants to move from dry thorn and dry deciduous habitats to evergreen and shola habitats of the upper Nilgiris.
Habitat type	Moist deciduous, semi-evergreen, shola-grasslands and plantations.
Major land use	Forest and associated natural habitats, tea and coffee plantation and human settlements
Elephant movement	Seasonal, movement is high in months of August to November; 60-80 elephants use the corridor.
Linear infrastructure	• National Highway 67 and associated high traffic • State Highway (Gundalpet - Coimbatore). • 40 km of High-tension power line (11,000 KV)
Corridor status	Active. Intensity of use by elephants stable
Bottlenecks & Threats	• In lower elevation Deivamalai village and Silver Cloud estate. • In between upper elevation (TANTEA) and lower elevation (Silver cloud estate), only 300 m length of forests are available. • In upper elevation, only 200m forest area is available between Royal valley and Outcherlony estates. • National Highway 67, Silver cloud tea factory.
Human Elephant Conflict	• Conflict is low in this area due to the fact that most of the land is being used by tourist resorts and there is little cultivation of crops.
Recommendations	1. Taking over of large tract of Janmam lands, whose lease period has expired and notifying them as RFs for corridor protection. 2. Regulation for land use and land cover changes in private lands.

	3. Schools and colleges which are located in the peripheral areas should be targeted for awareness education 4. Corridor needs to be notified to check the rapid developments. 5. The corridor is newly identified; hence need more detailed study/ground truth information for more scientific information.

11. Mudumalai - Nilambur via O' Valley Corridor (Interstate corridor)





Connectivity	Connects Mudumalai TR (Tamil Nadu) to Nilambur North Forest Division (Kerala) via Gudalur Forest Division in Tamil Nadu.
State	Tamil Nadu and Kerala
Corridor Dimensions	Length = 35 km, width = 1 km
Geo coordinates	76 31' 47.725 E, 11 32' 53.874 N; 76 24' 34.841 E, 11 25' 30.235 N
Forest ranges	Gudalur, Naduvattam and O Valley Ranges
Revenue villages	31 Revenue villages fall in the corridor
Ecological Importance	Forest = 5209 ha; Agriculture/Estates = 3408 ha; Habitation = 1311 ha
Habitat type	Moist deciduous and semi-evergreen forests
Major land use	Forest = 61,392 ha, Agriculture = 1,193 ha, Habitation = 195.40 ha
Elephant movement	Regular but peak during south west monsoon season; 60 elephants use the corridor.
Linear infrastructure	• National Highway 67 and associated high vehicular traffic • State Highway (Gundalpet -Coimbatore) and Gudalur to Nilambur • High tension power line (11,000 Kv), 40 kms • Working factories viz. Manjushree Factory (Smokehouse) at Guind, Silver cloud tea factory and Periyashola tea factory • Non-working factories like Bharathinagar & Seaforth factories • Govt offices like Municipality & Panchayat offices, Police station
Corridor status	Active. Intensity of use by elephants increased
Bottlenecks & Threats	• *Obstructions*: Several factories and constructions in the corridor obstruct the movement of the elephants viz. Silver Cloud tea factory; Labour lines of Manjushree Estate, O'Valley etc • *Human settlements*: About 26 settlements (2000 households) are located in the corridor, causing biotic pressure and physically obstructing elephant movement. • *Plantations*: Several tea, coffee and cardamom estates are located along the corridor; some protected by electric fences, which affect the free movement of elephants (Balmadi estate).

	• *Vehicular traffic*: NH-67 connecting Ooty-Bengaluru passes through the corridor. Nearly 113.5 vehicles/hour were recorded with the movement of four-wheelers as highest (1pm - 10pm).
Human Elephant Conflict	• The nature of this landscape, with the corridor being located in a mosaic of forest patches, tea/coffee/clove/cardamom estates and human habitations, is the major cause for elevated HEC in this region; both human deaths and injury.
Recommendations	1. Relocation of public from fragmented areas of O'Valley range through proper schemes. 2. Immediate taking over possession of the large tract of Janmam lands from the plantations, whose lease period has and notifying these private lands as Reserved Forests for corridor protection. 3. As a short-term remedy, EPT and other preventive methods can be resorted to this may provide some immediate relief. 4. Electric fences obstructing movement should be removed. 5. Regulation for LULC changes in private lands, needed.

1.5 LEGAL IMPLICATIONS

Elephants are protected under Schedule I of the Indian Wildlife (Protection) Act, 1972 and are listed as 'Endangered' in the IUCN Red List. They are also listed under Appendix I of CITES which prohibits trade in live animals and even their products.

1.5.1 Laws relevant for Elephant Conservation

The following legislations are considered relevant for elephant protection and conservation: –

Thematic Field	Name of the Legislation	Relevant Sections / Rules
A. Wildlife Related	Wildlife Protection Act 1972	Section 9 - Prohibition on Hunting of Elephants Section 11 (1) (a) - Hunting of Elephants to be permitted in certain cases Section 11 (2) - Killing/ wounding in good faith Section 12 - Grant of Permit for Special Purposes Section 29 & 35 (6) - Destruction/removal of Wildlife from Sanctuary and National Park Section 11 (1) (a) Proviso & 39 (4) - Rehabilitation / Rescue of Elephants Rule 10 (Sch 3 (7 & 8)) of Recognition of Zoo Rules, 2009 - Acceptance of Rescued Elephants by Zoos Section 33 & 33-A - Measures in the interest of elephants Section 42 - Ownership of Captive Elephants Section 42A (1) - Surrender of Ownership certificate (Rule 7 of Captive Elephant (Transfer or Transport) Rules, 2024 - Terms and conditions of Transfer) Section 43 (1) (2) & Proviso - Regulation of Transfer of Captive Elephants (Rule 9 of Captive Elephant (Transfer or Transport) Rules, 2024 also applicable)
B. Forestry Related	Indian Forest Act 1927	Section 26 - Prohibitions as per Indian Forest Act 1927 (similar provision in various State Acts)
	Van (Sanrakshan Evam Samvardhan) Adhiniyam 1980	Section 2 - Development of Forests and Wildlife

	Biological Diversity Act 2002	Section 41 - Promoting Conservation
	Scheduled Tribes & other Traditional Forest Dwellers (Forest Rights) Act, 2006	Section 2 (a) & 4 (2) - Declaration of critical wildlife habitat
C. Animal Welfare Related	Wildlife Protection Act 1972	Section 11 (1) (a) Proviso - Cause 'minimum trauma'
	Prevention of Cruelty to Animals Act, 1960	Section 11 (1) read with 11 (a) & (c) - Welfare of animals
	Bhartiya Nyaya Sanhita 1860	Section 425, 428 & 429 - Mischief by killing or maiming elephant
D. Environment Related	Environment Protection Act 1986	Section 3 (1) - Measures to protect and improve environment Section 5 read with Rule 5 (1) of Environment (Protection) Rules (EPR) 1986 - Prohibitions and restrictions on the location of industries Section 3 (1), (2) (v) (xiv) & (3) read with Rule 5 (3) of the EPR, 1986 - Eco sensitive Zones (ESZ)
E. Drugs Related	Drugs & Cosmetics Act 1940	Section 26A - regulate, restrict or prohibit manufacture of drug in public interest
	Insecticides Act 1968	Section 27 - Prohibition of sale etc., of insecticides (weedicides) for reasons of safety of wild animals
	Narcotics Drugs & Drugs Psychotropic Substances Act 1985	Section 8 (c) - Restrictions on the possession, acquisition, use, consumption, and transport of any narcotic drug or psychotropic substance
	Indian Veterinary Council Act, 1984	Section 31 - Role of Veterinarians
F. Crime and Procedure Related	Wildlife Protection Act 1972	Section 50 - Procedures related to the prevention and detection of the offences Section 59 - Officers to be Public Servants within the meaning of Section 21 of IPC, 1860
	Bhartiya Nyaya Sanhita 1860	Sections 172 to 189 - Contempt of the Lawful Authority of Public Servants
	Nagarik Suraksha Sanhita 1973	Sections 41, 46, 47, 49, 50, 51, 52, 56, 57 - Dealing with the Arrests (refer section 50 (1) (c) of WLPA) Sections 61, 62, 70, 91, 93 - Compel Appearance & Production of Things (refer section 50 (8) of WLPA) Section 144 - Maintenance of Public order & Tranquillity (refer section 50 (7) of WLPA) Sections 157, 158, 160, 161, 162, 163, 164, 172, 173 - Investigation (refer section 50 (8) of WLPA) Sections 190, 195 - Conditions requisite for initiation of proceedings (refer section 50 (9) of WLPA)
	Bhartiya Sakshya Adhiniyam 1872	Sections 36, 45, 46, 51, 83 – Relevancy of Statements, Expert opinion and Documents as evidence (refer section 50 (8) (d) & 50 (9) of WLPA)
	Indian Arms Act 1959	Sections 3 & 7 - Illegal arms or license possession/ acquisition (refer sections 34 & 51 (4) of WLPA)

G. Land Related	Land Acquisition Act 1894	Section 6 - Land required for elephant habitat/ corridor (refer Section 24 (2) (b) of WLPA)
	Indian Easement Act 1982	Section 4 & 52 - Conservation of Elephants by issue of 'Easement' and 'License'
H. Sectoral Related	Electricity Act 2003	Sections 135 (1) & 161 - Electrocution of elephants
	Railways Act 1989	Sections 11 (a) & 29 (2) (c) - Various construction works (tunnels, culverts, embankment etc) and Control of train speed as a mitigatory measure
	National Highways Act 1956	Section 5 - Construction of Over-passes and Under-passes on the roads for elephant movement
I. Mitigation Related	Disaster Management Act 2005	Sections 30 & 31 - Development of District Disaster Management Plan for prevention, mitigation, preparedness and response measures

The synergy in various conservation laws having human elephant interaction manifestation allows to investigate and address the issues and related processes in multi-dimensional way in order to get generalized and specific redressal measures.

Also, various international laws and conventions like Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES); Convention on Migratory Species (CMS); Ramsar Convention on Wetlands; and Convention on Biological Diversity (CBD) highlight the global importance of conserving elephants and their habitats, recognizing their ecological significance and the need for international cooperation to protect them.

1.6 HISTORY OF PAST MANAGEMENT

The past management of NER can be discussed into pre-colonial, colonial and post-colonial periods:

Pre-Colonial Period (before 1800s)

- During this period, forests were used by the indigenous communities (Todas, Kotas, Irulas, Kurumbas, etc.) for subsistence (fuelwood, honey, wild fruits, grazing, shifting cultivation in patches) and utilization was of low-intensity and largely sustainable; maintaining intact shola-grassland mosaics and dry deciduous tracts. As regards the ecological balance, forests were biodiversity-rich and supported elephant populations across continuous ranges.

Colonial Period (before 1800s-1947)

- During this period, there was maximization of timber and revenue productivity and ecological concerns were secondary. Forest-dependent communities were restricted and forests were increasingly viewed as state property for commercial yield. Productivity measured in cubic meters of timber extracted, not ecosystem services The British reserved large tracts of forests for commercial exploitation (especially teak, rosewood, and sandalwood). Systematic felling was introduced in Nilgiris, Sathyamangalam, Erode, and Dharmapuri divisions for railway sleepers, shipbuilding, and export. Conversion of shola-grasslands in Nilgiris and Gudalur into tea, coffee, cinchona, and eucalyptus plantations was significant; and the plantations aimed at high productivity per acre. Replacement of native vegetation with exotics reduced ecological productivity for wildlife. Grazing licenses were issued and fire used as a management tool to maintain grass for livestock; but also caused long-term degradation of understorey and regeneration.

Early Post-Independence Period (1947–1980s)

- Continuation of timber extraction for industries, plywood, matchwood, and paper mills (e.g., in Erode and Dharmapuri) was there and in Hosur - Krishnagiri belt, increased utilization of sandalwood and fuelwood for local industries was there. The Forest department was managed as a revenue-generating department - auctioning bamboo, timber, and firewood and scientific working plans were prepared division-wise, emphasizing yield regulation (annual allowable cut) and coupe felling cycles. Expansion of agriculture in foothills and valley forests in Nilgiris and land grants in Gudalur (janmam lands) - converted to plantations resulted in the fragmentation of the forests, in turn, elephants and other wildlife began losing habitat and human-elephant conflict increased in tea/ coffee plantation belts.

Conservation-Oriented Shift (1980s–2000s)

- During this period, establishment of sanctuaries and national parks (Mudumalai & Sathyamangalam, later constituted as Tiger Reserve) and biosphere reserve (Nilgiri BR) brought conservation into attention. There was ban on green felling in 1980s-1990s reducing direct timber productivity and emphasis shifted to non-timber forest products (NTFPs) like honey, medicinal plants, amla, and bamboo. Eucalyptus, casuarina, and wattle was planted widely in degraded areas to meet fuelwood demand and productivity measured in short-rotation pulpwood and fuelwood yield. Balance between resource utilization (community fuelwood, NTFPs) and biodiversity protection.

Contemporary Period (2000s–Present)

- Productivity now measured in ecological services envisages biodiversity conservation, carbon sequestration, watershed function. Strict protection regimes in Mudumalai TR, Sathyamangalam TR, and Cauvery WLS reduced forest utilization. Forest Rights Act (2006) enabled limited community access in some areas (firewood, grazing, minor NTFPs). Eco-tourism initiatives (Nilgiris, Mudumalai, Sathyamangalam) focused on sustainable utilization of forest resources. In Hosur, Krishnagiri and Dharmapuri, industrial and urban growth was seen with high demand for sand and timber. Rising human-elephant conflict due to historical fragmentation of productive forests and diversion of fertile valley forests to agriculture could be observed. Forest productivity was increasingly linked to ecosystem services and carbon finance (e.g., REDD+ pilots, carbon sequestration projects) and utilization is now more governed by non-extractive values like eco-tourism, biodiversity offsets, and carbon markets in the reserve.

1.6.1 Forest resource productivity and utilization

Forest productivity in this landscape varies strongly with forest type: high above-ground biomass (AGB) in moist evergreen/shola patches (higher elevations of Nilgiris), intermediate AGB (~14-275 t / ha) in moist deciduous (Mudumalai, parts of Sathyamangalam), and lower AGB in dry deciduous / fragmented peri-urban patches (Dharmapuri, Krishnagiri, Hosur, parts of Erode/Gudalur). Fire, invasive species (e.g., Lantana), plantations (eucalyptus/wattle), and fragmentation are major productivity depressors.

As per the State of Forest Reports (SFR) in the last 2 decades (2003 to 2023), there has been constant reduction in the 'Growing stock' of the recorded forest area of Tamil Nadu and the data has been normalized proportionately to reflect for the NER area of 4662.45 km^2. However, as compared to 2021 assessment, there is slight increase in 2023 of the growing stock of forests and ToF (Fig-1.8).

Fig-1.8: Growing stock of recorded forests and ToF in NER (as per normalized data in SFR reports)

Similarly, the carbon stock (in million tons) for Nilgiri Elephant Reserve (NER) as normalized from SFR report of 2023 (Table-1.6), can be projected as under:

Table-1.6: Carbon stock of Nilgiri ER as compared to the State

	Forest Cover	Above Ground Biomass (AGB)	Below Ground Biomass (BGB)	Dead wood	Litter	Soil Organic Carbon (SOC)	Total
TN	26450 km^2	61,872	21,053	2,866	3,123	1,28,646	2,17,560
NER	4662 km^2	10,438	3,552	483	527	21,702	36,701

Main drivers of spatial variation in productivity include:

- *Forest type & climate gradient*: montane shola > moist deciduous > dry deciduous/scrub in AGB and regeneration potential.
- *Disturbance regime*: repeated fire/ livestock grazing suppresses tree recruitment & reduce AGB.
- *Land-use change & plantations*: conversion to tea, coffee, eucalyptus changes standing biomass characteristics (commercial yield vs. ecological productivity).
- *Fragmentation & edge effects*: smaller patches have lower biomass density and altered microclimates, reducing productivity and forage value.
- *Management history*: areas under sustained protection and low anthropogenic pressure retain higher productivity; areas with timber extraction & industrial supply chains show depleted stocks.

Forest utilization in the reserve can be perceived as under:

- *Timber extraction*: Historically, heavy in all divisions; now mostly restricted, but legacy of plantations (eucalyptus, wattle, teak) dominates.
- *NTFPs*: Vital source of subsistence/ livelihood (tamarind, gooseberry, honey, soap-nut, bamboo, medicinal plants).
- *Fuelwood & Grazing*: Continues as the most direct form of utilization across Eastern Ghats divisions (Erode, Dharmapuri, Krishnagiri, Hosur).
- *Tourism & Ecosystem Services*: Major indirect utilization in Nilgiris, MTR and STR.
- *Concerns*: Over-dependence, lack of sustainable harvest norms, invasive species spread, and conflict with elephants where agriculture–forest interfaces overlap.

1.6.2 Forest leases including NTFP collection

There are several kinds of leases for quarrying, supply of pulpwood, NTFP collection, etc in the reserved forest areas. In the PAs there is no removal of forest biomass including NTFPs, but in the buffer areas, the exploitation of the resources detrimental to wildlife interest e.g. grazing, lopping, fires for new flush of grass are there. The impact of the leases on the forest ecosystem also has consequences on the forest diversity and ecological functions.

Important leases in the NER include:

Divisions	Details of Lease
Nilgiris	• *TNEB lease* is there for the power-house at Glenmorgan (9.95 ha) in Governor shola range, feeding to Singara power-house. • *Central Potato Research Station:* An area of 16.796 ha has been leased out for the research on potato.
Gudalur	• *TANTEA*: 2666.31 ha area was leased out to TANTEA in Gudalur for rehabilitation of Sri Lankan Tamils in tea and other plantations in 1968.
Mudumalai	• *Thengumarahada settlement* (500 acres of RF leased in 1948) for farming to the cooperative society of forest workers; area lies in the corridor connecting MTR - STR and is a prime foraging habitat along the Moyar river. • *TNEB Projects*: It has major hydro-electric projects (PUSHEP & MUSHEP) in in Avarallah RF of Masinagudi range (510.05 acres of land leased in 1948 and surplus land of 193.12 acre resumed in 1990-91). Further land actually required for the project needs to be reassessed. • *Mundan Chettis Settlement*: For the purposes of relocation of the inhabitants living inside Mudumalai 289.495 ha of forest land was allocated in the Ayyankolli area in Bitherkad Range of Gudalur division. • *Under Ground OFC Cable*: Cable has been laid from Thorapalli to Kakanallah check-post on Gudalur-Mysore Road by BSNL (0,25 ha), Defence (0.7 ha) and Reliance Communications. • Besides, leases exist for tribal residential school at Kargudi, Canteen and Rinderpest check-post at Theppakadu.
Sathyamangalam	• *PWD Lease*: Forest land up to the inundation level of the Bhavanisagar dam has been given on lease to the PWD department. In the recent years, few encroachments have been noticed. In south west of the STR, there is a horticultural farm, developed on the land leased by the Forest Department. • *Quarries for minor minerals*: In the buffer zone of STR, there are many small quarries located on the southern boundary of TN Palayam Range, Kottamalam of Germalam Range and eastern boundary of Bhavanisagar Range. • *Grazing Permits*: In buffer areas of STR no grazing permits are issued but grazing pressure remains a major threat in the upper plateau. The Bargur cattle (endemic variety) is reared and depends upon the forest areas of this region for grazing.
Erode & Dharmapuri	• In Erode and Dharmapuri division, tribes are given concessions like cultivation of land under annual lease. Since 2003, rights to collect MFP have been given to VFCs and FDA villages, free of cost.
Hosur/ CWLS	• In Cauvery North and South Wildlife Sanctuares, there are no existing lease units in the sanctuary area excepting Tribal VFCs, which are allocated MFP.

1.6.3 Forest health and protection including anthropogenic pressures

Forest health is the combination of structural integrity, regenerative capacity, functional productivity, resilience to disturbance and the ability to continue delivering ecosystem services.

The anthropogenic and developmental pressures on forests in the NER including threats are further exacerbated by the poor status of regeneration, forest fires, damage due to forest disease and pests, grazing, and invasive weed species leading to forest degradation.

There are 89 villages in the ESZ of MTR, 22 in STR and 165 in CNWLS causing biotic and development pressures within the Elephant Reserve. About 31 human settlements are located along the Mudumalai - Nilambur via O'Valley corridor causing biotic pressure and physically obstructing movement of elephants making them more aggressive, leading to conflict. The NER is traversed by the NH 948 road; however, the proposed road widening proposal under FCA, 1980 was rejected. Similarly, the construction of Kanakkampalayam dam in Guthiyalathur RF involving felling of 1518 nos of trees in 35.80 ha area was turned down by the CEC.

Division-wise health and priority problems can be summarized as under:

Divisions	Current Health and Protection Status
Nilgiris	• Intact shola patches retain high AGB and good regeneration where protected, but large tracts on lower slopes and plantation interfaces show degraded understorey, exotic plantations (eucalyptus/wattle) and invasive understory. Tourism and settlements fragment the landscape; fire occurs in drier pockets.
Gudalur	• Remnants of evergreen/moist deciduous exist, but plantation conversion and intensive estate management reduce native regeneration; repeated HEC incidents show edge effects and forage deficits in forests.
MTR	• Relatively better in core areas but vulnerable in fringes. Long-term fire data show recurring fires influencing regeneration dynamics; bamboo/grass patches important for wildlife, but susceptible to disturbance. Annual fires, cause extensive damage to ground flora and restrict fodder availability during the critical dry season. • MTR is invaded by several exotic plant species (~60-70%) such as *Lantana, Eupotorium, Ageratum, Parthenium & Mikania.* In recent years, invasion of *Senna spectabilis* in the PA poses greater threat in Masinagudi range. • Habitat degradation remains a major threat mostly in the eastern part of MTR due to cattle grazing, removal of fuel wood, NTFP collection and affects the habitat quality and also results in disturbance to wildlife.
STR	• Large blocks but variable health. Corridor pinch-points and edge degradation from agriculture and roads lower functional connectivity and local AGB; fires reported with increasing frequency in certain ranges. • Habitat degradation due to invasive species, cultivation in dam spread area, fire wood & NTFP collection, cattle grazing and forest fire are major threats to the forest. • Among the most prominent weeds having an adverse impact are *Prosopis juliflora* (~15,000 ha) and *Senna spectabilis*. • Cattle grazing is rampant in the core zone and goat browsing in the buffer zone. Bargur cattle (endemic variety) reared by locals, also graze in the adjoining forests.
Erode	• Small, fragmented remnants with low structural complexity and poor regeneration causing high edge effects, grazing pressure and local extraction. Like STR, fire and grazing are the major threats in the area.
Dharmapuri	• Degraded dry deciduous tracts with heavy fuelwood extraction, grazing, and quarrying pressures and low recruitment rates are the key conservation issues.

	• Illegal cattle penning & goat browsing is responsible for the forest degradation; and illegal collection of NTFP (tamarind, gooseberry, naval, bamboos etc) are common.
CWLS	• Highly fragmented scrub and degraded forest with very high infestation of *Lantana, Chromolaena, Eupatorium & Prosopis*; peri-urban pressures from road expansion. • Cattle grazing, apart from causing poor or no regeneration of native species, it contributes much for the spread of zoonotic diseases leading to loss in biodiversity.
Hosur	• Peri-urban remnant patches with very low biomass and high edge disturbance; industrial expansion threatens remaining connectivity. • Removal of fuel wood (~150 MT per annum) and heavy cattle grazing, causes forest degradation, damaging all-natural regeneration, hardening of top soil and forest fire. • Destructive collection of Tamarind by the tribal is common; besides graziers have the practice of lopping Hardwickia, Glyricidia, Tamarind & Ficus trees for their cattle.

The dominant **anthropogenic pressure** in the reserve includes:

- *Conversion to plantations & agriculture*: tea/coffee estates and short-rotation exotics replace native forests and lower forage quality, biodiversity and cause fragmentation (Nilgiris, Gudalur).
- *Invasive species* (Lantana, exotic understory): suppresses tree recruitment, alters fire regimes and reduces forage; spreads across dry deciduous tracts; control needed for regeneration.
- *Fire* (anthropogenic & accidental): recurring fires reduce recruitment, shift species composition towards fire-tolerant, lower-biomass state (MTR, STR, Nilgiris fringes).
- *Fuelwood & grazing pressure*: continual extraction and livestock browsing suppresses sapling growth (Erode, Dharmapuri, Krishnagiri, Hosur).
- *Quarrying / sand & minor minerals*: localized but high impact due to soil removal, hydrology change and edge creation (Dharmapuri/Krishnagiri).
- *Infrastructure & roads*: linear barriers fragment habitat and increase mortality; roads also open up areas to further encroachment.
- *Urban/ Industrial expansion*: converts forest to non-forest and reduces effective habitat especially in Hosur and Krishnagiri areas.
- *Human-wildlife conflict responses* (retaliation, snares, illegal fencing): where HEC is high, anti-wildlife measures and illegal deterrents further degrade habitat and animal populations.

1.6.4 Biodiversity and wildlife conservation

Various administrative units of the NER have a mixed landscape of montane shola-grassland and wet evergreen forest (Nilgiris) - moist deciduous forest and bamboo (MTR/ STR) - dry deciduous forest / scrub and peri-urban fragments (Erode, Dharmapuri, Krishnagiri, Hosur).

Wildlife patterns and biodiversity values are strongly determined by (a) vegetation type and elevation, (b) availability of forage/grass and water across seasons, and (c) landscape connectivity (corridors and riparian strips). Conservation action must therefore be habitat-centric and connectivity-driven.

Key biodiversity components focusing on the taxa and associated habitat envisages:

- *Large mammals / flagship species*: includes Asian elephant, tiger, leopard, gaur, sambar, spotted deer/chital, barking deer, dhole. In Nilgiris, MTR and STR, there is a strong presence of tigers, elephants, gaur and dhole in well-protected core area; and in Erode, Dharmapuri, Krishnagiri and Hosur divisions, there are smaller remnants, but important as dispersal/ foraging areas and stepping stones for elephants and other wide-ranging species.

- *Montane endemics*: includes Nilgiri langur and several endemic birds (e.g., some hornbill & leaf-lore species); and shola grasslands also support unique amphibian/ plant assemblages.
- *Birds & pollinators*: Mixed forests support hornbills, woodpeckers and migratory assemblages; including riparian systems which are vital for waterbirds.
- *Understorey & forage resources*: Native grasses, bamboo clumps and shola understorey drive seasonal feeding patterns for elephants, gaur and small ungulates. NTFP species viz. tamarind, soap-nut, honey flora) also serves as biodiversity and livelihood components.
- *Key habitats*: includes shola-grassland mosaics, bamboo/grass patches, riparian corridors, dry-deciduous gallery forests, and large contiguous moist-deciduous blocks.

Core wildlife-habitat relationship (WHR) to guide action envisages:

- *Forage-driven movement (seasonality)*: Elephants move seasonally following availability of grasses, bamboo and water. In dry months they descend to valleys/plantations, increasing HEC and thus restoring in-forest forage reduces chances of crop raiding.
- *Keystone forage*: Bamboo diebacks or loss of grassland reduces food availability for herbivores, pushing them into croplands and hence requires to be protected and restored.
- *Shola-grassland mosaics for specialists*: Several endemic plants/ lichens depend on intact mosaics and hence any conversion of these to plantations destroys these habitats irreversibly on management timescales.
- *Corridors & riparian strips for connectivity*: Small riparian strips and hill ridges act as movement routes and their loss creates pinch-points and leads to more predictable HEC hotspots.
- *Edge & matrix quality matters*: Plantation monocultures (tea, eucalyptus) have low biodiversity value and can either act as barriers or attractants (if crops are palatable). Managing matrix quality (e.g., mixed native shade trees) reduces conflict and improves permeability.
- *Disturbance regimes (fire, grazing, invasives)*: Repeated fire and invasive species (e.g., Lantana, Senna, Prosopis etc) reduce regeneration and forage carrying capacity, causing long-term shifts in species presence/abundance.

Threats most relevant to biodiversity values includes habitat conversion; fragmentation and corridor loss; invasives and altered fire regimes; over-extraction (NTFP, fuelwood, timber) and uncontrolled grazing; roads, fences, powerlines & infrastructure; human-elephant conflict; and small reserve/peri-urban pressures.

Research and knowledge gaps should focus on fine-scale movement ecology of elephants in western-eastern ghat gradient; role of matrix composition (tea/coffee/plantation types) in permeability and attractivity to elephants; habitat restoration trials and invasive control; and socio-ecological studies on crop choice, HEC tolerance, barrier efficacy and effective incentive structures in buffer villages.

1.6.5 Management of soil and water resources

Forest management activities can alter forest soils, water quality, and the capacity of habitats to sustain wildlife populations and there is a strong linkage between soils and hydrological functions. The threat to the landscape on account of catchment degradation, discharge of effluents, and mining in the NER are major threats to ecological functions.

Why soil & water management matters for elephants

- Elephants are large, mobile herbivores whose seasonal movements follow water and forage. Soil and water condition determines forage productivity (grass, bamboo shoots, browse) and surface water availability in dry months.
- Degraded soils lead to reduced root-zone moisture and less grass/ bamboo regeneration and thus elephants move into farms for crops and irrigation tanks, in turn leading to increased HEC.
- Restoring catchment hydrology and soil health therefore increases in-forest forage & water, reduces off-reserve movement, and stabilises elephant movement corridors.

Various soil-water conservation interventions undertaken in the NER can be grouped as:

A - Landscape / catchment interventions

- Protection of upper catchments & riparian buffers: - In the upper catchment (Nilgiris), there is no further clearance or felling of trees or any major earthwork in the reserve or the upper catchments of priority corridors including keeping the riparian buffer, wider where slope is steep.
- Contour trenching, Gully plugging etc on degraded slopes: - Small contour trenches (graded), gully plugs and loose rock check dams to slow runoff, increase infiltration and reduce gully formation has been executed especially in STR, Dharmapuri and CWLS/ Hosur fringe slopes.
- Recharging groundwater with check-dams/percolation ponds: - Series of check-dams across ephemeral streams to raise water table and sustain springs especially in Eastern ghats region.
- Catchment protection through native afforestation: - Planting of degraded slopes with native species, to increase infiltration and stabilize soils e.g., *Acacias, Terminalia, Dalbergia*, and native grasses on contours in Erode, Dharmapuri and Hosur areas.

B - In-forest, elephant-focused water & forage management

- Seasonal waterholes/ Solar operated borewells: - Excavated shallow ponds, lined with clay where seepage is slow, sited in forest interiors to discourage edge movement have been created in the reserve. Solar pumps have also been installed for filling from the borewells.
- Bamboo clump protection: - Protection and expansion of bamboo patches which also increases the forage quality has been carried out in many places in the NER.
- Native grassland restoration & forage plots: - Experimental trials of grassland restoration have been tried in shola/deciduous matrices with native species including experimental forage plots in forest interiors.
- Recharge of perennial springs: - Protection of natural springs with masonry aprons and erosion control to avoid siltation which is critical in Nilgiris / Gudalur highlands.
- Soil organic matter improvement (mulch, vetiver terraces): - Mulching, contour vetiver strips, and organic soil-building in degraded terraces to restore water holding capacity has been tried in Eastern ghat region.

C - Edge & village-side interventions

- Strategic placement of community water points away from corridor edges: - Location of community ponds, well inside the forest borders, from known pinch-points and main elephant routes have been constructed in most divisions under TBGP and Project Elephant schemes.
- Crop choice & field-water management: - Efforts have been made to create awareness and encourage low-attractant cropping (e.g., certain millets, pulses) in high-risk bands; avoid irrigated

- sugarcane/ banana near corridors.

D - Erosion control in infrastructure & industry areas

- Enforcement of silt fences and construction sediment control along roads and industrial sites in Hosur/ Krishnagiri. Mine / quarry rehabilitation with staged backfilling, bench planting and water retention measures.

1.6.6 Ecological sustainable development including ecotourism

Ecological sustainable development (ESD) is the cardinal principle for sustainable forest management to sustainably manage the forest, water and ecosystem processes including sustainable ecotourism.

A structured overview of existing ESD initiatives across the NER landscape, spanning Western Ghats divisions and Eastern Ghats divisions may be envisioned as under:

1. Ecodevelopment & Community-based Conservation

- *Ecodevelopment Committees (EDCs)*: Active in Mudumalai Tiger Reserve, Sathyamangalam Tiger Reserve, and Cauvery Wildlife Sanctuary. They provide alternative livelihoods (eco-guides, anti-poaching watchers, handicrafts, small enterprise funding) and help reduce dependence on fuelwood/NTFP collection through LPG schemes, solar lighting, and stall-feeding of cattle.
- *Joint Forest Management (JFM) / Village Forest Committees*: Formed at the time of implementation of Tamil Nadu Afforestation Project (TAP) mainly in the fringe forest areas and implement afforestation, soil & water conservation, and fire management activities. They also facilitate micro-credit, women's SHGs, and developing eco-tourism links.
- *Forest Rights Act (FRA) implementation (partial)*: Some tribal hamlets in Nilgiris & Sathyamangalam have received Individual Forest Rights and are awaiting Community Forest Rights (CFRs), enabling community-led sustainable resource management.

2. Tribal Development & Livelihoods

- *Indigenous communities*: include *Todas, Kotas, Kurumbas, Irulas, Paniyas, & Kattunayakans*.
- *Livelihood programs*: TRIFED (Tribal Cooperative Marketing Development Federation) supports honey, wild food, herbal products, handicrafts; NGOs like Nilgiris Adivasi Welfare Association (NAWA), Centre for Tribal & Rural Development (CTRD), and Keystone Foundation work on NTFP value chains, organic agriculture, eco-enterprises (honey, spices, wild coffee, forest-based handicrafts). Tribal cooperatives and SHGs are also involved in eco-tourism, handicrafts, eco-restaurants, and homestays.
- *Education & health initiatives* are supported by Adi-Dravidar and Tribal Welfare Department and various NGOs who work in the region to integrate development with conservation awareness.

3. Ecotourism

- *Western Ghats* (Nilgiris, Gudalur & MTR): Ecotourism facilities have been well- developed in the Western Ghats region of NER and Mudumalai TR has visitor services in the form of jeep safaris, eco-guides, interpretation centres, tribal craft exhibitions etc. Cairn hills in Nilgiris and Genepool ecopark in Gudalur division have appropriately been developed and do not threaten the ER values. Keystone & local collectives operate community-led tourism (honey trails, tribal culture).
- *Eastern Ghats* (STR, Erode, Dharmapuri, CWLS/ Hosur): Ecotourism in Eastern Ghats is not so well-developed as compared to the Western Ghats, however, it is progressing well. In STR, ecotourism centres exist at Bhavanisagar and Hasanur with facilities like trekking, community watch & guide services. Tribal museum at Bhavanisagar, eco-cottages at Bargur & nature camp facility at Thattakarai (Erode) attract lot of tourists in the region. One crocodile farm is established at Hogenakkal besides Aiyur Centre in CWLS. Community-based eco-tourism (CBET) under TBGP has been established with adequate facilities like accommodation, safety materials etc., at Aiyur. Ecotourism amenities do not impact the elephant reserve.

4. Sustainable Resource Management

- *Soil & water conservation*: Check dams, percolation ponds, Gully plugs etc constructed under CAMPA, NABARD, TBGP and other schemes.
- *Agroforestry & organic farming*: Tree cultivation in Private Land (TCPL) under TBGP is one of the flagship programs of the Forest dept in the Eastern Ghat divisions. NGOs & Horticulture dept promote spice cultivation, shade-grown coffee, organic certification in Nilgiris & Gudalur areas.
- *NTFP management*: Community collection under regulated permits (honey, soapnut, shikakai, tamarind) and training in sustainable harvesting is done in the forest divisions.
- *HEC mitigation*: Solar fencing, elephant-proof trenches, early warning systems, and village-based conflict response teams have been formed under TBGP and other Govt schemes.

5. Opportunities for Scaling Sustainable Development

- Shola–grassland restoration in Nilgiris plateau, riparian restoration in Sathyamangalam & Erode.
- Strengthen EDC revenue-sharing models: clear guidelines on tourism revenue to communities.
- Integrate FRA with ecodevelopment: CFR management plans for elephants, and NTFPs.
- Eco-tourism circuits: Western - Eastern Ghats tribal eco-tourism loop (Nilgiris-MTR-STR-Hosur).
- Green value chains: Nilgiris honey, coffee, medicinal plants marketed with global eco-labels.
- Community PES models: payments for water recharge, corridor protection, and fire management.

1.6.7 Socio-economic and cultural benefits to local community

Forests provide basic needs; are a source of energy, employment, traditional medicine and other subsistence needs for the majority of local communities. The contribution of forests, to the total household income of local communities is immense with some people depending on forests as their only source of subsistence, while others are partially dependent.

Also, local culture presents unique options for locally based economic and other development. The unique culture and heritage have numerous economic and social benefits viz. activities of visitors in consuming cultural products and taking part in cultural activities and experiences. The income generated from heritage eco-tourism can lead to an improved state of community and social well-being.

The existing socio-economic & cultural benefits to communities in the NER may be classified as under:

1. Direct Economic Benefits

- Employment in forestry & eco-tourism: - As Eco-guides, jeep safari drivers, interpretation centre staff in MTR/ STR; tribal youth trained as nature interpreters, anti-poaching/ fire watchers.
- Livelihood from Non-Timber Forest Produce (NTFP): - Honey, resin, soapnut, shikakai, tamarind, medicinal plants collected under regulated permits; Tribal cooperatives & SHGs (e.g., honey collection in Nilgiris, bamboo craft units in STR).
- Agro-based incomes: - Tea, coffee, pepper, cardamom (Nilgiris & Gudalur); Millets, tamarind, ragi, mango, banana (Dharmapuri, Krishnagiri).
- Government schemes: - CAMPA wages for afforestation, fire management. MGNREGS linkages for soil & water conservation; Tribal development grants and subsidies through Tribal Dept.

2. Indirect Economic & Social Benefits

- Tourism spillovers: - Homestays, eco-restaurants, handicraft sales (Toda embroidery, Kurumba art, bamboo products); small transport services (jeeps) and local produce sales to visitors.
- Education & health: - Forest Department's eco-clubs in schools, tribal hostels and schools; NGO-supported health clinics and nutrition programmes (esp. in Gudalur & STR).
- Skill development: - Training in hospitality, handicrafts, organic farming, beekeeping.

3. Cultural Benefits

- Tribal cultural identity revitalisation: - Showcasing Toda embroidery, Kurumba dance, Irula music in eco-tourism fairs (Bannari festival); cultural exchange in eco-development events.
- Sacred landscapes: - Toda sacred groves, hill shrines, elephant-linked rituals (esp. Kurumbas, Irulas) which provide cultural continuity and also serve as protected ecological niches.
- Community cohesion: - Formation of SHGs, EDCs, and village committees strengthens local governance and cultural networks.

Division-wise distribution of socio-economic benefits is as under:

Division	Socio-Economic & Cultural Benefits
Nilgiris	Toda embroidery (GI tagged), tea/coffee estates providing employment, eco-tourism (Cairn hills), shola conservation cultural values.
Gudalur	Tribal cooperatives for honey, wild coffee, spice marketing; NGOs enabling fair trade & health services; cultural identity strengthening for Paniyas & Kattunayakans
MTR	EDC-based benefits- safari jobs, eco-guides, handicraft sales; reduced dependency on firewood through LPG distribution; cultural integration in tourism
STR	Community eco-tourism centres (treks, camping); bamboo craft training; employment as watchers & guides; recognition of Irula and Kurumba heritage
Erode	NTFP collection (tamarind, broom grass), eco-clubs in schools, local employment in soil & water conservation projects
Dharmapuri	Agro-based livelihoods (ragi, tamarind); linkages with Hogenakkal eco-tourism, cultural identity through temples & forest rituals
CWLS	Tribal SHGs in mango, tamarind processing; eco-tourism at Cauvery sites; cultural events linked to elephant corridors
Hosur	Industrial spill-over employment and eco-tourism pilots; Irula & Kurumba groups engaged in handicrafts and cultural fairs

Overall socio-cultural gains can be perceived from their enhanced incomes from diversified livelihood options; reduced forest dependence via alternative energy & livelihood schemes; strengthened cultural pride through promotion of indigenous art, craft, and rituals; improved education & health access due to welfare linkages; and community empowerment via EDCs, SHGs, and Cooperatives.

1.6.8 Administrative setup and communication

Nilgiri Elephant Reserve (NER) has 2 tiger reserves (Mudumalai TR & Sathyamangalam TR), 3 wildlife sanctuaries (Thanthai-Periyar WLS, Erode and Cauvery North WLS & Cauvery South WLS, Hosur) and 4 territorial forest divisions (Nilgiris, Gudalur, Dharmapuri & Hosur forest divisions).

The organogram of the NER (Fig-1.9) is as under:

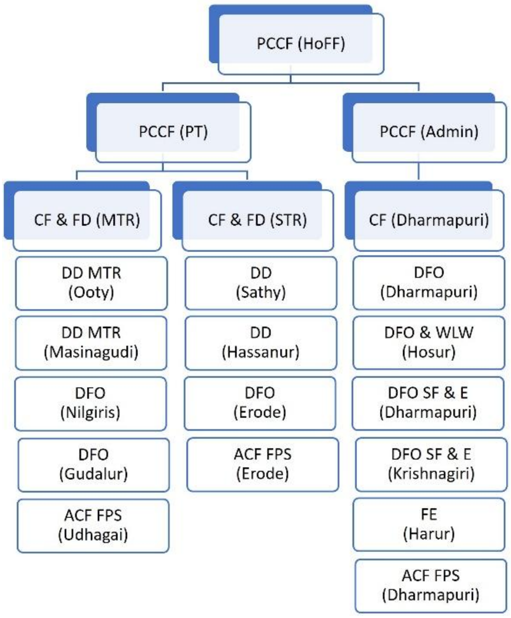


Fig-1.9: Organogram of Nilgiri Elephant Reserve

- **State level**: Tamil Nadu Forest Department (TNFD) is the parent agency responsible for forest and wildlife policy, elephant coordination in the state, and for issuing statewide directions and circulars. Operational authority for wildlife management sits with the Forest Department through the Chief Wildlife Warden / PCCF (PT) and Conservators at the Circle level.
- **Regional / Circle level**: Tiger reserve units (e.g., Mudumalai, Sathyamangalam) operate under a Field Director / Deputy Director who reports to the PCCF (PT) / CWLW depending on the structure. Territorial forest units primarily operate with the Conservator of Forests (CF, Dharmapuri) but wherever divisions are in the buffer zone or adjoining tiger reserves, they are controlled by the Field Directors (like Nilgiris/ Gudalur under FD, MTR and Erode under STR).
- **Division level**: Each forest division is headed by a Divisional Forest Officer or District Forest Officer (like Nilgiris, Gudalur, Erode, Dharmapuri and Hosur) who oversees territorial ranges and beats. Wherever, territorial division is a sanctuary, the same is controlled by the DFO & Wildlife Warden (as in case of Cauvery North/ South wildlife sanctuaries, Hosur and Thanthai-Periyar wildlife sanctuary, Erode). Of the many activities, divisions maintain the lease registers, HEC records, patrolling, forest protection squads and interface with district administration besides implementation of the scheme works.
- **Range / beat level** (field staff): Ranges are led by Range Forest Officers (RFOs) and beats are managed by Forest Guards / Watchers. They implement patrolling, immediate response, community outreach and local reporting. This is the most important level for rapid response to incidents and for enforcement.

The existing **communication and related infrastructure** in the NER include:

- *Vehicles*: This includes patrol jeeps / 4x4s (primary rapid-response and patrolling vehicle); motorbikes used by beat staff; tractors for depot/plantation work; trucks for departmental logistics; elephant kumki for elephant rides, monsoon patrolling and rescue operations; Swaraj Mazda vans for ecotourism etc.
- *Arms & ammunition*: Territorial and PA units maintain armed patrol squads / anti-poaching units. Armament issuance, secure storage, and rules of engagement are governed by state-level orders; frontline staff attend periodic training. Specific weapon types and ammunition counts are operationally sensitive and managed under departmental security protocols.

- *Wireless & Radio infrastructure*: VHF radio remains the backbone for inter-staff voice communications in most ranges, handheld sets for guards and vehicle-mounted sets for RFOs/DFOs, with repeater stations at higher-elevation sites to extend coverage across ridges.
- *Other Equipment*: Telemetry / GPS collars, which are project-based assets, have been used in elephant movement studies (typically by research institutions). GPS instruments and surveillance drones are used by the field staff for monitoring purposes. Cameras & camera-trap networks have been used by the Tiger monitoring cell in reserves (STR, MTR).

1.6.9 Research, Monitoring and Training

NER has always been a hub of scientific research studies; and different universities, research institutions and wildlife scientists have undertaken numerous studies especially in the two Tiger Reserves.

Apart from research, various ecological and socio-economic monitoring protocols have been undertaken and the findings utilized in decision-making and appropriate course of action for future management. Example: population estimation and monitoring of elephants in the Elephant Reserve.

A division-wise summary of the various studies undertaken include:

Division	Principal institutions	Research / Monitoring activities
Nilgiris	Salim Ali Centre for Ornithology & Natural History (SACON); Keystone Foundation; ATREE; Govt. Arts College, Ooty, TN Forest Dept	Avifauna surveys, shola–grassland ecology, long-term biodiversity monitoring, community biodiversity inventories.
Gudalur	Keystone Foundation; Govt. Arts College Udhagamandalam; TN Forest Dept	Human–elephant conflict (HEC) social studies, landscape use studies, NTFP/ value-chain participatory research.
MTR	Wildlife Institute of India (WII) projects; IISc- Centre for Ecological Sciences (CES) Keystone Foundation; TN Forest Dept	Tiger/leopard/dog sympatry studies, elephant dung/ line-transect population monitoring, camera-trap grids, long-term wildlife estimation (NTCA protocol).
STR	WII (surveys/ NTCA linkages); Keystone Foundation; TN Forest Dept	Camera-trap based carnivore monitoring, corridor studies, vulture/raptor and large herbivore monitoring, HEC incident monitoring.
Erode	TN Forest Dept; local universities; Keystone Foundation	HEC incident recording, small-mammal and bird surveys in remnant patches, habitat restoration monitoring.
Dharmapuri	TN Forest Dept; IISc / university collaborations; NGOs (regional)	Catchment & dry-deciduous habitat studies, erosion/rehabilitation monitoring, HEC mapping.
CWLS/ Hosur	TN Forest Dept; Keystone Foundation; research collaborators (universities)	Elephant movement / corridor studies, roadkill monitoring, peri-urban wildlife impact studies.

Typical research & monitoring methods used in the NER includes

- *Camera-trap grids* (tiger, leopard, carnivore occupancy) by WII, TR teams and research partners.
- *Line-transects & dung/ indirect counts* (elephant indices) - regular animal censuses.
- *Telemetry / GPS collars* - project-based studies to map elephant movement corridors (research).
- *Vegetation & forage sampling* (permanent plots) - IISc/ ATREE and FD collaborative plots.
- *Social surveys & HEC studies* - local universities / NGOs (conducted in Gudalur, MTR & STR.

Training

- *Training for Officers on management themes*: Leadership skills; decision making; planning; protection; information technology; and personal management etc (conducted at TNFA).
- *On the Job training on various specialized themes*: Legal provisions; wildlife crime and intelligence; weapon training; wireless and communication; fire management; human-wildlife conflict; ecological restoration; tourism; field techniques; invasive species etc.
- Training is also imparted to the *EDC/ ETMC members* on ecodevelopment and eco-tourism activities besides training to the ministerial staff on computerisation/ office procedures.
- *WII training-of-trainers* - All-India tiger estimation protocols (standardized methods) held in MTR.
- *Field trainings* at Theppakadu elephant camp (Mudumalai) - hands-on HEC response, kumki/ elephant handling, and rapid-response orientation before censuses.
- *Community monitoring* (Keystone) - capacity building for tribal monitors, community conservation committees and school outreach.
- *Short courses & certificate programs* (WII / SACON / university partners) - wildlife management, forensic ID, camera-trap analysis, occupancy modelling and field survey methods.

1.7 INTERFACE LAND USE SITUATION

The land use situation in the interface area is driven by the expansion of human activity and infrastructure development near forest landscapes in the NER and the interface area is a human dominated landscape with multiple land use including cultivated lands, grazing grounds, village lakes and ponds and small scale to medium sized industrial complexes, buildings, tourism resorts and a network of linear infrastructure (roads, etc). Their expansion has vastly increased the extent of fragmented landscapes. The interface of land use typically looks within an elephant reserve:

- Core Conservation Areas
- Human Coexistence Areas
- Human Settlement Areas
- Corridors

The interface of land use in NER aims to strike a balance between conserving elephant populations and their habitats while addressing the needs of local communities and promoting sustainable development. and is crucial for understanding the dynamics of human-elephant interactions, potential conflicts, and the overall impact on the conservation of elephants and biodiversity. The key aspects of the interface land use situation in NER envisages: land use change over time; ecological corridors; human-elephant conflict areas; agricultural practices; water bodies; tourism infrastructure; forest management practices; co-existence zones; traditional land use practices; conservation initiatives; community engagement etc.

Forest Division	Dominant interface (fringe) land uses	Likely pressure hotspots	Priority management actions (fringe)
Nilgiris	Large tea estates and other commercial plantations, horticulture, tourism infrastructure & scattered settlements along valley and roads.	Expansion of plantations & tourist facilities near reserve boundaries; conversion of remnant forest patches.	Prioritise plantation-to-native-restoration pockets, fence/ roadside mitigation, community tourism zoning and conflict mitigation measures.
Gudalur	Tea/ coffee plantations, smallholder horticulture, estate labour settlements and peri-urban growth near towns.	Linear plantation belts; narrow habitat corridors; smallholder conversion along Sigur and lower slopes.	Promote shade-grown/ biodiversity-friendly trees; secure and restore narrow corridor strips; community agreements on grazing/ NTFP access.

MTR	Subsistence agriculture, seasonal cultivation, grazing, NTFP collection, tourism-related development in buffer zone of MTR	Grazing and cultivation pockets, roadside/ tourism corridor development (Theppakadu-Moyar corridor).	Strengthen buffer zone livelihood alternatives, regulated tourism, grazing control and participatory patrols.
STR	Dryland agriculture, pasture, small towns/ villages, some plantations interspersed with scrub/ dry-deciduous patches.	Expansion of agriculture/ settlements into elephant corridors; fragmentation along connectivity axis to Western Ghats.	Corridor protection (land-use planning), conflict mitigation measures (crop compensation, early warning), strategic habitat restoration in pinch-points.
Erode	Intensive irrigated and rainfed agriculture in plains up to reserve edges; peri-urban growth.	Cropland expansion, fuelwood/ fodder extraction and livestock incursions into forest margins.	Buffer plantations for fuel/ fodder, community fuelwood plantations, and stricter enforcement in high-pressure beats.
Dharmapuri	Semi-arid dryland agriculture (millets, pulses), grazing and small-scale quarrying/ mining in some belts.	Agricultural expansion in rain-shadow pockets; soil/ land degradation and small quarries near forest edges.	Erosion control, community watershed recharge, regulation of quarrying and targeted afforestation in degraded fringe lands.
CWLS/ Hosur	Rapid peri-urban & industrial expansion (Hosur city), peri-urban agriculture, quarries and brick kilns.	Urban/ industrial land-conversion of agricultural/ forest land; high HEC in certain locations/ areas.	Integrate land-use planning with municipal/ industrial authorities, regulate quarries/ brick kilns, corridor safeguards (esp. Denkankottai).

The cross-cutting regional observations of the interface land use situation in the NER can be visualized as under:

- *Plantations vs native forest*: In the Nilgiris/ Gudalur zone, commercial plantations (tea/ coffee) dominate many fringe landscapes and have lesser biodiversity though area appears ‘green’.
- *Livelihood dependence*: In MTR and parts of STR, local communities still depend on NTFPs, grazing and small-scale agriculture right at the forest edge and this has bearing on the exclusionary protection.
- *Connectivity threats*: STR (and ranges connecting MTR - Nilgiris - Biligiri Ranganatha) is a critical corridor; fringe land-use change has vast impact on elephant movement.
- *Urban/industrial growth pressure*: Hosur is the clearest example of urban/ industrial conversion of forest/ agricultural land at the interface; Dharmapuri/ Erode show pressures from agriculture and mining/ quarrying.

1.7.1 Historic land-use changes and linkage with current management including HEC

The historical land use within NER and its changes over time, as well as its linkages with current management, particularly in addressing Human-Elephant Conflict (HEC), are complex issues. This can be examined with reference to the two distinct landscapes:

	Western Ghats	Eastern Ghats
Historic Land Use	Shola-grassland mosaics at higher elevation were altered by plantations (tea, eucalyptus, wattle), forestry operations and tourism infrastructure; valley and foothill forests were subjected to selective clearing and settlements. Rapid conversion of forest to tea and coffee estates and irrigated agriculture during/after colonial period were prominent in Gudalur region. Mosaic of protected forest were set aside early on in Mudumalai but the surrounding areas saw settlement and agricultural expansion with related habitat fragmentation at forest borders, which increased with the increase in the population and agricultural intensity.	Large tracts remained forested but peripheral areas (valleys) were converted to agriculture and settlements in Sathyamangalam region; linear infrastructure and fragmentation increased. Urban and peri-urban expansion in parts of Erode district increased the edge areas. The eastern/ NE parts of the Nilgiri - Hosur - Bannerghatta landscape experienced intense land-use change with agricultural intensification, rapid industrialization (Hosur) and extensive fragmentation; documented loss of corridors and dispersal habitat has been especially severe since the late 20th century.
Current Management	The reserve has a mosaic of RF, PA/ TR and private estates. Active measures include barriers in hotspots, patrolling, compensation schemes and a growing emphasis on community engagement and early-warning systems. Recent local responses include helplines and targeted capture/management of 'problem' animals in Gudalur area. Forest department interventions through 'kumki elephants' is significant in MTR which also combines with anti-poaching, community outreach, compensation, and research-based monitoring.	STR is now a key PA with explicit corridor conservation efforts connecting to neighbouring reserves. Management focuses on enforcement, corridor protection and community outreach. Local studies indicate rising HEC in forest-border communities especially in Erode belt with mixed success in ad-hoc mitigation (fencing, compensation). Hosur division has recorded exceptionally high HEC case counts in recent years, prompting multi-agency responses, mapping of hotspots, and some corridor acquisition/land protection efforts. However, urban/industrial growth makes on-ground mitigation and corridor restoration difficult.
HEC Pattern	Conflict concentrates at forest-estate-village interfaces (tea estates and villages at lower slopes). Crop damage and occasional human fatalities occur when elephants move down in dry months or when grass/forage availability declines. Frequent crop raids and occasional serious incidents in O'Valley (Gudalur) and estate fringes are seen; conflict correlates with agricultural calendars and loss of nearby forage. Peak crop depredation is in monsoon/post-monsoon when crops and natural forage overlap; community tolerance variable and is impacted by compensation and mitigation reliability.	Conflict often follows corridor pinch-points and forest perimeters; villages near reserve boundaries report crop and property loss. Hosur shows some of the highest number of reported incidents (crop/ property loss, human injuries/fatalities) in recent regional datasets because elephants traverse fragmented habitats and are funnelled into human landscapes.

Overall, managing NER requires a multi-faceted approach that balances the needs of local communities with the conservation of elephants and their habitats. The necessary information relevant to the HEC has been detailed for development of the strategies in chapter-4 of the Conservation Plan.

1.7.2 Protected area and interface situation

The PAs in MTR, STR, Thanthai-Periyar WLS (recently constituted from Erode Forest division) and Cauvery North and Soutth Wildlife Sanctuaries are surrounded by a rural/semi-urban agricultural landscape with villages, lakes, ponds, buildings and linear development projects. The buffer area to the PAs/ TRs (excepting newly declared Thanthai-Periyar WLSS) have already been declared as Eco-Sensitive Zones (ESZs) to create "shock absorbers" by regulating and managing the activities around such areas and prevent negative impacts to the eco-fragile areas due to the impact of developmental activities and would also minimize forest depletion and human-elephant conflict in the region (Fig-1.10).

The necessary information relevant to the ESZ area has been detailed along with the socio-economic information for development of the strategies in chapter-5 of the Conservation Plan.

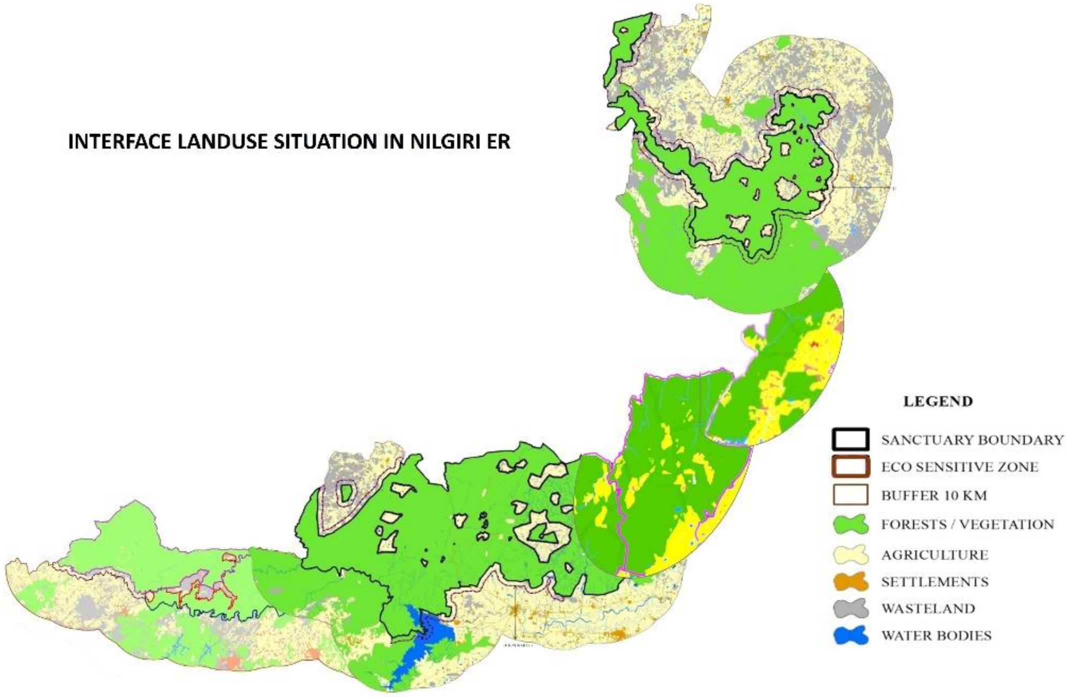


Fig-1.10: Interface Land Use situation around Protected Area and Managed Forests

1.7.3 Managed forests and interface situation

The managed forest interface situation in Nilgiris and Gudalur divisions of Western ghats and Erode, Dharmapuri and Hosur divisions in Eastern ghats, is about biophysical, social and socio-ecological interactions between managed forests and outlying areas with intense human activities. The influence of humans on their local environment, through road expansion, agricultural practices, and animal husbandry impacts the various ecosystem services of the forest.

The necessary information relevant to various drivers and pressures has been detailed for development of the zonation and strategies in chapter-3 of the Conservation Plan

1.8 PRODUCTION SECTORS IN THE REGION

In Nilgiri Elephant Reserve, the 'Production sectors' typically refer to the various economic activities and sectors that contribute to the region's development and livelihoods of the local communities. Balancing these production sectors with conservation efforts is crucial to ensure sustainable development and the well-being of both humans and elephants.

Some key production sectors, in Western and Eastern Ghats of the NER are:

PRODUCTION SECTORS	Western Ghats	Eastern Ghats
Forestry & allied industries	In Nilgiris, plantations mainly of eucalyptus, wattle are present. Mixed forest with tea/coffee landscape is seen in Gudalur area. Protected forest is present in MTR, where timber extraction is not permitted and livelihood activities managed via community programs.	Forest resources and sandalwood depot function under STR with fuelwood plantations in fringe reserved forests. Dry-zone reserved forests, farm forestry in taluks north of the Eastern Ghats. Forestry activities are limited compared to industrial/ urban development.
Agriculture & Horticulture	Hill agriculture around Nilgiris (potatoes, carrots, temperate vegetables grown); Coffee, tea, smallholder farms, spices and mixed hill agriculture is around Gudalur and agriculture (edible crops) occurs in peripheral villages in Gudalur/Masinagudi buffer villages	Agriculture in fringe taluks include paddy, sugarcane, millets in STR and turmeric market is famous in Erode market. Mango as horticulture is important in Dharmapuri/ Krishnagiri districts. Flowers, vegetables, market gardening, greenhouse cultivation near Hosur and Bagalur is significant.
Animal Husbandry	Government livestock/dairy farm and breeding station and district dairy & fodder development programmes in the Nilgiris district.	Smallholder dairying and sheep/goat rearing in taluks around the STR. Livestock & poultry programmes in Erode, Dharmapuri & Hosur present.
Mining	Small-scale quarrying in fringe areas of Nilgiris and Gudalur; complete prohibition of mining in the PA.	Small-scale quarrying reported in peripheral areas of STR including many polishing units. Black granite / dolerite quarries and mining leases exist in Dharmapuri/ Krishnagiri. Limited quarrying and construction stone operations in Hosur region.
Tourism	In Nilgiris, wildlife / shola visitor spots are there (Wenlock Downs, Glenmorgan); Gene pool garden in Gudalur attracts tourists; and MTR acts as the key eco-tourism hub with park lodges, safari circuits on Ooty-Mysore highway.	STR safari / wildlife tourism, forest camps and eco-tourism circuit (Erode-STR corridor) exists along with birding in forested blocks. Hill/fringe nature sites and local forest-based tourism in CWLS. Hogenakkal Falls in Dharmapuri attracts tourists.
Fisheries	Upper plateau has many water bodies (Pykara) supporting fisheries including local small reservoir/pond fisheries in Gudalur; no major fisheries in MTR	Small reservoir/irrigation tanks used locally for inland fishery around the fringe villages including Bhavani reservoirs feed.
Tea / Coffee estates	Numerous tea estates and branded tea gardens exist in Nilgiris; multiple private tea & coffee estates are across Gudalur, near O' Valley, & coffee estate in Singara (buffer zone of MTR).	Not a tea/coffee region

Road / Rail transport	Major road: Ooty -Mysore (via Pykara and Kalhatti); state highways	Major roads: NH & state roads passing through STR (especially Hassanur area); Road network linking Dharmapuri-Hosur and major junction at Hosur on NH.
Industry & SMEs	Small agro-processing, tourism services, cottage industries around Ooty; Tea/coffee processing, INDCOSERVE in Nilgiris; small agro-processing units in Gudalur town; and tourism-related service industry (lodges) in buffer zone of MTR	Textile hub (powerloom/ handloom), turmeric processing, agro-processing units, small chemicals and tanneries around STR/ Erode. Granite processing and mineral-processing units and a number of small mines/quarries in Dharmapuri/ Krishnagiri. Major industrial & automobile hub at Hosur.
Handicrafts & Artisanal Production	Traditional Toda tribal embroidery (organized groups / artisans) in Nilgiris; local cottage artisans / eco-tourism handicrafts present in Gudalur and Masinagudi area.	Wood carving & small wood handicraft businesses in STR; textile-linked artisan clusters in Erode; granite finishers, stone-processing micro-units and small artisans in Pappireddipatti/ Palacode areas (Dharmapuri); metal/ wood/ auto-ancillary artisan workshops in Hosur.
Hydro-electric project	Pykara hydro-complex (multiple small stations/regulating storages) exists in Nilgiris and Moyar hydel project exists in the MTR buffer and both are significant for the hydrology of NER	No major hydro project in Eastern Ghats. Regional hydro resources (Bhavani basin) feeding irrigation & local power. Small irrigation reservoirs in the region; and drinking water project in Hogennakkal.
Thermal power & Renewable Energy Project	No thermal plant or major renewable power project in Nilgiris district	No thermal power station in the region but roof-top/ captive solar projects for industry (SIPCOT) present.
Religious tourism & Communication projects	Local churches, temples and hill-station pilgrimage/visitor sites in and around Nilgiris, Gudalur and MTR. Communications infrastructure exist along main roads.	Local temples (Bannari Amman), pilgrim routes exist; communications infrastructure follow major road corridors and mining/ industrial areas.

Balancing these production sectors ensures that economic developmentvb benefits local communities while also preserving the ecological integrity of the Nilgiri Elephant Reserve.

1.8.1 Impact of Production Sectors on Wildlife

The Production sectors in an Elephant Reserve can have both direct and indirect impacts.

- '**Direct impacts**' on wildlife, particularly on elephant populations and other biodiversity are often the result of habitat alteration, human-wildlife conflicts, and disruptions to ecological processes.
- '**Indirect impacts**' are often associated with changes in the landscape, ecosystems, and human-wildlife interactions and may not involve direct physical harm to wildlife but can have significant consequences for the overall ecological balance and the well-being of elephant populations.

Some of the direct and indirect impacts of production sectors on wildlife in NER include:

Production Sectors	Direct impacts	Indirect impacts
Forestry/ allied industries (Nilgiris-Gudalur; STR-Dharmapuri fringes)	• Monoculture plantations (eucalyptus, wattle, shade trees) leading to reduced biodiversity, altered soil chemistry, and lowered groundwater recharge	• Loss of traditional NTFP livelihoods; • Monoculture plantations alter fire regimes, making forests more flammable.
Agriculture & Horticulture (Nilgiris; Bagalur green-houses; Dharmapuri (mango belts)	• Agrochemical runoff leading to stream eutrophication; • Soil erosion from hill slopes; • Water used for irrigation leading to lowered flows; competition with ecological water needs.	• High fertiliser/pesticide use leads to bioaccumulation and trophic impacts. • Crop-raiding by elephants increases leading to secondary HEC.
Animal Husbandry (MTR buffer villages; Nilgiris (dairy farms): Hosur / Erode farms)	• Grazing in forest fringes causing suppression of regeneration, soil compaction, invasives; • Disease transmission between domestic livestock and wild herbivores (e.g., FMD); • Fodder extraction from forests;	• Overgrazed buffer forests facilitate invasive weeds (lantana, parthenium). • Livestock diseases spill into wildlife & population declines.
Mining (Dharmapuri (black granite / dolerite quarries): STR fringes; Hosur/ Krishnagiri stone quarries)	• Habitat destruction from open pits/ quarry; • Blasting & vibration leading to wildlife disturbance; • Dust deposition on vegetation impairing photosynthesis; • Sedimentation from spoil/ wash-off cause aquatic habitat degradation	• Induced migration cause labour settlements expand into forest fringes. • Dust deposition lowers agricultural yield nearby.
Tourism (MTR); Nilgiris; STR/ CWLS campsites)	• Wildlife disturbance (noise, lights) altering behaviour of wildlife; • Waste generation and improper disposal (plastic, food waste); • Infrastructure footprint (lodges, parking) causing habitat loss;	• Seasonal surges raise water demand & shortage in villages • Cultural change in host communities. • Wildlife habituation causing altered behaviour/crop-raid
Fisheries (Bhavani basin/ reservoir in STR)	• Altered reservoir management (fluctuating levels) affecting riparian breeding habitats	• Conflict between fisher groups & irrigation farmers; pressure wetlands for draining/ alteration
Tea / Coffee Estates (Nilgiris & Gudalur estates and Estate roads in Gudalur to Masinagudi corridors)	• Large contiguous monocultures leading to the replacement of native shola/shrubland, reduced structural habitat heterogeneity; • Agrochemical use (fungicides, insecticides) leading to non-target species mortality/ contamination;	• Settlement expansion cause pressure on forests • Monocultures reduce pollinator diversity & crop productivity in adjacent farms. • Shade tree choice (exotic silver oak, grevillea) alters bird/mammal community composition.

	• Road and estate infrastructure causing fragmentation; and gated fences obstruct animal movement	
Road / Rail transport (NH / SH through STR (Hassanur road); Hosur road)	• Habitat fragmentation and cutting across wildlife corridors; • Roadkill / wildlife mortality; • Barrier effects to seasonal movements and gene flow;	• Induced development (shops, settlements) along transport corridors. • Wildlife movement altered (corridor abandonment). • Illegal logging/poaching facilitated by road access.
Industry & SMEs (Erode (textiles & dyeing SMEs; Hosur industrial estates; Dharmapuri granite units)	• Point-source effluents (dye, tannery effluents) cause contamination of rivers; • Air emissions (particulate, SOx, NOx) from combustion; • Solid waste & hazardous wastes (tanneries, chemical units); • Land take for estates and logistics parks leading to habitat loss.	• Industries attract migrant populations - urbanisation in forest fringes. • Long-term groundwater decline agriculture shifts to high-risk borewell farming. • River pollution reduces downstream fisheries & drinking-water quality.
Hydro-electric Projects (Pykara hydro complex-Nilgiris & MTR)	• Inundation of forest and agricultural land leading to permanent habitat loss; • Altered downstream flow regime changes sediment transport and riparian vegetation; • Reservoir shoreline erosion and weed proliferation (invasives). • Construction impacts: blasting, roads, transmission corridors.	• Altered flood pulses change sediment deposition (reduced soil fertility downstream). • Colonies established in forest edges cause increased forest clearance. • Reservoirs promote invasive aquatic weeds (Eichhornia, Salvinia).
Thermal / non-RE project generation units (Hosur/ Erode)	• Air pollution (particulate matter); • High water withdrawal & thermal pollution; • Fly ash generation; GHG emission	• Ash pond seepage: indirect contamination of water. • Climate change feedback phenological shifts in flora
Religious tourism & Communication projects (Bannari, STR; Communication towers along ridgelines in Hosur/ Nilgiris)	• High visitor concentrations at pilgrim sites causing trampling, litter, pressure on water/sanitation • Infrastructure (temple complexes, roads, parking, mobile towers) leading to land take and visual intrusion & clearing of vegetation; • Unauthorized expansion of pilgrim settlements into sensitive slopes.	• Roads & facilities for pilgrim access causing indirect forest clearing. • Increased fuelwood demand for festivals. • Communication towers alter bird flight behaviour, especially raptors.

Cross-sector cumulative & synergistic direct and indirect impacts (common patterns) can be summarized as under:

DIRECT IMPACT	INDIRECT IMPACT
Corridor severance: roads, plantations and estates cumulatively fragment movement routes (especially damaging in STR- a cross-state corridor)	*Corridor vulnerability*: Roads, mining and settlements indirectly sever Sathyamangalam - Mudumalai elephant corridor
Water-budget stress: irrigation, industry, captive use, and tourism cumulatively lower aquifer levels and seasonal stream flows.	*Water scarcity loop*: Horticulture, industry and tourism indirectly force borewell overuse
Multiple pollution sources: agricultural runoff, industrial effluent and domestic waste lead to compounded water quality decline	*Chemical contamination and pollution*: negatively impact aquatic ecosystems and long-term groundwater decline with related agriculture shifts to high-risk borewell farming
Human elephant conflict: expansion of agriculture, settlements, roads and livestock into forest margins increases crop raiding, livestock depredation and retaliatory killing	*Disruption of migration routes*: Roads, urban development and expansion of settlements potentially impact their access to seasonal resources and indirectly affect their behaviour.
Invasive species spread: disturbed sites (plantations, roadsides, quarry spoils) become footholds for invasives (Lantana, Senna, etc), altering fire regimes and native recovery	*Invasive species spread*: agriculture, forestry plantations, grazing indirectly create “stepping stones” for invasives

Region-wise direct impact of the production sectors can be summarized as under:

- *Nilgiris (Western Ghats)*: water-land interactions dominate (hydro – hort. runoff - tourism waste).
- *Mudumalai-Sathyamangalam*: wildlife corridors under pressure from roads, tourism, grazing.
- *Dharmapuri-Hosur (Eastern Ghats)*: industry/ mining pollution, water depletion, transport corridor

Mitigating the direct impacts of production sectors on wildlife and striking a balance between economic development and wildlife conservation is essential for the long-term well-being, besides, addressing indirect impacts through an integrated approach for maintaining the ecological integrity of Nilgiri ER.

1.8.2 Assessment of inputs of line agencies

Assessing the inputs of line departments and agencies in NER involves evaluating the contributions and actions of various government bodies responsible for wildlife conservation especially elephants, forest managem, and related sectors.

An assessment of the inputs of key departments and agencies in NER include:

Line Department / Agency	Key Inputs for Elephant Conservation	Divisions Involved
Forest Department	Patrolling, anti-poaching, habitat management, corridor protection, kumki deployment, rescue/capture, compensation processing, solar fencing, trenches, waterholes, awareness etc	All divisions (Nilgiris, Gudalur, MTR, STR, Erode, Dharmapuri, CWLS, Hosur)
District Administration	Multi-agency coordination, land acquisition for corridors, disaster management	All districts
Police	Law & order support during captures, crowd control, traffic management, enforcement	All divisions

Revenue Department	Land tenure checks, corridor acquisition, compensation claims, settlement of encroachments	All divisions
Animal Husbandry	Veterinary support (tranquilisation, post-capture care), disease surveillance, post-mortems, camp elephant care	All divisions (esp. Gudalur & Mudumalai for captures)
PWD / Highways	Wildlife signages, speed restrictions, mitigation at road crossings, underpasses, realignments	Nilgiris (NH), STR Erode, Hosur
Electricity Board (TANGEDCO)	Insulating/relocating wires, underground cabling, rapid response to prevent electrocution deaths	All divisions, esp. STR, Erode, Hosur
Agriculture / Horticulture Dept	Crop-diversion advice, farmer training, alternative livelihood schemes, compensation facilitation	Gudalur, Erode, Dharmapuri, Hosur
Tribal Welfare / Social Welfare	Mahout housing & welfare, tribal livelihood schemes, rehabilitation	Mudumalai, Gudalur
Rural Development & Panchayats	Village watch groups, maintaining fences, awareness drives, community mitigation	All divisions
Fisheries / Irrigation	Manage reservoirs & canals to avoid elephant congregation near villages	STR, Erode, Dharmapuri
Wildlife Crime Control Bureau	Intelligence gathering and crackdown on poaching, illegal trade, snares etc	All divisions
Project Elephant / MoEFCC	Funding, policy guidance, technical support	All divisions
Research Institutes (IISC, BNHS, SACON)	Corridor monitoring, camera-traps, conflict mitigation pilots (bee fences, lights), monitoring	Strong in Nilgiris, MTR, STR, Erode, Hosur
NGOS/ VOs (NWEA, Keystone) & Tech. Vendors	Community engagement and training, AI-based early-warning systems, SMS alerts, helplines,	All divisions. Pilots in STR, Erode, Gudalur

A comprehensive assessment of these inputs can provide insights into the strengths, weaknesses, and areas for improvement in the conservation efforts within NER and can also inform strategies for enhancing collaboration and achieving sustainable outcomes for both elephant and local communities.

CHAPTER 2: CONTEXT AND SITUATION

Elephant habitats are notified as Elephant Reserves (ER) which are the basic management unit for elephant conservation and management. The elephants in the Nilgiri Elephant Reserve (NER) range over forested hilly tracts of the Western Ghats and its adjacent Eastern Ghats.

2.1 DISTRIBUTION PATTERN AND ABUNDANCE STATUS OF ELEPHANT

In Tamil Nadu, the ERs are distributed across 5 major regions viz Nilgiri, Coimbatore, Anamalai, Srivilliputhur and Agasthiarmalai with a total area of 9,131.70 sq km. The ecological boundaries of NER extend into adjoining ERs viz. Coimbatore ER of Tamil Nadu, Mysuru ER of Karnataka and Wayanad & Nilambur ERs of Kerala (Fig-1). The Nilgiri ER covers 2 tiger reserves (Mudumalai & Sathyamanagalam), 3 wildlife sanctuaries (Periyar Thanthai, Cauvery North & Cauvery South) and 4 forest divisions (Nilgiris, Gudalur, Dharmapuri & Hosur).

NILGIRI AND ADJOINING ERs

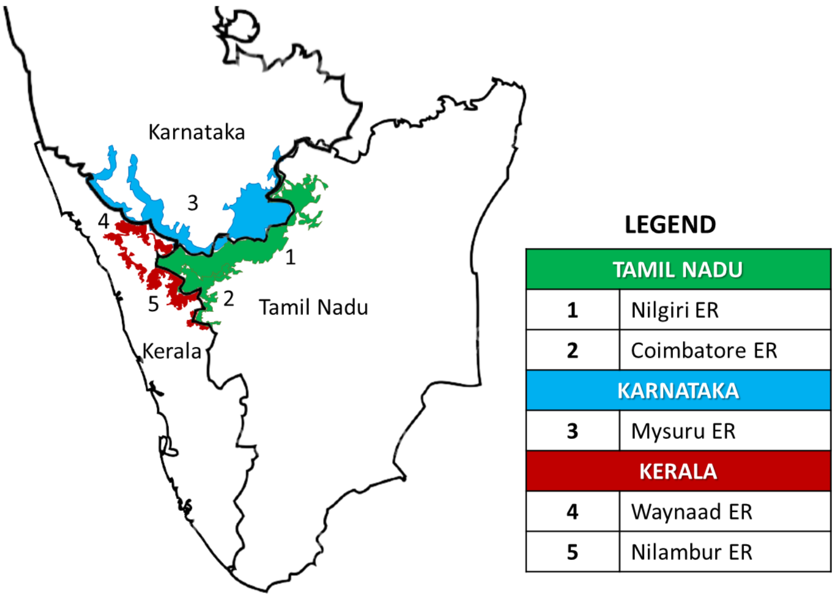


Fig-2.1: Adjoining Elephant Reserves of Nilgiri ER

2.1.1 Population estimation and monitoring framework

The ever increasing anthropogenic and development pressures has led to the fragmentation of elephant habitats, affecting their numbers, demography and ranging patterns across their range (Fig-2.2).

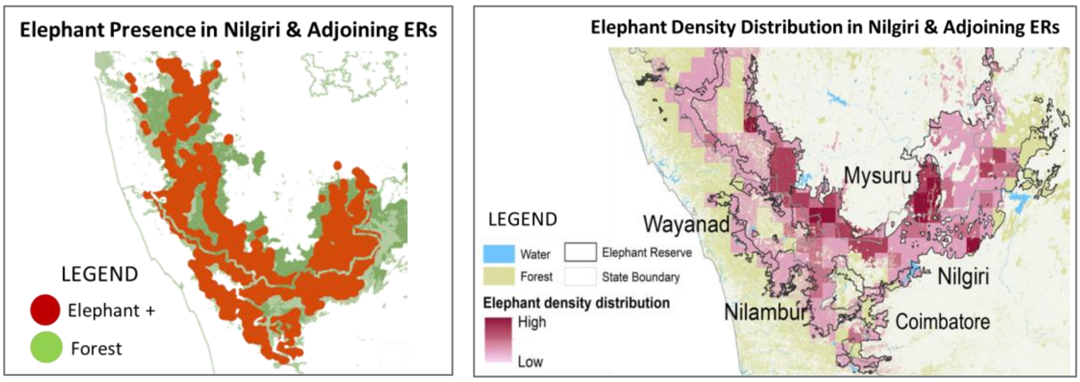


Fig-2.2: Elephant presence and density distribution in Nilgiri ER and adjoining ER Landscape

Reliable baseline information on the distribution, demography and population dynamics of free-ranging elephants has been made available through 'All India Synchronised Elephant Population Estimation' of elephants with the help of Project Elephant.

Population estimation and monitoring of elephants involve systematic and scientific approaches to assess the number, distribution, and health of elephant populations. The framework which is commonly used for population estimation and monitoring of elephants in Nilgiri Elephant Reserve (Box-2.1) is:

- *Census and Surveys:* Ground-based surveys involve direct observation and counting of elephants by trained personnel and the method is also being used in conjunction with aerial surveys by drones for validation. Besides, the indirect method of dung count, is also considered as good in monitoring the population, measuring seasonal distribution of the elephants etc.
- *Identification and Individual Recognition:* Creating photographic catalogues of individual elephants, especially those with distinct markings or features, aids in the identification of individuals during surveys besides DNA analysis of elephant dung can provide information on individual elephants, helping in population estimation and genetic studies.
- *Remote Sensing and Technology:* Deploying camera traps at strategic locations to capture images of elephants and other wildlife helps in estimating population density and monitoring movement patterns. Use of GPS collars and satellite technology to track the movement of individual elephants, provides valuable data on their home range, migration routes, & behaviour.

Among various methods in vogue over the past 3-4 decades in estimating elephant populations, following methods have been consistently employed in Tamil Nadu since 2002 considering their relative simplicity:

a) Direct sighting using 'Sample Block Count' method: Data collected includes details of the number of elephants counted (yj), the area sampled (xj), and the total area of the division (Xj). The population estimation in NER is done (Box-2.2) as under:

Box-2.2: Population estimation by Sample Block Count Method

- Estimating elephant number (Y) = *(y / x)* × *X*
- Estimating variance *(v)* = $\frac{X^2}{(n(n-1)} \times \sum_{j=1}^{n} \frac{(yj-y)^2}{(xj-x)^2}$
- Estimating standard error √*v* = standard error of the estimate of the total elephant population
- Estimate of 95% Confidence Interval *CI= [(Estimate(Y)−1.96×√v), ((Y)+1.96×√v)]*

  (*CI= Estimate of the upper and lower confidence interval of the total elephant population*)

Where

X = Total area of the region (forest division)

n = Total Number of blocks in that region (forest division)

yj = No. of elephants in the jth block j=1,2,…,n

xj = Area in km^2 of the jth block

y = The total number of elephants counted in all sample blocks

x = Total area (in km^2) of all sample blocks

(y/x) = Estimate of elephant density/km^2

As per the synchronised elephant population estimation conducted in Tamil Nadu during 2023, the details of the sampled area and number of elephants counted in various divisions of NER (Table-2.1) is as under:

Table-2.1: Synchronised Population Estimation of Elephants in NER

Division	Total Area (km^2)	Effective Elephant Habitat (km^2)	Total Area Sampled (km^2)	No. of Elephants counted	Density (Nos per km^2)	Est. Elep. Popul. (Nos)	SE	LCL	UCL
MTR-Core	241	241	120	221	1.84	444	18.90	407	481
MTR-Buffer	447.5	347.73	156	155	0.99	346	10.63	325	367
Nilgiris	527.57	190	61.94	7	0.11	21	1.61	18	24
Gudalur	464.18	151.71	150	79	0.53	80	2.71	75	85
STR-Core	881.31	881.31	225	101	0.45	396	8.89	379	413
STR-Buffer	573.99	573.99	150	71	0.47	272	9.21	254	290
Erode	821.47	784.57	193.86	39	0.20	158	3.63	151	165
Dharmapuri	1600	400	75	27	0.36	144	10.04	124	164
Hosur	1492	1000	200	21	0.11	105	2.67	100	110
	7049	**4570**	**1332**	**721**	**0.54**	**1966**		**1833**	**2099**

The total number of elephant sightings encountered during the sample block count method was 721. The estimated number of elephants for the NER was 1966 with Lower Confidence Limit (LCL) as 1833 and Upper Confidence Limit (UCL) as 2099. The elephant density was 0.54 per sq.km.

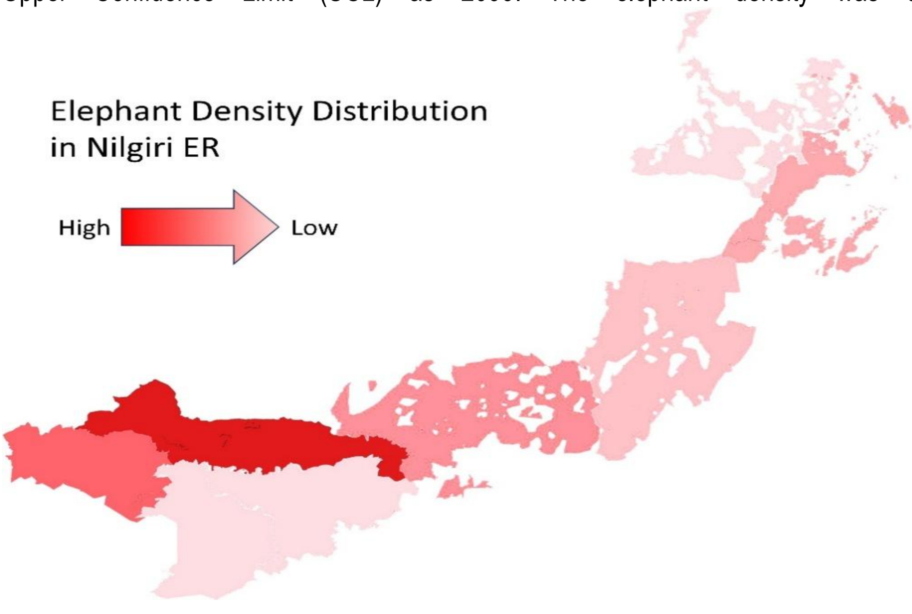


Fig-2.3: Elephant density distribution map of Nilgiri ER

b) Indirect estimate using line transect (Dung Count) method: In each sample block, a transect of a maximum length of 2 km was laid across an altitudinal gradient. Line-transect dung count data were used to estimate dung density using Distance Software, which was converted into elephant density by incorporating the elephant defecation rate and elephant dung decay rate following the formula of Barnes & Jenson (1987) (Box-2.3). In the absence of specific data for different elephant populations, the defecation rate of 16.33 (SE = 0.08) calculated by Watve (1992) and the decay rate of 0.0097 dung piles/day (SE=0.002) calculated by Varma et al. (1995), both at Mudumalai Wildlife Sanctuary (Nilgiri ER), were used in the present analysis.

Box-2.3: Population estimation by Dung Count Method

- Density of Elephants (E) = Y x r / D

Where,

Y = Density of dung

R = Daily rate of dung decomposition

D = The number of dung piles deposited / elephant per day

- Estimating elephant number (Y) = E x X

E = Elephant density

X = Effective elephant habitat

The dung data were analyzed by evaluating different models of detection probability (half-normal, uniform, and hazard rate) with cosine adjustment available in Distance software. The best fit model for each dataset was assessed using Akaike's Information Criterion (AIC) value.

The estimated elephant dung density, elephant density, and elephant population in NER conducted during 2023 using line transect dung count method (Table-2.2), is as under:

Table-2.2: Population Estimation of Elephants using Dung Count Method in NER

Division	**Nos. of Line Transect**	**Total Length (km)**	**Total No. of Dung**	**Dung/ Density (No/km^2)**	**SE**	**LCL**	**UCL**	**Elep. Density (No/km^2)**	**Est. Elep. Pop.**
MTR-Core	24	49.2	743	3970.9	664.51	2863	5579	2.35	566
MTR-Buffer	33	66.49	354	1579.3	320.55	1059	2355	0.93	323
Nilgiris	14	31.2	148	296.22	101.17	145	606	0.17	32
Gudalur	30	67.1	147	542.71	141.62	324	908	0.32	49
STR-Core	45	94	200	515.74	86.47	371	718	0.3	264
STR-Buffer	30	60	284	901.57	190.7	591	1376	0.53	304
Erode	44	89.58	402	507.33	83.44	365	705	0.3	235
Dharmapuri	15	30	126	641.55	264.13	277	1486	0.38	152
Hosur	40	80.06	395	436.35	72.79	312	610	0.25	250
	275	**567.63**	**2799**	**1228.5**	**103.23**	**1042**	**1448**	**0.72**	**2175**

The total number of dung recorded during the Line Transect was 2799 in the total length of 567.63 kms and dung density was estimated as 1228.5 nos / km^2. The elephant density was calculated as 0.72 per sq.km and number of elephants as 2175.

c) Waterhole count for assessment of Population structure:

The data on population structure were collected during the sample block count and by monitoring waterholes. The sex was differentiated based on the presence or absence of a tusk for individuals above two years. Individuals <2 years were sexed and special care was taken to differentiate tuskless males (makhna) based on characteristic features such as the presence of penis sheath, slanting back, broad musculature at trunk base, and the social context of the individual (solitary sub-adult or adult without tusks). The age of elephants was classified into four major classes based on their shoulder heights following Sukumar et al. (1988). The categories were calf (<1 yr old; <120 cm height), juvenile (1–5 yrs old; 121–180 cm), sub-adults (5–15 yrs old; 181–210 cm for female and 181–240 for male) and adults (15 yrs; >210 cm for female and >240 cm for male) (Table-2.3 & Fig-2.4). Individuals were recorded as 'Unidentified' if they could not be categorized into a specific age and sex.

Table-2.3: Percentage of population characteristics of elephants in NER (Block and Waterhole count)

Division	Elephant Classification (%)								Sex Ratio			
	AF	SAF	JF	AM	SAM	JM	C	UC	AM:AF	SAM:SAF	AF:C	T:M
MTR-Core	32	26	11	4	7	7	12	1	1:0.13	1:0.16	1:0.38	1:0.03
MTR-Buffer	22	24	8	15	14	4	13	1	1:0.68	1:0.59	1:0.59	1:0.06
Nilgiris	62	8	0	0	0	8	23	0	NA		1:0.38	NA
Gudalur	22	25	7	11	18	3	14	0	1:0.50	1:0.73	1:0.65	1:0.07
STR-Core	16	25	5	16	16	2	12	9	1:1	1:0.66	1:0.75	1:0.09
STR-Buffer	27	11	5	13	14	1	17	12	1:0.50	1:1.33	1:0.64	NA
Erode	22	11	2	11	20	7	15	13	1:0.50	1:1.80	1:0.70	NA
Dharmapuri	34	14	0	31	3	0	10	7	1:0.90	1:0.25	1:0.30	1:0.10
Hosur	24	26	0	17	10	0	10	14	1:0.70	1:0.36	1:0.40	1:0.17
	261	**170**	**38**	**118**	**102**	**32**	**126**	**57**	**1:0.43**	**1:0.53**	**1:0.51**	**1:0.04**

(Note: AF-Adult Female; SAF-Sub adult Female; JF-Juvenile Female; AM-Adult Male; SAM-Sub adult Male; JM-Juvenile Male; C-Calf; and UC-Unidentifies Class)

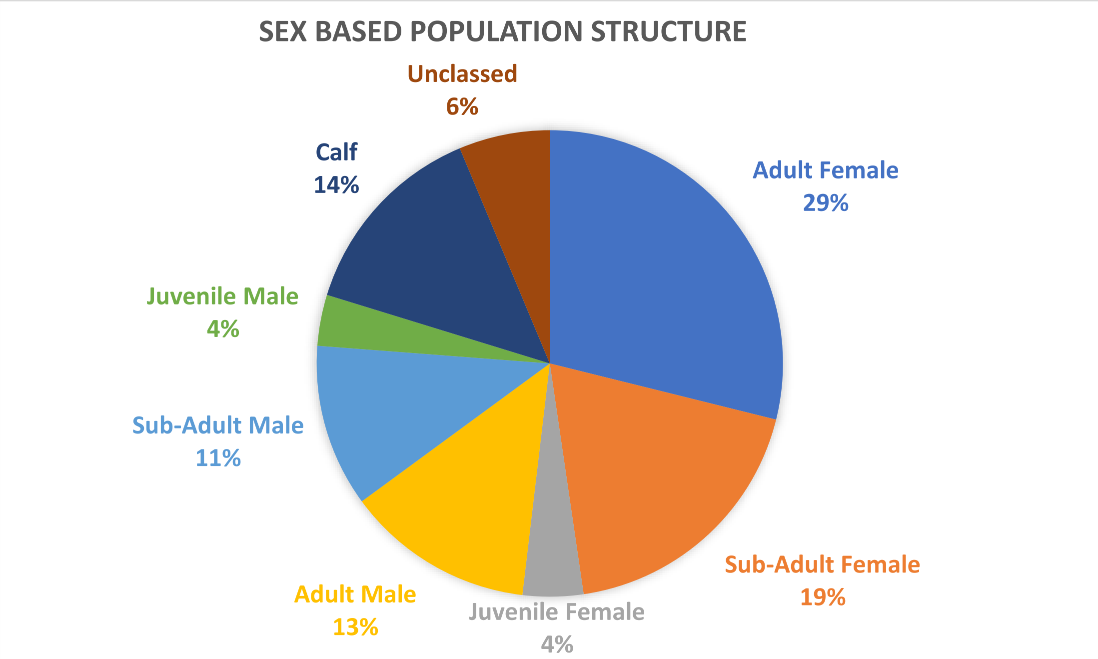


Fig-2.4: Sex based Population Structure in NER

The adult females (29 %) and sub-adult females (19 %) were a higher percentage of the whole elephant populations of NER as compared to the males with male: female ratio of 1:1.86 (almost 1:2).

The population monitoring at the landscape level has many constraints, the most crucial being the methodology to be used, i.e. direct count and indirect count methods; however, the recent estimation by WII, Dehradun adopting DNA analysis shows comparable results in the region. Besides count, the visibility, habitat, terrain and field logistics are the key constraints. While knowing elephant numbers may be important for managing local populations, demographic parameters and distribution patterns are perhaps more crucial to ascertain long-term trends for conservation.

2.1.2 Spatial database development

The development of a spatial database for elephant reserve involves creating a geospatial information system that integrates various layers of spatial data to support effective management and conservation efforts. A step-by-step guide for developing a spatial database in the NER (Box-2.4) envisages:

Box-2.4: Proposed Spatial database development for NER

- Determine the data requirements for the specific objectives of the spatial database, such as monitoring elephant populations, managing habitats, and addressing human-wildlife conflicts.
- Collect spatial data including satellite imagery, aerial photographs, drone data, topographic maps, and existing GIS datasets (Geomatics Centre). Gather attribute data related to elephant populations, habitat characteristics, human settlements, land use, and infrastructure.
- Create separate layers for different thematic data, such as: elephant distribution and movements; habitat types and conditions; water bodies and rivers; human settlements and infrastructure; ecological corridors; and land use and land cover.
- Georeference raster datasets and scanned maps to ensure they align correctly with the spatial reference system of the GIS. Integrate spatial and attribute data into a comprehensive database. Ensure consistency in data formats, projections, and attributes.
- Design a spatial database schema considering the relationships between different layers and attributes. Choose an appropriate relational database management system (RDBMS) such as PostgreSQL, MySQL, or SQLite.
- Conduct spatial analyses to derive additional information, such as habitat suitability modelling, connectivity analysis, and hotspot identification. Use remote sensing techniques for image processing and classification to generate land cover and land use maps.
- Incorporate GPS tracking data from collared elephants to monitor and analyse their movements. Include data on human-elephant conflicts, such as conflict incident reports and locations.
- Consider integrating the spatial database with a web enabled GIS platform for easy access, visualization, and sharing of information.

The database should be designed to facilitate evidence-based decision-making, conservation planning, and sustainable management of NER.

2.2 HABITAT QUALITY AND UTILIZATION

Assessing habitat quality and utilization in Nilgiri Elephant Reserve is crucial for effective wildlife management and conservation. Elephant habitats need to provide the necessary resources for their survival, including suitable food, water, and cover. The primary components of 'habitat quality' includes-forage availability & nutritional quality, water availability, cover & resting sites, safe movement & connectivity, low anthropogenic risk and reproductive and refuge areas.

The diet of elephant in the region consists mostly of grass (84.6%) than browse (15.4%), and browsing was more during the dry season than the wet season in all habitats. The habitat utilization patterns exhibited that the number of habitat types used by herds and bulls was determined by the spatial location of the home range. Apart from environmental factors, hierarchy a behavioural factor, also plays an important role in resources utilization by different individuals in the population.

An overview of the evaluation of habitat quality and utilization in NER (Box-2.5), envisages:

Box-2.5: Habitat Quality Assessment, Utilization and Monitoring in NER

- *Habitat Quality Assessment:*
  - Assess the composition of plant species including key forage species preferred by elephants.
  - Evaluate the abundance, distribution and nutritional values of preferred food sources.
  - Assess the abundance/distribution and status of invasives, causing habitat degradation.
  - Assess the availability and reliability of water sources for elephants.
  - Evaluate the availability of suitable cover and shade (dense or forested areas) for elephants.
- *Habitat Utilization Studies and Seasonal Variations:*
  - Use GPS technology for analysing habitat utilization, migration routes, seasonal movement.
  - Identify and monitor high-usage areas through camera traps.
  - Understand distribution and habitat use through dung and sign surveys of elephant.
  - Evaluate how habitat quality changes with seasons affecting movement/ habitat preferences.
  - Study seasonal migration/ movement patterns, through multiple habitats or different areas.
- *Behavioural Studies, Health and Reproductive Success:*
  - Analyse the feeding behaviour of elephants, including their preferences and feeding intensity.
  - Study areas of elephants' resting & socialization, providing insights into habitat utilization.
  - Monitor the health of elephants to understand how habitat quality influences their well-being.
  - Study reproductive success, which indicate availability of suitable habitats and resources.
- *Corridor Utilization and Conflict Hotspots:*
  - Assess utilization of ecological corridors as essential connectivity between habitat patches.
  - Identify locations where HEC are frequent due to limitations in habitat quality or availability.
- *Community Involvement:*
  - Involve local communities in habitat assessments for traditional knowledge about habitat use.
  - Gather information from communities on elephant movement, habitat preferences & conflict.
- *Monitoring and Conservation Management:*
  - Establish long-term monitoring programs to track changes in habitat quality and utilization.
  - Use adaptive management, adjusting conservation strategies based on ongoing monitoring.
  - Based on the assessment, develop and implement habitat management strategies.

Assessing habitat quality and utilization in NER requires a holistic approach, combining ecological studies, technology, and community engagement. By understanding how elephants interact with their habitat, we can implement measures to enhance habitat quality, reduce human-elephant conflicts, and ensure the long-term well-being of both elephants and ecosystems.

2.3 RESOURCE DEPENDENCY OF VILLAGES

The resource dependency of communities on natural resources viz fuel wood, NTFP. livestock grazing, etc in the NER exists on varying extents. There is conflict on account of the community's access to resources, distribution of resource revenues as well as other benefits.

The prominent villages and blocks in the NER include:

- *Nilgiris-Gudalur-MTR*: Gudalur, Mudumalai (settlement), Masinagudi, Nellakotta, Srimadurai. Masinagudi lies in the buffer zone of MTR and is a focal village for forest–people interactions
- *STR*: Prominent villages include Nallur, Kothamangalam, Malayadipudur, Makkinancombai. Many small panchayats line the reserve boundary and include forest tribal settlements.

- *Erode fringe*: Bannari, Kodiveri area villages and forest tribal settlements are traditional grazing and NTFP use locations adjacent to forest blocks.
- *Dharmapuri (Hogenakkal region)*: Pennagaram, nearby river-bank villages used for fishing and NTFP collection, villages dependent on Cauvery for irrigation & fishing.
- *Hosur / Krishnagiri fringe*: include Thally area, Hosur fringe villages (e.g., Soodachandram / surrounding panchayats), Pennagaram & Hogenakkal area villages near Cauvery WLS.

Understanding resource dependency is essential for implementing effective conservation strategies that balance the needs of both people and elephants. The key aspects of resource dependency in villages situated within elephant reserves (Box-2.6) includes:

Box-2.6: Key aspects of Resource Dependency in villages of NER

- *Agricultural Dependence:* Many villages in and around NER are agriculturally dependent, both subsistence and cash crops viz. paddy, sugarcane, banana, maize, plantain, and depend for sustenance. High-energy crops are major drivers of crop-raids (HEC) and retaliatory conflict.
- *Water Resources:* Villages in these areas depend on water resources for domestic use, irrigation and fishing. Competition for water can lead to HEC, especially during dry periods.
- *Livestock Grazing:* Livestock, such as cattle and goats, are significant assets for rural communities. Grazing areas may overlap with elephant habitats, leading to conflicts and potential loss of livestock and can also lead to disease transfer.
- *Fuelwood and Small Timber:* Villagers often rely on nearby forests for fuelwood and its extraction along forest edges/ trails creates HEC besides heavy extraction degrades understorey forage.
- *Non-Timber Forest Products (NTFP)*: Communities depend on the collection of NTFPs (honey, tamarind, medicinal plants, wild fruits, lemon grass) for livelihood, but over-exploitation can impact ecosystems besides seasonal collection (especially during monsoon/fruiting seasons) brings people into core/corridor areas, raising HEC risk and increasing accidental encounters.
- *Tourism:* In some areas, tourism related to wildlife and elephants can be a source of income for local communities through activities like ecotourism, homestays, and guide services.
- *Wage Labour:* Daily labour in plantations (tea/coffee/areca), brick kilns, forest-based labour and livelihoods tied to forest/plantation can influence tolerance & willingness to adopt mitigation.

HEC implications of resource dependency may be summarized as under:

- Villages with high crop dependence (plantain, sugarcane, paddy) near perennial water and corridors have highest immediate HEC risk.
- Villages with high NTFP/ fuelwood dependence have frequent forest intrusions.
- Grazing dependence maintains open grassland; can attract elephants and reduce wild forage.
- Plantation landscapes may appear forested but are low-quality elephant habitat and can create edge-effects and corridor pinch points.
- Peri-urban villages show lower forest dependence but may suffer episodic HEC when elephants stray from corridors.

Balancing the resource needs of local communities with the conservation of elephants and their habitats is a complex challenge. Resource-dependency profiles with related dependence and conservation risks associated with the typical village archetypes in the NER (Table-2.4) may be analysed as under:

Table-2.4: Example of resource-dependency profiles (typical village archetypes) in NER

Resource-dependency profiles	Typical places	Dependence	Conservation risk
Forest-edge tribal / hamlet (high extraction)	Small hamlets inside STR / Erode tribal villages	Very high fuelwood, grazing, NTFP; low cash crop	Heavy forest use, high local knowledge but limited alternatives
Agricultural interface village (high HEC exposure)	Gudalur fringe villages, Masinagudi-Sigur plateau, Pennagaram/ Hogenakkal fringe	Crops (plantain, sugarcane), seasonal labour, some NTFP	High crop-raid incidence and retaliatory potential
Plantation & wage-labour village	Pandalur & Gudalur tea / coffee plantation areas	Plantation wages, occasional fuelwood NTFP	Human habitations along linear plantations can fragment corridors
Peri-urban / industrial fringe (Hosur, parts of Erode)	Hosur fringe villages	Wage labour in industry, small fields; less direct dependence	HEC occurs where remnant forest patches remain

There are several schemes and programs of the Tamil Nadu Forest Department to reduce resource dependency. The approach has been to adopt participatory resource management programs (JFM, Eco-development etc). The program focus includes better livelihood opportunities, and reducing the dependency of forest-fringe communities on forests (e.g., cattle grazing, fuelwood and fodder collection, NTFP collection, right of way) by participatory forest management; animal husbandry practices (promoting stall feeding practices or incentivizing improved livestock breeds); and addressing livelihood needs of communities by skill development, poverty alleviation and alternate income generation schemes of the government. The cross-sector linkages for community development (coordination and cooperation with line departments), integrating and dovetailing schemes of line departments for HEC mitigation measures and schemes for community development also facilitate elephant conservation.

2.4 CURRENT STATUS, CHARACTERISTICS, CAUSES AND EMANATING CHALLENGES OF HEC

The anthropogenic & developmental pressure has resulted in widespread loss and shrinkage of elephant habitat, degraded forage resources, reduced and unviable landscape connectivity, and the dispersal of elephants into adjoining landscapes. Among these, the increase in human population in the interface area, land use change in proximity to elephant habitat, including linear infrastructure, mining, change in cropping pattern and above all habitat fragmentation, loss and degradation have the greatest impact.

- It is estimated that approximately 50-55 persons and nearly 12-15 elephants are killed annually in Tamil Nadu of which 80% relate to the NER. Substantial number of incidences exist in human injury inflicted by the elephants (fig-2.5). Nearly 8000 - 10,000 ha of agricultural land gets impacted by crop damage due to the elephants every year in the landscape, and nearly 4000 - 5000 families are adversely affected due to HEC. The challenge is not only in the Nilgiri Elephant Reserve (NER) landscape but also extends in the adjoining Elephant Reserves of Andhra Pradesh, Karnataka and Kerala.

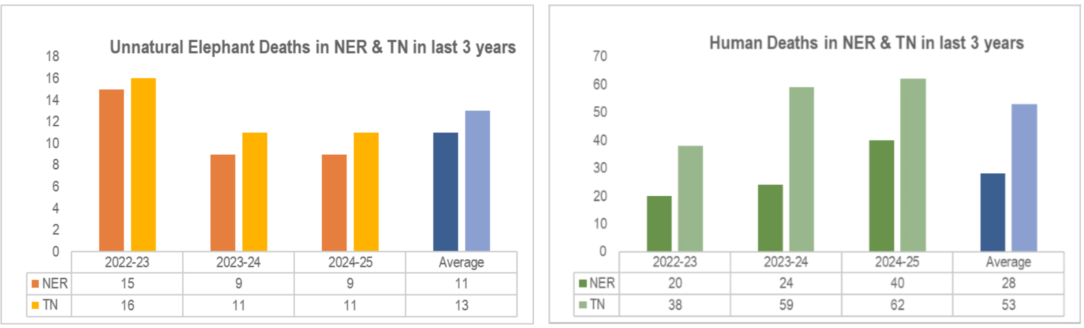


Fig-2.5: Elephant and Human Deaths in the NER landscape compared to State figure

From the above graph, it is quite evident that both elephant and human deaths are maximum in NER landscape when compared with the State figure of all the elephant reserves (5 ERs) indicating the high intensity of conflict in the landscape.

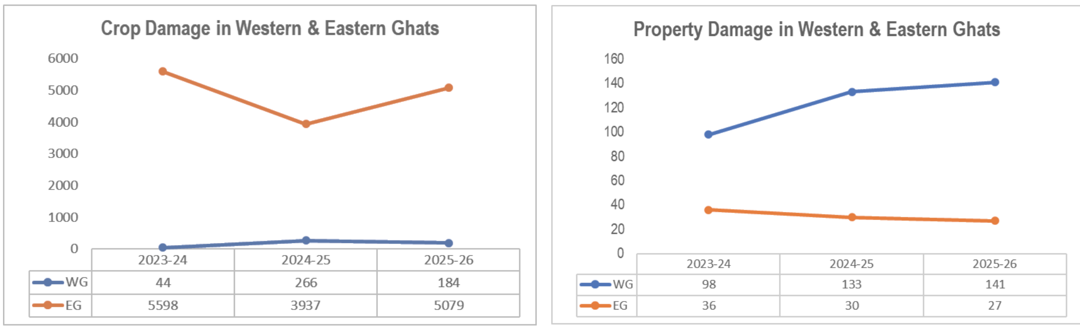


Fig-2.6: Crop Damage and Property Damage in Western and Eastern Ghats

Also, it is observed that the crop damage is maximum in the Eastern Ghat because of the prevailing agriculture practices at the forest fringes (Hosur-Dharmapuri) when compared to the tea-coffee estates in the Western Ghats; but recorded property damage is higher in the upper reaches of Nilgiris because of the labour lines and colonies falling in the elephant path especially in the Gudalur region.

2.4.1 Common Characteristics, Causes and Solutions of HEC

Common Characteristics, causes and solutions of HEC in NER include:

HEC in the Nilgiri Elephant Reserve is primarily *spatially patchy and seasonal*: concentrated along forest–agriculture interfaces (valley edges, tea and coffee estates, riverine crop belts and smallholder farms), with bursts of crop-raiding and village incursions during lean forest forage months or when ripening agricultural crops (maize, paddy, bananas, sugarcane) are accessible. Conflicts include crop damage, occasional house raids/destruction, direct human injuries and fatalities, and retaliatory actions (poaching, poisoning, capture requests). Hotspots are repeatedly reported in Gudalur, O' Valley and parts of the Nilgiris-Moyar corridor, with demographic and behavioural variation among problem elephants (some repeated raiders/tuskless bulls).

Direct causes:

- *Landscape fragmentation & loss of continuous habitat*: Historic clearing (plantations, settlements, roads) and ongoing fragmentation have broken formerly continuous elephant range into patches and corridors, forcing elephants to move through human-used landscapes and concentrate use in narrow bottlenecks where raids occur.

- *Attractive crops and land-use change at the forest edge*: Expansion of high-calorie cash crops and low-security smallholdings (maize, bananas, sugarcane, tapioca) near forest margins creates strong food incentives for elephants to leave forest cover and enter fields at night. Field studies from Gudalur document this crop-attractant effect.

- *Seasonal resource bottlenecks and water availability*: Dry-season shortages of natural forage and surface water push herds to lower elevations and into cultivated valleys; perennial watercourses and irrigation schemes in agricultural areas can concentrate elephant movement and encounters.
- *Population & social drivers (individual problem animals & social learning)*: A small number of habituated individuals or groups (e.g., older males or family groups that have learnt to raid) can cause repeated local damage; young elephants can learn crop-raiding behaviour socially, creating local "traditions" of raids.
- *Inadequate or poorly-sited deterrents and reactive management*: Ad hoc fencing, ineffective scare devices and delayed response leave gaps that elephants exploit; where responses focus on capture/removal without addressing drivers, conflicts re-emerge.

Field-based Options:

- *Protect and restore connectivity (landscape / corridor approach)*: Secure and restore ecological corridors (riverine strips, ridge links, private-land agroforestry) between core blocks (Mudumalai-Bandipur-Sathyamangalam-Nilgiris). Land-use zoning that keeps high-risk crops away from narrow corridors and incentivises elephant-friendly buffers (planting fruit/forage strips inside forest margins, payment for ecosystem services) reduces crossing of villages.
- *Crop & village-level deterrents & non-lethal exclusion*: Evidence-backed measures: coordinated, community-maintained solar/wire electric fencing on key fields, beehive-fencing (where feasible), strategic chili-based deterrents, and properly designed trenches/raised bunds. These work best when mapped to elephant movement paths and combined with rapid response teams.
- *Early-warning, monitoring and rapid-response systems*: Deploy GPS/AI camera based early-warning at identified hotspots and a well-trained rapid response unit (kumki teams, field staff) to drive elephants back to forest at first detection (e.g. AI/edge-camera identification in Gudalur). As a scaling approach, such systems reduce surprise night incursions when integrated with community alert channels.
- *Incentives, compensation reform and livelihood alternatives*: Timely, transparent compensation and quick damage assessment reduce retaliatory pressure. Complement payouts with alternative livelihood support, crop-insurance for smallholders, and incentives to switch to less palatable crop types in high-risk blocks. Community micro-grants for local guard groups and livelihood diversification (eco-tourism, value-added forest products) increase tolerance.
- *Community co-management & behaviour change*: Work with local communities to map local movement corridors, school programmes about risk times (avoidance at dusk/night), and collective harvesting schedules to reduce lone-farmer risk. Evidence from the Nilgiris shows participatory mapping and local monitoring raise compliance and reduce incidents.
- *Strategic population & individual management - cautious application*: Relocation/capture should be a last resort, used only after assessment of the animal's behaviour and landscape carrying capacity; translocation can move the problem rather than solve root causes and has risks to elephant welfare. Where necessary, it must follow legal safeguards and post-release monitoring.

2.4.2 Key Drivers and Stressors of HEC and Emanating Challenges

The general drivers of HEC are human-related factors/activities and/or natural-system dynamics that help drive ecological resource conditions in the ER whereas the stressors are the specific physical, chemical, or biological disturbances to which the elephant reserve and resources respond.

I. Key Drivers of Human–Elephant Conflict

- *Landscape Fragmentation and Corridor Disruption:* The NER landscape has been progressively fragmented by plantations, highways, settlements, power lines, and irrigation infrastructure. Traditional elephant movement routes between MTR, STR, Nilgiris plateau, Cauvery North forests, and Hosur landscapes have narrowed into bottlenecks. This forces elephants to traverse villages and farmlands, increasing repeated conflict in Gudalur - O' Valley, Hasanur - Thalavadi, and Hosur - Denkanikottai belts.

- *Expansion of Agriculture in High-Risk Zones*: Agricultural expansion along forest edges and corridors- especially maize, banana, sugarcane, tapioca, & ragi- creates strong food attractants. In Gudalur, Nilgiris plateau, Erode - STR fringe, and Dharmapuri foothills, cropping patterns overlap directly with elephant pathways, converting farmlands into predictable feeding grounds.

- *Degradation of Natural Forage and Water Sources:* Invasive weeds (Lantana, Senna, Prosopis), fire impacts, overgrazing, and reduced understorey regeneration have lowered natural fodder availability. Seasonal drying of waterholes in MTR - STR and eastern forests pushes elephants toward irrigated fields, reservoirs, and canals, increasing dry-season incursions.

- *Increasing Elephant Population and Range Expansion:* Protection success in core reserves has led to stable or increasing elephant numbers. Limited scope for spatial expansion within protected areas results in spillover into peripheral divisions (Erode, Dharmapuri, Hosur), where forest -agriculture interfaces dominate.

- *Habituation and Social Learning:* Repeated exposure to crops and weak deterrence has led to behavioural conditioning in certain bulls and herds. Crop raiding becomes a learned, socially transmitted behaviour, particularly in Gudalur - Pandalur belt, STR fringes, and Hosur landscape.

- *Infrastructure and Linear Barriers:* Roads (NH-181, state highways), rail lines, canals, power fencing, and settlements act as partial barriers. These fragment movement and concentrate elephant crossings at predictable points, creating chronic conflict zones.

II. Major Ecological and Socio-Economic Stressors

- *Human Population Pressure:* Rapid growth of settlements, labour colonies, estate housing, and peri-urban expansion (Hosur, Gudalur, Sathyamangalam) increases exposure of people and resources to elephant movement.

- *Economic Dependence on Vulnerable Crops:* Small and marginal farmers dominate much of NER's fringe landscape. Dependence on high-risk crops makes households extremely vulnerable to elephant damage, intensifying negative attitudes.

- *Climate Variability and Extreme Events:* Erratic monsoons, prolonged droughts, and heat stress affect forest productivity. These climatic pressures exacerbate seasonal migration of elephants into agricultural areas, especially in eastern divisions.

- *Inadequate Maintenance of Mitigation Infrastructure:* Solar fences, trenches, and barriers often suffer from poor maintenance, theft, vegetation growth, and power supply failures. Broken systems become 'learning points' for elephants.

- *Delays in Compensation and Relief:* Procedural delays in crop and ex-gratia payments reduce trust in management systems. Farmers facing repeated losses often resort to risky self-defence or retaliatory actions.

- *Weak Community Participation:* In several hotspots, local institutions for collective guarding, corridor protection, and early warning are weak or absent. Individual-based responses dominate, reducing effectiveness.

- *Tourism and Estate Activities:* High tourism pressure in Nilgiris - MTR and estate operations in Gudalur increase night-time traffic and human presence in corridors, elevating encounter risks.

III. Emanating Management and Conservation Challenges

- *Chronic and Spatially Entrenched Conflict Zones:* Certain landscapes (O' Valley - Padi belt, Hasanur -Thalavadi corridor, Hosur - Kandikottai zone) have become permanent conflict hotspots. Traditional short-term responses are no longer sufficient.
  Challenge: Shifting from reactive to landscape-scale solutions.

- *Escalation of Human Casualties and Social Tension:* Repeated encounters have increased fatalities and injuries in eastern and northern NER zones. This fuels political pressure, media scrutiny, and demands for translocation or culling.
  Challenge: Maintaining public support for conservation while ensuring safety.

- *Reduced Corridor Functionality:* Encroachments and land-use change continue to erode corridor width and quality.
  Challenge: Securing corridors across private and revenue lands with limited legal tools.

- *Financial Sustainability of Mitigation:* Long-term fencing, monitoring, compensation, and rapid response require sustained funding.
  Challenge: Dependence on short-term project funds and schemes.

- *Limitations of Translocation and Capture:* Problem elephant captures often result in recurrence elsewhere or animal mortality.
  Challenge: Managing individual animals without undermining population stability.

- *Cross-Boundary Coordination:* NER spans Tamil Nadu, Karnataka, and Kerala landscapes. Elephant movements transcend administrative boundaries.
  Challenge: Weak institutional mechanisms for inter-state conflict management.

- *Technological Integration Gaps:* Early-warning systems, AI cameras, and GPS tracking exist in pilots but lack full-scale integration.
  Challenge: Scaling technology with local ownership and reliability.

- *Erosion of Community Tolerance:* Persistent losses and fear gradually reduce coexistence attitudes, leading to illegal deterrents, poisoning, or obstruction of corridors.
  Challenge: Preventing long-term breakdown of human–wildlife coexistence.

Addressing these stressors and challenges requires a holistic and multidisciplinary approach that involves collaboration among conservationists, govt agencies, local communities, & other stakeholders.

Table-2.5: Key Drivers, Stressors and Emanating Challenges in NER

Drivers	Stressors	Resulting Challenges
Fragmentation	Settlement pressure	Corridor loss
Crop attraction	Economic vulnerability	Retaliation
Resource scarcity	Climate stress	Seasonal spikes
Habituation	Weak deterrents	Chronic raiders
Poor planning	Governance gaps	Reactive management

In the Nilgiri Elephant Reserve, HEC is no longer a 'local protection issue' but a landscape governance challenge driven by interacting ecological, economic, and institutional forces. Effective management now requires: corridor-centric planning; agricultural landscape redesign; community co-management; climate-adaptive habitat restoration; and integrated inter-departmental governance rather than isolated fencing or capture-based responses.

2.5 ASSESSMENT OF THREATS INCLUDING SPATIAL-TEMPORAL RISK ASSESSMENT

A spatial-temporal risk assessment may provide a nuanced understanding of the dynamic nature of threats faced by elephants in reserves. Continuous monitoring and adaptive management based on the assessment, are crucial for the effective conservation and management of elephant populations.

Assessment of major threats contributing to HEC may be summarized as under:

Table-2.6: Assessment of major threats in NER

Threat	Characteristics	Threat Level	Impact
Habitat Fragmentation & Corridor Constriction	Narrowed traditional elephant corridors (Gudalur–O' Valley, Hasanur-Thalavadi, Hosur belt)	Very High	Chronic conflict zones, repeated crop raids, increased encounters
High-Risk Agricultural Expansion	Cultivation of palatable crops (banana, maize, sugarcane, tapioca, ragi) along forest edges	High	Lasting crop depredation and farmer vulnerability, retaliatory actions
Degradation of Forest Forage and Water	Spread of invasives, reduced grasslands, forest fires, and drying of natural water sources	Moderately High	Increased dry-season migration into farmlands and villages
Linear Infrastructure and Barriers	Highways, railways, canals, fences, and power lines obstruct natural movement	High	Concentration of conflict at crossing points, accident risks
Behavioural Adaptation and Habituation	Repeated exposure to crops and weak deterrence has led to habitual raiding	High	Formation of "problem elephants" and chronic raiding clusters
Climate Variability and Extreme Events	Erratic rainfall, droughts, reduce forest productivity & water availability	Increasing	Seasonal escalation of conflict and range shifts

2.5.1 Spatial Risk Assessment of HEC in NER

Based on corridor distribution, land use, conflict records, and landscape structure, the NER can be classified into four spatial risk zones.

Table-2.7: Spatial Risk Assessment in NER

Risk Zone	Locations	Characteristics	Risk Profile	Management Priority
Very High-Risk Zones (Chronic Hotspots)	• Gudalur - O' Valley - Padi - Nellakotta belt • Hasanur - Thalavadi corridor (STR fringe) • Hosur - Denkanikottai - Kandikottai belt • Palacode - Morappur belt (Dharmapuri)	• Narrow corridors • High-density agriculture • Dense human settlements • Regular elephant crossings	• Frequent crop raiding • High probability of human casualties • Persistent property damage	Critical

High-Risk Zones (Seasonal Hotspots)	• Nilgiris plateau fringes • East MTR boundary • Erode - STR transition zones • Southern Gudalur and Devarshola areas	• Seasonal cropping • Moderate corridor width • Partial fencing coverage	• Seasonal peaks in conflict • Moderate casualty risk • High crop loss	High
Moderate-Risk Zones (Buffer Landscapes)	• Interior forest - agri. transition zones • Peripheral villages around STR and MTR • Dharmapuri foothills	• Mixed land use • Lower settlement density • Irregular elephant movement	• Sporadic conflict • Limited casualties • Localised crop damage	Medium
Low-Risk Zones (Core Forest & Urban Areas)	• Interior MTR and STR forests • Urban centres (Ooty core, Sathy town, Hosur town core)	• Limited agriculture • Restricted elephant presence	• Rare conflict • Occasional dispersal events	Routine monitoring

2.5.2 Temporal Risk Assessment of HEC in NER

HEC in NER shows strong seasonal and diurnal patterns as under:

- *Seasonal Risk Pattern*: Peak conflict is observed in March-June and October-December; whereas lowest conflict is recorded during early monsoon (July–August).
- *Agricultural Cycle-Conflict Linkage*: Crop maturity period is the most critical driver of large-scale incursions
- *Diurnal (Daily) Risk Pattern*: Most human fatalities occur between 19:00 and 05:00 hours
- *Long-Term Temporal Trends*: Observed trends indicate eastward and northward expansion of conflict into Dharmapuri and Hosur; increasing duration of conflict seasons; rising involvement of sub-adult males; and higher frequency of repeat incidents in same villages implying HEC is shifting from episodic to structural and permanent in several landscapes.

2.5.3 Integrated Threat Risk Matrix for NER

The integrated threat matrix for the NER covering spatial and temporal risk assessment may be summarized as under:

Table-2.8: Spatial Risk Assessment in NER

Threat Factor	Spatial Impact	Temporal Impact	Overall Risk
Corridor loss	High	Permanent	Very High
Crop expansion	High	Seasonal	High
Resource scarcity	Moderate	Seasonal	High
Infrastructure	Localised	Permanent	High
Habituation	Localised	Long-term	High
Climate stress	Landscape-wide	Increasing	High

2.5.4 Emerging and Future Threats

Following are the emanating risks in the NER landscape

- *Urban-Industrial Expansion* (Hosur-Krishnagiri belt): Rapid industrial growth threatens to block remaining corridors.
  Risk: Landscape-level fragmentation
- *Climate Change Intensification:* Longer dry spells and erratic monsoons may push elephants further into human landscapes.
  Risk: Extended conflict seasons
- *Declining Social Tolerance:* Repeated losses and fatalities may reduce coexistence attitudes.
  Risk: Increased retaliatory actions
- *Technology Dependence:* Partial deployment of early-warning systems without maintenance.
  Risk: System failures during peak conflict

Overall, threat status may be considered as **High-Risk, Structurally Entrenched HEC Landscape** and the spatial-temporal assessment indicates that in the Nilgiri Elephant Reserve HEC is concentrated in identifiable corridors and transition belts; conflict peaks are predictable in time and space; and current mitigation remains largely reactive.

Effective management must therefore be corridor-centred, seasonally targeted, village-cluster based, climate-adaptive and community-integrated rather than uniform across divisions.

2.6 EXISTING SITUATION IN THE ZONE OF INFLUENCE

Current situation across the Zone of Influence (ZoI) encompassing land use, people, infrastructure, wildlife status, mitigation assets, governance, and key gaps that influence elephant movement and conflict in the NER may be summarized as under:

Spatial & land-use setting

- *Mosaic landscape*: The ZoI is a heterogeneous mosaic - upland evergreen/ shola fragments on the Nilgiris plateau; semi-evergreen and dry-deciduous blocks in MTR/ STR; and mixed dry deciduous/plantation and agricultural mosaics in Erode, Dharmapuri and Hosur.
- *Corridor network*: Historically connected movement routes (Plateau - Moyar - Bhavani - Cauvery North - Hosur) remain functionally present but are narrowed into bottlenecks at valley floors, roads and plantation edges.
- *Agricultural interface*: Extensive smallholder and estate agriculture (tea, coffee, tea/ coffee shade areas in Nilgiris and Gudalur; paddy, sugarcane, banana, maize, tapioca in eastern belts) occurs right up to forest edges and in narrow valley corridors- creating predictable attractant strips.

Human Settlements & Demographics

- *Settlement pattern*: Dense village clusters, estate labour colonies and peri-urban sprawl (notably around Hosur and parts of Gudalur-Pandalur) increase interface area. Many villages are linear along roads and rivers- coincident with elephant movement paths.
- *Livelihoods*: Majority smallholder farmers and plantation labour; seasonal agricultural labour migration; some household income from tourism (Nilgiris-MTR) and casual wage work (Erode/Hosur). High dependency on vulnerable crops in many villages.
- *Vulnerability*: High proportion of marginal farmers with small land parcels, limited capital for fencing/mitigation and high sensitivity to single raid losses.

Infrastructure and Linear features

- *Major roads & rail*: NH/SH corridors, branching state roads and a limited rail network bisect key corridors (e.g., Moyar-Gudalur corridor, Bhavani valley). Road traffic increases nocturnal disturbance and collision risk.
- *Irrigation & reservoirs*: Canals, tanks and perennial irrigation pockets create localized water/forage hotspots that attract elephants in dry months.
- *Electricity & telecoms*: Powerlines and poles fragment canopy and act as obstacles in some stretches; electrified fencing exists in pockets but suffers maintenance issues.

Wildlife status & elephant use

- *Elephant presence*: Regular movement documented across all divisions- core concentrations in MTR/STR and Nilgiris, with seasonal and permanent spillover into Erode, Dharmapuri and Hosur.
- *Behavioural patterns*: Identified problem individuals and groups (habitual raiders) in several hotspots; increased presence of sub-adult males in fringe areas. Social learning of raiding behaviour reported in many local studies.
- *Other species*: Habitat fragmentation also affects other wide-ranging species (gaur, tiger, sloth bear), creating multi-species management trade-offs at the interface.

Mitigation assets & field capacity (existing)

- *Physical deterrents*: Patchy deployment of solar electrified fences, trenches and channel barriers in selected villages; pilot beehive fencing in a few sites; trenches in some ranges but many are inadequately maintained.
- *Response teams*: Kumki/rapid response units exist in core reserves (MTR/STR) but coverage is uneven in peripheral divisions (Erode, Dharmapuri, Hosur). Local forest staff are often overstretched.
- *Early warning & monitoring*: Small pilot camera/AI-based drones in Gudalur and some STR/MTR ranges; community alert systems exist informally, but no integrated, real-time district-level alert network.
- *Compensation & relief*: Formal compensation mechanisms exist but suffer from delays, and inconsistent assessment.

Governance, institutions & coordination

- *Forest dept capacity*: Strong conservation presence in tiger reserves but limited personnel per km² in many ranges; ranger/patrol strength fluctuates.
- *Cross-sector coordination*: Coordination between forest, agriculture, irrigation, highways and revenue departments is ad hoc. Development approvals (plantations, irrigation projects, road widening) often proceed with limited HEC/corridor screening.
- *Community institutions*: Village-forest committees (VFC), self-help groups (SHG) and NGO partnerships exist, but coverage and capacity are variable across divisions.

Socio-political context & attitudes

- *Tolerance levels*: Heterogeneous- Nilgiris estate owners and tourism-linked households often more tolerant; marginal farmers in high-loss zones show growing intolerance. Political salience is high in districts with repeated human fatalities.
- *Retaliation risk*: Evidence of illegal deterrents (electrocution, poisoning, snares) and livestock killings in the past decade- localized but concerning where trust in compensation is low.

Key drivers active in the ZoI

- Narrowed corridors due to land conversion and road expansion.
- Seasonal water/forage shortages pushing elephants into irrigated fields.
- Attractive cropping patterns along corridors (bananas, maize, sugarcane).
- Insufficient rapid-response coverage in eastern peripheral divisions.
- Maintenance failures of fences and deterrents (power outages, theft, vegetation).
- Delayed compensation and weak grievance redressal mechanisms.

Data, monitoring and evidence gaps

- *Regional harmonised HEC database*: Lack of an integrated, geocoded year-by-year incident database covering all divisions in the same format and coordinated system limits inter-operability, trend tracking and hotspot ranking.
- *Corridor ownership & land-tenure mapping*: Fine-scale maps of private/revenue parcels within corridor footprints are incomplete.
- *Behavioural identification*: Systematic identification and monitoring of repeat problem individuals/herds (GPS collars / camera IDs) is limited.
- *Socio-economic vulnerability mapping*: No uniform vulnerability index (household income, crop type, reliance on agriculture) across ZoI to prioritise compensation/ assistance.

Immediate operational priorities

- Map and secure top corridor bottlenecks (combine land-use, tenure, incident history).
- Expand and standardise rapid response coverage- deploy additional kumki/ response teams oriented to eastern divisions.
- Repair & standardise deterrents in very-high risk villages (solar/ steel rope fencing) with local maintenance funds.
- Create an integrated HEC dashboard (geocoded incidents, compensation status, response logs) shared across divisions.
- Fast-track compensation reform (timely payments, simplified verification, mobile disbursal pilots).
- Community engagement packages (livelihood diversification grants, night-watch incentives, school safety programmes) for hotspot clusters.

The ZoI of the Nilgiri Elephant Reserve is a **highly dynamic human–nature interface** where surviving corridors, mixed agriculture, and increasing human pressures create predictable and concentrated HEC. Current mitigation assets exist but are fragmented and unevenly distributed. Closing data and governance gaps- especially around corridor land-tenure, integrated incident reporting, and coordinated response- is essential to shift management from reactive to anticipatory, and to preserve both elephant movement and local livelihoods.

2.7 PROPOSED MANAGEMENT: VISION, GOALS, OBJECTIVES, PROBLEMS AND STRATEGIES

Managing an elephant reserve requires a comprehensive approach that considers ecological, social, and economic factors. By implementing a holistic management approach that integrates ecological conservation, community engagement, research, law enforcement, sustainable development, policy advocacy, and adaptive management, the elephant reserve can effectively protect and conserve its iconic wildlife while promoting the well-being of local communities and ecosystems.

2.7.1 The Vision

The vision typically encompasses several key objectives aimed at conserving and protecting elephant populations and their habitats.

- The vision of the Nilgiri Elephant Reserve (NER) is to ensure the long-term survival of elephant populations, preserve biodiversity and maintain the ecological integrity of the reserve while fostering sustainable coexistence with human communities and promoting the conservation of natural habitats for the benefit of current and future generations.

2.7.2 The Goal

A goal is an articulation of broad generalized management objectives in consonance with the conservation policy for securing the elephant population and habitat.

- The primary goal of the Nilgiri Elephant Reserve (NER) is to ensure the conservation and sustainable management of elephant populations and their habitats in the landscape by addressing ecological, social, and economic aspects to achieve a balance between the needs of elephants and those of human communities.

In this context, the Nilgiri Elephant Reserve (NER) has two overarching goals:

1. Ensure the long-term survival of viable (demographically and genetically) populations of elephants through land-use planning, regulation and consolidation in the larger natural landscapes of the state based on sound scientific theory and social principles.
2. Substantially reduce the levels of human-elephant conflict (HEC) to relieve human suffering from loss of crops, property and life, in a manner that would promote greater tolerance and acceptance of elephants in the larger landscape by local communities, protect their livelihoods, and ensure their effective participation in conservation.

2.7.3 Objectives of management

Considering the values and threats in the landscape relating to elephant population dynamics and habitat characteristics, the overarching objectives of Nilgiri ER management typically may include:

- Ensure the long-term viability and health of elephant populations within the reserve; and preserve and promote genetic diversity to maintain the adaptive capacity of the elephant population.
- Preserve and protect critical elephant habitats, including feeding grounds, migration corridors, and breeding areas; and implement measures to restore degraded habitats and maintain connectivity between different habitat patches.
- Implement strategies to reduce conflicts between elephants and local communities, including crop protection, early warning systems, and community-based initiatives; and envisage positive relationships between local communities and authorities through education, awareness, and community participation in conservation efforts.
- Promote sustainable land use practices that balance the needs of both elephants and local communities, minimizing negative impacts on ecosystems; and develop and support alternative livelihood options for communities living in and around the reserve to reduce dependency on resources within the reserve.
- Protect and maintain ecological corridors that facilitate movement of elephants between different habitats; and restore and rehabilitate disrupted or degraded corridors to enhance connectivity.
- Conduct research on elephant behaviour, movement patterns, habitat preferences, and ecological requirements; and implement long-term monitoring programs to track changes in elephant populations, habitat conditions, and human-elephant interactions.
- Develop and implement strategies to help elephant populations and their habitats adapt to the impacts of climate change, including changes in vegetation, water availability, migration patterns.

- Implement guidelines and management practices for tourism to minimize negative impacts on elephants and their habitats.
- Conduct educational programs and awareness campaigns to inform local communities about the importance of conservation and the ecological role of elephants; and educate tourists about responsible wildlife viewing practices to minimize disturbances to elephants and their habitats.
- Develop and implement emergency response protocols to address immediate threats to elephant populations, such as disease outbreaks or natural disasters including management of elephants in captivity.
- Collaborate with neighbouring elephant reserves for the conservation of shared elephant populations and ecosystems; and share best practices and research findings with the global conservation community.
- Empower local communities to actively participate in conservation decision-making and management processes; and ensure that communities receive tangible benefits from elephant conservation efforts, fostering a sense of ownership and cooperation.
- Build the capacity of local communities, conservation professionals, and government agencies involved in elephant reserve management.

Adaptive management strategies, continuous monitoring, and collaborative efforts are key to achieving these objectives in the dynamic and ever-changing landscape of Nilgiri elephant reserve.

2.7.4 Problems in achieving objectives

It is necessary to list all such impediments against the objectives and the options available to achieve them. While the objectives of managing NER are designed to promote conservation, biodiversity, and human-elephant coexistence, several challenges and problems can hinder the successful achievement of these objectives.

These problems are often complex and interconnected, requiring multifaceted strategies for resolution. 'Objectives-Problem Matrix' analysis will guide designing viable strategies.

Some key problems in the landscape include:

Conservation of Elephant Populations (Population Viability & Genetic Diversity)

- Fragmented habitats restricting gene flow between sub-populations
- Narrowed and degraded corridors limiting dispersal
- Mortality from conflict, electrocution, accidents and poaching
- Limited long-term genetic and demographic monitoring
- Increasing isolation of fringe populations (Hosur–Dharmapuri belt)

Habitat Protection & Restoration (Habitat Conservation & Restoration)

- Encroachments and land-use change in forest margins
- Invasive species dominance (Lantana, Senna, Prosopis)
- Inadequate funding for large-scale restoration
- Competing development priorities
- Limited availability of native planting material

Human-Elephant Coexistence (HEC Mitigation & Community Engagement)

- Chronic hotspots with limited scope for physical mitigation
- Poor maintenance of fences and barriers
- Delays in compensation
- Low community trust in institutions
- Habituation of elephants to crops

Sustainable Resource Management (Balanced Land Use & Livelihoods)

- Dependence on high-risk crops

- Weak land-use zoning enforcement
- Limited livelihood alternatives in fringe villages
- Market constraints for alternative crops
- Insecure land tenure in corridor zones

Corridor Protection & Connectivity (Corridor Management & Restoration)
- Private land ownership in corridor areas
- High land values near urban centres
- Weak legal protection for corridors
- Resistance from landholders
- Infrastructure projects bisecting corridors

Research & Monitoring (Ecological Studies & Monitoring Programs)
- Lack of integrated GIS database
- Limited funding for long-term studies
- Shortage of trained technical staff
- Fragmented data across divisions
- Weak link between research and management

Climate Change Adaptation (Adaptation Strategies)
- Limited local climate projections
- Absence of climate-resilient habitat plans
- Inadequate water-security planning
- Poor integration of climate risks in working plans

Tourism Management (Responsible Tourism Practices)
- Unregulated tourism in sensitive zones
- Night-time traffic through corridors
- Pressure for infrastructure development
- Limited visitor awareness / enforcement capacity

Public Awareness & Education (Community & Tourist Education)
- Low literacy of HEC risks in fringe areas
- Language and cultural barriers
- Lack of sustained outreach programmes
- Limited educational material / school-level integration

Crisis Response & Emergency Management (Emergency Protocols & Disease Monitoring)
- Absence of standardised emergency SOPs
- Limited veterinary infrastructure
- Delayed response in remote areas
- Poor disease surveillance systems
- Weak coordination with health departments

Regional Collaboration (Conservation & Knowledge Exchange)
- Weak inter-state coordination mechanisms
- Data-sharing restrictions and different policy priorities
- Irregular joint meetings and lack of common action plans

Community-Based Conservation (Empowerment & Benefit Sharing)
- Limited revenue-sharing mechanisms
- Weak local institutions
- Lack of legal backing for community roles
- Insufficient capacity building

Capacity Building (Training & Skill Development)

- Staff shortages in field units
- Limited training budgets
- Inadequate exposure to new technologies
- Lack of refresher programmes

Management Implication

The Objectives - Problem Matrix indicates that HEC in the Nilgiri Elephant Reserve is systemic and landscape-driven, not merely site-specific. Therefore:

- Solutions must be corridor-centred, village-cluster based, and seasonally targeted.
- Physical mitigation alone is insufficient without governance reform and community partnership.
- Priority should shift from reactive damage control to preventive landscape management.

Addressing these problems requires a holistic and adaptive approach, involving collaboration between stakeholders and multipronged strategies.

2.7.5 SWOT analysis

SWOT analysis for Nilgiri Elephant Reserve (NER) envisages:

Strengths (Internal Positive Factors)

- *Large, contiguous forest landscape*: forms part of the Western-Eastern Ghats connectivity complex; includes strong core areas (MTR, STR, Nilgiris plateau forests) and supports one of India's largest contiguous elephant populations.
- *High ecological and genetic value*: maintains viable breeding populations and genetic exchange with Karnataka and Kerala landscapes; and diverse habitats: shola–grasslands, moist deciduous, dry deciduous, riverine forests.
- *Strong institutional presence in core areas*: well-established protection and management systems in MTR and STR; experienced frontline staff and 'Kumki' units and long history of elephant management.
- *Rich knowledge base*: extensive research, long-term observations, and NGO/academic engagement and availability of traditional ecological knowledge among local communities.
- *National and International recognition*: high conservation priority under Project Elephant and visibility attracts funding, research interest, and policy attention.
- *Existing mitigation infrastructure*: solar fencing, trenches, patrol roads, response teams in key areas and pilot early-warning and monitoring systems.

Weaknesses (Internal Limiting Factors)

- *Fragmented corridor protection: m*any critical corridors lie on private/revenue lands; weak legal status for several movement routes; and limited land acquisition and easement mechanisms.
- *Uneven management capacity: s*trong in core reserves, weaker in peripheral divisions (Erode, Dharmapuri, Hosur); and staff shortages and high workload in fringe ranges.
- *Reactive conflict management: e*mphasis on fencing, chasing, and capture rather than prevention; and limited landscape-scale planning integration.
- *Poor maintenance of mitigation assets: f*requent breakdown of fences and trenches; and inadequate local maintenance funding.
- *Fragmented data and monitoring: n*o fully integrated GIS-based HEC and wildlife database; and incident records scattered across divisions.
- *Compensation and grievance gaps: d*elays and procedural complexity; and low perceived fairness among farmers.

- *Limited community ownership: m*any interventions remain department-driven; and weak local stewardship institutions in hotspots.

Opportunities (External Positive Factors)

- *Landscape-level planning momentum:* growing recognition of corridor-based conservation; and policy support for landscape and ecosystem approaches.
- *Technological advances:* AI cameras, GPS collars, drones, mobile apps; and scope for integrated early-warning systems.
- *Funding and partnership potential:* Central schemes (Project Elephant, CAMPA); CSR funding from industrial clusters (Hosur–Krishnagiri); and NGO and academic partnerships.
- *Community-based conservation models:* scope for payment for ecosystem services (PES); eco-tourism benefit sharing; and community ranger and monitoring schemes.
- *Climate adaptation financing:* access to climate resilience and restoration funds; and integration with watershed and drought-proofing programmes.
- *Inter-state collaboration platforms:* opportunity to strengthen Tamil Nadu-Karnataka-Kerala coordination; and joint monitoring and response mechanisms.
- *Sustainable agriculture initiatives:* promotion of low-risk crops and agroforestry; and organic and wildlife-friendly branding potential.

Threats (External Risk Factors)

- *Rapid urbanisation and industrial growth:* Hosur-Krishnagiri-Dharmapuri belt expansion; real estate pressure in Nilgiris and Gudalur; and loss of remaining corridors.
- *Infrastructure expansion:* road widening, rail upgrades, power lines, canals; and increased fragmentation and mortality risk.
- *Climate change impacts:* prolonged droughts and erratic monsoons; reduced forest productivity and water availability; and longer conflict seasons.
- *Declining social tolerance:* repeated crop losses and fatalities; growing political pressure for translocation or culling; and risk of retaliatory actions.
- *Invasive species proliferation:* Lantana, Senna and Prosopis reducing forage; and high restoration costs.
- *Policy and governance uncertainty:* shifting development priorities; delays in corridor notification; and inconsistent enforcement.
- *Disease and health risks:* potential outbreaks (TB, EEHV, foot-and-mouth spillover); limited disease surveillance.

SWOT Matrix

Table-2.9: Summary of SWOT Analysis

Dimension	Key Elements
Strengths	Large connected forests, strong core reserves, high biodiversity, experienced staff
Weaknesses	Corridor insecurity, uneven capacity, weak data systems, reactive management
Opportunities	Technology, partnerships, climate finance, community models
Threats	Urbanisation, infrastructure, climate stress, declining tolerance

Strategic Interpretation for NER

- Leverage strengths: Use strong core reserves and institutional experience as anchors for landscape management and corridor protection.
- Address weaknesses systematically: Prioritise corridor legalisation; unified data systems; community co-management; and capacity building in peripheral divisions

- Capitalise on opportunities: Scale up early-warning technologies; PES and eco-tourism benefit sharing; and climate-resilient restoration
- Mitigate major threats proactively: Mainstream wildlife concerns into regional planning; infrastructure design; and urban development policies

2.7.6 Formulation of strategies in consonance with the existing plans

Considering the elephant not only as a keystone species but also an umbrella and flagship species, the plan besides necessitating a landscape-level approach has to be overarching in the implementation areas under different management regimes viz. guidelines of the Tiger Conservation Plan (TCP); management plans for the Protected Areas (PA); traditional forestry management as per Working Plan (WP) prescriptions guided by the National Working Plan Code; and Zonal Master Plan (ZMP) in the fringe areas governed by the Eco-sensitive Zone (ESZ) guidelines (Table-2.10).

Table-2.10: Strategic Alignment with Existing Plans

Planning Instrument	Core Focus	Alignment Requirement in NER
Tiger Conservation Plans	Core–buffer protection, habitat security	Integrate elephant corridors and HEC mitigation in buffers
Management Plans	Biodiversity conservation	Mainstream elephant needs across habitats
Working Plans	Forest operations	Integrate habitat restoration and corridor safeguards
Zonal Master Plans	Land-use regulation	Incorporate wildlife-sensitive zoning

Strategic Principle

Formulating effective strategies for the management of NER involves addressing the unique challenges and opportunities presented by the reserve's ecological, social, and economic context. The management strategies function as a landscape overlay, harmonising sectoral plans rather than operating in isolation. Integrated Strategy Framework for NER envisages:

Landscape Connectivity & Habitat Security Strategy (Aligned with TCPs, WP, MP)

- Integrate priority corridors into TCP buffer-zone prescriptions.
- Notify and demarcate corridors in Working Plans and Management Plans.
- Implement assisted natural regeneration and invasive control in corridor forests.
- Establish habitat restoration blocks in degraded buffer and fringe zones.
- Regulate forestry operations in movement routes.

Human–Elephant Coexistence Strategy (Aligned with TCP Buffer Plan, WP, District Plans)

- Prepare village-cluster HEC mitigation plans linked to Working Plans.
- Integrate fencing, beehive belts, and crop buffers into buffer-zone prescriptions.
- Establish permanent rapid-response units under TCP guidelines.
- Institutionalise time-bound compensation systems.
- Promote community watch and alert systems.

Sustainable Land-use & Livelihood Strategy (Aligned with Zonal Plan, District Plans)

- Declare “Wildlife Sensitivity Zones” in Master Plans.
- Restrict high-risk cropping in corridor zones.
- Promote agroforestry and low-attractant crops.
- Link livelihood schemes with eco-development plans.
- Integrate PES (Payment for Ecosystem Services) mechanisms.

Corridor Protection & Restoration Strategy (Aligned with TCPs, WP, MP)

- Include corridor parcels in TCP buffer management maps.
- Secure land through purchase, lease, easements, or swaps.
- Restore bottlenecks through vegetation enrichment.
- Design wildlife crossings in road projects.

- Integrate corridor safeguards in Master Plans.

Research, Monitoring & Decision-Support Strategy (Aligned with TCPs, MP)
- Develop unified GIS-based NER database.
- Integrate elephant monitoring into TCP protocols.
- Establish long-term research plots.
- Implement GPS/AI-based monitoring.
- Publish annual NER status reports.

Climate Adaptation & Resilience Strategy (Aligned with Climate Action Plan, WP)
- Map climate-vulnerable ranges.
- Restore drought-resilient fodder species.
- Secure perennial water sources.
- Integrate climate risk in Working Plans.
- Establish emergency habitat support protocols.

Responsible Tourism Management Strategy (Aligned with Tourism Policy, TCP, MP)
- Enforce visitor caps in buffer zones.
- Regulate night traffic in corridors.
- Establish wildlife-sensitive tourism guidelines.
- Promote low-impact eco-tourism models.
- Mandatory visitor orientation.

Awareness, Education & Behaviour Change Strategy (Aligned with Ecodevelopment Plan)
- Integrate HEC modules in school curricula.
- Conduct seasonal safety campaigns.
- Develop multilingual IEC material.
- Establish interpretation centres.
- Train community educators.

. Emergency Response & Health Management Strategy (Aligned with Disaster Plan, TCP SOPs)
- Develop NER-wide emergency SOPs.
- Establish mobile veterinary units.
- Integrate disease surveillance systems.
- Maintain emergency equipment pools.
- Conduct mock drills.

. Inter-State & Inter-Agency Coordination Strategy (Aligned with NWAP)
- Constitute Tri-State NER Coordination Committee.
- Develop joint corridor management protocols.
- Share monitoring data.
- Conduct annual joint reviews.
- Develop common response standards.

. Community-Based Conservation Strategy (Aligned with EDCs, JFM)
- Strengthen VFCs/EDCs.
- Implement benefit-sharing mechanisms.
- Develop community ranger programmes.
- Support women SHGs in conservation enterprises.
- Promote participatory corridor protection.

. Capacity Building & Institutional Strengthening Strategy (Aligned with Training Plans)
- Establish NER Training Calendar.
- Conduct GIS/technology training.
- Leadership programmes for field officers.
- Exposure visits.
- Performance-linked incentives.

Priority Actions

The framework (Table-2.11) directly links key constraints to practical strategies and field-level actions, and is suitable for inclusion in the landscape management. Priority actions include -

Table-2.10: Problem-Strategy-Priority Action Matrix

Problem	Strategy	Priority Actions
Habitat Fragmentation & Corridor Loss		
Land conversion in corridors	Secure and legally strengthen corridors	• Notify critical corridors • Land purchase/lease in bottlenecks • Conservation easements
Infrastructure blocking movement	Mainstream wildlife-sensitive design	• Wildlife underpasses/overpasses • Retrofit culverts • Corridor-friendly road widening
Private land ownership	Incentivise conservation	• PES schemes / Tax rebates • Agroforestry buffers
Chronic Human–Elephant Conflict		
Repeated crop raiding	Hotspot-based mitigation	• Cluster fencing/ Beehive belts • Crop zoning
Poor deterrent maintenance	Community-managed systems	• Village fence committees • Maintenance funds
Habituated elephants	Early behavioural intervention	• Targeted deterrence teams • GPS tracking of repeat offenders
Weak Community Trust & Livelihood Dependence		
Delayed compensation	Reform compensation systems	• Digital claims • 15-day settlement rule
High dependence on risky crops	Livelihood diversification	• Low-risk crop subsidies • Value-chain support
Low participation	Incentivise stewardship	• Conservation honorariums • Community protection scheme
Habitat Degradation & Resource Scarcity		
Invasive species	Systematic restoration	• Lantana/ Senna removal drives • Native planting
Seasonal water stress	Water security planning	• Perennial waterholes • Rainwater harvesting
Poor grass regeneration	Active habitat management	• Controlled burns • Grass reseeding
Climate Vulnerability		
Drought stress	Climate-resilient habitats	• Drought-resistant fodder plots • Assisted regeneration
Flood/heat events	Disaster preparedness	• Climate early-warning systems • Contingency funds
Unregulated Tourism & Disturbance		
Night traffic	Corridor protection rules	• No-night zones • Speed regulation
Visitor pressure	Responsible tourism	• Visitor caps • Eco-certification
Awareness gaps	Behavioural change	• Mandatory briefings • Interpretation centres

The formulation of strategies in the Nilgiri Elephant Reserve (NER) follows an integrated, landscape-based approach that aligns elephant conservation objectives with existing Tiger Conservation Plans, Management Plans, Working Plans, and Zonal/Master Plans. It focuses on securing ecological connectivity through corridor protection and habitat restoration, reducing human–elephant conflict through hotspot-based mitigation and community engagement, and promoting compatible land use and alternative livelihoods in sensitive areas. The strategies incorporate climate-resilient habitat management, unified research and monitoring systems, responsible tourism practices, and extensive awareness programmes. Strong emphasis is placed on inter-departmental and inter-state coordination, institutional strengthening, and community participation to ensure effective implementation.

Overall, the approach seeks to shift from fragmented, short-term interventions to coordinated, long-term landscape governance that supports both elephant conservation and sustainable development.

CHAPTER 3: MANAGING DRIVERS AND PRESSURES

3.1 ZONATION IN NILGIRI ELEPHANT RESERVE (NER)

A zone is an area set apart for meeting management objectives and is not a legal category but a management entity. The NER is a mosaic of forest areas under different management regimes, categorized as Tiger Reserve (MTR & STR); Protected Areas (Cauvery North WLS, Cauvery South WLS, Tanthai-Periyar WLS) and Forest divisions (Nilgiris/ Gudalur/ Erode/ Dharmapuri) which are RF areas.

As per the Elephant Reserve Notification vide G.O (Ms) No 151 E&F (FR.5) Dept dated 19-9-2003 in respect of Tamil Nadu State, Nilgiri Elephant Reserve (NER) is constituted with an area of **4662.45 km²** covering the districts of Nilgiris, Erode and Dharmapuri with the following zonation:

- Core area - 716.22 km²
- Buffer area - 3946.23 km²

The existing boundaries of the following erstwhile 8 divisions were considered in the declaration (fig-3.1):

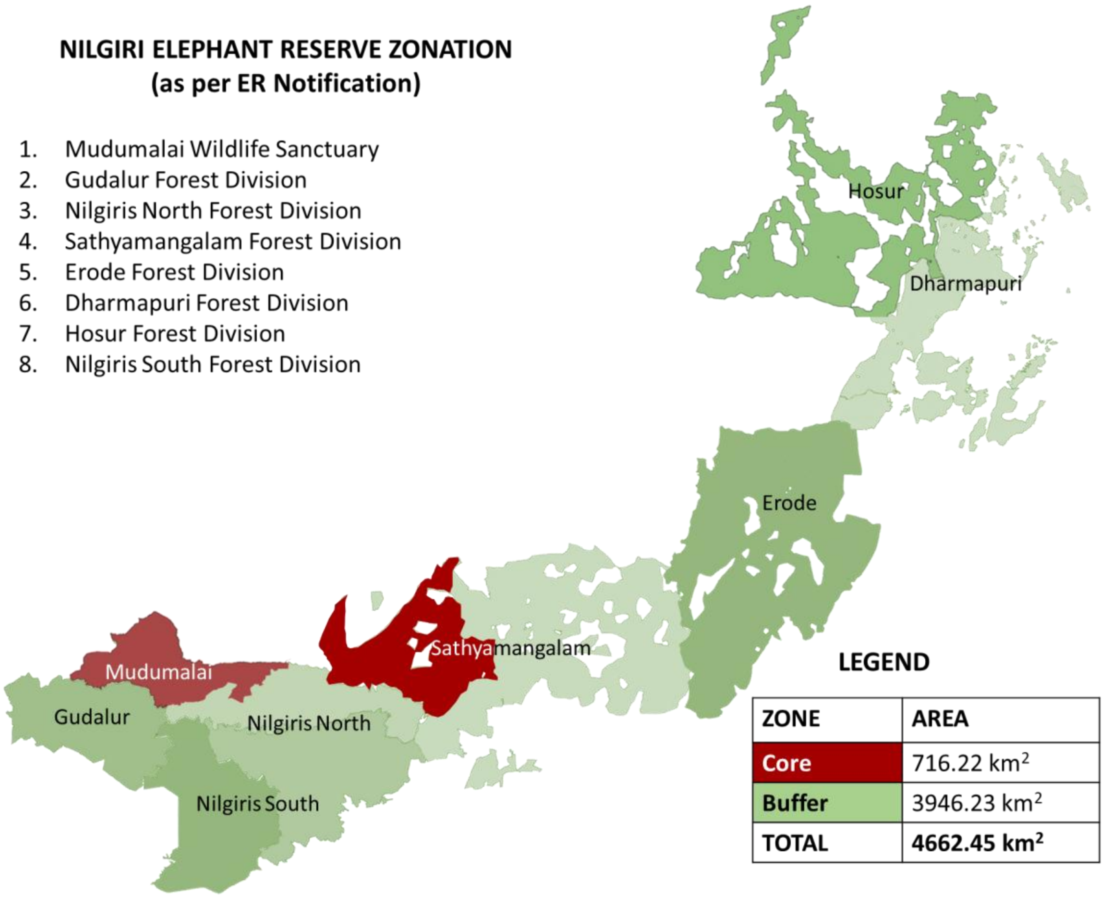


Fig-3.1: Nilgiri Elephant Reserve (Nilgiris-Eastern Ghats) as per Notification

In the absence of the boundary map and the existence of only one Protected Area (Mudumalai) at the time of declaration of the NER, it is presumed that the core area must have been constituted with Mudumalai WLS in the Western Ghats and probably Sathyamangalam (part) in the Eastern Ghats with the rest of the Forest divisions forming the buffer area.

As per the 'Framework for preparation of Elephant Conservation Plan for the Elephant Reserves' developed by PE-WII-MoEFCC, Govt of India (2024) (Fig-3.2), 3 zones have been suggested in the ERs.

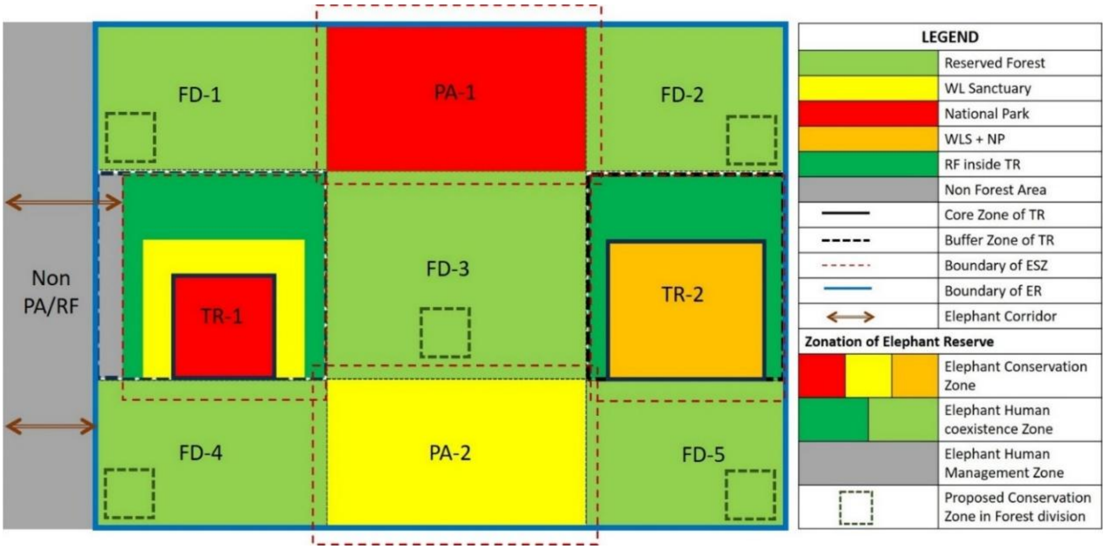


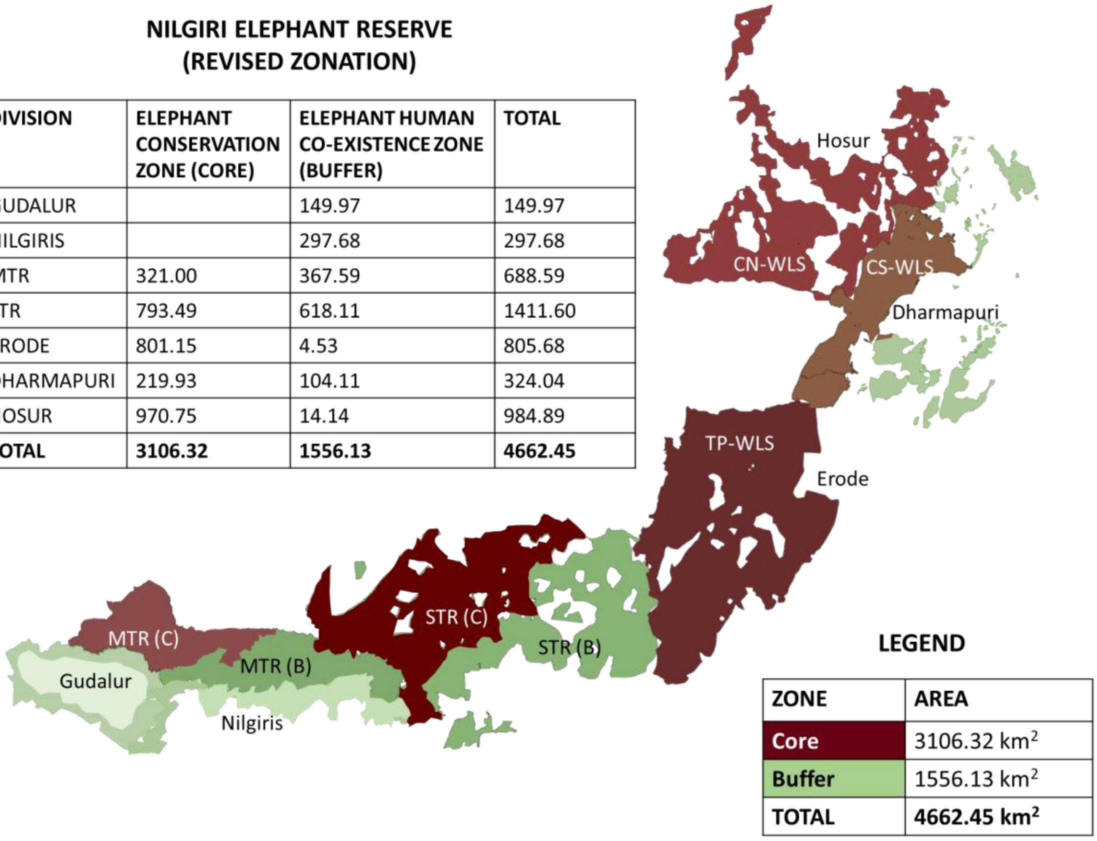
Fig-3.2: Zonation of ER as per MoEFCC framework (FD-Forest Division; TR-Tiger Reserve; PA-Protected Area)

Revised Zonation of NER

Consequent to the declaration of many areas as Protected Areas and Tiger Reserves in the erstwhile NER landscape and also taking into consideration the overall boundary limitation of the NER, the redistributed areas for the 3 zones will be as follows (Fig-3.3):

NILGIRI ELEPHANT RESERVE (REVISED ZONATION)

DIVISION	ELEPHANT CONSERVATION ZONE (CORE)	ELEPHANT HUMAN CO-EXISTENCE ZONE (BUFFER)	TOTAL
GUDALUR		149.97	149.97
NILGIRIS		297.68	297.68
MTR	321.00	367.59	688.59
STR	793.49	618.11	1411.60
ERODE	801.15	4.53	805.68
DHARMAPURI	219.93	104.11	324.04
HOSUR	970.75	14.14	984.89
TOTAL	**3106.32**	**1556.13**	**4662.45**



ZONE	AREA
Core	3106.32 km^2
Buffer	1556.13 km^2
TOTAL	**4662.45 km^2**

Fig-3.3: Re-distributed Areas of Core & Buffer in the NER as per MoEFCC framework

It's important to note that the specific zonation plan can vary from one elephant reserve to another, as it depends on factors such as the size of the reserve, local ecology, and presence of human settlements.

3.1.1. Elephant conservation zone

This would encompass the larger and more secured inviolate forested habitats that hold a substantial proportion of the elephant population of the Reserve. This zone is devoid of any human intervention and is well protected. It exists to conserve natural ecosystems, wildlife, habitat, and species and genetic variation. Natural resources, flora, and fauna are allowed to thrive on their own and nature takes its evolutionary course. This area is largely undisturbed with natural successions of vegetation and nature being preserved. It has reliable water resources; generally devoid of human settlements and anthropogenic impacts.

- The core areas of Mudumalai & Sathyamangalam TRs, and Thanthai-Periyar WLS, Cauvery North WLS and Cauvery South WLS in Dharmapuri and Hosur are part of this zone.

The emphasis within this zone would be on maintaining the habitat integrity at the landscape scale by protecting and strengthening corridors, preventing elephants from moving into agricultural land and settlements both along the periphery and within enclaves, and affording maximum protection to elephants against any poaching. The area also has strict and regulated ecotourism.

3.1.2. Elephant-human coexistence zone.

Elephant populations in small numbers, either isolated or connected to the major conservation zones, but ranging over a restricted or a fragmented habitat in which conflicts exist would qualify for inclusion in the coexistence zone.

- The buffer zones of the MTR and STR as well as the Reserved Forests of the Nilgiris, Gudalur, Erode, Dharmapuri and Hosur fall in this category within the overall ESZ notified area.

Several interventions/activities for ecological restoration are permitted; area is more prone to fire and invasion of alien species. This area is open for tourism, nature education and research and largely falls in coexistence zone. The buffer has separate management strategies and the conservation approach is the coexistence of humans and wildlife.

In the Forest divisions of elephant reserves, the criteria of habitat quality and elephant population viability may be adopted to explore areas to be considered as core and buffer. The core areas identified may be integrated preferably into the other core areas, otherwise can be considered as stand-alone areas. These areas are extremely rich in biodiversity and have viable populations of Elephants and other animals and qualify as source areas for elephants. The working circles based on the above criteria can be distributed to the core and buffer depending on their values and objectives of management. However, in NER, such areas have already been notified as PAs (Thanthai-Periyar WLS; Cauvery North & South WLS).

3.1.3. Elephant human management zone

The elephant human management zone would include areas where small or isolated groups of elephants, with questionable viability, or solitary bulls' range over a predominantly human-settled landscape, and the social and economic costs of maintaining the elephants here are unacceptably high. These areas have a high level of human elephant conflict (viz. Gudalur/ Hosur-Dharmapuri). The elephants have to be driven or removed from this zone by capture and translocation. Instances of problem/aggressive elephants are not uncommon and have to be managed as per the provision of the Wildlife (Protection) Act,1972

The fringe area beyond the boundaries of the PAs and territorial reserved forest are the vast agricultural landscape, rural/ semi urban areas identified and notified as eco-sensitive zones (surrounding PAs) and zones of influence (surrounding territorial reserved forest).

- This interface area has small insular forest habitats and vast agricultural lands where isolated small elephant populations are residents and remain there for the most part of the year viz. Gudalur area; Thali & Sanamavu in Hosur (Fig-3.4).

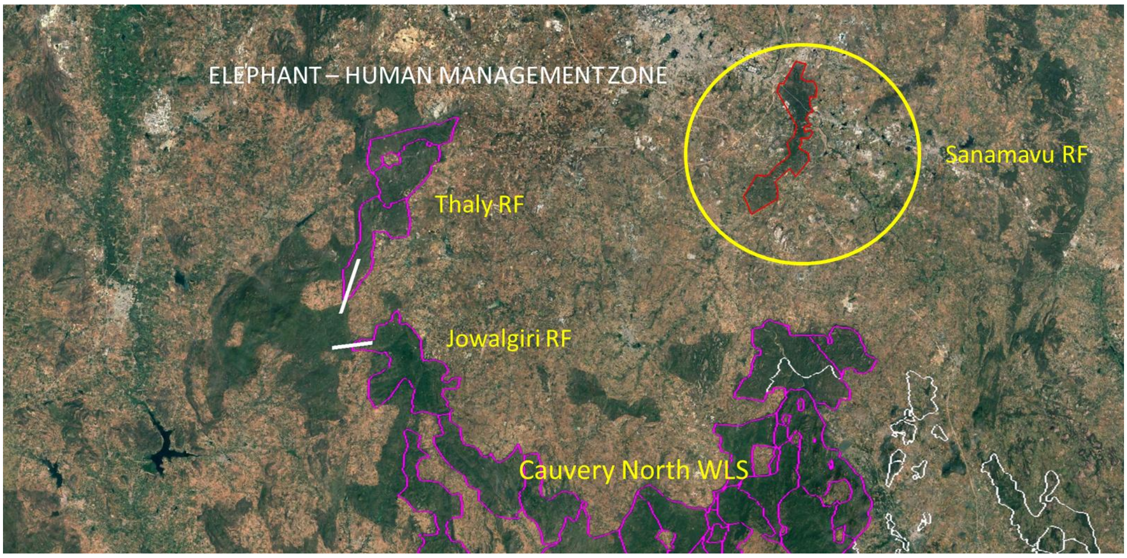


Fig-3.4: Sanamavu RF- the isolated forest patch regularly used by the elephants

These populations have a negative interaction with communities and are a source of perpetual conflict. Human activities are rampant here including dependency on forests, cultivation of crops attracting elephants, mining and linear infrastructure which disrupts the free movement of animals. The coexistence is to be supported by participatory forest management as well as management intervention.

The mainstreaming of conservation in the sectoral plans of line departments/agencies in this zone will contribute to ecological sustainability. Tribals, local population, scientists, Govt department, Railways, Animal Husbandry, NHAI, businesses, etc. have to align their activities and work together to manage and use the area in a sustainable way that will benefit the people who live here and reduce conflict.

3.2 ELEPHANT-HABITAT RELATIONSHIP (EHR) IN THE REGION

Elephant-Habitat Relationship (EHR) refers to the intricate and dynamic connection between elephants and their habitat. This relationship is essential for the survival and well-being of elephant populations. Understanding the EHR is crucial for effective elephant conservation and management.

An EHR database can be characterized and assessed by the following factors:

- Elephant-habitat and its classification
- Elephant population, distribution and dynamics
- Elephant life history and ecological attributes
- Elephant reserve boundaries (legal, ecological and administrative)
- Topographic variables including elevation, terrain ruggedness index (TRI), and distance to river;
- Climatic variables including mean annual precipitation (MAP) & mean annual temperature (MAT);
- Vegetation variables, land-use/land-cover (LULC), normalized different vegetation index (NDVI);
- Anthropogenic variables including human footprint, distance to road and water source.

Gathering Elephant Habitat Relationships Data

- Data on elephant habitat relationships can include information from habitat inventories, species inventories, correlation studies of species-habitat relationships, and other sources.

3.2.1 EHR in NER

The EHR in NER reflects how elephants use, respond to, and modify different habitat types across elevation gradients and human-dominated interfaces (Table-3.1).

Table-3.1: EHR Status and Ecological Implications in NER

Habitat Characteristics	EHR Relationship	Ecol. Implications	EHR Status
High-Elevation Shola–Grassland & Plantation Mosaics (Nilgiris & Upper Gudalur)			
• Elevation 1500-2600m • Shola-grasslands • Tea/ coffee estates & settlements in valley • Cool, moist climate with seasonal grass	• Used for seasonal foraging and transit • Grasslands provide high-quality fodder • Sholas offer shade and resting sites • Movement along valley corridors/ estate boundaries	• Natural forage is limited in extent • Plantations block traditional routes • High interface with agriculture lead to frequent crop raids	Moderately suitable habitat with high fragmentation and conflict risk
Moist & Dry Deciduous Forests (MTR–STR–Erode Belt)			
• Elevation: 300-1200 m • Moist & dry deciduous forests & riverine • Major rivers: Moyar, Bhavani, Cauvery • Core elephant range in NER	• Forms the primary ecological backbone of NER • Supports breeding herds and large aggregations • High availability of grasses, browse, bark, and water • Seasonal movement between moist & dry zones	• Highest carrying capacity • Riverine belts as movement paths • Degradation (fires, invasives) reduces forage quality	High-quality core habitat supporting population viability
Dry Forest–Agriculture–Urban Interface (Dharmapuri, Hosur, Eastern Erode)			
• Dry deciduous and thorn forests • Rocky hills, scrublands, reservoirs • Extensive agriculture & peri-urban expansion • Narrow and degraded corridors	• Used mainly as movement corridors & spillover zones • Limited natural forage • High dependence on crops (maize, ragi, sugarcane, banana) • Increasing presence of solitary bulls & small groups	• Acts as a “sink landscape” with high mortality risk • Frequent human encounters • Poor habitat quality drives repeated incursions	Marginal habitat with severe conflict pressure
Corridor Habitats and Transitional Landscapes			
• Narrow forest strips, river valleys, ridgelines • Often interspersed with farms and roads • Mostly on private/ revenue lands	• Critical for seasonal and genetic connectivity • Intensively used during migration periods • Highly sensitive to disturbance	• Minor degradation causes disruption • Bottlenecks concentrate conflict • Key determinant of population health	Functionally vital but structurally fragile

Seasonal and Resource-Based Habitat Use

Elephant habitat use in the NER shows strong seasonal and resource-driven patterns.

- During the monsoon season (June–September), elephants concentrate in moist deciduous forests and montane grasslands where fresh grass and browse are abundant.
- In the post-monsoon period (October–December), as crops mature near forest edges, elephants move into valley bottoms and agricultural landscapes, leading to higher levels of crop raiding.
- During the dry summer months (March–June), scarcity of surface water and decline in natural forage push elephants toward riverine belts, reservoirs, irrigation canals, and cultivated fields, making water availability the primary driver of movement.

Throughout the year, the spatial distribution of elephants is governed mainly by access to water, seasonal grass flush, and high-calorie crops, with human-modified habitats increasingly influencing natural ranging behaviour and intensifying human–elephant conflict.

Influence of Habitat Quality on Elephant Behaviour

Habitat quality strongly influences elephant behaviour in the NER.

- In intact and resource-rich forests, elephants maintain normal ranging patterns, remain within natural habitats, and show low levels of conflict with humans.
- As habitat quality declines due to degradation, invasive species, water scarcity, or fragmentation, elephants are forced to range more widely in search of food and water, increasing their use of human-dominated landscapes.
- In narrow or degraded corridors, repeated crossings and movement bottlenecks develop, leading to predictable conflict hotspots.
- In crop-dominated fringe areas, easy access to high-calorie food promotes habituation and the development of crop-raiding behaviour, particularly among certain individuals.

Overall, poor habitat quality encourages risk-taking, altered movement patterns, and dependency on agricultural resources, thereby intensifying human–elephant conflict and undermining long-term ecological stability.

Landscape-Level Elephant–Habitat Relationship (EHR) Pattern

At the landscape level, the Elephant-Habitat Relationship in the Nilgiri Elephant Reserve follows a distinct **source–sink–connector pattern**.

- High-quality core habitats in Mudumalai, Sathyamangalam, and the Nilgiri forest blocks function as “source areas” that support breeding, population growth, and long-term viability.
- Surrounding fringe and eastern landscapes such as Gudalur margins, Dharmapuri, and Hosur act as “sink areas,” where habitat quality is low, human presence is high, and elephants face increased risks from conflict and mortality.
- These source and sink areas are linked by narrow corridor and riverine habitats, particularly along the Moyar, Bhavani, and Cauvery North belts, which serve as critical “connectors” for seasonal movement and genetic exchange.

The stability of this system depends on the integrity of these connectors; any degradation or blockage disrupts movement, concentrates elephants in marginal habitats, and intensifies conflict. Therefore, maintaining strong core habitats and functional corridors is essential for sustaining ecological balance and coexistence in the NER landscape.

Current Constraints on a Healthy Elephant–Habitat Relationship (EHR)

The elephant–habitat relationship in the Nilgiri Elephant Reserve is currently constrained by multiple interacting pressures.

- The spread of invasive plant species and frequent forest fires have reduced the availability and quality of natural forage.
- Progressive narrowing of corridors due to settlements, roads, plantations, and other infrastructure has disrupted traditional movement routes and concentrated elephant movement into bottlenecks.
- Replacement of native vegetation with monoculture plantations has further limited food and shelter resources.
- Increasing water scarcity, especially in the eastern and peripheral ranges, forces elephants to move toward human-dominated landscapes during dry seasons.
- In addition, growing disturbance from traffic, tourism, and human activity reduces habitat security and alters normal ranging behaviour.

Together, these factors weaken habitat functionality, increase dependence on agricultural areas, intensify human–elephant conflict, and undermine the long-term ecological balance of the reserve.

Management Implications of EHR in NER

The EHR in the NER shows that elephant population stability depends on -

- the integrity of core forests (MTR-STR-Nilgiris),
- conflict intensity is closely linked to the condition of fringe habitats, and
- long-term viability relies on functional corridors.

Degradation or fragmentation in any of these components disrupts natural movement patterns, increases ranging into human-dominated landscapes, and intensifies human-elephant conflict. Effective management must therefore focus on maintaining habitat quality and connectivity at the landscape scale rather than relying on isolated, site-level interventions.

Priority actions include restoring grasslands and riverine habitats, controlling invasive species, securing and rehabilitating critical corridors, improving water availability within forests, regulating plantations and linear infrastructure in movement zones, and strengthening protection in degraded fringe areas. Together, these interventions are essential for stabilising elephant behaviour, reducing conflict, and sustaining ecological balance and coexistence in the NER.

In the Nilgiri Elephant Reserve, elephants exhibit a multi-habitat dependency system, relying on high-elevation grasslands for seasonal forage, deciduous forests for core sustenance, corridors for connectivity, and fringe landscapes as forced extensions during resource stress. Degradation of any one component destabilises the entire system, leading to increased ranging, crop raiding, and conflict. Strengthening habitat quality and **connectivity across all divisions** is therefore central to maintaining ecological balance, population viability, and long-term coexistence.

3.3 MAINTAINING HABITAT INTEGRITY AND CONTIGUITY IN THE LANDSCAPE & CORRIDORS INCLUDING ECOSYSTEM BASED MANAGEMENT

The spatial connectivity of elephant populations between multiple forest habitats and protected areas of NER at the landscape level is necessary to maintain habitat integrity. The corridors are under great threat and loss of connectivity impedes migration and such isolated populations become endangered. To maintain habitat integrity and quality there is need to assess the data on the following:

- Data on the habitat quality in the landscape

- Data on carrying capacity, the ranging and foraging pattern
- Identified corridors in the landscape and new potential corridors
- Status of the corridor and functionality; the impact of forest dependency on people; impacts of development projects; rural/semi-urban development; and disturbance from linear projects.

The key strategies mainly envisage corridor protection and management with land-use planning, regional collaboration and habitat restoration for ensuring habitat integrity and contiguity in the NER

3.3.1 Integrated management through landscape area strategy

Developing and implementing a Landscape Area Management Strategy requires collaboration, ongoing commitment, and adaptive management to address the dynamic nature of ecosystems and the challenges faced by elephant populations in NER. It is essential to maintain a balance between conservation objectives and the socio-economic needs of local communities within the landscape.

3.3.1.1 Delineation of Landscape Management Areas (LMA)

Objective: Define ecologically functional units for coordinated management.

LMA Type	Coverage	Key Field Locations
Core Conservation Areas	High-quality EHR	MTR / STR core, Nilgiri South Forest
Buffer & Interface Zones	Forest–agriculture interface	Gudalur–Pandalur belt, Hasanur fringe
Corridor Management Areas	Connectivity strips	Moyar Valley, Bhavani Corridor, Cauvery North–Hosur belt
Multiple-Use Landscapes	Agro-forest mosaics	Dharmapuri foothills, Erode fringes
Urban-Influence Zones	High development pressure	Hosur–Denkanikottai belt

Management Action: Prepare GIS-based LMA maps and notify LMAs in various Plans (TCP/WP/MP).

3.3.1.2 Collecting inventory on the Landscape Management Area

Objective: Build a comprehensive ecological and socio-economic database.

Domain	Data Elements	Field Sources
Ecological	Forest type, forage, water, invasives	Range surveys, RS-GIS
Wildlife	Elephant density, routes, mortality	Camera traps, patrol logs
Land Use	Crops, plantations, settlements	Revenue maps, satellite data
Infrastructure	Roads, canals, power lines	PWD, Irrigation Dept
Socio-economic	Livelihoods, dependency	Village surveys

Management Action: Establish an NER GIS–MIS Cell and update inventory every 3 years.

3.3.1.3 Assessing current situation, trends, potentials and human use

Objective: Understand pressures and opportunities within each LMA.

Factor	Key Indicators	NER Examples
Habitat Quality	Canopy cover, grass biomass	Declining in eastern STR
Connectivity	Corridor width, blockages	Narrowing in Gudalur–Moyar
Conflict	Incident frequency	O' Valley, Hasanur
Development	Expansion rate	Hosur belt
Resource Use	Grazing, fuelwood	Dharmapuri fringe

Management Action: Conduct LMA Assessment every 5 years and produce "Red–Amber–Green" maps.

3.3.1.4 Setting overall multi-use goals

Objective: Balance conservation, livelihoods, and development.

Landscape-Level Goals:

- Maintain uninterrupted elephant movement between Nilgiris–MTR–STR–Hosur.
- Reduce corridor encroachment by ≥50% in 10 years.
- Limit high-risk cropping in core corridors.
- Enhance forest water availability.
- Improve livelihood resilience in fringe villages.

Management Action: Integrate goals into Zonal Plans; endorse through inter-departmental committees.

3.3.1.5 Devise a reasonable array of alternatives to meet overall goals

Objective: Develop multiple pathways to achieve landscape goals.

Option	Description	Example
Protection-Focused	Strict land acquisition	Moyar bottleneck
Incentive-Based	PES and agroforestry	Gudalur corridor farms
Infrastructure-Led	Underpasses, redesign	Hasanur highway
Community-Led	Stewardship models	Dharmapuri villages
Mixed Strategy	Combined approach	Bhavani belt

Management Action: Prepare scenario models for each priority corridor.

3.3.1.6 Evaluation of alternatives and decision making

Objective: Select optimal strategies using transparent criteria.

Criterion	Weight	Assessment Tool
Ecological Impact	High	Habitat models
Social Acceptance	High	Stakeholder consults
Cost	Medium	Budget analysis
Feasibility	High	Institutional review
Sustainability	High	Risk assessment

Management Action: Use Multi-Criteria Decision Analysis (MCDA); approval by Steering Committee.

3.3.1.7 Develop Management Area strategies and schedule actions

Objective: Operationalise selected strategies.

LMA-Specific Strategies:

A. Core Areas (MTR, STR)
- Invasive control
- Grassland restoration
- Waterhole networks

B. Corridors (Moyar, Bhavani, Cauvery North)
- Land purchase/lease
- Native planting
- Crossing structures

C. Interface Zones (Gudalur, Dharmapuri)
- Cluster fencing
- Crop diversification
- Livelihood grants

D. Urban Fringe (Hosur)
- Green buffers
- No-development zones
- Industrial CSR corridors

Management Action:

- Phase I - Mapping, land security
- Phase II - Restoration, mitigation
- Phase III - Consolidation

3.3.1.8 Develop a monitoring system and evaluation process

Objective: Ensure adaptive, evidence-based management.

Component	Indicators	Tools
Habitat	Vegetation cover, water	RS-GIS, plots
Connectivity	Crossing frequency	Camera traps
Conflict	Incident trends	HEC database
Community	Participation, income	Surveys
Compliance	Encroachment status	Patrol audits

Management Action:

- Institutional Mechanism: NER Landscape Monitoring Unit; Annual "State of NER Landscape" Report; and Independent 5-year evaluations
- Adaptive Feedback: Annual review for strategy adjustment; Mid-term correction protocols

Strategic Outcome: If implemented systematically, this Landscape Area Strategy will have following outcomes across the Nilgiri Elephant Reserve -

- Maintain functional habitat contiguity
- Secure critical corridors
- Reduce conflict-driven fragmentation
- Integrate conservation into development
- Build long-term ecological resilience

Field-Based Priority Focus Areas in NER

Landscape Block	Priority Issue	Strategy Focus
Gudalur–Moyar	Corridor bottleneck	Land security & fencing
Hasanur–Thalavadi	Highway barrier	Underpasses
Bhavani Valley	Agriculture pressure	Agroforestry buffers
Dharmapuri Foothills	Habitat degradation	Restoration & livelihoods
Hosur Belt	Urbanisation	Zoning & green corridors

3.3.2 Components of Landscape analysis

'Landscape elements' have three kinds of structures: a matrix, corridors & patches. Landscape analysis involves study of physical, ecological, and anthropogenic factors influencing the landscape (Box-3.1).

Box-3.1: Components of Landscape Analysis in NER

Components of landscape analysis in NER:

- Physical and Biogeographical Characteristics - Topography (plateaus, valleys, escarpments, hill ranges); Elevation gradients (Nilgiri plateau to eastern plains); Geology and soil types; Drainage (Moyar, Bhavani, Cauvery tributaries); Climate patterns (rainfall, temperature)
- Habitat and Vegetation Analysis - Forest type distribution (shola, moist deciduous, dry deciduous, scrub); Grassland and riverine habitats; Plantation and monoculture areas; Invasive species spread; Habitat degradation zones
- Landscape Connectivity & Corridor Analysis - Mapping of traditional and current corridors; Corridor width and continuity; Bottlenecks; Barrier analysis (roads, canals, settlements)
- Wildlife Distribution and Population Analysis - Elephant density and herd structure; Seasonal distribution patterns; Breeding- calving areas; Mortality hotspots; Presence of habitual raiders

- Land-Use and Land-Cover Analysis - Agricultural zones and crop types; Plantations and estates; Urban and peri-urban expansion; Industrial areas; Mining/quarrying sites
- Human Settlement and Socio-Economic Analysis - Settlement distribution and density; Livelihood patterns; Land ownership-tenure; Poverty - vulnerability indices; Cultural practices
- Human–Elephant Conflict (HEC) Pattern Analysis - Incident location mapping; Seasonal and diurnal patterns; Crop loss distribution; Human casualty records; Repeat hotspot identification
- Infrastructure and Development Impact Analysis - Roads, railways, canals; Power lines and pipelines; Tourism infrastructure; Housing and industrial estates; Planned projects
- Resource Availability and Carrying Capacity Analysis - Forage biomass estimation; Water source distribution; Seasonal scarcity zones; Grazing pressure; Fire frequency
- Disturbance and Pressure Analysis - Grazing intensity; Fuelwood extraction; Tourism pressure; Traffic volume; Fire and drought incidence
- Climate and Environmental Change Analysis - Rainfall and temperature trends; Drought/flood frequency; Vegetation shifts; Water-table changes; Extreme events
- Cultural and Traditional Knowledge Analysis - Traditional migration knowledge; Conflict coping practices; Sacred groves; Customary land use; Indigenous warning systems
- Risk and Vulnerability Analysis - Ecological vulnerability; Social vulnerability; Infrastructure risk; Climate sensitivity; Governance risk

Landscape Analysis in NER:

Landscape analysis shows that NER functions as a large but increasingly fragmented conservation mosaic, where high-quality core habitats are surrounded by intensively used human landscapes.

- Strong ecological "**source areas**" are concentrated in Mudumalai Tiger Reserve, Sathyamangalam Tiger Reserve, and major Nilgiri forest blocks, which support breeding herds and maintain population stability. However, **connectivity** between these cores is maintained mainly through narrow and vulnerable corridors such as the Gudalur–Moyar valley, Hasanur–Thalavadi belt, Bhavani valley, and Cauvery North–Hosur landscape, where forest patches are interspersed with farms, roads, and settlements.
- The analysis reveals that **habitat quality** declines sharply from west to east. While moist and dry deciduous forests in MTR–STR retain good forage and water availability, eastern divisions such as Dharmapuri and Hosur show degraded dry forests, invasive species dominance, and seasonal water scarcity. For example, in the Palacode–Morappur belt of Dharmapuri, reduced grass cover and drying tanks regularly push elephants into maize and ragi fields during summer. Similarly, in the Hosur–Denkanikottai zone, urban expansion and industrial estates have narrowed corridors, forcing elephants to move through village clusters at night.
- **Land-use analysis** indicates that agriculture and plantations are major drivers of conflict. In Gudalur and Pandalur, tea and banana plantations block traditional routes, leading to repeated crop raiding along estate boundaries. In the Bhavani valley and STR fringes near Hasanur, sugarcane and maize cultivation coincide with corridor alignments, creating permanent conflict hotspots. These areas show high overlap between elephant movement paths & human land use.
- **Human-elephant conflict mapping** confirms that incidents are spatially concentrated and predictable. Chronic hotspots occur in O' Valley–Padi belt (Gudalur), Hasanur–Thalavadi (STR fringe), and Hosur foothills, where narrow corridors, dense settlements, and attractive crops intersect. Temporal analysis further shows that conflict peaks during March–June (water stress) and October–December (crop maturity), indicating strong links between resource scarcity and elephant movement.
- **Infrastructure analysis** highlights roads and canals as major fragmentation factors. Highway widening near Hasanur and increased traffic on Nilgiris–Gudalur routes have created disturbance zones and mortality risks. In several locations, elephants repeatedly cross at the same points, such as along the Moyar river bridge area and near Bhavani irrigation channels, demonstrating forced movement through limited openings.

- **Socio-economic assessment** shows high vulnerability in fringe villages dominated by small and marginal farmers. In Dharmapuri and eastern Erode, households dependent on single seasonal crops suffer disproportionate losses, leading to low tolerance. At the same time, community institutions and mitigation infrastructure are uneven, with strong response systems in MTR/STR but weaker coverage in peripheral divisions.

Overall, the landscape analysis indicates that NER follows a clear source-connector-sink pattern: strong core forests sustain the population, fragile corridors maintain connectivity, and degraded fringe landscapes act as conflict-prone sink areas. Field evidence from Gudalur, Hasanur, Bhavani, Dharmapuri, and Hosur shows that degradation or blockage in any one component immediately increases ranging, crop raiding, and human risk. The results highlight that long-term conservation in NER depends on strengthening corridor security, restoring degraded eastern habitats, regulating land use in movement zones, and improving livelihood resilience in interface villages. Without these landscape-level interventions, conflict and fragmentation are likely to intensify despite strong protection in core areas.

3.3.3 Ecosystem Based Management

Ecosystem-based management (EBM) in NER involves adopting a holistic approach that considers the entire ecosystem, its components, and the interactions between them. The critical aspects of ecosystem-based management envisage- ecosystem assessment, stakeholder engagement, spatial planning, elephant corridor protection, integrated habitat management, sustainable resource use, community-based conservation, economic valuation of ecosystem services, and climate change adaptation.

This assessment reflects outcomes from integrated habitat management, conflict mitigation, community engagement, and landscape governance initiatives implemented over the past decade.

3.3.3.1 Emphasizing connectivity within and between habitats

Connectivity ensures that elephants and other wildlife can move freely across landscapes, facilitating natural behaviours such as migration, foraging, and breeding.

Results Achieved:

- Maintenance of functional movement between Nilgiris-MTR-STR-Erode-Hosur landscapes.
- Reduced isolation of sub-populations through corridor-focused interventions.
- Improved seasonal movement continuity along riverine and valley systems.

Field Locations:

- Gudalur-Moyar Valley Corridor: Targeted protection and fencing realignment have reduced blockage near O’ Valley and Padi villages.
- Hasanur-Thalavadi Belt (STR fringe): Traffic regulation and habitat management have improved movement across highway stretches.
- Bhavani Valley (Erode-STR): Agroforestry buffers and corridor demarcation have stabilised elephant crossings.
- Cauvery North-Hosur Landscape: Community engagement and zoning have partially secured remaining movement strips.

Outcome: Connectivity has been retained in most major corridors, preventing genetic isolation and supporting landscape-scale population viability.

3.3.3.2 Protection and restoration of ecosystem’s structure, functions and processes

The protection and restoration of the ecosystem's structure, functions, and processes in NER are essential for maintaining ecological integrity, biodiversity, and the overall health of the ecosystem.

Results Achieved:

- Improvement in forage availability and habitat quality.
- Partial recovery of grassland and riverine systems.
- Enhanced water security in core and buffer areas.

- Reduced dominance of invasive species in priority zones.

Field Locations:

- MTR Core and Buffer: Grassland restoration and waterhole networks in Moyar and Masinagudi.
- STR Eastern Ranges: Lantana removal and assisted regeneration near Hasanur and Germalam.
- Nilgiris Forest Division: Shola–grassland restoration in Upper reaches.
- Dharmapuri Foothills: Native planting and tank rejuvenation near Palacode.

Outcome: Restoration efforts have strengthened ecological processes such as grazing cycles, water retention, and natural regeneration, reducing seasonal habitat stress.

3.3.3.3 Incorporating social dimensions-ecosystem values and resource uses

Incorporating social dimensions, ecosystem values, and resource uses in NER is crucial for achieving sustainable conservation and promoting harmonious coexistence between wildlife & local communities. Integrating social considerations ensures that conservation initiatives are culturally sensitive, economically viable, and contribute to the well-being of both ecosystems and people.

Results Achieved:

- Greater recognition of ecosystem services (water security, soil conservation, tourism value).
- Improved community participation in protection and monitoring.
- Reduced unsustainable dependence on forest resources in selected villages.

Field Locations:

- Gudalur & Pandalur: Estate workers and farmers engaged in fence maintenance and corridor protection.
- STR Fringe Villages (Hasanur cluster): Formation of village watch groups and eco-development committees.
- Dharmapuri Villages: Promotion of alternative fuel and fodder sources.
- Nilgiris Plateau: Integration of eco-tourism and conservation livelihoods.

Outcome: Communities increasingly view forests as shared ecological assets rather than restricted spaces, improving cooperation in conservation activities.

3.3.3.4 Integrating biological, socio-economic and governance perspectives

A holistic approach that considers the ecological health, community well-being, and effective governance structures is essential for the success of conservation initiatives.

Results Achieved:

- Shift from species-only management to landscape governance.
- Better coordination between forest, revenue, agriculture, and district administrations.
- Conflict mitigation integrated with livelihood and land-use planning.
- Improved responsiveness through inter-departmental platforms.

Field Locations:

- MTR–STR Landscape: Joint patrolling and shared monitoring protocols.
- Erode–STR Interface: Alignment of irrigation planning with corridor needs.
- Hosur Belt: Coordination with industrial and urban planning authorities.
- Gudalur Division: Integrated HEC mitigation and compensation systems.

Outcome: Management decisions are increasingly based on combined ecological, economic, and administrative considerations, enhancing long-term effectiveness.

3.3.3.5 Developing common vision among stakeholders and informed adaptations based on local and scientific knowledge

A shared vision ensures that diverse stakeholders are aligned toward common goals, and informed adaptations leverage traditional ecological knowledge and scientific expertise for effective conservation.

Results Achieved:

- Emergence of shared conservation goals among stakeholders.
- Increased use of scientific data in field planning.
- Incorporation of traditional knowledge in conflict management.
- Strengthened adaptive management practices.

Field Locations:

- MTR & STR: Use of long-term monitoring and camera-trap data in annual planning.
- Gudalur & Nilgiris: Integration of traditional movement-route knowledge in corridor mapping.
- Dharmapuri & Hosur: Participatory mapping of conflict zones.
- NER Landscape Reviews: Periodic multi-stakeholder consultations.

Outcome: A common understanding has developed that long-term coexistence depends on maintaining habitat integrity and shared responsibility, enabling timely adaptation to emerging challenges.

Table-3.2: Integrated Results of Ecosystem-Based Management in NER

Dimension	Key Results	Field Evidence
Connectivity	Sustained corridor functionality	Gudalur–Moyar, Hasanur
Ecosystem Functions	Improved forage and water	MTR, STR, Nilgiris
Social Integration	Enhanced community stewardship	Gudalur, Dharmapuri
Governance Integration	Coordinated planning	Hosur, Erode
Adaptive Vision	Shared conservation goals	Landscape reviews

Ecosystem-based management in the NER has produced measurable positive outcomes by strengthening habitat connectivity, restoring ecological functions, integrating community needs, and improving governance coordination. Field experience from Gudalur, MTR, STR, Bhavani Valley, Dharmapuri, and Hosur shows that landscape-scale restoration combined with social engagement has reduced habitat stress and moderated conflict in several hotspots. The development of a shared vision, supported by scientific monitoring and local knowledge, has enabled adaptive management and improved institutional learning. While challenges remain in rapidly urbanising and highly fragmented zones, the overall results demonstrate that ecosystem-based approaches have enhanced ecological resilience, social acceptance, & long-term sustainability of elephant conservation in the NER landscape.

3.4 ADDRESSING AND MONITORING VARIOUS DISTURBANCE REGIMES IN THE EHR

Elephant habitats across NER are increasingly exposed to multiple forms of disturbances which arise from both ecological processes and human-driven activities such as agriculture, infrastructure expansion, tourism, and resource extraction. Collectively, they reshape landscapes, degrade habitat quality, and obstruct traditional movement routes that elephants have relied on for centuries.

Understanding these disturbance regimes is critical, as elephants are wide-ranging species that depend on large, contiguous habitats for their survival. Any disruption, whether through invasive plant spread, habitat loss, or infrastructure development, not only reduces habitat suitability but also intensifies HEC. The extent and impact of these disturbance regimes may vary across the landscape (Table-3.3).

Addressing and monitoring disturbance regimes in the Elephant-Habitat Relationship (EHR) is essential for effective conservation and management in NER. Disturbance regimes can include both natural and human-induced factors that impact the habitat and influence the behaviour of elephants.

Strategies for addressing and monitoring various disturbance regimes in the EHR include:

- *Addressing Disturbance Regimes:* through human-wildlife conflict mitigation; anti-poaching and law enforcement; habitat restoration and protection; land use planning; infrastructure planning and development; tourism management; community engagement and livelihood improvement.
- *Monitoring Disturbance Regimes:* using camera traps and remote sensing; GIS-based monitoring; satellite telemetry and GPS tracking; human-elephant conflict reporting systems; ecological surveys; social surveys and community feedback; behavioural observations; law enforcement monitoring.

Table-3.3: Impact of Various Disturbance Regimes

S. N	Disturbance Regime	Impact
1	Spread of Invasives	• Alters native vegetation composition & reduces quality forage • Creates dense thickets that obstruct elephant movement • Prevents native trees and shrubs, affecting habitat regeneration
2	Linear Infrastructure	• Fragments habitats/ blocks traditional movement routes • Causes accidental deaths due to vehicle/ train collisions • Creates permanent barriers - restricts seasonal migrations
3	Habitat Loss and Degradation	• Leads to recurrent vegetation loss through fires/ lopping • Reduces forage availability due to overgrazing/ extraction • Converts forest land into human-dominated landscapes • NTFP species wherever exploited are locally extirpated
4	Mining and Quarrying	• Generates noise, dust, vibration that disturb elephants • Degrades vegetation/ soil quality in adjoining habitats
5	Land Use Changes	• Alters cropping patterns; increased chances for crop raiding • Expands built-up areas, shrinking elephant ranges outside PAs • Rapid urbanization encroaches elephant habitats outside PAs • Shrinks corridors and intensifies conflict near urban fringes
6	Other Projects & Disturbances	• Tourism-based disturbance due to increased noise, light, and vehicles bring waste accumulation and habituation of elephants • Pilgrimage inside RF brings large crowd, & waste into sensitive habitats; causes health issues for elephants; and disturbs natural behaviour of elephants
7	Corridor Obstructions	• Movement obstructions block migratory corridors, forcing elephants into new conflict-prone routes • Forests encircled by villages restricts elephant access to resources; and increases interaction with human settlements
8	Poaching and other Threats	• Low power lines/ live wire fencing poses high electrocution risk • Crude bombs and snares inflict severe injuries and mortality • Exposure to agricultural toxins affects elephant health • Open wells/ canals lead to accidental elephant falls and fatalities • Solid waste dump sites affects elephant health

By addressing and monitoring disturbance regimes in the Elephant-Habitat Relationship, conservationists and authorities can implement adaptive management strategies to ensure the long-term sustainability of elephant populations and their habitats.

3.4.1. Spread of invasives

The spread of invasive alien species (IAS) in NER has significant negative impacts on the ecosystem, including competition for resources, alteration of habitats, and potential harm to native flora and fauna.

Majority of invasives belong to Asteraceae/ Verbenaceae because of efficient adaptation for survival / distribution on land. Critical ones in the landscape include: *Lantana camara, Chromolaena odorata, Neltuma juliflora, Parthenium hysterophorus, Eupatorium adenophorum, Senna spectabilis etc.*

The spread of invasives in NER can have significant negative impacts on the ecosystem, including competition for resources, alteration of habitats, and potential harm to native flora and fauna (Fig-3.5). It can lead to environmental degradation, economic losses, health issues, food and water shortages, and natural disasters. Protecting areas with abundant forage is crucial for species like elephants, making invasive plant management a conservation priority. Effective management requires significant resources to restore ecosystems and maintain their essential services.

Invasive alien species like *Lantana camara* and *Senna spectabilis* harm ecosystems by:

- Altering vegetation patterns, microhabitats, and resource availability
- Changing light and nutrient conditions, suppressing native species growth
- Increasing fire risk, causing seed mortality, and favoring invasive persistence
- Reducing fodder availability and exacerbating human-wildlife conflict
- Degrading forests and outcompeting native species

Fig-3.5: Common Invasive Alien Species in the Landscape- Neltuma, Lantana & Senna

The Elephants require large foraging areas with abundant nutritional forage, therefore protecting such areas from deleterious invasive plants is a conservation priority. Effectively addressing the problem can require field managers to invest substantial resources in management operations and work to restore ecosystems in order to re-produce their goods and services.

Amongst the introduced tree species, invasiveness is observed in Neltuma and Senna. Certain weeds like Eupatorium, Lantana and Parthenium are still extensive. Thus, invasives may create demographic instability in tree species and reduce diversity, potentially changing the structure of forest in future.

Dominant Invasive Species in the NER Landscape

Across NER, the most ecologically significant invasive species are:

Species	Common Name	Major Impact
Lantana camara	Lantana	Suppresses grass and native shrubs
Chromolaena odorata	Siam weed	Rapid coloniser of open forests
Eupatorium adenophorum	Crofton weed	Dominates montane grasslands
Neltuma juliflora	Prosopis	Converts grasslands to thorn scrub
Senna spectabilis	Senna	Blocks understorey regeneration
Parthenium hysterophorus	Congress grass	Degrades fringe habitats

Result: As per the study carried out by the TBGPCCR and data of TNFD, the approximate spread of critical species in the NER has been recorded as:

- Lantana - 247185 ha; Prosopis - 30782 ha; and Senna - 20174 ha

Invasives occupy substantial portions of buffer/ fringe habitats, altering forage availability and habitat.

Situation in Various Divisions of NER

A. Nilgiris Plateau and Upper Gudalur Division

Field Situation	*Key Locations*	*Observed Results*	*Outcome*
• High spread of Eupatorium and Chromolaena in shola-grassland mosaics. • Lantana spread in lower elevations estate fringes. • Suppression of native grasses and herbs.	• Pandalur slopes	• Decline in montane grassland quality. • Reduced seasonal fodder availability. • Increased elephant movement into plantations and farms.	Montane habitats have become less productive, weakening as seasonal foraging areas.

B. Mudumalai Tiger Reserve (MTR)

Field Situation	*Key Locations*	*Observed Results*	*Outcome*
• Extensive lantana infestation in dry deciduous forests. • Chromolaena in fire-affected & open patches. • Reduced regeneration of bamboo and palatable shrubs.	• Masinagudi Range • Moyar Valley • Kargudi-Theppakadu sector	• Reduction in grass biomass. • Concentration of elephants along riverine strips. • Increased seasonal pressure on buffer villages	Lantana dominance has lowered carrying capacity in core elephant habitats

C. Sathyamangalam Tiger Reserve (STR) and Eastern Erode

Field Situation	*Key Locations*	*Observed Results*	*Outcome*
• Mixed invasion by Lantana, Senna, Prosopis. • Prosopis colonisation in dry valleys & scrub zones. • Senna expansion in regenerating forest patches.	• Hasanur-Thalavadi belt • Germalam-Bargur ranges • Bhavani catchment fringes	• Conversion of grasslands into thorny thickets. • Restricted elephant movement. • Increased interface with agriculture.	Habitat openness has declined, creating movement barriers and forage scarcity.

D. Dharmapuri Forest Division

Field Situation	*Key Locations*	*Observed Results*	*Outcome*
• Widespread Prosopis and Lantana in foothills. • Parthenium along roads and tanks. • Low native shrub regeneration.	• Palacode-Morappur belt • Pennagaram fringes • Cauvery tributary zones	• Replacement of fodder-rich scrub with thorn forests. • Reduced habitat suitability. • High dependence on crops.	Dry forests have shifted toward low-quality “sink habitats”

E. Hosur Forest Division

Field Situation	*Key Locations*	*Observed Results*	*Outcome*
• Prosopis and Lantana dominance in corridor. • Parthenium/ Chromolaena along urban fringes. • Fragmented forests vulnerable to reinvasion.	• Denkanikottai-Kandikottai belt • Thally foothills • Hosur–Krishnagiri corridor	• Narrowing of functional corridors. • Increased human - elephant encounters. • Reduced corridor permeability.	Invasives are accelerating corridor degradation in this high-pressure landscape

Landscape-Level Ecological Impacts

- *Decline in Forage Availability:* suppression of grasses (Themeda, Heteropogon, Cymbopogon); reduction in browse species; and seasonal fodder shortages
- *Alteration of Habitat Structure:* conversion of open forests to dense shrublands; reduced visibility and movement space; and increased fire susceptibility.
- *Disruption of Ecological Processes:* slower natural regeneration; altered nutrient cycling and increased erosion in degraded patches.
- *Intensification of HEC:* wide ranging habitat degradation; greater crop raiding; and more chronic hotspots.

Effects on Elephant Behaviour

The behavioural response vis-à-vis habitat condition in NER has been observed as under:

- Lantana-dominated forests - Avoidance / corridor concentration
- Prosopis thickets - Restricted movement
- Degraded grasslands - Increased crop dependence
- Restored patches - Localised habitat use

Result: Invasives promote risk-taking and crop-raiding behaviour

Management Interventions and Their Results

Control Measures Implemented	*Observed Outcomes*	*Field Examples*
• Mechanical uprooting (MTR, STR) • Assisted regeneration (Nilgiris, Gudalur) • Patch-wise restoration (Dharmapuri) • Fire-assisted removal (limited areas)	• Temporary improvement in forage. • Rapid reinvasion where follow-up is weak. • Better results in areas with 3 to 5-year maintenance.	• Masinagudi grassland restoration plots • Hasanur regeneration blocks • Nilgiris shola restoration sites

Result: Invasive control is effective only with sustained, long-term maintenance

Key Constraints in Managing Invasives

Following constraints in managing invasives in NER is observed:

- Large infested area versus limited manpower
- High regeneration capacity of invasives
- Lack of sustained funding
- Climate variability aiding spread
- Weak community participation in removal

Control and Management Strategies

Managing and curbing their spread is essential to preserving the ecological balance and integrity of the forest. These invasive weeds can be eradicated either by closing the forest canopy or by ensuring growth of local palatable grasses, as a thick mat, to suppress them. This requires location specific carefully planned medium to long term strategy.

- Implement mechanical control methods, such as manual removal or cutting, to manage invasives and utilize machinery, where needed, for large-scale removal.
- Use herbicides judiciously and ensure that chemical control methods are environmentally safe and do not harm non-target species (better avoid them).
- Introduction of biological control agents to manage invasives to be done after conducting thorough risk assessments (e.g. Lantana in Bandipur and BRT TRs, which dried up due to the lace bug *Telenomia scruplosa*, recovered subsequently; similarly, *Xylocopa spp* -carpenter bees attack on Senna in Wayanad did not yield favourable response (Fig-3.6). The outcome indicates limitations/ ineffectiveness of biological control agents.

Lantana Control Operation (Innovative Strategy):

- Innovative management strategy envisages removal of Lantana by 'cut-rootstock method' on the basis of biological & ecological attributes (Fig-3.6). The advantages of this strategy are: its cost effectiveness; simple and easy to adopt; ensures successful control without chemicals and exotic biological control agents, and minimum disturbance of soil.

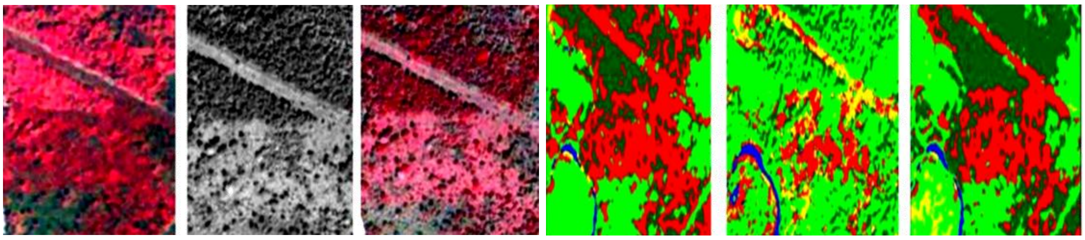
Fig-3.6: Xylocopa attack on Senna spectabilis; Lantana control by Cut-Rootstock method

Monitoring and Research

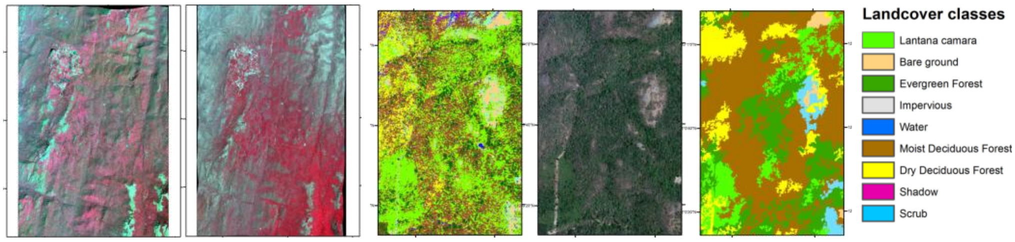
- Conduct regular surveys and inventories to monitor the presence and spread of invasive species including documentation of changes in vegetation and biodiversity.
- Utilize GIS mapping to track the distribution of invasive species within the reserve and develop spatial models to predict potential areas at risk of invasion.
- Conduct research on the biology and ecology of invasive species to better understand their spread and potential control methods to develop management strategies.

Mapping Invasives by Remote Sensing

- Multi-date satellite data facilitates monitoring phenological changes & integration of other attributes can be useful in predicting spread. Hyperspectral data have been used by researchers for detection and mapping of invasive species. There is potential of LISS-IV and Cartosat-1 data in detection and mapping of invasive species such as Lantana (Fig-3.7).
- The improved ability of the object-based approach to delineate structurally distinct objects with characteristic spectral & spatial characteristics of their own, as well as with reference to their surroundings, allows for much flexibility in identifying invasive understorey shrubs among the complex vegetation of the tropical forest than that provided by the parametric classifier (Fig-3.7).



LISS-IV Cartosat-1 Merged Image Classified Output of LISS-IV, Cartosat-1 & Merged



FCC- Wet Season & Dry Season Pixel based classification & Object based classification

Fig-3.7: Top- LISS-IV & Cartosat-1 Merged Data for differentiation & mapping of Lantana (Red color) Bottom- Improved ability of Object Based Classification using Hyperspectral Remote Sensing

Lessons from other States: Experimental trials have been undertaken in the adjoining Wayanad area as part of invasive species management (Box-3.2) and lessons could be drawn in respect of NER.

Box-3.2: Invasive species management in Kerala- Senna and Lantana

- As per the field reports, invasive alien plant species happens to be a key driver of habitat degradation in Kerala's forest landscapes. Although invasives such as Lantana camara and Chromolaena were recognised management concerns for decades, their ecological impact has intensified, reducing habitat quality and forage availability for elephants.
- A major emerging threat is *Senna spectabilis*, which has rapidly spread across large tracts of forest in Wayanad, aggressively replacing native vegetation and invading forest edges and disturbed areas. Its dominance has significantly degraded habitat quality, prompting elephants to move into agricultural fields along forest fringes. Field observations indicate that *Senna* is now spreading across the wider Nilgiri Biosphere Reserve landscape, with early, sporadic occurrences recorded beyond Kerala, signalling a potential regional threat.
- Kerala has responded through systematic field experimentation, particularly in Wayanad, to identify effective control measures. Conventional cutting and uprooting proved inadequate due to rapid regeneration. Greater success has been achieved through targeted chemical methods, notably the 'drill-and-fill' and 'hack-and-squirt' techniques, where herbicides are applied immediately after stem injury, resulting in high mortality. These treatments are followed by multi-year removal of seedlings/saplings to prevent reinvasion and facilitate habitat restoration.
- Parallel efforts are underway to manage *Lantana*, including the testing of innovative mechanical tools to improve uprooting efficiency under local conditions. These initiatives are supported by multi-institutional collaboration involving the KFRI, NBAIR, and others.
- Overall, Kerala's approach reflects an adaptive, science-based and landscape-oriented strategy aimed at restoring habitat quality and addressing one of the underlying ecological drivers of human - elephant conflict.

The spread of invasive plant species has emerged as one of the most serious ecological constraints in the NER. Lantana, Prosopis, Eupatorium, Chromolaena, and Senna have significantly reduced natural forage, altered forest structure, and weakened corridor functionality across NER. Field evidence from Masinagudi, Hassanur, Palacode, Denkanikottai, and Nilgiris shows that invasive-dominated habitats support fewer elephants, promote wider ranging, and intensify human–elephant conflict. While control efforts have yielded localised improvements, long-term success depends on landscape-scale removal, sustained funding, community participation, and continuous ecological restoration (Box-3.3). Without these, invasive species will continue to undermine habitat quality and conservation outcomes in NER.

Box-3.3: TN Policy on Invasive Plants and Ecological Restoration (TN PIPER, 2022)

- *The policy aims at the prevention of unintentional or deliberate introduction of invasive alien plant species and the identification, prevention of spread, appropriate control and eradication of all invasive plant species in terrestrial and wetland ecosystems of TN state. Appropriate measures to control and eradicate invasive alien plant species must always be supported by rigorous research and monitoring along with proper ecological restoration of natural habitats. The control and management of invasive plant species require the participatory efforts of diverse stakeholders including govt authorities, local administration, civil society, academic institutions, industrial businesses, & local communities including farmers, fishers, and forest dwellers, and general public.*

Implementation Strategies

- *Mapping and Prioritisation*: Prepare annual GIS-based maps of invasive hotspots (Lantana, Prosopis, Eupatorium, Chromolaena, Senna); rank sites by ecological importance (corridors, core habitats, buffers, restoration zones); and identify “no-delay” priority zones (Gudalur-Moyar, Hasanur belt, Bhavani valley, Hosur corridor).
- *Site-Specific Removal Planning*: Prepare micro-level invasive control plans for each range/beat; select control method (manual, mechanical, assisted fire, combined) based on terrain and species; and demarcate treatment blocks (5-20 ha) for phased implementation.
- *Mechanical and Manual Removal*: Organise systematic uprooting/cutting of invasives with root removal; use brush cutters and mechanical tools in dense infestations; remove biomass from site to prevent resprouting; and prioritise riverine zones, grasslands, and corridor strips.
- *Post-Removal Restoration*: Immediately plant native grasses, shrubs, and fodder species after clearing; promote assisted natural regeneration (ANR) where seed banks exist; develop nursery networks for native species; and ensure minimum 3-5 years of maintenance.
- *Corridor-Focused Interventions*: Create invasive-free “green lanes” in corridors (minimum 200-500 m width where feasible); maintain vegetation buffers along movement routes; and integrate invasive control with fencing and crossing structures.
- *Fire and Invasive Management Integration*: Prevent repeated burning in cleared sites; maintain fire lines around restored areas; and combine invasive removal with fire-risk reduction planning.
- *Community Engagement and Employment*: Employ local youth/SHGs under wage-based removal programmes; Link invasive removal to MGNREGS/eco-development schemes; train community groups in control methods; and promote community stewardship of restored patches.
- *Monitoring and Documentation*: Maintain invasive control registers at beat and range levels; use fixed photo-points and vegetation plots; track- area cleared (ha)/ regeneration success (%)/ reinvasion rate/ update GIS database annually.
- *Research and Technical Support*: Partner with universities and research institutes for best-practice methods; pilot biological and ecological control options where feasible; and test low-cost restoration models for dry forests and grasslands.
- *Sustainable Biomass Utilisation*: Explore use of removed biomass for briquettes, compost, fencing material, energy use; and develop small-scale value chains to offset management costs.
- *Landscape-Level Coordination*: Synchronise invasive removal across adjoining divisions; implement “block-wise” treatment instead of scattered efforts; and coordinate with adjoining ERs.

Strategic Outcome: If these actions are implemented consistently, NER can achieve improved forage availability; stronger corridor permeability; reduced conflict pressure; lower reinvasion rates; and enhanced ecosystem resilience.

3.4.2. Biotic pressures and Overgrazing

Overgrazing by cattle inside an elephant reserve can have detrimental effects on the ecosystem, leading to habitat degradation and impacting both plant and animal species (Fig-3.8). Overgrazing can also weaken wildlife populations, making them more susceptible to diseases. Stress from competition for resources, reduced food availability, and habitat degradation can compromise the immune systems of elephants, making them more vulnerable to pathogens.

Major Sources of Biotic Pressure in NER

Across the NER landscape, biotic pressure mainly arises from:

- *Livestock grazing*: cattle, buffalo, goats, and sheep from fringe villages; seasonal pastoral movement into forest interiors and informal grazing by estate workers and small farmers
- *Fuelwood and fodder extraction*: collection of firewood, leaf fodder, and poles along with the lopping of palatable tree species
- *Non-Timber Forest Produce (NTFP) collection*: honey, gooseberry, tamarind, medicinal plants; often concentrated in corridor and buffer zones
- *Illicit resource use*: encroachment-based farming and small-scale timber and bamboo removal

Result: These pressures reduce forage, degrade understorey vegetation, and weaken habitat resilience.


Fig-3.8: Habitat degradation due to overgrazing in Nilgiri elephant reserve

Situation in Various Divisions of NER

A. Nilgiris Plateau and Upper Gudalur Division

Field Situation	*Key Locations*	*Observed Results*	*Outcome*
• Moderate to high grazing pressure near settlements and estates • High fuelwood dependence in labour colonies • Fodder extraction from shola edges	• Pandalur and O' Valley fringes • Naduvattam–Sholur belt	• Decline of native montane grasses • Soil compaction in grasslands • Reduced regeneration in shola margins • Increased weed invasion	Reduced productivity of high-altitude seasonal foraging habitats

B. Mudumalai Tiger Reserve (MTR)

Field Situation	*Key Locations*	*Observed Results*	*Outcome*
• Seasonal livestock incursions from Masinagudi, Bokkapuram, and Moyar villages • Illegal grazing in buffer and tourism zones	• Masinagudi Range • Moyar Valley • Kargudi–Theppakadu sector • Bokkapuram fringe	• Reduced bamboo and grass regeneration • Competition with wild ungulates • Increased disease transmission risk	Decline in forage availability in prime elephant habitats

C. Sathyamangalam Tiger Reserve (STR) and Eastern Erode

Field Situation	*Key Locations*	*Observed Results*	*Outcome*
• High livestock pressure from Bargur, Germalam, and Thalavadi villages • Traditional grazing inside forests • Goat and sheep grazing in scrub and dry forests	• Hasanur–Thalavadi belt • Germalam Range • Bargur Plateau • Bhavani catchment fringes	• Conversion of grasslands to scrub • Suppression of tree seedlings • Accelerated lantana and senna invasion • Increase in fire	Long-term habitat simplification and loss of structural diversity

D. Erode Forest Division (Non-STR Areas)

Field Situation	*Key Locations*	*Observed Results*	*Outcome*
• Open-access grazing in reserve forests • Fodder cutting along irrigation channels • Encroachment-linked grazing	• Bhavani valley fringes • Anthiyur slopes • Gobichettipalayam periphery	• Depletion of ground vegetation • Riverine habitat degradation • Erosion along slopes	Reduced corridor quality and increased conflict risk

E. Dharmapuri Forest Division

Field Situation	*Key Locations*	*Observed Results*	*Outcome*
• Very high grazing pressure in dry forests • Nomadic and semi-nomadic pastoral use • Extensive goat and sheep herds • Fuelwood dependence	• Palacode-Morappur belt • Pennagaram fringes • Cauvery tributary zones	• Near-total loss of grass cover • Prosopis and thorn scrub dominance • Soil erosion and hardpan formation • Poor natural regeneration	Transformation of forests into low-quality "sink habitats".

F. Hosur Forest Division

Field Situation	*Key Locations*	*Observed Results*	*Outcome*
• Intense grazing in fragmented corridor patches • High pressure from peri-urban livestock owners • Fodder cutting and dumping of waste	• Denkanikottai–Kandikottai belt • Thally foothills • Hosur–Krishnagiri corridor	• Corridor narrowing • Loss of palatable species • Increased disturbance • Reduced movement permeability	Severe degradation of critical connectivity zones

Landscape-Level Ecological Impacts

- *Decline in forage availability*: reduction of key grasses (Themeda, Heteropogon, Cymbopogon); and loss of browse species (Grewia, Ziziphus, Bauhinia)
- *Altered vegetation structure*: open forests converted to scrub; and dense thorn thickets replacing grasslands
- *Impaired regeneration*: seedlings trampled or browsed; and poor recruitment of native trees
- *Soil degradation*: compaction and reduced infiltration; and increased runoff and erosion
- *Increased invasive species*: overgrazed sites favour Lantana, Prosopis, Parthenium

Effects on Elephant Behaviour

The behavioural response vis-à-vis habitat condition in NER has been observed as under:

- Heavily grazed forests - Wider ranging

- Reduced grasslands - Crop dependence
- Degraded corridors - Bottleneck crossings
- Disturbed patches - Night-time movement

Result: Overgrazing indirectly promotes crop raiding and chronic conflict

Management Interventions and Their Results

- *Measures Implemented:* grazing regulation in MTR/STR cores; stall-feeding promotion (Nilgiris, Gudalur); eco-development fodder plots; Joint forest management monitoring; & seasonal grazing bans
- *Field Examples:* stall-feeding schemes in Masinagudi villages; fodder plots in Hasanur fringe; and community agreements in Palacode
- *Results:* localised vegetation recovery; reduced pressure near core zones; and limited success in open-access landscapes
- *Key Findings:* Control is effective only where community participation is strong

Key Constraints in Managing Biotic Pressure

Following constraints in managing biotic pressure in NER is observed:

- High livestock populations in fringe villages
- Cultural dependence on open grazing
- Limited fodder alternatives
- Weak enforcement in territorial divisions
- Political sensitivity of grazing regulation
- Poor coordination with Animal Husbandry Department

Biotic pressures and overgrazing constitute a major, persistent threat to habitat integrity in the NER. Field evidence from Masinagudi, Hasanur, Palacode, Denkanikottai, and Gudalur shows that uncontrolled livestock grazing, fodder extraction, and fuelwood dependence have reduced natural forage, impaired regeneration, and accelerated invasive species spread. These impacts weaken habitat quality, force elephants to range more widely, and intensify human-elephant conflict. While regulatory and community-based measures have yielded local improvements, long-term mitigation requires integrated livestock management, fodder security programmes, stronger community institutions, and coordinated action with rural development and animal husbandry agencies.

Implementation Strategies

- *Mapping and Prioritisation of Grazing Pressure:* Prepare GIS-based maps of livestock entry routes, grazing hotspots, and fodder extraction zones; rank areas by ecological sensitivity (corridors, grasslands, riverine belts, restoration sites) and identify “zero-grazing priority zones” in MTR, STR cores, key corridors, and regeneration blocks.
- *Regulation and Zoning of Grazing:* Demarcate ‘No-Grazing’, ‘Regulated Grazing’, and ‘Controlled Use Zones’ within each division; introduce seasonal grazing permits linked to carrying capacity; enforce complete exclusion in corridors and restoration areas; and synchronise zoning with Working Plans and village revenue maps.
- *Promotion of Stall-Feeding and Fodder Security:* Support stall-feeding systems through subsidies and training; develop village-level fodder banks and silage pits; establish fodder plots on revenue and panchayat lands; and promote high-yield fodder varieties outside forest areas.
- *Community-Based Grazing Management:* Form Village Grazing Management Committees (VGMCs); prepare village-level grazing calendars; introduce rotational grazing systems; and link compliance with access to development schemes.
- *Alternative Livelihood and Incentive Schemes:* Provide incentives for reducing herd size; promote dairy cooperatives, improved breeds, and value-added products; support non-livestock income sources (eco-tourism, NTFP processing, crafts); and introduce conservation-linked incentives.

- *Strengthening Enforcement and Field Patrolling:* Increase joint patrols in high-pressure zones; use GPS-based patrol tracking; establish grazing-watch posts in corridor areas; and impose graded penalties for repeated violations.
- *Habitat Restoration and Forage Recovery:* Create livestock-exclusion plots in degraded habitats; restore grasslands with native species; implement soil and moisture conservation works; and remove invasives to improve natural fodder.
- *Disease Prevention and Veterinary Support:* Conduct regular livestock vaccination camps; monitor for zoonotic and transmissible diseases; establish quarantine protocols near forest fringes; and coordinate with Animal Husbandry Department.
- *Regulation of Fuelwood and Fodder Extraction:* Promote LPG/biogas/solar cookers in fringe villages; develop community woodlots; supply subsidised fodder during lean seasons; and monitor lopping and extraction points.
- *Integration with Rural Development Programmes:* Converge with MGNREGS, NRLM, and watershed schemes; use development funds for fodder plots and water structures; and link conservation compliance with scheme eligibility.

Expected Outcomes: If implemented consistently, these strategies will result in reduced grazing pressure in sensitive habitats; improved vegetation recovery; stronger corridor functionality; lower disease transmission risk; and enhanced community cooperation.

3.4.3. Forest fire management and monitoring

Nilgiri Elephant Reserve has large diverse landscape with a spectrum of vegetation types, terrain and climatic conditions that are prone to fire. In tropical deciduous forests, fire is a natural phenomenon due to higher levels of water stress during summer but the same is caused by various anthropogenic reasons.

Area burnt: key findings & trend signals

Long-term remote-sensing work across the NER landscape shows very large inter-annual variation in burnt area (historical peaks in the late 1980s–2000s, much lower mapped extent in some recent years). One multi-temporal Landsat analysis reported burnt-area estimates falling from ~1,318 km² (1989) to ~15.7 km² (2013) across parts of the NER- demonstrating major annual variability and the sensitivity of estimates to methods and years. For Mudumalai (MTR) specifically, published remote-sensing studies report an average annual burnt area on the order of ~3,000–3,200 ha/year in earlier decades (study period 2000s), with most incidents clustered in the dry season (Feb–Mar).

As per the Forest Fire Vulnerability Report of Tamil Nadu (2019), the forest fire vulnerability in the various forest divisions of NER have been computed as under (Table-3.4):

Table-3.4: Forest Fire Vulnerability in Nilgiris Elephant Reserve (in km²)

	Very High	***High***	***Moderate***	***Low***	***Very Low***	***Total***
Nilgiris	30.13	144.91	71.56	49.01	2.07	297.68
Gudalur	15.18	72.96	35.99	24.77	1.07	149.97
MTR	69.73	334.98	165.49	113.53	4.86	688.59
STR	117.97	907.71	243.83	138.08	4.01	1411.60
Erode	67.37	518.18	139.28	78.56	2.29	805.68
Dharmapuri	37.92	201.15	63.35	21.44	0.18	324.04
Hosur	149.43	600.74	189.87	41.89	2.96	984.89
Total	**487.73**	**2780.63**	**909.37**	**467.28**	**17.44**	**4662.45**
Percent	**10.46**	**59.64**	**19.50**	**10.02**	**0.37**	**100.00**

Spatial pattern - where fires occur and which parts of NER are most vulnerable

- Highest fire frequency / vulnerability: dry-deciduous, thorn-scrub and savanna/grassland mosaics on the eastern and lower-elevation side of the landscape — that is, much of STR fringe, Erode, Dharmapuri and Hosur divisions (Palacode-Morappur, Bhavani valley, Denkanikottai/Thally). These vegetation types burn easily and often.
- Intermediate vulnerability: buffer and fringe belts around MTTR (Masinagudi, Moyar) and Gudalur where Lantana/Chromolaena and degraded grass patches ignite after dry spells.
- Lower but still important vulnerability: montane shola–grassland mosaics on the Nilgiris - they burn less frequently but fires here (e.g., Eupatorium or dry grass burns) can damage rare shola fragments and regeneration sites, with long recovery times.
- Key corridor/bottleneck risk points: narrow river valleys (Moyar, Bhavani), plantation margins (Gudalur-Pandalur), and transport/road verges near Hasanur and Denkanikottai - fires in these places can sever connectivity or damage restoration blocks. (Field reports & district fire-tracing records reference these corridors).

Seasonality and ignition drivers

- *Seasonal window*: the pre-monsoon dry season (roughly February-April, sometimes extending into May) is the peak for detection and spread of fires across NER - remote-sensing and field studies consistently find the majority of fire incidents in late winter/early summer.
- *Main ignition sources*: (a) NTFP collection and Antler collectors (b) deliberate agricultural/field stubble burning and grazing-related fires, (c) accidental ignition from passing vehicles/railways and tourism activity, (d) escaped controlled burns and honey-hunting/camp fires, (e) deliberate fuelwood/land-clearing in fringe areas. Climate-linked dry spells amplify risk.

Ecological & management impacts (significance for elephants and corridors)

- *Forage and habitat*: frequent burns in dry deciduous and grassland mosaics reduce grass biomass and palatable browse, shifting animals (including elephants) to seek forage elsewhere - increasing seasonal movements into agricultural lands (HEC escalation).
- *Regeneration & invasives*: repeated burning favours invasive pioneers (Chromolaena, Lantana, Prosopis), hindering native tree/grass regeneration and lowering long-term carrying capacity.
- *Corridor function*: fires in narrow corridors or valley bottlenecks can destroy canopy/stepping stones and temporarily block movement routes, making elephants funnel through fewer crossings and increasing human-elephant interactions. Field examples include fire impacts near Moyar crossing points and Bhavani valley edges.
- *Operational strain*: multiple small fires spread across divisions strain field resources, leading to ad-hoc suppression and diverted staff away from patrols and HEC response.

Implementation Strategies

Forest fire management and monitoring are crucial aspects of conservation, especially in NER, where forest fires can have significant impacts on both elephants and their habitats. Strategies for forest fire management and monitoring in elephant reserves, envisage:

- *Prevention Strategies:* Conduct awareness campaigns to educate local communities and visitors about the risks of forest fires and establish and maintain fire lines / firebreaks to create barriers that control the spread of wildfires.
- *Early Detection Systems:* Install elevated surveillance towers in strategic locations to enhance early detection capabilities and utilize remote sensing technology to detect wildfires in real-time.

- *Developing Fire Likelihood Model:* Develop Forest fire likelihood model in spatial domain using causative and anti-causative factors as a variable with habitat flammability as another variable and plan mitigation strategy accordingly (Fig-3.9).
- *Firebreaks and Controlled Burns:* Create and maintain mechanical firebreaks by clearing vegetation in specific areas to prevent the spread of fires and conduct controlled / prescribed burns before onset of fire season to reduce fuel loads and minimize the risk of wildfires.
- *Firefighting Infrastructure:* Equip the reserve with firefighting tools, such as fire trucks, water tankers, and handheld firefighting equipment including modern extinguishers.
- *Community Engagement:* Provide training programs for local communities on fire prevention and firefighting techniques and also establish community-based fire brigades to respond rapidly to fire incidents.
- *Remote Sensing:* Utilize remote sensing & GIS technology for monitoring the extent and spread of wildfires and develop fire vulnerability maps based on historical data and real-time monitoring.
- *Patrols and Aerial Surveillance:* Conduct regular ground patrols with field personnel to monitor signs of wildfires and use aerial surveillance, such as drones for enhanced monitoring coverage.
- *Early Warning Systems:* Develop and implement early warning systems to alert authorities and communities about potential fire threats and utilize sirens, mobile alerts, and other communication channels for timely warnings. The Forest Survey of India (FSI) uses remote sensing technologies for issuing fire alerts but ground-based detection is also essential.
- *Research and Innovation:* Support research initiatives focused on understanding fire behaviour and its ecological impact and explore innovative technologies for improved fire monitoring, detection, and management.

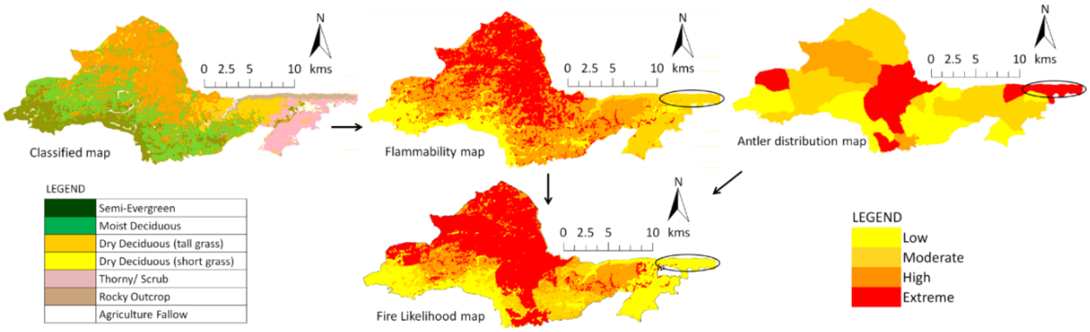


Fig-3.9: Developing Forest Fire Likelihood Model based on Causative & Anti-causative factors

Forest fire in the NER is a seasonal, spatially concentrated hazard: dry-season (Feb-Apr) fires in dry-deciduous, scrub and degraded grassland mosaics (STR fringe, Erode, Dharmapuri, Hosur) cause the bulk of annual burnt area, while buffer fires in Mudumalai and plantation-margins in Gudalur threaten restoration sites and corridor pinch points. Annual burned-area totals vary greatly year to year (historical peaks of thousands of hectares vs. much lower recent years), so management must combine pre-season risk mapping, community fire-guards, dedicated fire-tracing, protection of restoration blocks, early-warning integration, and post-fire invasive control to protect habitat integrity and corridor function.

3.4.4. Catchment capability and water scarcity including wetlands

NER contains critically important upland catchments (shola-grassland complexes in the Nilgiris / Upper Bhavani, Moyar and Bhavani catchments) that function as water-sponges for downstream plains, but catchment condition is variable: good in some core forest blocks and degraded in many fringe/corridor areas. Loss of catchment function (soil compaction, invasives, loss of grasslands) is already reducing dry-season baseflows and the reliability of small wetlands.

Catchment capability (by sub-landscape)

A. Nilgiris / Upper Bhavani (High-elevation shola–grassland)

- *Role*: critical headwater and groundwater recharge for the Bhavani sub-basin; shola mosaics retain and slowly release monsoon water.
- *Status*: pockets of intact shola retain good hydrological function (e.g., Upper Bhavani), but fragmentation, invasive plants (Eupatorium/Chromolaena) and uncontrolled grazing/fire have reduced retention in other patches. Loss here threatens downstream Bhavani flows.

B. Gudalur – Moyar Valley (Corridor catchments)

- *Role:* Moyar and side streams drain Mudumalai–Gudalur, feed Bhavani system and create perennial pools.
- *Status:* core valleys still supply baseflows, but plantation margins and conversion of riparian strips have lowered local retention; restoration and protection of riparian strips are urgent to maintain corridor water points.

C. Mudumalai (MTR) & Moyar (Masinagudi, Theppakadu)

- *Role*: wetlands/vayals seasonally store water and sustain grasslands used by elephants.
- *Status*: many small vayals/wet meadows show invasion and hydrological alteration; studies warn loss of these seasonally-waterlogged grasslands unless protected. Field examples: Masinagudi/ Moyar valley vayals showing invasion and altered hydrology.

D. Sathyamangalam (STR) / Bhavani valley (Erode interface)

- *Role*: Bhavani catchment supplies irrigation and sustains riverine corridors (important seasonal water for animals).
- *Status*: Groundwater over-withdrawal and intensive agriculture have stressed the basin; The analysis show declining groundwater and need for recharge measures in the Bhavani basin. Vulnerable locations include Bhavani riparian belts and Hasanur-Thalavadi lowlands.

E. Dharmapuri, Krishnagiri (Palacode, Denkanikottai / Hosur)

- *Role*: eastern foothill catchments supply local tanks/reservoirs used by wildlife and communities.
- *Status*: these areas are drought-prone; district and CGWB plans identify urgent artificial-recharge and tank rehabilitation needs (Palacode / Denkanikottai FIRKA plans). Several canal/works projects (e.g., Jarthalav-Pulikkarai) are being pursued to improve availability.

Wetlands and small waterbodies (condition & hotspots)

- *Mudumalai vayals (seasonal grassland wetlands)*: under invasion and hydrological disturbance; loss reduces dry-season grazing and drinking points for elephants.
- *Bhavani riverine wetlands and tanks (Erode / Sathyamangalam fringe)*: facing siltation, pollution, and over-abstraction; downstream water quality/quantity issues documented in basin studies.
- *Denkanikottai / Krishnagiri wetlands*: biologically rich but water-limited; local floristic studies show diversity but also pressure from extraction and land-use change.

Trends & drivers of water scarcity affecting catchments

- *Agricultural intensification & groundwater withdrawal*: especially in Bhavani basin and eastern taluks — reduces baseflows and dries small wetlands.
- *Land-cover change* (plantation expansion, invasive encroachment): reduces infiltration (woody invasives, afforestation in grasslands alter hydrology). Shola–grassland replacement impacts sponge function.

- *Climate variability*: erratic monsoons and longer dry spells amplify scarcity in eastern NER. (Noted in district/CGWB analyses and reserve assessments.)
- *Siltation & tank deterioration*: small tanks/reservoirs (Palacode, Panchapalli, Nagavathy etc.) losing capacity through siltation and poor maintenance.

Key ecological and elephant-management implications

- Reduced availability of dry-season drinking/fodder points forces elephants to extend ranging into agricultural lands and intensifies HEC (notably in Gudalur – Bhavani – Dharmapuri corridors). This is particularly visible in Masinagudi-Moyar and Palacode-Morappur seasonal movements.
- Loss of small wetlands (vayals) erodes seasonal refugia used by herds and increases the likelihood of concentrated use of the remaining water points (higher crop-raiding near tanks).
- Catchment degradation reduces long-term carrying capacity, contributing to source–sink imbalance across NER and making peripheral ranges more conflict-prone.

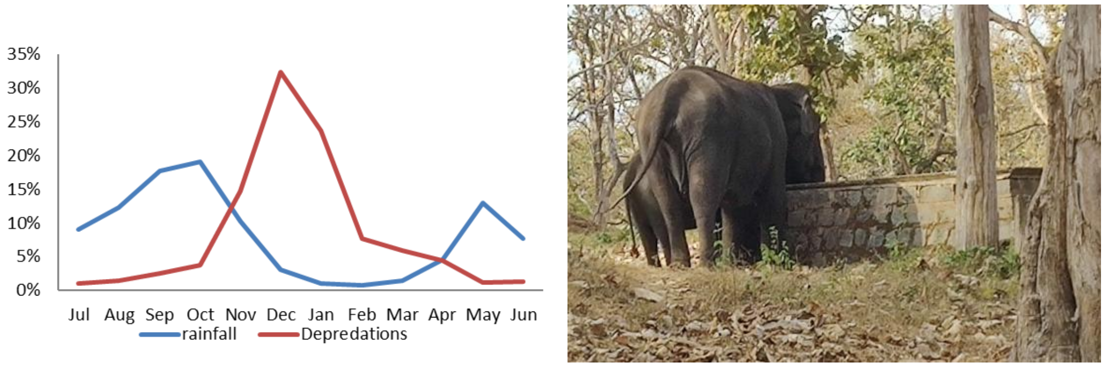


Fig-3.10: Relationship of crop depredation (incidences/month) with distribution of rainfall (mm/month) normalized in percent - planning waterhole during pinch period

Vulnerable locations

- Upper Bhavani (Nilgiris) - safeguard shola–grassland recharge areas.
- Masinagudi / Moyar valley (Mudumalai edge) - protect vayals and riparian pools.
- Bhavani riparian belts (Hasanur-Bhavani-Erode fringe) - recharge and silt management.
- Palacode / Morappur tanks (Dharmapuri) - tank desiltation, canal link completion.
- Denkanikottai / Hosur corridor wetlands - protect remaining ponds and springs; guard against industrial/urban discharge.

Fig-3.11: Shrinking of the Riverine Vegetation (MTR) due to land-use changes in the Upper Nilgiris

Implementation Strategies

- *Landscape-Level Water Planning*: Prepare a NER Water Security Plan integrating rivers, springs, tanks, vayals, and artificial water points; map seasonal water availability and dry-season deficit zones; and prioritise water interventions in corridors, buffers, and conflict hotspots.

- *Protection of Natural Water Sources*: Legally and physically protect perennial springs, streams, and riverine pools; establish buffer zones (100–300 m) around critical water sources; and prevent encroachment, pollution, and livestock contamination.
- *Restoration of Wetlands and Vayals*: Desilt and rehabilitate seasonal wetlands and grassland vayals; restore feeder channels and natural drainage; control invasives in wetland margins and replant native vegetation; and maintain restored wetlands for at least 3–5 years.
- *Catchment and Recharge Area Management*: Restore shola–grassland mosaics and upper catchments; implement contour trenches, check dams, and percolation ponds; promote soil and moisture conservation on slopes; and prevent conversion of recharge zones to plantations or settlements.
- *Strategic Development of Artificial Water Points*: Create scientifically located waterholes in dry and corridor areas; ensure spacing based on elephant home-range and movement patterns; use gravity-fed or rainwater-harvesting systems where possible; and avoid over-concentration that may cause habitat degradation.
- *Rainwater Harvesting and Storage*: Construct rooftop and ground-level rainwater harvesting systems in forest infrastructure; develop small reservoirs in suitable depressions; and integrate harvesting with forest rest houses, camps, and check-posts.
- *Riverine and Riparian Habitat Restoration*: Re-establish native vegetation along riverbanks and streams; remove invasive species from riparian zones; stabilise eroded banks to improve water retention; and protect floodplain wetlands from conversion.
- *Regulation of Water Extraction in Fringe Areas*: Coordinate with district authorities to regulate borewells near forest boundaries; promote drip irrigation and water-efficient farming; discourage water-intensive crops in corridor zones; and encourage community water budgeting.
- *Drought Preparedness and Emergency Water Management*: Prepare pre-summer water contingency plans; identify emergency water supply points for wildlife; maintain mobile water tanks for extreme droughts; and establish rapid repair teams for damaged water structures.
- *Integration with Invasive and Grazing Management*: Remove invasives around water bodies to improve recharge; restrict grazing near wetlands and springs; develop fodder plots away from water sources; and create livestock exclusion zones in priority habitats.
- *Technology-Based Monitoring and Early Warning*: Install water-level loggers in key tanks and springs; use remote sensing to monitor drying trends; maintain a GIS-based water availability dashboard; and trigger early interventions in deficit zones.
- *Institutional Coordination and Convergence*: Integrate water actions into Working Plans, Management Plan, Zonal Master Plan and TCPs; converge with MGNREGS, watershed programmes, and CAMPA.
- *Research and Adaptive Management*: Study elephant water-use patterns and preferences; assess impacts of artificial water points on habitat; pilot low-cost recharge technologies; and revise strategies based on monitoring results.

Expected Outcomes: If implemented systematically, these strategies will improve dry-season water security; stabilise elephant ranging patterns; reduce forced movement into farms; lower human-elephant conflict; enhance habitat carrying capacity; and support long-term population viability

Integrated Water Resource Management:

- Envisage development of conjunctive basin management by judicious use of the surface and ground water with the help of Department of Water Resources / Ground Water Board, and ensure recharging as well as availability of the ground water during the pinch period.
- Implement adaptive management strategies to respond to changing hydrological conditions, climate patterns, and human activities.

The NER's hydrological health rests on a few critical upland catchments (Nilgiris/Upper Bhavani, Moyar) and a network of small wetlands and tanks that buffer seasonal scarcity. While core shola blocks still perform recharge functions, catchment capability is under pressure from land-cover change, invasives, siltation and groundwater over-use - particularly across the Bhavani-Moyar-Erode and Dharmapuri-Hosur plains. Protecting headwater sholas, restoring vayals and tanks, implementing targeted watershed recharge works, and integrating these measures into corridor protection are the highest-value actions to secure water for wildlife and reduce the dry-season drivers of human–elephant conflict.

3.4.5. Habitat restoration and monitoring

The NER landscape has large tract of forests, managed under various silvicultural systems and practices. The anthropogenic pressures continue to degrade and fragment forest land especially the narrow corridors, threatened due to intense human activity. There are large-scale monoculture plantations with low forage nutrition which are not conducive to wildlife habitat including for the elephants.

Habitat restoration and monitoring are essential components of effective conservation efforts in NER and also aims to enhance and maintain suitable habitats for elephants and other wildlife, promoting biodiversity and ecological balance.

Restoration interventions executed

- *Invasive removal*: Mechanical/manual Lantana, Chromolaena, Senna and Prosopis removal in corridor strips and grassland patches.
- *Grassland restoration*: Native grass reseeding (Themeda, Heteropogon, Cymbopogon) and assisted natural regeneration (ANR) after clearing.
- *Riparian & wetland rehabilitation*: Desilting of vayals/tanks, protection of springheads, planting of native riparian species.
- *Soil & water works*: Contour trenches, check-dams, percolation ponds in catchments to improve baseflow.
- *Grazing management*: Exclosure plots, community fodder banks, stall-feeding trials.
- *Fire management*: Fire-tracing, fuel-breaks and protection around restoration blocks.
- *Corridor micro-works*: Securing narrow bottlenecks by clearing invasives and planting native corridors with minimum disturbance widths.

Field examples & specific locations

- *Masinagudi (MTR)* - vayal desilting, Lantana removal and grass reseeding; measurable increase in grass biomass and elephant visits; pilot shows improved dry-season forage.
- *Upper Bhavani (Nilgiris)* - shola-edge ANR plots: seedling establishment of native species and improved infiltration in treated patches.
- *Gudalur-O' Valley (Gudalur Forest Division)* - corridor bottleneck clearing & native buffer planting; local reduction in short-range field incursions where community watch-maintained fences.
- *Hasanur / Thalavadi (STR fringe)* - targeted lantana clearing/riparian revegetation along highway crossing; improved crossing behaviour recorded (more daytime crossing, fewer night surprises).
- *Palacode / Morappur (Dharmapuri Forest Division)* - tank rehabilitation and upstream silt traps; local wells and tank storage rose temporarily, benefitting wildlife and villages.
- *Hosur / Denkanikottai (Hosur Forest Division)* - small corridor greening pilots combined with industrial CSR funding; early signs of improved corridor visibility and limited use by transient bulls.

- *Bhavani valley/Erode fringe (Erode Forest Division)* - agroforestry buffer trials along riverine strips showing modest reduction in crop attractiveness where farmers adopted low-attractant species.

Key success factors (what made restoration work) could be attributed to maintenance for at least 3 years (weeding, watering, grazing exclusion); and integration with water works (desilting, recharge).

Main constraints (why some efforts failed) could be due to the lack of follow-up in the cleared areas and grazing pressure, and limited funding.

Implementation Strategies

The strategies for habitat restoration and monitoring in NER could envisage:

- *Prioritisation and Spatial Planning*: Prepare GIS-based maps of degraded habitats (Fig-3.12), invasive hotspots, corridors, and wetland sites; rank sites based on ecological value, corridor importance, conflict pressure, and restoration feasibility; and focus first on bottlenecks: Gudalur-Moyar, Hasanur-Thalavadi, Bhavani valley, Palacode foothills, Denkanikottai corridor.
- *Site-Specific Restoration Planning*: Develop micro-restoration plans for selected block (5-50 ha); define objectives: forage recovery, connectivity, water retention, or conflict reduction; and select species and methods suited to elevation and forest type.
- *Invasive Species Removal*: Conduct phased mechanical/manual removal of Lantana, Chromolaena, Prosopis, Eupatorium and Senna; remove roots and biomass to prevent resprouting; and schedule follow-up clearing every 6-12 months.
- *Assisted Natural Regeneration (ANR)*: Protect and promote natural seedlings through weeding, mulching, and fencing; retain seed trees and mother clumps; and use ANR wherever soil seed banks exist.
- *Native Species Planting*: Establish decentralised nurseries for site-specific native species; use mixed planting (grasses, shrubs, trees) to mimic natural structure; and maintain ≥70% survival through watering and mulching.
- *Grassland/ Bamboo and Forage Restoration*: Reseed native grasses in cleared patches including bamboo planting; control grazing and fire in restored grasslands; and establish fodder-rich buffer strips in corridors.
- *Wetland and Riparian Restoration*: Desilt and rehabilitate vayals, tanks, and springs; restore feeder channels and natural drainage; and plant native riparian species along streams.
- *Soil and Moisture Conservation*: Construct contour trenches, gully plugs, and percolation pits; improve moisture retention in slopes/ degraded patches; integrate with watershed programs.
- *Water Source Enhancement*: Maintain and create water holes to ensure a reliable water supply for elephants and other wildlife during pinch period and implement restoration projects to improve water flow and quality in rivers and streams.
- *Grazing and Disturbance Control*: Establish exclosure plots in regeneration zones; enforce grazing-free periods; and provide alternative fodder and stall-feeding support.
- *Corridor-Focused Restoration*: Develop “green corridors” of minimum 200-500 m width; restore vegetation continuity in bottlenecks; and remove physical and biological barriers.
- *Integration with Fire Management*: Maintain fire lines around restoration blocks.; remove dry biomass periodically; and include restored sites in fire-risk maps.
- *Standardised Monitoring Framework*: Establish permanent vegetation plots and photo-points; monitor grass biomass, canopy cover, regeneration; and use camera traps for wildlife use.
- *Remote Sensing and GIS Monitoring*: Track NDVI, canopy change, & moisture indices annually; update degradation/restoration layers every year; and integrate into NER-GIS dashboard.

- *Wildlife Response Monitoring*: Record elephant visitation frequency and movement paths; monitor changes in conflict near restored sites; and compare restored vs control areas.

Expected Outcomes: Consistent implementation of these strategies will result in improved forage and water availability; stronger corridor connectivity; reduced degradation and invasives; better elephant habitat quality; and evidence-based adaptive management

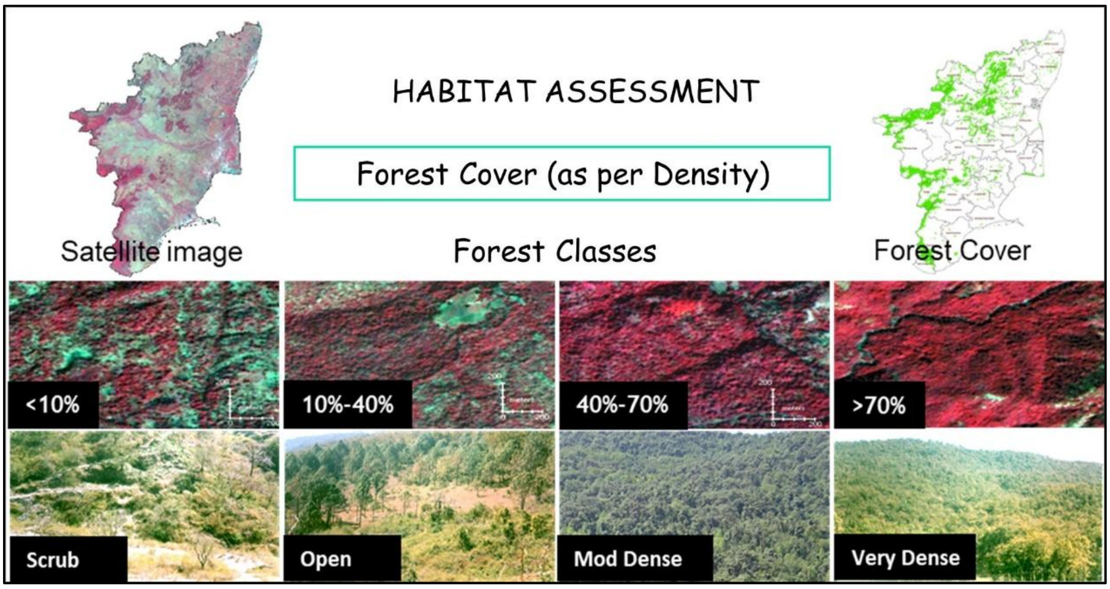


Fig-3.12: Habitat Assessment using remote sensing technology

Habitat restoration in the NER has shown real, local ecological and behavioural benefits where interventions are well-targeted, sustained and integrated with water and social measures. However, scaling these benefits to landscape/population level requires multi-year maintenance, community involvement, grazing/invasive controls, hydrological works and treatment of longer corridor blocks rather than spot interventions. Continued monitoring with standardized indicators will allow managers to convert site-level successes into durable landscape outcomes.

3.4.6. NTFP and other leases

Effective management of NTFP collection, forest and other leases in NER requires a collaborative and adaptive approach that prioritizes both ecological sustainability & well-being of communities.

Common NTFPs in the NER landscape (what is harvested)

- *Honey products* - forest honey (wild hive collection).
- *Bamboo (culms and shoots)* - usable for handicrafts, small construction and fodder; often supplied under regulated schemes.
- *Medicinal & aromatic plants* - various shola/forest herbs and roots used locally and sold via collectors (local ethnobotanical use in Nilgiris).
- *Fodder, fuelwood and leaf-fodder* (including lopping produce) - fuel and fodder extraction remain major local uses at village-forest interface.
- *Minor fruits, wild fruits & tamarind* - village use and local market sale (scattered across Gudalur, Nilgiris foothills).
- *Cane / rattan and fiber* - local basketry and craft materials where present in riparian strips.
- *Resins, gums and essential oils* (limited) - in some patches (species dependent).

The exact species list and commercial importance vary across Nilgiris (shola-grassland, upper elevation) versus dry deciduous eastern ranges (STR, Dharmapuri, Hosur).

Field references & typical collection locations

These are the landscape locations where NTFP collection is commonly recorded or is known to be important:

- *Nilgiris (Upper Nilgiri shola–grassland blocks)* - medicinal plants, some wild fruits, shola herbs; controlled collection in fringe labour colonies.
- *Gudalur / Pandalur / O'Valley* - honey, fuelwood, leaf-fodder, some wild fruit collection; edges of tea/coffee estates are active collection zones.
- *Mudumalai (Masinagudi, Moyar, Theppakadu ranges)* - honey, fuelwood, bamboo culms, grazing fodder (buffer villages heavily use NTFPs).
- *Sathyamangalam / Bhavani valley (Hasanur, Thalavadi, Bargur)* - bamboo, fodder, medicinal plants and wild fruits in riparian belts and scrub patches.
- *Dharmapuri / Palacode / Morappur & Hosur / Denkanikottai* - fuelwood, grazing fodder, Prosopis/other invasive wood removal (local uses), and small-scale fruit/NTFP collection in tanks and riparian strips.

Other leases / tenures encountered in NER

- *Historical plantation leases and Janmam/privately-held estates* - Many parts of NER (Gudalur, parts of Mudumalai margins) contain plantation estates (tea, coffee) established on landed tenures (e.g., Janmam lands). These are not forest-department leases in the narrow sense but large private holdings that affect corridor integrity.
- *Revenue / settlement tenures & reserved forest notifications* - Some revenue lands on corridor alignments have had ambiguous status and are subject to notification/acquisition or conversion to reserved forest where corridors are protected. Recent case law and directives caution against commercial development on corridors. (E.g., court actions on Segur/Nilgiris corridors illustrate legal measures to restrict commercial uses in corridors.)
- *Forest department leases / contracts for NTFP, bamboo supply, eco-tourism & fisheries* - Department may issue short-term contracts for bamboo extraction, NTFP procurement, tank fisheries or small eco-tourism concessions (rest houses, elephant camps) - all guided by Working Plans and policy notes.
- *Grazing/commons arrangements & local permits* - In many fringe areas, grazing remains regulated via local permits or customary arrangements; some areas operate under seasonal grazing guidelines in Working Plans.
- *Community-based usufruct / benefit-sharing arrangements* - Under eco-development and JFM, communities may receive user-rights, quotas or revenue shares for NTFP collection

Field implications

- *NTFPs are livelihood critical in many fringe villages* - management must ensure legal, sustainable access while protecting corridor function (example: honey and fuelwood in Masinagudi/ Gudalur).
- *Leases & private holdings shape corridors* - plantation estates and revenue-tenure parcels (Gudalur, some Nilgiri foothills) can block movement; historic lease documents (Janmam) complicate corridor negotiation and acquisition.
- *Working Plan prescriptions must be explicit about restricting commercial NTFP leases inside critical corridors and core movement zones* - some Working Plans and TCPs already recommend this; enforcement is the key.
- *Community engagement and fair pricing via the Minor Forest Produce trade rules, VFCs and local SHGs helps both conservation and livelihoods* - scale up community procurement, value-addition (e.g., honey processing), and link to market channels.

- *Legal caution on commercial infrastructure in corridors* - recent court rulings reinforce bans on resorts/commercial constructions in corridors; any lease or tender overlapping corridors must be critically reviewed.

Implementation Strategies

- *Inventory, Mapping, and Baseline Assessment*: Prepare a division-wise GIS inventory of NTFP collection zones, Lease/contract areas, Plantation estates and revenue tenures and corridor overlaps; document collectors, volumes, seasons, and legal status and update the database annually.
- *Zoning and Spatial Regulation*: Demarcate No-Extraction Zones (corridors, core habitats, vayals, restoration sites), Regulated Use Zones (buffers, fringe forests) and Community Use Zones; prohibit commercial leases inside priority elephant corridors and integrate zoning into Working Plans, Management Plans and TCPs.
- *Sustainable Harvesting Protocols*: Develop species-wise harvest guidelines (quantity, method, season); enforce non-destructive techniques (no root cutting, limited lopping); introduce rotational harvesting blocks; and fix annual extraction quotas based on regeneration surveys.
- *Strengthening Permit and Licensing Systems*: Issue time-bound, geo-referenced permits; link permits to compliance history; digitise NTFP permits and transit passes; and cancel licences for repeated violations.
- *Community-Based NTFP Management*: Empower VFCs/EDCs/SHGs to manage collection; prepare village-level NTFP calendars; allocate community quotas; and provide incentives for compliance.
- *Value Addition and Livelihood Support*: Promote local processing units (honey, herbs, bamboo crafts); support branding and market linkages; facilitate cooperative marketing; and reduce dependency on raw extraction.
- *Lease Review and Rationalisation*: Conduct legal and ecological audits of all existing leases; identify leases overlapping corridors and sensitive habitats; renegotiate, relocate, or phase out harmful leases; and ensure all new leases pass ecological screening.
- *Regulation of Plantations and Private Holdings*: Promote corridor-friendly management in estates; encourage buffer planting with native species; restrict fencing and night lighting in corridors; and negotiate conservation easements where feasible.
- *Control of Fuelwood and Fodder Extraction*: Develop community woodlots outside forests; promote LPG/biogas/solar cookers; provide subsidised fodder during lean seasons; and monitor lopping hotspots.
- *Monitoring and Compliance Enforcement*: Maintain NTFP/Lease Registers at beat/ range level; conduct joint patrols during peak collection seasons; use GPS-enabled inspections; and apply graded penalties for illegal extraction.
- *Integration with Corridor and Habitat Management*: Link NTFP regulation with restoration and grazing control; remove extractive activities from restored patches; align lease management with corridor action plans; and treat corridors as “low-use landscapes”.
- *Capacity Building*: Train field staff in NTFP species identification, sustainable harvest techniques, conflict-sensitive enforcement and develop field manuals and SOPs.
- *Conflict-Sensitive Management*: Restrict NTFP collection during peak elephant movement hours; provide safety training to collectors; establish early-warning systems near collection sites; and reduce night-time forest entry.
- *Documentation and Reporting*: Produce annual ‘NTFP and Lease Status Reports’; track area under leases/ extraction volumes/ compliance rates/ corridor impacts; and integrate with NER monitoring framework.

- *Exit and Transition Strategies*: Design livelihood transition plans for phased-out leases; provide skill training for alternative employment; link affected families to government schemes; and ensure no sudden loss of income.

Expected Outcomes: Consistent implementation will lead to reduced habitat disturbance; protected elephant corridors; improved community incomes; lower illegal extraction; transparent lease governance; and stronger coexistence framework.

Effective management of NTFPs and leases in NER requires a collaborative and adaptive approach that prioritizes both ecological sustainability and the well-being of local communities. Engaging stakeholders in decision-making processes and continuously monitoring and adjusting management practices are key elements of successful conservation efforts in this landscape.

3.4.7. Linear and other development projects

The NER has a substantial number of linear infrastructures, mainly transmission lines, and roads apart from railway lines and canals etc. These projects fragment, reduce and isolate habitats and impact elephant movement and traditional migration paths. Moreover, the road and power transmission lines cause mortality due to road kills and electrocution.

Ooty - Gudalur road widening (Ooty–Gudalur / Ooty–Mysore corridor)

- *Location / corridors*: Ooty–Gudalur stretch through Nilgiris / Gudalur (passes close to shola–grassland patches and known movement routes).
- *Impacts*: road widening increases vehicle speed & traffic volume, severs small stepping-stone patches, creates barrier effects and higher mortality risk at crossing points; construction can damage restoration/plantation edges used by elephants.
- *Mitigations* (priority): avoid alignment through narrow corridor pinch-points; design wildlife underpasses/large culverts at historic crossing points; traffic calming and night-time speed limits; permanent signposting and monitoring at Moyar valley approaches.

Hasanur–Sathyamangalam highway improvements / road upgrades (STR fringe)

- *Location / corridors*: Hasanur–Thalavadi–Sathyamangalam highway corridor (STR fringe / Bhavani valley).
- *Impacts*: highway expansion and increased heavy traffic fragment corridor, raise collision risk, and produce disturbance leading to altered crossing times and bottlenecks. STR is a core connector between Nilgiris/MTR and Erode/Bhavani areas.
- *Field references*: STR corridor mapping and fire/linear intrusion assessments identify the Hasanur band as vulnerable; elephant-corridor summaries note highways as linear intrusions.
- *Mitigations*: install underpasses/overpasses or wildlife bridges at known crossing points, reduce night-time traffic / enforce speed limits, install fencing funneling to safe crossings, and continuous monitoring (camera and roadkill surveys).

Bangalore–Chennai Expressway / Hosur–Krishnagiri corridor upgrades (including Hosur elevated expressway proposals)

- *Location / corridors*: Hosur-Krishnagiri-Denkanikottai area (Hosur-Denkanikottai-Palacode landscape) - important eastward connector and sink interface.
- *Impacts*: a high-speed access-controlled expressway or elevated corridor would create a barrier across remaining movement strips, accelerate urban/industrial expansion, and eliminate night-crossing options for elephants, increasing mortality and long-range diversion into villages.
- *Mitigations*: realign expressway away from core corridor segments where feasible; provide a set of grade-separated wildlife crossings (bridges/underpasses) at predictable crossing points; landscape-scale zoning to avoid industrial sprawl in corridor LMAs; strict no-development buffer on either side.

Bhavani basin irrigation projects & major canals (Bhavanisagar / Lower Bhavani Project)

- *Location / corridors*: Bhavani catchment, Moyar-Bhavani corridor, Bhavani valley (STR–Erode interface).
- *Impacts*: large irrigation infrastructure and reservoir management (water table alterations, canal networks) change floodplain connectivity and may sever small riparian stepping stones and seasonal vayals used by elephants. Canal embankments and road-side canal works may create movement barriers.
- *Mitigations*: ensure design of canals includes wildlife crossings, maintain riparian vegetation strips, manage reservoir drawdown to preserve downstream pools during dry season, and avoid embankment structures at key crossing points.

High-tension power transmission lines and associated access tracks

- *Location / corridors*: linear HTL corridors crisscrossing forest blocks and corridors across NER (various ranges).
- *Impacts*: tall towers and cleared right-of-way create long, open linear strips that fragment canopy cover and can act as fire lines or invasion conduits; access roads built for construction & maintenance increase human access and disturbance. MoEFCC corridor inventory flags transmission lines where they intersect corridors.
- *Mitigations*: bury lines where feasible in critical corridors (or micro-routing to avoid pinch points), minimise cleared ROW width, close or restrict access tracks, and restore native vegetation under lines with fire-resistant planting.

Road widening / local state highways & rural road networks inside corridors (multiple stretches)

- *Location / corridors*: numerous state highways/major district roads that intersect Gudalur-Moyar, Hasanur, Bhavani valley, Hosur foothills, and Nilgiris fringes. Examples include local widening works around Moyar, Gudalur and Sathyamangalam approaches.
- *Impacts*: compounding effect of many smaller widened roads; cumulative fragmentation, increased night traffic, more driver-elephant encounters, and higher human presence. NHAI/State headlines acknowledge multiple projects (Ooty-Gudalur etc.).
- *Mitigations*: adopt wildlife-sensitive road design across all schemes; continuous speed enforcement, wildlife signage, dedicated under/over-passes at known crossing points, and avoidance of upgrades in pinch-points unless accompanied by mitigation.

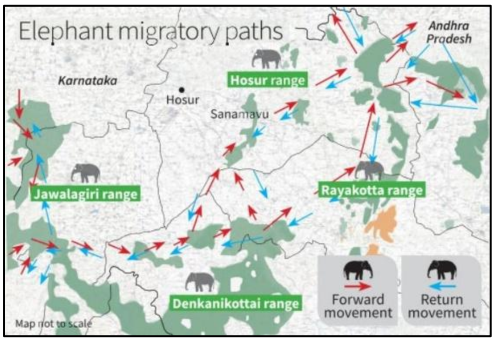


Fig-3.13: Impact of Expressway in Hosur region; and suggested elephant crossing (Source: https://practical.engineering/blog/2024/12/17/the-hidden-engineering-of-wildlife-crossings)

Implementation Strategies

- *Mandatory Corridor-Overlay Screening (Pre-project)*: Require every linear or major project proposal to include a **NER Corridor Overlay** check as a first filter; If an alignment intersects a corridor LMA, it moves automatically to the “avoid/realign” category (Priority example: Ooty-Gudalur / Moyar valley pinch points).

- *Avoidance as First Principle:* Funders/approvals must document why avoidance is impossible before accepting mitigation; realign routes to bypass known pinch points and stepping stones (Field priority: Hasanur–Thalavadi pinch points in STR fringe.
- *Mandatory Multi-disciplinary EIA with Movement Data:* EIAs must include elephant telemetry, camera-trap crossing data, seasonal movement maps and cumulative-impact analysis; and independent peer review required for any project in/near LMAs.
- *MCDA Decision Framework for Trade-offs:* Use a transparent Multi-Criteria Decision Analysis (ecology, social, economic, feasibility) to choose between alignment options.
- *Design Standards for Roads & Rail (Wildlife-Sensitive Design):* Standardise minimum dimensions for elephant underpasses/overpasses (wide span, >6–8 m clearance where feasible) and specify approach funnelling; and apply these for highways (e.g., Ooty–Gudalur, Hasanur stretches) and rail sections (Hosur sector).
- *Location-Specific Crossing Provisioning:* Provide grade-separated crossings at mapped historic crossing nodes; add low-angle ramps, broad culverts and earth ramps where topography permits; and ensure spacing of safe crossings matches local elephant movement distances.
- *Temporary & Permanent Traffic Management:* Impose **night-time closures or strict speed limits** in corridor sectors until crossings are functional; and use enforced speed cameras, rumble strips and speed-calming near Moyar, Bhavani crossing points.
- *ROW Minimisation & Access Control:* Minimise the cleared Right-of-Way width; forbid creation of new permanent access roads through corridors; and close and rehabilitate temporary construction tracks immediately post-works.
- *Vegetation and Fire-Safe ROW Management:* Restore native low-height, fire-resistant plantings under powerlines and along ROWs to reduce invasive spread and fire risk; and prevent ROW maintenance practices that widen invasions.
- *Construction-Phase Safeguards (SOP):* Limit heavy construction to daytime, avoid monsoon and peak movement seasons (Mar–Jun, Oct–Dec); and prohibit night-work in high-use LMAs; require onsite wildlife liaison officer and rapid response protocol.
- *Compulsory Mitigation Finance:* Projects must fund a mitigation trust (CAMPA/NER-Corridor Fund) sized to build, maintain crossings, restore adjacent habitat and pay long-term monitoring; and include maintenance budgets for 10+ years.
- *Cumulative Impact and Cumulative Mitigation:* Assess cumulative effects of multiple small roads/lines - treat them as a single system; and prioritise blocking of small intrusions that together create impermeable barriers (Hosur foothills).
- *Post-construction Restoration & Rehabilitation:* Immediate decommissioning of temporary roads, regrading, soil stabilization, native replanting and 3- 5year maintenance contracts; and protect restored patches with grazing exclusion and fire lines.
- *Monitoring & Compliance:* Require baseline camera-trap & telemetry before construction, then continuous post-construction monitoring; and if threshold impacts occur (e.g., >x mortalities, >y reduced crossings), trigger corrective measures (retrofit crossing, traffic curbs).
- *Real-Time Early-Warning Systems:* Install thermal/AI detection and road-side alert systems at known crossing hotspots tied to railway/road control rooms (pilot in Hosur rail stretches); and integrate with traffic control to slow/stop movement.
- *Restrict Linear Development in High-Value LMAs:* Establish legal “no-development” buffers around core and narrow corridor segments (width commensurate with species’ ecology); and use zoning in Master Plans to prevent industrial/resort expansion (Hosur–Denkanikottai).
- *Ensure Wildlife Passage Dimensions & Substrate:* Crossings must have natural substrate, daylight, gentle slopes, and be wide enough to avoid elephant aversion.
- *Minimise Human Presence & Night Lighting:* Prohibit permanent worker settlements, night lighting, permanent service stations near corridors; limit construction camps & restore after use.

- *Integrate Linear Projects into Landscape Restoration:* For each linear intrusion, require adjacent habitat restoration equal to or greater than area impacted e.g., replanting, invasive removal.
- *Community & Stakeholder Engagement:* Early, documented consultation with affected villages, VFCs and transport agencies; co-design crossing placements and safety protocols; and local community members as watchers during construction and long-term monitors (employment).
- *Inter-agency Corridor Review Body:* Constitute a standing NER Corridor Review Panel (District Collector + Forest + Highways + Rail + Power + Planning + independent ecologist) to vet designs, monitor compliance and approve remedial action.

WII's Ecofriendly measures to mitigate the impact of linear infrastructure on wildlife

- Design and construct wildlife crossings, overpasses and underpasses, to facilitate the movement of elephants and other wildlife across linear infrastructure and ensure that crossings are strategically located based on wildlife movement patterns & migration paths.
- Establish and enforce speed limits in areas with high wildlife movement to reduce the risk of vehicle collisions with elephants and install warning signs to alert drivers about the presence of wildlife crossings.
- Integrate linear development plans into comprehensive landscape level planning for the entire elephant reserve and minimize new linear infrastructure within core areas and critical habitats and prioritize alternative routes.
- Conduct detailed EIAs for proposed linear development projects to assess potential impacts on the elephant and its habitats and implement mitigation measures to minimize adverse effects including establishing monitoring programs to assess impact

Managing linear and other development projects in elephant reserves requires a holistic approach that involves collaboration among government agencies, local communities, conservation organizations, and developers. By integrating conservation principles, it is possible to reduce negative impacts on elephant habitats and promote sustainable coexistence between humans and elephants.

3.4.8 Other site-specific disturbances and natural disasters

The other site-specific disturbances and natural disasters in NER operate alongside linear projects and land-use change and significantly influence elephant behaviour, habitat quality, and conflict patterns.

1. Landslides, Slope Failures & Soil Erosion (Nilgiris & Gudalur)

- *Key Locations*: Upper Nilgiris & Gudalur-Pandalur belt
- *Nature of Disturbance*: Rain-triggered landslides, road-cut failures, and gully erosion; loss of topsoil and vegetation cover; and damage to shola-grassland mosaics
- *Impacts on Elephants*: Disruption of traditional hill-slope movement paths; loss of forage patches; temporary blockage of corridors; and increased movement along roads and settlements.
- *Field Relevance*: Most frequent in Nilgiris and upper Gudalur after intense monsoon events.

2. Droughts & Prolonged Dry Spells (Eastern & Peripheral NER)

- *Key Locations:* Palacode-Morappur (Dharmapuri), Denkanikottai-Thally (Hosur), Bhavani valley (Erode fringe) and Hasanur foothills (STR fringe)
- *Nature of Disturbance:* Failure of seasonal rains; drying of tanks, springs, and vayals; and groundwater depletion
- *Impacts on Elephants:* Forced long-distance movement for water; increased crop raiding; concentration near few remaining water sources; and higher inter-herd competition
- *Field Relevance:* Most severe in Dharmapuri Forest Division and Hosur Forest Division.

3. Forest Fires (Seasonal & Accidental)

- *Key Locations:* Masinagudi-Moyar Valley (MTR), Hasanur-Thalavadi belt (STR), Bhavani catchment fringes and Palacode slopes

- *Nature of Disturbance:* Dry-season ground and crown fires; mostly human-induced; linked to grazing and fuelwood use.
- *Impacts on Elephants:* Loss of forage and shelter; temporary abandonment of ranges; increased movement to agricultural lands; and invasive spread after fire
- *Field Relevance:* Recurring in MTR and STR fringes.

4. Floods, Flash Floods & Waterlogging (Riverine Zones)

- *Key Locations:* Moyar river banks, Bhavani-river floodplains, Lower Gudalur streams, and Palacode tanks
- *Nature of Disturbance:* Sudden high flows during heavy monsoon; iInundation of low-lying corridors; and bank erosion
- *Impacts on Elephants:* Temporary isolation of herds; restricted movement; displacement to higher agricultural lands; and increased road crossings
- *Field Relevance:* Notable along Moyar-Bhavani corridors in MTR-STR-Erode interface.

5. Invasive Species Explosions (Post-Disturbance)

- *Key Locations:* Masinagudi ranges, Hasanur plateau, Gudalur slopes and Palacode scrub forests
- *Nature of Disturbance:* Rapid colonisation by Lantana, Chromolaena, Eupatorium, Prosopis & Senna; often follows fire, drought, or clearing
- *Impacts on Elephants:* Suppression of grasses; reduced browse; narrowed pathways; and increased crop dependence
- *Field Relevance:* Widespread across NER, especially in degraded buffers.

6. Human-Induced Noise & Disturbance (Non-Linear)

- *Key Locations:* Masinagudi tourism zone, Ooty-Gudalur route, Hasanur roadside settlements and Denkanikottai industrial fringe
- *Nature of Disturbance:* Tourism vehicles; festivals and loudspeakers; quarrying/blasting; industrial noise
- *Impacts on Elephants:* Avoidance of daytime movement; increased nocturnal activity; stress-induced aggression; and erratic ranging
- *Field Relevance:* High in tourism-intensive parts of MTR and Nilgiris.

7. Quarrying, Mining & Stone Crushing

- *Key Locations:* Dharmapuri foothills, Hosur-Krishnagiri belt and Bhavani valley margins
- *Nature of Disturbance:* Rock quarrying; blasting vibrations; dust pollution; & access road creation
- *Impacts on Elephants:* Corridor disruption; habitat fragmentation; noise-induced avoidance; and increased human presence
- *Field Relevance:* Major issue in eastern NER transition zones.

8. Disease Outbreaks & Health Emergencies

- *Key Locations:* Masinagudi fringe villages, Hasanur cattle belt and Palacode pastoral zones
- *Nature of Disturbance:* Livestock-borne diseases (FMD, HS); contaminated water sources; and stress-related illnesses
- *Impacts on Elephants:* Risk of pathogen spillover; reduced immunity; occasional mortality; and altered movement to avoid infected zones
- *Field Relevance:* Associated with high grazing pressure zones.

9. Cyclonic Rains & Extreme Weather Events

- *Key Locations:* Nilgiris highlands, Gudalur slopes and Upper Bhavani catchment
- *Nature of Disturbance:* Very heavy rainfall; wind damage; tree falls; and landslide chains

- *Impacts on Elephants:* Trail obstruction; temporary habitat loss; increased roadside movement; and separation of family groups
- *Field Relevance:* Notable during northeast monsoon years.

10. Poaching & Illegal Activities (Localized Disturbance)

- *Key Locations:* Remote MTR interior, STR buffer and Dharmapuri scrub tracts
- *Nature of Disturbance:* Snaring; illegal timber/NTFP; and night-time intrusion
- *Impacts on Elephants:* Avoidance of affected areas; increased stress; and disruption of movement patterns
- *Field Relevance:* Low frequency but high impact in remote patches.

11. Encroachments & Temporary Settlements

- *Key Locations:* Gudalur revenue forests, Palacode fringe & Hosur corridor
- *Nature of Disturbance:* Seasonal huts; crop expansion; and grazing camps
- *Impacts on Elephants:* Loss of resting sites; increased human encounters; narrowed corridors
- *Field Relevance:* Chronic in Gudalur and eastern divisions.

Following is a consolidated, field-oriented account of other site-specific disturbances and natural disasters affecting elephants in the Nilgiri Elephant Reserve (NER) landscape, with locations, impacts, and management implications (Table-3.5). These factors operate alongside linear projects and land-use change and significantly influence elephant behaviour, habitat quality, and conflict patterns.

Table-3.5: Integrated Impact on Elephants (Landscape Level)

Disturbance Type	Primary Effect	Secondary Impact
Landslides	Path disruption	Road dependence
Drought	Water scarcity	Crop raiding
Fire	Forage loss	Invasives
Floods	Corridor blockage	Displacement
Noise	Behaviour change	Night conflict
Quarrying	Fragmentation	Avoidance
Disease	Health stress	Reduced fitness

Management Implications:

- Natural disasters and localised disturbances often trigger sudden shifts in elephant movement.
- Combined effects (fire + drought + invasives) multiply habitat stress.
- Peripheral divisions (Dharmapuri, Hosur, Erode) are most vulnerable to disturbances.
- Disturbance-driven displacement is a major hidden driver of chronic HEC

Implementation Strategies

- *Risk Mapping and Early-Warning Systems*- Prepare multi-hazard GIS maps (fire, drought, landslide, flood, invasion, disease); identify “disturbance hotspots” in each division; integrate satellite alerts (fire, rainfall anomalies, NDVI drought signals); and establish division-level early-warning dashboards.
- *Disaster Preparedness Planning*- Develop range-wise disaster management plans; prepare pre-monsoon and pre-summer readiness checklists; stock emergency equipment (fire tools, water pumps, first-aid kits); and identify rapid-response teams in each range.
- *Drought and Water-Stress Management*- Secure perennial springs and tanks; create emergency wildlife water points; implement watershed and recharge works; and prepare drought-year contingency water plans.

- *Landslide and Erosion Mitigation*- Stabilise vulnerable slopes using bio-engineering; restrict heavy construction on steep terrain; re-vegetate landslide scars rapidly; and improve drainage along hill roads.
- *Flood and Riverine Corridor Management*- Maintain natural floodplains; remove obstructions from streams; restore riparian buffers; and protect seasonal refuges on higher ground.
- *Forest Fire Prevention and Control*- Maintain and update fire lines annually; establish community fire-watch groups; use controlled early-season burns where ecologically justified; and deploy mobile fire units in high-risk zones.
- *Invasive Species Control after Disturbances*- Launch rapid invasive-removal teams post-fire/flood; replant cleared areas with native species; monitor reinvasion annually; and integrate with restoration programmes.
- *Regulation of Noise, Tourism, and Blasting*- Declare low-disturbance zones in key habitats; enforce limits on tourism vehicles and timings; regulate quarry blasting schedules; and install noise-monitoring devices in hotspots.
- *Quarrying and Mining Impact Management*- Prohibit new quarries in corridors and buffers; review existing quarry permits; enforce rehabilitation plans; and monitor vibration & dust levels.
- *Disease Surveillance and Veterinary Support*- Conduct regular livestock vaccination; monitor wildlife health indicators; establish wildlife disease response units; and control grazing near water sources.
- *Encroachment and Temporary Settlement Control*- Regular patrols to detect new encroachments; rapid eviction with rehabilitation support; prevent seasonal grazing camps in corridors; and secure reclaimed lands through restoration.
- *Post-Disaster Habitat Restoration*- Rapid replanting and ANR after fires/floods; desilt damaged wetlands; stabilise eroded soils; and restore movement trails.
- *Community-Based Disaster Management*- Form Village Disaster Response Committees; train local volunteers in fire/flood response; promote community reporting systems; and link disaster response with livelihood schemes.
- *Technology-Based Monitoring*- Use drones for fire and landslide assessment; install camera traps in disturbance zones; apply GPS-based patrol tracking; develop mobile reporting Apps.

Expected Outcomes- Consistent implementation will lead to reduced habitat loss from disasters; faster ecological recovery; stabilised elephant movement; lower conflict after crises; stronger community participation; and climate-resilient landscapes.

3.4.9 Climate change and disaster risk reduction

Climate change in the NER is already amplifying hydrological extremes (longer dry spells, more intense but less reliable rain events), increasing fire risk in dry mosaics, and shifting vegetation composition (toward thorny/invader-dominated types). These changes reduce dry-season water and forage, compress elephant movements into fewer refugia and corridors, and raise the frequency and severity of human–elephant conflict and mortality.

Observed and projected climate / hazard trends (field-relevant)

- *Rising temperatures and erratic rainfall* - studies and basin assessments document warming and altered rainfall seasonality that reduce baseflows and recharge in Bhavani and adjacent basins. This increases dry-season water stress across the eastern NER.
- *Increased fire hazard in dry deciduous and degraded grassland mosaics* - repeated dry-season fires (often human-ignited) occur in MTR and STR fringes and reduce forage/regeneration.

- *Catchment fragility and groundwater decline* - CGWB and district plans show localized groundwater stress in Bhavani and Dharmapuri basins, increasing vulnerability of tank/spring networks used by elephants.
- *Vegetation reorganisation / aridification signals* - regional analyses report conversion of evergreen/deciduous cover toward more drought-tolerant thorn/grass communities, undermining forage quality impacting large herbivores.

These trends affect elephant ecology and conflict by reduced dry-season water points as elephants travel farther increasing crop raids and mortality risk (Masinagudi-Moyar-Palacode movement pulses); fires encourage Lantana/Chromolaena/Prosopis reinvasion, which reduces grass biomass and shrinks usable foraging patches with elephants respond by concentrating along riverine strips, creating hotspot conflicts. Besides, corridor bottlenecks become more hazardous when headwater vayals/ tanks dry or are damaged by landslides/ fires, elephants are forced into narrow crossing points (Moyar, Bhavani valley, Hasanur), increasing collision and retaliatory incidents (Table-3,6).

Table-3.6: Field Locations and Characteristic Features of the High-priority hotspots

Field Location	**Characteristic Features**
Upper Nilgiris	Key recharge shola-grassland; vulnerable to plantation conversion, changing rainfall, and headwater drying.
Masinagudi-Moyar (MTR buffer & corridor)	Recurrent buffer fires and vayal degradation; small fires and elephant mortality incidents reported
Hasanur-Thalavadi (STR fringe)	Fire-prone corridor; road & slope works plus altered fire regimes threaten crossing points
Bhavani basin / Erode fringe	Groundwater stress and agricultural intensification reduce baseflows and wetland persistence
Palacode–Morappur / Dharmapuri plains	Drought-prone; tank networks need desiltation and recharge works to remain functional for wildlife and villages
Hosur / Denkanikottai (eastern sink landscapes)	Urbanisation and drying reduces small springs and ponds elephants depend on, increasing interface conflict

Climate change and disaster risk reduction are critical considerations in the management of NER. The impacts of climate change, such as altered precipitation patterns, increased frequency and intensity of extreme weather events, and rising temperatures, can exacerbate existing challenges in elephant conservation. Implementing strategies for disaster risk reduction is essential to enhance the resilience of elephant habitats and local communities. Sound forestry practices can reduce risk as it will provide buffering of extreme temperatures and precipitation, flood risk reduction, storm risk reduction etc.

Implementation Strategies (Disaster-Risk Reduction (DRR) & Climate-Adaptation)

- *Climate Risk Mapping and Vulnerability Assessment:* Prepare GIS-based climate–hazard maps (drought, fire, flood, landslide, heat stress); identify climate "hotspots" in corridors, buffers, and fringe villages; update vulnerability maps every 3-5 years; and integrate climate layers into NER landscape planning.
- *Strengthening Water Security (Top Priority)* - Protect and map critical springs, vayals, and tanks; desilt and rehabilitate priority wetlands and reservoirs; restore feeder channels and micro-catchments; construct recharge structures (check dams, percolation pits); and maintain emergency wildlife water points during drought years.
- *Climate-Resilient Habitat Restoration* - Use drought-tolerant native species for plantations; promote Assisted Natural Regeneration (ANR); restore grasslands and riparian buffers; control invasives after climate disturbances; and maintain habitat heterogeneity for resilience.

- *Forest Fire Risk Reduction* - Prepare annual fire-risk zoning maps; maintain and widen fire lines in vulnerable blocks; establish community fire-watch teams; deploy early-season fuel reduction measures; strengthen rapid fire-suppression units.
- *Drought Preparedness and Response* - Develop Division-wise drought contingency plans; identify drought refugia and protect them; stock water tankers and pumps for emergencies; restrict grazing and extraction during severe droughts; and monitor vegetation stress indicators.
- *Flood and Riverine Corridor Management* - Protect natural floodplains; remove obstructions from streams; stabilise riverbanks with native vegetation; prevent encroachments in flood-prone corridors; and maintain elevated refuges for wildlife.
- *Landslide and Soil-Erosion Management* - Map landslide-prone slopes; apply bio-engineering techniques (vetiver, native grasses); improve drainage along hill roads; restrict heavy construction in steep catchments; and restore landslide scars immediately.
- *Corridor Climate Resilience* - Maintain multiple alternative movement routes; develop “climate refugia” along corridors; protect stepping-stone habitats; restore degraded bottlenecks; and avoid development in recharge and refuge zones.
- *Early-Warning and Monitoring Systems* - Install fire, drought, and rainfall monitoring systems; use satellite alerts (MODIS/VIIRS/NDVI); establish sentinel spring-flow monitoring stations; integrate alerts into a central NER dashboard; and enable mobile-based field reporting.
- *Wildlife Health and Disease Preparedness* - Conduct livestock vaccination drives; monitor wildlife health indicators; protect water sources from contamination; establish wildlife disease response teams; and maintain veterinary emergency protocols.
- *Community-Based Climate Adaptation* - Train villages in disaster preparedness; promote rainwater harvesting; support fodder banks and stall-feeding; encourage climate-resilient livelihoods; and establish village response committees.
- *Post-Disaster Rapid Restoration* - Activate rapid restoration teams after fires/floods; remove debris and invasives quickly; replant and reseed affected patches; repair damaged water structures; and secure disturbed corridors.
- *Climate-Smart Infrastructure Development* - Apply climate-resilient design for roads, culverts, and crossings; elevate structures in flood-prone zones; ensure drainage capacity for extreme rainfall; and use green engineering solutions.
- *Research and Technical Support* - Partner with research institutions; develop habitat–climate response models; monitor long-term vegetation and hydrology trends; and pilot low-cost climate adaptation technologies.
- *Performance Monitoring and Evaluation* - Track climate and DRR indicators annually burnt area, functional water points, spring discharge, NDVI trends, HEC frequency and publish annual “Climate Resilience Report”.

Expected Outcomes: Consistent implementation will result in improved drought and fire resilience; stable water and forage availability; reduced disaster-driven displacement; lower climate-induced HEC; stronger corridor functionality; and climate-resilient elephant populations.

3.5 CORRIDORS: DESCRIPTION, PROTECTION AND MANAGING DISPERSING POPULATIONS

Elephant corridors are crucial components of elephant reserves and conservation efforts aimed at maintaining connectivity between fragmented habitats. These corridors serve as pathways that allow elephants to move between different areas, facilitating natural behaviours such as migration, foraging, and breeding.

As per the report of Elephant Corridors of India (Project Elephant, MoEF&CC, Govt of India (2023), nearly 11 elephant corridors (Fig-1.7) have been documented in the Nilgiri Elephant Reserve.

Description of Elephant Corridor:

The description of elephant corridors within Nilgiri Elephant Reserve includes:

- *Definition* - Elephant corridors in the Nilgiri Elephant Reserve are ecologically defined landscape linkages that enable seasonal and long-term movement of elephants between core habitats, feeding grounds, water sources, and breeding areas. These corridors may consist of continuous forest tracts, riparian belts, grassland patches, plantation mosaics, or narrow forested strips within human-dominated landscapes. In NER, corridors are often semi-natural rather than pristine, reflecting centuries of coexistence between wildlife and human land use.
- *Connectivity* - in NER is primarily maintained between major protected areas and forest divisions, including Nilgiris- Gudalur- MTR- STR- Erode- Dharmapuri- Hosur landscapes. These corridors ensure genetic exchange, demographic stability, and dispersal of herds. However, connectivity is increasingly constrained by roads, railways, settlements, plantations, and industrial growth, especially in eastern and southern fringe zones. Maintaining functional connectivity is therefore central to sustaining population viability.
- *Natural Migration Routes* - in NER are shaped by seasonal availability of water, forage, & climatic conditions. Elephants typically move from high-elevation Nilgiri plateaus to lower valleys during dry seasons; along river systems such as the Moyar and Bhavani; and between dry deciduous forests of Sathyamangalam and moist forests of Mudumalai and Nilgiris. These routes have remained largely consistent over generations and are reinforced through social learning. Disruption of these traditional paths often leads to increased incursions into agricultural landscapes.
- *Habitat Preservation* - Corridor functionality depends on the quality of habitat within and around movement routes. Preservation efforts in NER focus on maintaining grasslands, riparian vegetation, vayals (seasonal wetlands), and forest understorey that provide food, water, and cover. Degradation due to invasive species, grazing, fire, and encroachment reduces corridor permeability. Habitat restoration, invasive control, and water conservation are therefore essential components of corridor management.
- *Corridor mapping* - in NER is undertaken using a combination of satellite imagery, GIS analysis, field surveys, camera-trap data, and community knowledge. Mapping identifies core corridors, secondary routes, bottlenecks, and stepping-stone habitats. These spatial datasets are integrated into Working Plans, Tiger Conservation Plans, Management Plans and landscape management strategies. Corridor maps guide infrastructure planning, land acquisition, habitat restoration, and regulatory zoning.
- *Corridor Conservation Measures* - include legal protection of priority corridors (Sigur corridors); regulation of construction and land conversion; restoration of degraded patches; creation of wildlife underpasses and overpasses; removal of invasive vegetation; establishment of buffer zones; and negotiated conservation agreements with private landholders. In high-conflict areas, corridor management is combined with fencing, early-warning systems, and community livelihood support to ensure coexistence.
- *Monitoring Protocols* - of elephant corridors in NER is based on multi-tier systems that include transects, patrol-based observations and community reporting. Key indicators include frequency of elephant crossings, seasonal use patterns, habitat condition, encroachment levels, and mortality incidents. Data are reviewed to assess corridor health, and monitoring ensures early detection of emerging threats and effectiveness of mitigation measures.

Elephant corridors in the Nilgiri Elephant Reserve form the backbone of landscape connectivity and population resilience. Defined by traditional movement routes and supported by functional habitats, these corridors link diverse ecological zones across the reserve. Their conservation requires accurate mapping, habitat preservation, regulatory safeguards, community participation, and continuous scientific monitoring. Sustained investment in corridor management is essential for maintaining ecological balance and long-term human–elephant coexistence in NER.

Protecting corridors, migration routes and managing dispersing populations in NER are crucial aspects of wildlife conservation, especially for large and wide-ranging species like elephants. Certain strategies that can be implemented include:

Corridor and Migration Path Protection:

In the Nilgiri Elephant Reserve (NER), corridor and migration path protection is implemented through an integrated landscape approach that safeguards traditional elephant movement routes linking the Nilgiris, Gudalur, Mudumalai, Sathyamangalam, Erode, Dharmapuri, and Hosur forest divisions.

- Priority corridors and seasonal pathways have been identified using GIS mapping, field surveys, camera-trap data, and community knowledge, and legally secured through Govt. order (Sigur), land acquisition (Gudalur), zoning regulations (MTR/ STR), and restrictions on land-use change (ESZ-Cauvery North Wildlife Sanctuary, Hosur) (Fig-3.14).
- Habitat quality within corridors is maintained through invasive species control, grassland and riparian restoration, protection of vayals and water sources, and regulation of grazing and fuelwood extraction (STR).
- Linear infrastructure is managed through realignment, wildlife underpasses and overpasses, traffic calming, and night-speed restrictions at crossing points (Hosur).
- Community participation is strengthened through eco-development programmes, participation incentives, and conflict-mitigation support, while continuous monitoring using patrol records, remote sensing, and telemetry enables adaptive management.

Together, these measures ensure functional connectivity, reduce movement disruption, and support long-term population viability and human–elephant coexistence across the NER landscape.

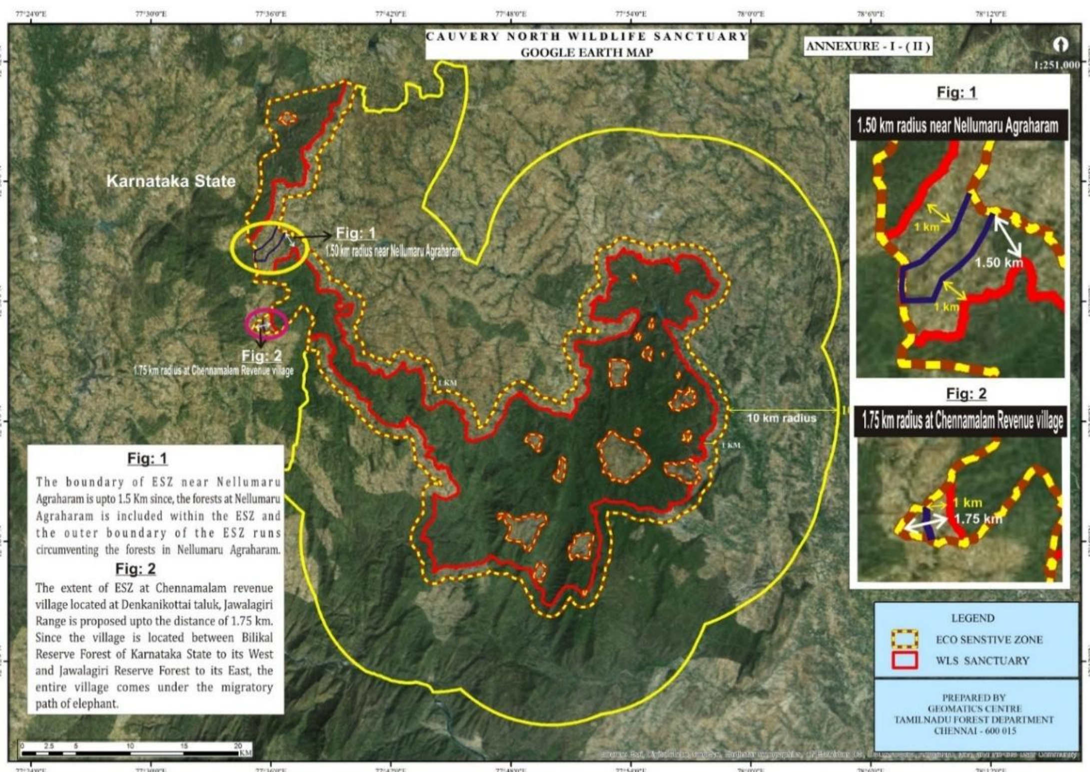


Fig-3.14: Thally-Billikkal and Billikkal-Jawalagiri Interstate Corridors

Managing Dispersing Populations:

In the NER, managing dispersing elephant populations- especially sub-adult males and newly forming herds- focuses on guiding natural expansion while minimising conflict and habitat degradation.

- Dispersal is most evident along eastern and southern edges, where elephants move from core areas such as Mudumalai Tiger Reserve and Sathyamangalam Tiger Reserve towards Dharmapuri Forest Division and Hosur Forest Division, driven by forage availability, water stress, and social pressures. A typical field example is the movement of solitary and small groups of bulls from the Moyar-Masinagudi sector into Palacode and Denkanikottai landscapes during dry seasons, leading to increased crop raiding and village encounters. Also, seasonal inter-state movement of elephant herd (Karnataka) is observed in Hosur division between October to January and return from February to March (Fig-3.15).

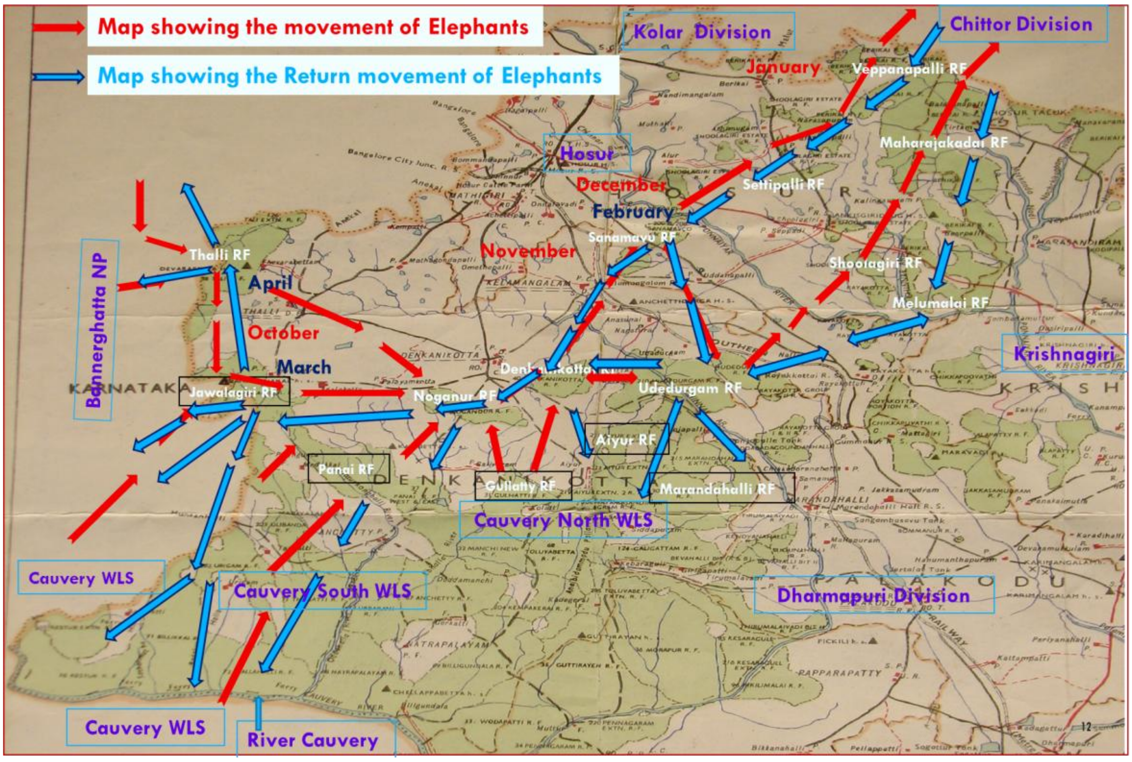


Fig-3.14: Seasonal Inter-state movement of Elephant herd in Hosur region

Implementation Strategies

Management responses include strengthening corridor continuity, restoring stepping-stone habitats and water points, constructing over-passes/underpasses, installing early-warning and solar-fence systems in fringe villages with eco-friendly crop protection measures, using drone technology/ rapid response teams for addressing conflict situations, and community outreach and training to prevent retaliatory actions.

Continuous monitoring through patrol data, camera traps, and incident records helps track dispersal routes and adapt interventions, ensuring that expanding elephant ranges are accommodated within the landscape while maintaining safety for both people and wildlife.

Consider translocating elephants only as a last resort when conflicts cannot be resolved in any other way by ensuring proper assessments as per the wildlife act, before initiating any translocation.

3.5.1 Local Overpopulation, Splinter Groups and related management options

The overpopulation or overabundance of elephants may be due to the increased birth rates, reduced predation and migration of population. The animals in an overpopulated area may then be forced to stray into adjoining agricultural landscapes attracted by the crops grown in those areas, exacerbating conflict.

- Localised “overpopulation” and splinter group formation in NER are typically not landscape-wide population explosions, but **area-specific crowding**, habitat compression, or dispersal bottlenecks. These situations arise due to water scarcity, habitat degradation, blocked corridors, social dynamics (sub-adult male dispersal), or prolonged concentration around resource-rich patches (vayals, tanks, crop fields).

Understanding Local Overpopulation in NER

In high-productivity areas such as MTR (Masinagudi-Moyar sector), STR (Hasanur-Bhavani valley) and Nilgiri plateau fringes, elephants may temporarily concentrate due to availability of perennial water, grass flush after fire, crop attractants in fringe agriculture and social structuring of matriarchal herds. Such crowding increases intra-species competition and pushes peripheral dispersal into Dharmapuri Forest Division and Hosur Forest Division.

Splinter Groups- Causes and Patterns in NER

Splinter groups in NER commonly arise due to sub-adult male dispersal; resource competition within herds; disturbance (fire, noise, tourism pressure); social conflict between matriarchs; and habitat fragmentation blocking traditional routes. Field examples include solitary bulls or small 2-4 elephant groups moving from Moyar valley into Palacode or Denkanikottai agricultural belts during dry months.

Ecological Risks of Local Crowding

- Over-browsing of limited forage patches
- Habitat degradation in high-use areas
- Increased disease transmission risk
- Crop raiding escalation
- Elevated mortality risk (electrocution, retaliation)

Implementation Strategies

Local overpopulation of elephants can lead to various challenges, including habitat degradation, human-wildlife conflict, and increased competition for resources. Effective management strategies are essential to address these issues. Some options for managing local overpopulation of elephants include:

A. Habitat-Based Solutions (Preferred Strategy)

- *Disperse Resource Concentration*: Create additional water points in underused forest patches; restore secondary grasslands; and rehabilitate peripheral wetlands to reduce clustering.
- *Strengthen Corridors*: Remove bottlenecks limiting outward dispersal; restore stepping-stone habitats in eastern NER; and prevent new development in narrow movement routes.
- *Improve Forage Distribution*: Reseed native grasses; remove invasive species in peripheral areas; and rotate grazing exclusion zones.

B. Conflict Mitigation for Dispersing Groups

- Solar fencing clusters in high-risk villages.
- Early-warning SMS and siren systems.
- Rapid Response Teams with trained kumkis.
- Community crop-guarding cooperatives.

C. Behavioural and Social Management

- Avoid unnecessary translocation unless the animal is chronic and violent.
- Use soft-driving techniques to guide splinter groups back to forest.
- Maintain calm and minimal-disturbance protocols during drives.

D. Veterinary and Health Monitoring

- Monitor body condition in high-density areas.
- Vaccinate livestock in buffer zones.
- Maintain disease surveillance in concentrated patches.

E. Last-Resort Measures

- Translocation only for persistent high-risk individuals.
- Captive management only under extreme safety conditions.
- Avoid large-scale removals that disrupt social structure.

Monitoring Framework: The key indicators for developing monitoring framework envisages- elephant density per block; herd size and composition; seasonal movement direction; HEC frequency in dispersal zones; forage availability index; and water persistence duration.

Development of Decision Matrix

In the NER, localised elephant crowding and splinter group formation are primarily symptoms of habitat compression, corridor disruption, & seasonal resource stress rather than true biological overpopulation. Effective management therefore focuses on rapid assessment within 24-72 hours of the incident by collection of the following data:

- Identity (if known), tusker/solitary bull/herd fragment?
- Incident type (crop raid, property damage, injury, fatality).
- Frequency (isolated / repeated).
- Season (musth, drought, post-fire period?).
- Habitat condition (water scarcity, corridor blockage?).
- Human behaviour trigger (illegal electric lines, chasing, encroachment).

Sustained monitoring and adaptive management ensure that dispersing populations are accommodated within the broader landscape while maintaining safety for both wildlife and local communities (Table-3.7).

Table-3.7: Decision Matrix

Risk Category	Field Indicators	Immediate Action	Medium-Term Strategy	Long-Term Outcome Goal
Category 1: Low Risk Dispersing Bull	Single crop raid, no aggression, moving naturally	Monitor only; advisory to village	Strengthen fencing, restore nearby forage/ water	Natural dispersal maintained
Category 2: Moderate Repeated Crop Raider	2–5 incidents in 1 season, avoids people	Soft driving back to forest; early-warning alerts	Improve corridor/ water access; cluster fencing	Reduce repeated entry
Category 3: High-Risk Conflict Individual	Enters villages repeatedly, property damage	Deploy RRT; kumki-based guidance	Identify resource bottleneck; remove attractants	Behaviour stabilised
Category 4: Aggressive / Human-Fatal Individual	Direct attack, repeated aggression	Intensive monitoring tranquilisation (if required)	Veterinary & behavioural assessment	Public safety ensured
Category 5: Landscape Compression Case	Multiple bulls concentrating due to drought / fire	Habitat intervention (water points, grass restoration)	Corridor reopening; grazing regulation	Reduce artificial crowding

Operational Protocols

Managing splinter bulls and localised high-conflict individuals in NER requires a graded response system that prioritises monitoring, habitat correction, and community-level mitigation before considering capture or translocation. The operational protocols as per the field conditions may be envisaged as under:

Monitoring First (Default Option)

- Use camera traps and patrol tracking.
- Map daily movement path.
- Avoid premature capture or translocation.

Soft Driving & Behavioural Guidance

- Use trained staff and kumkis only when necessary.

- Conduct drives during daylight.
- Avoid loud, aggressive pursuit.
- Maintain safe escape route into forest.
- Field Example: Masinagudi-Moyar sector bulls guided away from village clusters during dry season toward interior grass patches in MTR.

Conflict Mitigation at Village Level

- Solar fence clusters (not isolated fences).
- Early-warning SMS systems.
- Crop guarding cooperatives.
- Remove attractants (illegal electric fences, stored grain).
- Field Example: Palacode belt (Dharmapuri) - cluster fencing reduces repeated night entry of splinter bulls.

Habitat Redistribution Strategy: concentration due to resource stress-

- Desilt tanks/vayals.
- Create alternate water points.
- Remove invasives in peripheral forest patches.
- Restrict grazing during lean season.

Translocation (Last Resort): Use only if-

- Individual has repeated lethal aggression.
- Non-responsive to soft mitigation.
- Adequate release site with carrying capacity exists.
- Risks: Homing behaviour/ Stress mortality/ Conflict displacement elsewhere.

Captive Retention (extreme cases only)

- Only when public safety is severely compromised.
- Must follow legal and veterinary protocols.
- Avoid social disruption of herd structure.

Early Warning Indicators for Escalation

- Musth condition + proximity to dense settlements.
- Drought year + drying water sources.
- Fire-induced displacement.
- Corridor obstruction by new infrastructure.

Division-Specific Risk Patterns

The division-specific risk pattern may be summarised as under:

Division	Typical Splinter Pattern
Mudumalai	Dry-season bull dispersal
Sathyamangalam	Roadside conflict in Hasanur belt
Dharmapuri	Agricultural sink behaviour
Hosur	Industrial-edge night entry
Gudalur	Estate-border crop raiding
Nilgiris	Plateau-to-valley seasonal descent

Monitoring Indicators

Following monitoring indicators may be envisaged as far as NER is concerned:

- Incidents per individual per month.
- Distance from core forest.

- Water source availability.
- Crop stage (harvest season).
- Human crowd behaviour response time.

Straying of Elephants in NER

Besides, elephants may stray from their typical habitats or ranges for various reasons, and these include both natural and human-induced factors.

Straying of elephants in the NER typically occurs when seasonal movement routes intersect fragmented habitats, drying water sources, or expanding agriculture at the forest-village interface. During dry months, bulls and small splinter groups often move from the Moyar-Masinagudi sector of MTR toward the Bhavani valley and Hasanur fringes of STR, occasionally spilling into agricultural belts of Dharmapuri Forest Division (Palacode-Morappur) and Hosur Forest Division (Denkanikottai-Thally). Similarly, elephants descending from the Nilgiri plateau into Gudalur Forest Division may enter tea and paddy fields along estate boundaries when traditional corridors are narrowed by settlements or infrastructure. Such straying is often triggered by drought, fire, invasive-driven forage decline, or obstruction of natural pathways, and it leads to temporary congregation near crops and water bodies, escalating human-elephant conflict.

Effective management therefore focuses on maintaining corridor permeability, restoring water and forage in interior forests, and deploying early-warning and community-based mitigation systems in high-risk fringe villages.

3.5.2 Addressing Spatial activities of Resident human populations that lead to conflict

HEC in NER is strongly influenced by where and how resident communities use space- including agriculture, grazing, fuelwood collection, settlement expansion, road use, and seasonal labour movement. Effective mitigation requires spatial regulation, behavioural adaptation, and landscape planning, rather than only reactive conflict control.

- *Crop cultivation in corridor and fringe zones:* Crop cultivation along forest edges and within corridor alignments is a major spatial driver of human–elephant conflict. High-attractant crops such as paddy, banana, maize, and sugarcane in fringe villages of Mudumalai, Sathyamangalam, Dharmapuri, and Hosur divisions draw elephants during dry and harvest seasons. Addressing this requires crop zoning, promotion of low-attractant alternatives, cluster-based solar fencing, and coordinated crop-guarding systems rather than isolated, reactive measures.

- *Settlement expansion and encroachments:* Settlement expansion and encroachments into traditional movement routes further intensify conflict. Revenue land development in Gudalur, plateau fringes in the Nilgiris, and scrub interfaces in Dharmapuri and Hosur narrow corridors and increase night-time human presence. Mitigation involves enforcing no-development buffers in identified corridors, regulating building permits within Landscape Management Areas, discouraging outward village sprawl, and prioritising corridor-sensitive land-use planning.

- *Grazing and livestock movement:* Free-ranging cattle grazing in forest fringes reduces forage availability and increases human presence in elephant habitats, indirectly pushing elephants toward agricultural lands. Rotational grazing systems, stall-feeding, fodder banks and vaccination programmes help reduce pressure on forest resources.

- *Fuelwood and NTFP collection:* Frequent human entry into forests for fuelwood and non-timber forest produce disturbs elephant movement patterns and elevates encounter risk. Regulated collection timings, development of alternative energy sources, and establishment of community woodlots outside corridors can mitigate this pressure.

- *Tourism and recreational pressure:* High tourist traffic, especially in sensitive belts, causes noise disturbance and alters elephant movement behaviour, often shifting activity to night hours.

Managing vehicle numbers, enforcing time restrictions, and promoting wildlife-sensitive tourism practices reduce spatial disturbance.

- *Agricultural infrastructure and fencing practices:* Improper fencing, illegal electric lines, and irrigation structures without escape routes can injure elephants and obstruct natural movement. Standardised solar fencing, removal of illegal high-voltage lines, and provision of canal escape ramps are necessary safeguards.
- *Waste disposal and attractants:* Open garbage dumps and unsecured grain storage near settlements attract elephants and encourage repeated entry into villages. Implementing elephant-proof waste management systems and secure storage facilities reduces artificial food attractants.
- *Industrial and quarrying activities:* Blasting, mining and industrial expansion near corridor zones generate noise and habitat fragmentation, displacing elephants into conflict-prone areas. Restricting quarrying in sensitive zones and enforcing ecological audits are key preventive measures.
- *Integration into spatial planning:* Incorporating elephant corridor and conflict maps into district master plans, panchayat land-use plans and infrastructure approvals ensures development decisions account for ecological connectivity and reduce future conflict hotspots.
- *Community behavioural adaptation:* Strengthening community-based early-warning networks, coordinated crop guarding, and awareness campaigns helps modify human behaviour in high-risk seasons, reducing escalation of conflict situations.
- *Monitoring spatial conflict patterns:* Maintaining GIS-based heat maps of conflict incidents and overlaying them with land-use change data enables adaptive management. Continuous spatial monitoring allows authorities to anticipate emerging conflict zones and implement timely mitigation measures.

Overall, managing spatial human activities in NER requires integrating elephant corridor maps into district & panchayat planning, regulating land-use change in high-risk zones, strengthening community-based mitigation, and continuously monitoring spatial conflict patterns through GIS and field data. Proactive land-use planning aligned with elephant ecology is critical for sustaining long-term coexistence.

Spatial Conflict Mitigation Framework

The Spatial Conflict Mitigation Framework for the NER may be built on a GIS-based system that classifies the landscape into-

- core movement corridors
- high-conflict fringe buffers
- transitional dispersal areas
- relatively stable settlement zones

This classification may be derived from corridor mapping, long-term human elephant conflict (HEC) heat maps, land-use patterns, seasonal movement data, and water-source distribution, allowing spatially differentiated management rather than uniform interventions.

- In **core movement corridors**, which include narrow bottlenecks and high-frequency crossing zones, strict regulation is applied. New construction, land-use conversion, quarrying, and incompatible infrastructure are restricted, while habitat restoration, grassland revival, water-source protection, and wildlife-friendly infrastructure (such as underpasses and traffic calming) are prioritised to maintain corridor permeability.
- In **high-conflict fringe villages**, the focus shifts to mitigation and coexistence. Cluster-based solar fencing, early-warning systems, crop substitution strategies, coordinated crop guarding,

and secure storage systems are implemented to reduce attractants and prevent repeated elephant entry. These areas act as conflict buffers rather than strict exclusion zones.

- **Transitional dispersal areas**, where elephant use is occasional or emerging, are managed adaptively. Stepping-stone habitats are conserved, agroforestry buffers are promoted, and temporary deterrents are deployed as needed. Monitoring in these zones helps anticipate future corridor formation or conflict escalation.

- **Stable settlement and low-conflict areas** are designated for regulated development, ensuring that growth does not create new corridor fragmentation. Wildlife-sensitive infrastructure design, ecological screening of new projects, and avoidance of future bottlenecks are key components.

The framework integrates corridor overlays into local and district planning processes, ensuring that panchayat land-use plans, master plans, and infrastructure approvals incorporate ecological data. Regulatory tools such as Corridor Management Areas, ecological screening protocols, and mitigation bonds help institutionalise protection measures.

Community participation is embedded throughout the framework. Participatory mapping, corridor governance agreements, regulated grazing zones, and disaster preparedness coordination enhance local ownership and reduce resistance to conservation measures.

Monitoring and evaluation are continuous, using GIS dashboards, patrol data, remote sensing, and annual conflict audits. Key indicators include HEC frequency, corridor permeability, land-use change rates, and elephant crossing patterns, enabling adaptive zoning and management refinement.

The implementation timeline begins with GIS classification finalisation and pilot mitigation in priority hotspots, followed by scaling up restoration and mitigation measures and eventually institutionalising the framework within district and forest management plans. The guiding principle of the framework is to plan human land use around elephant movement patterns, thereby reducing spatial drivers of conflict while maintaining long-term landscape connectivity and coexistence in NER.

3.6 LIVELIHOOD DEPENDENCE & BIOTIC PRESSURES IN THE ELEPHANT HABITAT

Elephant habitats in NER overlap significantly with human-use landscapes, especially in buffer zones and revenue forests. Livelihood dependence varies spatially but remains substantial in fringe villages.

Agriculture-Based Dependence

- *Nature of Dependence*: Paddy, banana, sugarcane, maize (high-conflict crops); millets, ragi, groundnut (semi-arid eastern divisions); tea and coffee estates (Gudalur, Nilgiris)
- *Status*: High in Gudalur, Dharmapuri, and Hosur belts; Seasonal income strongly tied to harvest periods; crop loss directly translates to livelihood vulnerability.
- *Pressure on Elephant Habitat*: Agricultural expansion into corridor areas; irrigation canals and fencing obstructing movement; and increased human guarding and night-time disturbance.

Livestock Grazing

- *Nature of Dependence*: Cattle, goats, and buffalo grazing in forest fringes and particularly important in STR, Dharmapuri, and Erode sectors.
- *Status*: Moderate to high grazing intensity in eastern NER; and seasonal grazing peaks during dry months.
- *Biotic Pressure*: Competition for forage and water; soil compaction and reduced regeneration; and disease transmission risk.

Fuelwood & Biomass Extraction

- *Nature of Dependence*: Household energy needs; construction wood and small timber; and leaf litter and fodder collection.
- *Status*: Moderate in Nilgiris and Gudalur and higher in economically weaker eastern divisions.

- *Biotic Pressure*: Degradation of understorey vegetation; fragmentation of resting habitats; and increased human presence in core movement areas.

Non-Timber Forest Produce (NTFP)

- *Nature of Dependence*: Honey collection; medicinal plants; and bamboo & minor forest produce.
- *Status*: Important supplementary income source; and more structured under VFC/EDC systems in some divisions.
- *Biotic Pressure*: Generally low if regulated; and can increase disturbance during peak collection seasons.

Plantation and Estate Labour

- *Nature of Dependence*: Tea, coffee, and spice estates (Gudalur, Nilgiris); and daily wage employment.
- *Status*: Significant in Gudalur landscape; and estate boundaries overlap elephant routes.
- *Pressure*: Night-time labour movement; and estate fencing restricting corridor width.

Tourism-Based Livelihoods

- *Nature of Dependence*: Safari operations; homestays and resorts (Masinagudi belt); and transport services.
- *Status*: High in Mudumalai - Masinagudi - Ooty belt; and expanding in certain STR fringes.
- *Biotic Pressure*: Traffic disturbance; noise pollution; and waste generation.

Livelihood dependence in the NER varies across divisions but remains substantial in fringe villages through agriculture, grazing, biomass extraction, plantations, tourism, and NTFP collection. These activities generate moderate to high biotic pressures- particularly grazing, invasive spread, and habitat fragmentation- that reduce forage availability and corridor permeability.

Biotic pressures arise from direct resource extraction and land-use activities as under:

- *Grazing Pressure* - High in STR and Dharmapuri fringes; Leads to reduced grass biomass; and promotes invasive species dominance.
- *Invasive Species Spread* - Lantana, Chromolaena, Prosopis, Senna; particularly severe in Masinagudi and eastern NER; and linked to fire and grazing cycles.
- *Fuelwood Removal* - Gradual thinning of understorey; and affects regeneration and browse availability.
- *Encroachments* - Small agricultural extensions; temporary huts and grazing camps; and narrowing of corridors.
- *Water Resource Exploitation* - Tank desiltation without ecological planning; borewell expansion near corridors; and reduced perennial water persistence.

It is crucial to tailor these strategies to the specific needs and contexts of each region, considering the socio-economic and cultural factors of the local communities involved. In this context, the spatial variation in pressure and assessment (Table3-8) is given below:

Table-3.8: Spatial Variation in Biotic Pressure

Division	Livelihood Dependence	Biotic Pressure Level
Mudumalai	Tourism + fringe farming	Moderate
Sathyamangalam	Agriculture + grazing	High
Gudalur	Plantation + NTFP	Moderate
Dharmapuri	Rainfed farming + grazing	High
Hosur	Agriculture + industrial edge	High
Nilgiris	Plantation + tourism	Moderate
Erode	Irrigated farming	Moderate - High

Pressure - Response - Outcome Matrix

Pressure - Response - Outcome Matrix for NER, linking each livelihood activity to specific management interventions and measurable outcomes is detailed below:

1. Agriculture Expansion in Corridors

- *Pressure*: Cultivation of high-attractant crops (paddy, banana, sugarcane, maize) along corridor edges and fringe forests.
- *Response*: Crop zoning (low-attractant crops in high-risk belts); cluster solar fencing; corridor land-use regulation; and incentives for voluntary crop transition
- *Expected Outcome*: reduced crop raiding; lower elephant entry frequency; improved corridor permeability

2. Livestock Grazing in Forest Fringes

- *Pressure*: Open grazing reduces grass biomass, compacts soil, and competes with elephants.
- *Response*: Rotational grazing systems; stall-feeding incentives; fodder bank development; and grazing-free core corridor zones
- *Expected Outcome*: Improved forage regeneration; reduced habitat degradation; lower disease transmission risk

3. Fuelwood & Biomass Extraction

- *Pressure*: Frequent human entry into elephant-use areas and gradual understorey thinning.
- *Response*: Community woodlots outside corridors; LPG/clean-energy schemes; regulated collection timings; and monitoring of extraction hotspots
- *Expected Outcome*: Reduced disturbance; vegetation recovery; safer human access patterns

4. Invasive Species Spread

- *Pressure*: Lantana, Chromolaena, Prosopis, Senna reducing forage and blocking movement.
- Response: Mechanical removal; native grass reseeding; post-fire rapid restoration; and long-term maintenance contracts
- Expected Outcome: Increased grass biomass; restored movement; reduced habitat compression

5. Settlement Expansion & Encroachments

- *Pressure*: Village sprawl and estate boundary expansion narrowing corridors.
- *Response*: Corridor notification and zoning; building permit screening; voluntary relocation from bottlenecks; and strict enforcement against new encroachments
- *Expected Outcome*: Secured corridor width; reduced night-time encounters; and stabilised dispersal routes

6. Tourism Pressure

- *Pressure*: High vehicle density, noise, waste, and night disturbance.
- *Response*: Cap vehicle numbers; no-night-traffic zones in corridors; silent tourism protocols; and waste management systems
- *Expected Outcome*: Reduced behavioural stress; improved daytime elephant movement; and lower accidental encounters

7. Quarrying & Industrial Disturbance

- Pressure: Blasting vibrations, access roads, and worker settlements near corridors.
- *Response*: Prohibit new quarries in LMAs; environmental audits; blasting time restrictions; and rehabilitation of abandoned sites
- *Expected Outcome*: Reduced habitat fragmentation; lower displacement events; and improved corridor continuity

8. Water Scarcity & Resource Concentration

- *Pressure*: Drying springs and tanks causing crowding and conflict.
- *Response*: Tank desiltation; spring protection; check-dams and recharge works; and creation of distributed water refugia
- Expected Outcome: Reduced artificial crowding; stabilised seasonal movement; and lower drought-driven HEC

9. Waste & Artificial Attractants

- *Pressure*: Open garbage dumps and crop storage near forest edges.
- *Response*: Elephant-proof waste bins; secure grain storage; and strict anti-attractant enforcement
- *Expected Outcome*: Reduced repeat village entry; and lower habituation risk

10. Illegal Electric Fencing & Hazardous Practices

- *Pressure*: Electrocution risk and corridor obstruction.
- *Response*: Removal of illegal lines; standardised solar fencing; and joint enforcement drives
- *Expected Outcome*: Reduced elephant mortality; and safer deterrence mechanisms

11. Fire and Grazing Feedback Loop

- *Pressure*: Repeated fires → invasive spread → forage loss → crowding.
- *Response*: Fire-line maintenance; early-warning systems; community fire brigades; and rapid post-fire restoration
- *Expected Outcome*: Lower burnt area; faster habitat recovery; and stable forage availability

Overall Status Assessment

- Livelihood dependence is 'moderate to high' in buffer and fringe zones.
- Core PAs face 'low direct livelihood pressure', but buffers face high extraction pressure.
- Eastern NER (Dharmapuri, Hosur) experiences higher grazing and agricultural pressure.
- Tourism-driven disturbance is concentrated in Mudumalai - Nilgiris belt.
- Biotic pressures contribute to habitat degradation, corridor narrowing, and conflict escalation.
- **Integrated Landscape Outcome:** If responses are implemented systematically across NER, then there will be reduced ecological stress, improved habitat quality, stabilised dispersal, reduced conflict intensity, enhanced community participation, and long-term population viability.

3.6.1 Safeguarding threatened biodiversity values

The NER forms one of the most critical biodiversity landscapes in the Western Ghats-Eastern Ghats interface. Beyond elephants, it supports globally threatened mammals, endemic flora, riverine ecosystems, grasslands, and complex shola-montane systems. Safeguarding these values requires landscape-level, multi-species conservation aligned with habitat integrity and ecological processes.

Protection of Flagship and Umbrella Species

- NER supports viable populations of Asian elephants along with threatened large carnivores, herbivores, and endemic mammals. Protection of core habitats in Mudumalai Tiger Reserve and Sathyamangalam Tiger Reserve, along with Nilgiri plateau forests and eastern dry forests, ensures umbrella protection for co-occurring species.

- Key Actions: Strengthen anti-poaching patrols and intelligence networks; maintain prey base through habitat management; monitor population trends through camera traps and line transects; and reduce disturbance in breeding habitats.

Conservation of Endemic and Rare Flora

- Shola forests and high-altitude grasslands in Nilgiris harbour endemic plant species vulnerable to invasive spread and climate change.
- Key Actions: Prevent plantation encroachment into shola–grassland mosaics; remove invasive species (Lantana, Wattle, Eupatorium); restore native grasslands and riparian vegetation; and protect seed banks and regeneration patches.

Habitat Connectivity and Corridor Integrity

- Corridors linking Nilgiris - Gudalur - Mudumalai - Sathyamangalam - Erode - Dharmapuri - Hosur maintain genetic flow and species dispersal.
- Key Actions: Legally secure corridor bottlenecks; regulate infrastructure expansion; develop wildlife crossings where necessary; and restore degraded corridor habitats.

Wetland, Riparian and Riverine Ecosystem Protection

- River systems such as Moyar and Bhavani support aquatic biodiversity and seasonal wildlife congregation.
- Key Actions: Protect springs and vayals; prevent sand mining and riparian encroachment; maintain ecological flow regimes; and monitor water quality.

Grassland and Savanna Ecosystem Conservation

- Dry deciduous and savanna habitats in eastern NER are critical for herbivores and ground-nesting birds.
- Key Actions: Control woody encroachment; regulate fire frequency; restrict overgrazing; and restore native grass species.

Invasive Species Management

- Invasive plants significantly reduce biodiversity and habitat quality.
- Key Actions: Prioritised removal in high-value biodiversity patches; long-term maintenance and monitoring; integrate invasive control with livelihood employment schemes; and promote native species regeneration.

Mitigating Linear Infrastructure Impacts

- Roads, railways, and power lines fragment habitats and cause mortality.
- Key Actions: Install underpasses/overpasses; enforce speed restrictions in wildlife zones; restrict new linear development in sensitive areas; and monitor wildlife mortality data.

Climate Change Adaptation

- Climate variability affects water availability, vegetation patterns, and species distribution.
- Key Actions: Protect climate refugia; enhance water retention structures; promote climate-resilient habitat restoration; and monitor vegetation shifts and phenology.

Community-Based Biodiversity Governance

- Local communities depend on forest resources but are also key partners in conservation.
- Key Actions: Strengthen Eco-Development Committees; promote alternative livelihoods; incentivise conservation-linked income; and conduct biodiversity awareness programmes.

Research, Monitoring and Adaptive Management

- Scientific data must guide conservation strategies.
- Key Actions: Establish long-term ecological monitoring plots; maintain GIS-based biodiversity dashboards; collaborate with research institutions; & conduct periodic biodiversity assessments.

Integrated Conservation Outcome: If systematically implemented, these measures will maintain ecological connectivity, protect endemic and threatened species, restore degraded habitats, strengthen ecosystem services, enhance climate resilience and promote sustainable coexistence.

3.7. ELEPHANT PROTECTION

The major threat to elephants despite stringent protection is from elephant poaching, fragmentation, loss and destruction of habitat, fragile wildlife corridors and human-elephant conflict.

The NER has management units encompassing tiger reserves (Mudumalai & Sathyamangalam TR), protected areas (Thanthai-Periyar, Cauvery North & South WLS) and forest divisions (Nilgiris, Gudalur, Erode, Dharmapuri & Hosur). Approximately, two-third (2/3rd) of the NER is part of the PA network and core area of the tiger reserve; and another one-third (1/3rd) under forest and forest-buffer zone.

Protecting elephants is a critical component of conservation efforts to ensure its well-being.

Integrated Protection Approach

Elephant protection in NER must operate at three interconnected scales: core habitat security; corridor connectivity & dispersal management; human-elephant coexistence in fringe landscapes (Table-3.9).

Table-3.9: Strategies for Elephant Protection

Problem	Location	Site-Specific Measures
Securing Core Habitats	• Mudumalai-Masinagudi interior forests (MTR) • Nilgiri plateau; • Hasanur ranges (STR)	• Strengthen anti-poaching patrol grids / intelligence • Maintain inviolate areas with minimal disturbance. • Regulate tourism intensity in Masinagudi belt. • Monitor elephant herds using camera traps
Corridor Protection and Bottleneck Management	• Moyar-Masinagudi corridor • Hasanur-Thalavadi belt • Palacode-Bargur linkages • Denkanikottai-Thally stepping-stone patches	• Legally notify and secure corridor lands. • Remove encroachments regulate land-use conversion. • Restore degraded patches and invasive-dominated strips. • Install wildlife underpasses where highways intersect corridors.
Habitat Restoration and Forage Enhancement	• Masinagudi vayals • Bhavani riparian belts • Eastern scrub forests (Dharmapuri & Hosur)	• Remove invasive species (Lantana, Prosopis). • Restore native grasslands. • Promote assisted natural regeneration. • Protect seasonal wetlands and springs.
Water Security and Drought Mitigation	• Moyar river basin • Palacode tanks • Denkanikottai dry tracts • Upper Nilgiris catchment	• Desilt and restore tanks and vayals. • Construct check dams and recharge structures. • Protect perennial springs. • Create distributed water refugia.
Conflict Mitigation and Community Protection	• Masinagudi village • sHasanur settlements • Morappur-Palacode belt • Thally-Denkanikottai villages	• Cluster solar fencing. • Early-warning SMS systems. • Rapid Response Teams (RRTs). • Promote low-attractant crops in high-risk belts. • Provide timely compensation for crop damage.
Regulating Linear Infrastructure	• Ooty–Gudalur road • Hasanur highway stretch • Hosur rail corridor	• Install underpasses/overpasses. • Enforce speed limits and night restrictions. • Monitor crossing points with camera traps.

	• Bhavani valley crossings	• Avoid expansion in narrow bottlenecks.
Managing Dispersing Bulls and Splinter Groups	• Moyar-Masinagudi dry-season dispersal routes • Dharmapuri agri. fringe • Hosur industrial interface	• Monitor individual movement patterns. • Use soft driving before considering capture. • Remove attractants near villages. • Strengthen corridor permeability.
Veterinary and Disease Surveillance	• Grazing belts in STR and Dharmapuri • Village–forest interfaces	• Livestock vaccination drives. • Monitor elephant health and carcass analysis. • Maintain wildlife veterinary units.

Implementation Strategies

Besides site-specific measures, the general strategy may also envisage the following:

- Strengthen anti-poaching efforts through increased patrolling, surveillance, and the use of technology such as drones and thermal imaging cameras and implement strict law enforcement.
- Protect and preserve elephant habitats, including critical migratory corridors and implement measures to reduce habitat fragmentation and human encroachment.
- Develop and implement strategies to reduce human-elephant conflicts, such as early warning systems, crop protection methods, and community education and provide timely compensation for crop and property damage caused by elephants.
- Install effective fencing, to protect agricultural areas and human settlements from elephant raids and explore the use of technological solutions like sensor-based fences.
- Establish rapid response teams to address emergencies, such as injured or distressed elephants and collaborate with local authorities, veterinarians, and wildlife rescue organizations.
- Engage local communities in elephant conservation, emphasizing the economic and ecological benefits of preserving, and establish community-based monitoring and protection programs.
- Consider translocating elephants in emergency situations where HEC is severe or when elephants are at risk and ensure comprehensive assessments before translocating elephants.

3.7.1 Vulnerable Areas and Species susceptible for poaching

Poaching vulnerability in NER is spatially variable and influenced by remoteness, proximity to inter-state borders, access routes, grazing pressure, and wildlife concentration zones. While core protected areas maintain strong protection regimes, buffer and transition zones remain comparatively more vulnerable.

The vulnerable areas and the species at risk (Table-3.10) in the NER, include:

Table-3.10: Vulnerable Areas in NER

Sector	Location	Vulnerability Factor	Species at Risk
Moyar-Masinagudi-Gudalur Interface	Buffer areas of MTR & adjoining Gudalur forests	• Tourism-related movement • Estate boundaries and revenue land patches • Night-time traffic corridors • Historical snaring incidents	Elephant (ivory), deer species (meat), small carnivores
Hasanur-Thalavadi-Bargur Belt	Eastern fringe of STR	• Proximity to inter-state forest boundaries • Grazing & for NTFP • Remote hill terrain • Fire-prone/ degraded patches	Elephant (tusks), gaur, sambar, wild pig, occasional carnivores
Palacode-Morappur-Pennagaram Sector	Dharmapuri Forest Division	• Dry deciduous scrub with lower protection density	Elephant (retaliatory killing), spotted deer,

		• Interspersed forest-settlements • Livelihood hunting (bushmeat) • Corridor-linked movement of dispersing bulls	black-naped hare, wild pig
Denkanikottai-Thally-Hosur Interface	Hosur Forest Division	• Industrial and urban expansion • Rail and highway corridors • Cross-border wildlife trade risk • Snaring incidents in fringe forests	Elephant (accidental electrocution), small mammals, reptiles
Bhavani Valley & Riverine Corridors	Interface between STR & Erode Division	• River access routes • Seasonal congregation of wildlife • Fishing and sand extraction pressures	Elephants, otters, turtles, ungulates

Species Susceptible to Poaching in NER include:

- *Asian Elephant*: Targeted for ivory (adult males); risk of retaliatory poisoning/electrocution in crop-conflict areas; and vulnerable during solitary dispersal in fringe landscapes.
- *Large Carnivores* (Indirect Risk): Tiger and leopard occasionally targeted through snaring meant for prey; and retaliatory killing in livestock depredation zones.
- *Ungulates*: Sambar, spotted deer, wild pig frequently targeted for bushmeat; and snare traps remain a major threat in degraded buffers.
- *Gaur*: Susceptible in remote dry forest belts; occasionally targeted for meat.
- *Small Mammals & Ground Birds*: Porcupine, hare, jungle fowl vulnerable to snaring and opportunistic hunting.
- *Reptiles and Aquatic Species*: Turtles and freshwater species vulnerable in riverine systems; and illegal collection risk in remote water bodies.

Emerging poaching threat patterns in the NER include:

- Increased snaring in grazing-dominated landscapes.
- Accidental electrocution due to illegal fencing.
- Poisoning linked to crop conflict.
- Cross-border wildlife trade vulnerability in eastern NER.
- Poaching attempts during drought when wildlife congregates.

High-Risk Periods in NER are:

- Dry season (water source congregation).
- Festival (Pongal/ Diwali) and holiday seasons (increased human mobility).
- Post-fire habitat vulnerability periods.
- Agricultural harvest periods.

Overall Vulnerability Status:

Zone	Vulnerability Level
Core Tiger Reserves & Sanctuaries (MTR/ STR/ TPWLS/ CWLS)	Low
Buffer & Revenue Forests	Moderate - High
Eastern Dry Forests	High
Industrial-Forest Interfaces	Moderate - High

Suggested Management Implications include:

- Increase patrol intensity in eastern and buffer belts.
- Strengthen intelligence networks and informant systems.
- Remove snares through systematic combing operations.
- Enforce strict action against illegal electric fencing.
- Improve inter-state coordination for wildlife crime control.
- Deploy technology (drones, SMART patrol, camera traps).

By identifying vulnerable areas, understanding the species at risk, and implementing protection strategies, it is possible to enhance the resilience of the NER against poaching threats.

3.7.2 Traditional migratory routes

The Nilgiri Elephant Reserve forms one of the largest contiguous elephant landscapes in southern India. Elephant movements here are not random; they follow long-established seasonal migratory routes shaped by water availability, forage cycles, elevation gradients, and social learning passed across generations. These routes link moist montane forests, river valleys, dry deciduous forests, and eastern scrub landscapes.

The elephants rigidly follow their traditional migratory path and range over to new habitats to fulfil their requirements, and such large home ranges and dispersal facilitate them to avoid inbreeding and maintaining gene flow among populations. The elephants normally take the same migratory path in the reverse direction following a cyclic spatio-temporal movement. This traditional migration is influenced by the availability of high-quality forage and water sources on a year-round basis. The six distinct routes, which elephants follow in the NER (Table-3.11), are as under:

Table-3.11: Traditional Migratory Paths of Elephants in NER

Route	Landscape	Seasonal Pattern	Constraints
Nilgiri Plateau → Moyar Valley Descent Route	From Upper Nilgiris plateau down toward Glenmorgan–Singara–Moyar	Dry-season descent (February–June) when plateau grass moisture declines	Road traffic (Ooty–Gudalur), estate fencing, invasive spread
Mudumalai (Moyar) ↔ Sathyamangalam (Hasanur–Bhavani) Corridor	Moyar valley linking MTR to STR via Hasanur and Thalavadi	Bidirectional seasonal exchange depending on rainfall and forage availability	Highway traffic in Hasanur stretch, grazing pressure, fire recurrence
Sathyamangalam ↔ Bhavani Valley ↔ Erode Linkage	Bhavani river basin linking STR interior forests to Erode division	Dry-season congregation near riverine strips; dispersal during monsoon flush	Riverbank agriculture, sand extraction, irrigation canals
Sathyamangalam → Dharmapuri (Palacode–Morappur) Expansion Route	From Hasanur–Bargur hills into Dharmapuri Forest Division scrub forests	Increasingly used in recent decades due to population expansion & habitat compression	Fragmented scrub forest, agricultural interface, water scarcity
Dharmapuri → Hosur (Denkanikottai–Thally) Stepping-Stone Route	Easternmost dispersal route into Hosur Forest Division	Irregular but increasing usage, especially solitary bulls	Industrial expansion, highways, rail lines, settlement growth
Gudalur–Wayanad Cross-Border Movement (West Link)	Gudalur forests linking to Kerala landscapes (Wayanad side)	Monsoon-driven movement following rainfall gradients	Estate fencing, settlement sprawl, linear infrastructure

Key ecological characteristics of NER migratory routes may be summarised as under:

- *Elevation Gradient Movement*: Plateau → Valley → Eastern scrub.
- *Water-Driven Seasonal Shifts*: Rivers (Moyar, Bhavani) as anchors.
- *Social Learning*: Routes transmitted across generations.
- *Corridor Dependence*: Narrow bottlenecks critical for continuity.
- *Adaptive Expansion*: Increasing eastern dispersal due to habitat compression

Major Bottleneck zones of NER migratory routes include:

- Moyar valley crossing points
- Hasanur–Thalavadi highway stretch
- Palacode scrub–agriculture interface
- Denkanikottai fragmented patches
- Estate-bordered strips in Gudalur

Safeguarding these traditional pathways is fundamental to maintaining genetic flow, reducing habitat compression, and sustaining long-term population viability across the NER landscape.

3.7.2.1 Historic data and information on large mammal movements

Accessing historic data and information on large mammal (elephant) movements in NER is critical for understanding behaviour, planning conservation strategies, and mitigating human-elephant conflicts.

Historical population baselines and broad patterns

- Early surveys and syntheses (1990s–2000s) estimated thousands of elephants across the Nilgiri / Western-Eastern Ghats interface - a large, regionally viable population whose home-ranges and seasonal movements span hundreds to thousands of sq. km.

Long-term monitoring methods used

- Historic and ongoing work methods viz. systematic range-level censuses, camera-trap grids, patrol / incident records, local ecological knowledge, and radio- or satellite-telemetry of individual animals plus community reporting have helped to reconstruct seasonal routes and pinch points.

Documented elephant movement routes and seasonal patterns

- Field studies and synthesis work repeatedly record key seasonal axes: descent from the Nilgiri plateau into the Moyar-Masinagudi valley in the dry season; east-west linkages through Hasanur connecting Mudumalai ↔ Sathyamangalam; riverine movements along the Bhavani and Moyar; and increasing dispersal into Palacode-Dharmapuri and Denkanikottai-Hosur in some years. These routes are persistent but have shifted or become constrained where corridors narrow.

Changes over time and drivers of movement-pattern shifts

- Longitudinal analyses show that movement patterns have been altered by: (a) landscape change (plantation/settlement expansion, road/rail works), (b) water-resource variability (drying of vayals/springs), (c) fire and invasive plant dynamics that change forage distribution, and (d) demographic factors (male dispersal). Where these pressures intensify, elephants concentrate at remaining refugia or open new dispersal paths - often increasing HEC.

Human–elephant conflict (HEC) history & its relation to movement

- HEC incident databases compiled over decades show thousands of crop-raid events and multiple human and elephant casualties in the NER landscape; trend analyses link peaks in HEC to drought years, corridor blockage, and periods of high male dispersal. Historical HEC studies provide the empirical link between changing movement and rising conflict.

Movements of other large mammals and multi-species connectivity

- NER's large-mammal network is multi-taxa: tiger and leopard movement patterns mirror corridor connectivity needs, gaur and deer use riverine strips and dry deciduous blocks, and Nilgiri tahr show altitudinal movements on the plateau. Conservation surveys highlight that protecting elephant routes also benefits these taxa i.e., corridors are multi-species lifelines.

Historic conservation responses & monitoring evolution

- Project Elephant and TCP/ Working/ Management Plans have progressively institutionalised corridor protection. Over the last 2-3 decades, management has shifted from ad-hoc responses to mapped corridor protection, mitigation engineering (crossings, fencing clusters), and integrated monitoring dashboards - though implementation gaps remain in some pinch points.

Key Movement Milestones in NER: Free seasonal migration (pre-1970s); fragmentation and rising conflict (1980s–1990s); structured elephant monitoring (1992); NER formalised (2007); strengthened eastern habitat security (2013); expansion into new eastern landscapes (2014–2020); and climate and infrastructure-driven movement shifts (2020).

3.7.2.2 Monitor migratory and seasonal movements and demarcation of corridors

Monitoring migratory and seasonal movements requires systematic documentation of dry-season descent, east-west exchanges, eastern dispersal, & monsoon redistribution patterns across all divisions.

- *Seasonal registers* at range level, congregation mapping during drought, and identification of repeated crossing points form the foundation of movement monitoring.
- *Camera traps* strategically placed at bottlenecks, river crossings, road intersections, and dispersal edges help identify herd composition, frequency of corridor use, & emerging movement paths. Where feasible, *GPS telemetry* on selected individuals provides detailed insights into home-range variation and corridor dependence, especially in expanding eastern landscapes.
- *Patrol-based SMART monitoring* strengthens ground intelligence by geo-tagging sightings, recording track and dung density, mapping disturbance points, and detecting snaring or obstruction risks. Complementing this, *community intelligence networks* in fringe villages provide early-warning inputs and help document newly emerging routes near settlements.
- *Remote sensing and GIS* tools support landscape-scale monitoring by tracking vegetation productivity (NDVI), land-use change in corridor belts, water persistence, and overlaying HEC heat maps with movement data. This allows predictive assessment of seasonal movement shifts and corridor stress.
- *Scientific demarcation of corridors* relies on integrating historical records, camera-trap frequency, telemetry data, transect surveys, and local knowledge to identify repeatedly used, ecologically significant movement strips. Corridors are then classified into primary, secondary, dispersal routes, and stepping-stone habitats based on frequency and functional importance.
- *Field demarcation* involves ground-truthing, mapping corridor width, identifying obstructions, installing boundary markers in critical bottlenecks, and assessing land-use status. Legal recognition through corridor notifications (Sigur corridor), integration into Working Plans, and inclusion in district land-use planning ensures regulatory protection.
- *Infrastructure overlays* are assessed to identify intersections with roads, railways, canals, and settlements, enabling mitigation planning through underpasses, speed restrictions, and traffic management. Monitoring corridor health through indicators such as crossing frequency, land-use stability, invasive cover, mortality rates, and conflict trends supports adaptive management.

Effective monitoring of elephant migrations and establishment of corridors in the NER begins with systematic documentation of seasonal movement patterns across NER. This involves maintaining seasonal registers, mapping congregation sites, and recording crossing points during dry and monsoon periods. Camera traps at bottlenecks and river crossings, combined with GPS telemetry, provide detailed data on herd composition, route fidelity, and dispersal trends, while SMART patrol systems and geo-tagged field observations strengthen ground-based tracking.

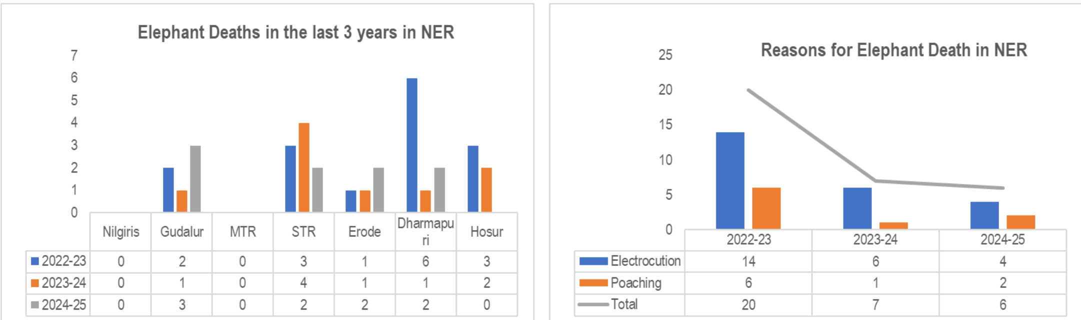
These data are integrated into GIS platforms to overlay movement routes with land-use patterns, water sources, and conflict heat maps, enabling identification of primary corridors, secondary routes, and emerging dispersal pathways. Scientific corridor delineation follows repeated-use criteria, ecological significance, and absence of viable alternate routes, supported by ground-truthing and width assessment. Continuous monitoring of corridor health- using indicators such as crossing frequency, habitat condition, invasive cover, mortality rates, and conflict incidence- ensures adaptive management, restoration of degraded bottlenecks, and sustained landscape connectivity across NER.

By combining technological advancements, community engagement, and ecological assessments, it is possible to monitor migratory movements and establish corridors contributing to long-term conservation.

3.7.3 Unnatural Deaths of the Elephants

Unnatural deaths of elephants in the Nilgiri Elephant Reserve (NER) primarily result from human-induced factors rather than natural ecological causes.

The most common causes include electrocution from illegal or poorly maintained electric fences in agricultural fringes (Dharmapuri & Hosur belts) (Fig-3.15), retaliatory poisoning following crop damage, snaring intended for bushmeat species, and collisions with vehicles along high-traffic stretches near Masinagudi and Hasanur. In some cases, irrigation canals without escape structures also contribute to accidental mortality. Dispersing solitary bulls are vulnerable when moving through fragmented scrub forests and settlement interfaces, where they encounter hazardous fencing, open wells, or hostile crowd. Linear infrastructure expansion, encroachments into corridors, and increased night-time human activity elevate mortality risk in bottleneck zones such as Moyar valley, Palacode scrub, and Denkanikottai fringes. While poaching for ivory has historically been a concern, current trends in NER show that electrocution and conflict-related incidents account for major reason for unnatural deaths (Fig-3.15).



	Nilgiris	Gudalur	MTR	STR	Erode	Dharmapuri	Hosur
2022-23	0	2	0	3	1	6	3
2023-24	0	1	0	4	1	1	2
2024-25	0	3	0	2	2	2	0

	2022-23	2023-24	2024-25
Electrocution	14	6	4
Poaching	6	1	2
Total	20	7	6

Fig-3.15: Unnatural Elephant deaths in the last 3 years in NER and major reasons for the deaths

Major reasons for unnatural deaths are summarized as under:

- **Electrocution**: Illegal high-voltage fencing around agricultural fields; sagging or low-hanging power transmission lines; and improperly installed electric deterrent systems
- **Retaliatory Poisoning**: Poisoned bait placed in crop fields; and chemical contamination of food sources after conflict incidents
- **Poaching for Ivory**: Targeted killing of tuskers; and removal of tusks post-mortem
- **Snaring and Wire Traps**: Wire snares set for bushmeat species; cable traps in scrub forests and grazing belts; and accidental entanglement leading to fatal injuries
- **Road Accidents** (Vehicle Collisions): High-speed traffic in corridor stretches; night-time vehicle movement in crossing zones; and poor visibility and lack of speed regulation
- **Railway Accidents**: Elephant crossings along rail corridors; and night-time train movement without warning systems
- **Irrigation Canal and Open Well Incidents**: Falling into open agricultural wells; and drowning in canals without escape ramps
- **Quarrying and Blasting-Related Trauma**: Injuries from rock blasting near forest fringes; and disorientation leading to accidents
- **Habitat Fragmentation-Induced Conflict Mortality**: Deaths resulting from increased human–elephant interface; and crowd aggression during village incursions

- **Disease Transmission Linked to Human Interface**: Infections from livestock contact; and secondary infections following snare injuries

Effective reduction of unnatural mortality requires strict enforcement against illegal electric fencing, installation of wildlife-friendly infrastructure, speed regulation on highways, rapid conflict response teams, improved waste and crop management practices, and systematic investigation of every carcass through forensic protocols (*TN Elephant Death Audit Framework*). Continuous monitoring, GIS-based hotspot analysis, and community engagement are essential to minimise human-induced elephant deaths and sustain long-term population stability across the NER landscape.

3.7.4 Anti- Electrocution Measures

Electrocution is one of the leading unnatural causes of elephant mortality in NER, particularly in agricultural fringes and dispersal corridors. Electrocution risk varies across divisions depending on agriculture intensity, dispersal frequency, corridor bottlenecks, and infrastructure density (Table-3.12).

Table-3.12: Ranking of divisions based on relative risk with priority interventions

Division	Risk Level	Risk Drivers	Priority Actions
Hosur (Denkanikottai-Thally Interface)	Very High	• Expanding industrial and peri-urban agriculture • Narrow stepping-stone habitats • Power infrastructure density	• Corridor-safe electrical design guidelines • Real-time power fault monitoring systems • Annual inter-department safety audit
Dharmapuri (Palacode-Morappur Sector)	Very High	• Rainfed agriculture interspersed with forest • Frequent dispersal of solitary bulls • High incidence of improvised fencing	• Intensive illegal fence removal campaign • Cluster solar fencing subsidies • Dedicated electrocution monitoring • Transformer relocation from corridor edges
STR (Hasanur-Thalavadi Belt)	High	• Extensive agri. interface • Dispersing bulls in eastern slopes • Illegal electric tapping incidents	• Joint Forest–EB enforcement drive • Installation of Earth Leakage Circuit Breakers (ELCBs) • Corridor-specific line height • Monthly monitoring in hotspots
Erode (Bhavani Valley)	Moderate-High	• Irrigated agriculture • Riverine corridor movement • Canal-side electric installations	• Install ELCBs in riverine agricultural belts • Provide canal escape ramps • Conduct seasonal patrols during peak crop stages
MTR (Masinagudi-Moyar Belt)	Moderate–High	• Agricultural fringes near Masinagudi • Sagging distribution lines in valley stretches • High dry-season elephant concentration	• Pre-summer inspection of fringe power lines • Mandatory certification of solar fencing • Transformer insulation in corridor crossings
Gudalur	Moderate	• Tea estate boundaries • Mixed revenue–forest mosaic	• Estate compliance audits • Promote wildlife-safe fencing • Inspection before monsoon
Nilgiris (Upper Plateau/ Slopes)	Low–Moderate	• Estate fencing • Occasional sagging lines in ghat roads	• Inspection of estate boundary • Maintain statutory line clearance • Awareness in plantation managers

Implementation Strategies

Effective prevention requires engineering corrections, strict enforcement, community engagement, and continuous monitoring.

- *Elimination of Illegal High-Voltage Fencing:* Conduct joint Forest-EB Department inspections in fringe villages; remove direct line tapping and high-voltage hooking; register and monitor repeat offenders; and establish toll-free reporting mechanisms for illegal fencing (Priority Zones: Palacode–Morappur, Denkanikottai–Thally, Hasanur belt)
- *Standardisation of Solar Fencing*: Promote approved low-voltage solar fencing designs; provide technical guidelines and subsidy schemes; ensure earthing systems comply with wildlife-safe standards; and conduct annual certification audits of installed fences (Objective: Shift from hazardous to regulated deterrence systems)
- *Insulation and Height Correction of Power Lines:* Raise sagging lines in elephant crossing zones; install insulated covering on low-hanging distribution lines; replace exposed transformers in corridor belts; and ensure minimum statutory ground clearance in forest fringes (High-Risk Stretches: Moyar valley, Hasanur road sections, Palacode scrub interface).
- *Installation of Automatic Power Trip Systems:* Deploy earth-leakage circuit breakers (ELCBs); install automatic trip switches in agricultural belts; and integrate smart meters to detect illegal tapping (Outcome: Immediate cut-off when fault current occurs).
- *Community Awareness and Behavioural Change:* Conduct seasonal awareness campaigns before harvest; educate farmers on legal consequences of electrocution; demonstrate safe fencing alternatives; and encourage cooperative cluster fencing instead of individual risky setups.
- *Rapid Response & Investigation Protocol:* Immediate site inspection within 12-24 hours of any elephant carcass report; forensic documentation of electrocution cause; prosecution under Wildlife (Protection) Act; and publicly reinforce legal accountability to deter repeat incidents.
- *Corridor-Specific Safeguards:* Identify electrocution hotspots using GIS mapping; conduct preventive inspections before dry season dispersal; avoid new electrical infrastructure in narrow bottlenecks; and relocate transformers away from corridor edges.
- *Monitoring & Data Integration:* Maintain division-wise electrocution database; overlay mortality data with land-use and fencing density; update risk maps annually; and share data across divisions for early-warning alerts.
- *Incentive and Compliance Mechanisms:* Provide subsidies for wildlife-safe fencing; offer insurance-linked compliance incentives; reward villages with zero electrocution incidents; and integrate compliance with compensation schemes.
- *Inter-Departmental Coordination:* Establish joint enforcement task force (Forest - TANGEDCO - Police); conduct pre-monsoon safety audits; ensure transformer fencing & grounding standards in forest edges; and develop SOP for power shutdown during elephant congregation events.

Expected Outcomes: Significant reduction in electrocution deaths; improved farmer compliance; safer corridor movement; reduced retaliatory conflict; and strengthened inter-departmental accountability.

Strategic focus for NER: Target high-risk eastern divisions first; standardise on fencing; and upgrade necessary infrastructure with strict enforcement.

3.7.5 Anti-Poaching Measures

Poaching threats in NER include ivory targeting of tuskers, snaring for bushmeat, retaliatory poisoning/ electrocution, and illegal wildlife trade across inter-state borders. Anti-poaching strategy must therefore be multi-layered -

- Prevention (patrolling & surveillance)
- Detection (technology & intelligence)
- Enforcement (legal & inter-agency coordination)
- Community partnership (livelihood support & awareness).

Following high-risk zones have been identified in respect of poaching:

- Moyar - Masinagudi corridor
- Hasanur - Thalavadi belt
- Palacode - Morappur scrub forests
- Denkanikottai - Thally fringe
- Bhavani riverine zones

Implementing effective **anti-poaching measures** is crucial for the protection of elephants in NER. Key anti-poaching measures for elephant reserve envisages:

- *Strengthening Patrolling Systems:* Deploy grid-based patrolling in core and buffer forests; use SMART patrolling for geo-tagged tracking of sightings and illegal activities; increase patrol frequency in eastern dry forests (Dharmapuri, Hosur) and corridor bottlenecks (Hasanur, Moyar); and conduct seasonal intensified patrols during drought and festival periods (Objective: Early detection of illegal entry and snaring activity).
- *Anti-Poaching Camps (APCs)*: Establish strategically located APCs in remote forest beats; maintain permanent presence in high-risk belts (Hasanur-Bargur, Palacode scrub); equip camps with communication, GPS, and night-vision devices; and ensure mobility through motorbikes and patrol vehicles (Objective: Rapid response and deterrence presence).
- *Intelligence Network and Informant System*: Develop confidential informant networks in fringe villages; coordinate with Wildlife Crime Control Bureau (WCCB); monitor cross-border wildlife trade routes; and track repeat offenders and suspicious movement patterns (Objective: Shift from reactive to intelligence-led enforcement).
- *Snare Detection and Removal Drives*: Conduct systematic combing operations in dry deciduous forests; use trained detection teams for wire-snare hotspots; map snaring patterns and maintain database; and intensify removal before peak poaching seasons (Objective: Reduce accidental capture of elephants and prey species).
- *Control of Illegal Electric Fencing and Poisoning*: Joint enforcement with electricity department; regular inspection of fringe agricultural belts; immediate legal action against high-voltage fencing; and awareness campaigns on legal fencing standards (Objective: Prevent retaliatory and accidental elephant deaths).
- *Technology-Based Surveillance*: Install camera traps in sensitive corridors; use drone reconnaissance in remote areas (Gudalur); deploy thermal imaging for night patrols; integrate real-time GIS dashboards for monitoring (Objective: Improve surveillance efficiency & coverage).
- *Strengthening Legal Enforcement*: Fast-track prosecution of wildlife crime cases with prosecution support; train field staff in evidence collection and documentation; conduct joint enforcement drives across divisions; and ensure coordination between forest, police, and revenue departments (Objective: Increase conviction rates and deterrence).
- *Super Sniffer (K9) Dogs:* Deploy specially trained super sniffer dogs (trained by WWF-Traffic India) to detect wildlife products, firearms, and other illegal items during patrols and inspections.

The following breeds are popular choices to be trained as Super Sniffer dogs: Belgian Malinois. German Shepherd Dogs. Labradors (Objective: Deter illegal trade of wildlife products).

- *Community Engagement & Livelihood Diversification*: Strengthen Eco-Development Committees (EDCs); provide alternative livelihood schemes to reduce bushmeat dependence; Involve communities in snare removal and monitoring; and promote conservation-linked incentives (Objective: Reduce socio-economic drivers of poaching).
- *Cross-Division and Inter-State Coordination*: Conduct joint patrols across division boundaries; share intelligence with adjoining divisions/ states; monitor inter-state movement corridors; and standardise enforcement protocols (Objective: Address landscape-scale wildlife crime).
- *Wildlife Mortality Monitoring*: Immediate investigation of carcasses; forensic analysis of tusk removal cases; maintain mortality database with cause classification; and identify emerging poaching trends (Objective: Detect patterns and prevent recurrence).
- *Capacity Building*: Train frontline staff in anti-poaching tactics; conduct periodic refresher courses; provide modern equipment and protective gear; and incentivise high-performance patrol teams (Objective: Strengthen field-level operational effectiveness).

Implementing a combination of these measures, customized to the specific context of the NER divisions, can significantly enhance the protection of elephants against poaching.

3.7.5.1 Anti-poaching camps and facilities

Anti-poaching camps (APCs) are constructed in remote parts of forests and lack basic facilities like power source or water connection. Establishing anti-poaching camps in NER (Fig-3.16) is extremely crucial to protect wildlife including elephants and maintain the ecological balance of their habitats.

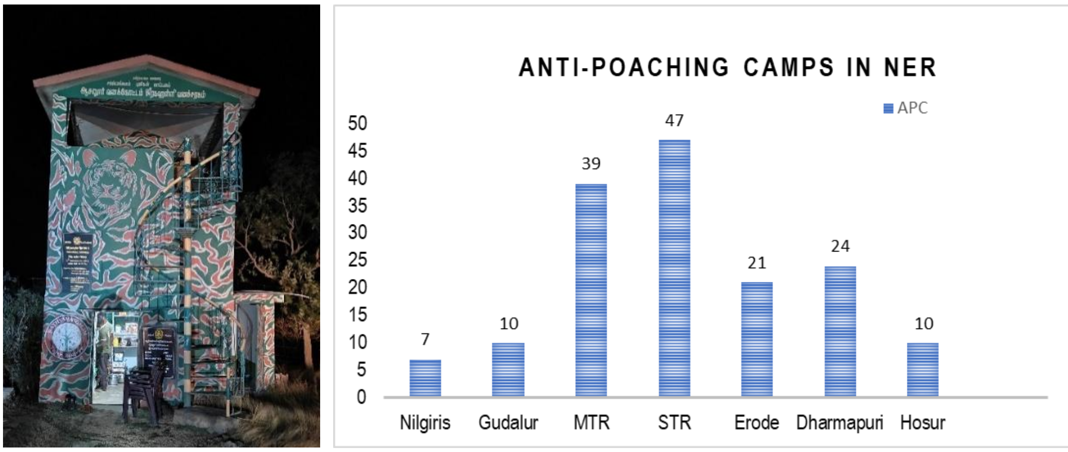


Fig-3.16 Anti-poaching camp in STR and total number of APCs in NER

Key aspects to consider when establishing camps are:

- Identify high-risk zones within the elephant reserve where poaching is more likely to occur and establish well-equipped and strategically located anti-poaching camps in these areas.
- Recruit the anti-poaching staff from the local villages, and help them work better, and efficiently by providing them with the field kits containing camouflaged uniform, caps, water bottles, backpacks, mosquito nets and repellents, binoculars, shoes and socks, first aid medical kit etc.
- Construct eco-friendly, sustainable and renewable energy-based anti-poaching camps using green building concepts, and reducing carbon footprint; the camp can be built with local materials and pre-fabricated hollow cement blocks which also provide thermal comfort.
- Provide accommodation facility and kitchen on the ground floor and observation room for round-the-clock vigil with the aid of high-resolution binoculars and a drone operating station on the first floor in the camp.

- Supply of good quality ration (rice, pulses, oil) and weekly supply of meat motivate the APWs to stay in the camps (FWT-cum-APC camp @ Palayam beat, Jeerahalli Range, STR).
- Construct an elephant-proof trench with an additional power fence around the anti-poaching camp for the protection against wild elephants and other animals.
- Instal rainwater harvesting system with the water storage facility to meet the water demand.
- Instal solar power energy panels with LED bulbs for power supply and fuel-efficient biomass cook stoves may be provided to conserve wood and create a smoke-free environment.
- Prohibit plastic usage in the camps and sustainable waste disposal to be encouraged.
- Equip the anti-poaching squads with appropriate gear, communication devices (wireless), night-vision equipment, and non-lethal deterrents.
- Develop skill of the anti-poaching squads with a curriculum including practical exercises and interactive sessions in wildlife tracking, surveillance, weapon operation, ambush, fire control methods, data collection and reporting, field investigation and law enforcement etc.
- Conduct regular training sessions for anti-poaching squads to ensure their skills are up-to-date and evaluate the effectiveness of the implemented strategies and make adjustments accordingly.

3.7.5.2 Developing Intelligence network and linkages

Effective elephant protection in NER requires a proactive, intelligence-led enforcement system that operates across divisions (Nilgiris, Gudalur, MTR, STR, Erode, Dharmapuri & Hosur) and coordinates with inter-state and national agencies. The goal is to prevent poaching, electrocution, retaliatory killing, and wildlife trafficking before incidents occur.

Developing an intelligence network and establishing linkages in NER is crucial for effective conservation and protection. Key steps to consider when developing such a network include:

- *Establishing a Multi-tier Intelligence Structure*

– *Tier 1: Beat-Level Informant Network*: Identify reliable community informants in fringe villages; maintain confidential reward-based reporting system; engage former offenders as monitored informants (where legally appropriate); and create village-level contact registry for rapid alerts.

– *Tier 2: Range & Division Intelligence Cells*: Designate Intelligence Officers at Division level; maintain offender watch-list and movement patterns; compile snaring/electrocution hotspot data; and conduct periodic risk assessments.

– *Tier 3: Landscape Coordination Cell (NER Level)*: Create NER Intelligence Coordination Unit; centralise wildlife crime database; share alerts across divisions in real time; and integrate GIS-based hotspot dashboards

- *Strengthening Inter-Agency Linkages:* Coordinate with Wildlife Crime Control Bureau (WCCB); establish joint task force with Police and Revenue Department; link with Electricity Department for electrocution prevention; and develop MoU-based intelligence sharing with neighbouring states (Objective: Break inter-state wildlife trade networks).
- *Corridor-Focused Intelligence Surveillance in High-risk Areas:* Monitor suspicious night movement; track sale of wire coils (snaring materials); map illegal electric line tapping and identify new encroachment patterns.
- *Community Intelligence & Incentives:* Institute suitable incentive/ scheme (Wildlife Guardian) in the village; reward actionable intelligence leading to conviction; protect anonymity of informants; and conduct awareness sessions on legal penalties.
- *Technology-Enabled Intelligence:* Use camera traps at sensitive crossing points; install covert surveillance near repeat hotspots; monitor mobile communication patterns (where legally authorised); and develop confidential WhatsApp alert groups for field officers.

- *Data Integration & Analytics:* Maintain unified wildlife crime database; Geo-tag snaring and mortality sites; analyse seasonal trends; and develop predictive risk models (drought - conflict - poaching overlay).
- *Capacity Building:* Train staff in intelligence gathering techniques; conduct mock investigation exercises; improve evidence collection and forensic handling; provide legal awareness training.
- *Rapid Response and Legal Follow-Up*: Ensure response within 12-24 hours of actionable tip; fast-track filing of cases under Wildlife Protection Act; monitor prosecution progress; and publicise convictions to deter offenders.
- *Monitoring High-Risk Individuals:* Maintain record of repeat offenders; monitor suspicious electrical contractors and scrap dealers; and track sale of illegal wildlife products.
- *Inter-Division Movement Monitoring:* Share intelligence when dispersing bulls move across divisions; alert divisions when conflict escalates; and monitor ivory seizure patterns regionally.

Expected Outcomes: Early detection of poaching attempts; reduction in electrocution and snaring incidents; improved conviction rates; stronger community participation; and secured elephant corridors.

By building a strong intelligence network and fostering collaboration among various stakeholders, it becomes possible to gather and disseminate information efficiently, respond promptly to threats, and enhance the overall conservation efforts in the reserve.

3.7.5.3 Creation of Enforcement Cell

The responsibility of law enforcement in Elephant Reserves is with the administrative units and their efforts are complemented by the WCCB - a premier wildlife enforcement agency. The creation of an enforcement cell and collaboration with other enforcement agencies are vital components of a comprehensive strategy to protect elephant reserves.

The establishment of a dedicated Enforcement Cell in NER is essential to strengthen intelligence-led protection of elephants and other wildlife across Nilgiris, Gudalur, Mudumalai Tiger Reserve, Sathyamangalam Tiger Reserve, Erode, Dharmapuri and Hosur forest divisions. The Cell should function as a specialised, landscape-level unit focused on preventing poaching, electrocution, retaliatory killings, snaring, wildlife trade, and corridor encroachments.

Objectives

- Prevent wildlife crimes, especially elephant-related offences.
- Centralise intelligence gathering and crime analysis.
- Coordinate enforcement across divisions and inter-state borders.
- Improve conviction rates through strong investigation and legal follow-up.
- Reduce unnatural elephant mortality.

Organisational Structure

- *NER-Level Enforcement Cell* (Headquarters): supported by Intelligence-cum-Surveillance officer, GIS & Data Analyst; and Field (operations) coordinator
- *Division-Level Enforcement Units*: One designated Enforcement officer per division and beat-level intelligence coordinators. Linked directly to the NER HQ Cell.

Functional Components

- *Intelligence & Surveillance Wing*: Maintain confidential informant network; monitor high-risk zones (Palacode, Denkanikottai, Hasanur, Moyar); track illegal fencing and snaring patterns; and maintain offender database.
- *Rapid Response & Field Operations*: Deploy mobile enforcement teams; respond within 12-24 hours of actionable intelligence; conduct joint raids with police when required; and seize illegal equipment (wire snares, electrical lines).

- *Legal & Prosecution Support*: Ensure proper evidence collection; coordinate forensic analysis; fast-track filing of cases under Wildlife (Protection) Act; and monitor court proceedings and conviction status.
- *Data & GIS Monitoring Unit*: Maintain wildlife crime dashboard; map electrocution, snaring, and poaching hotspots; analyse seasonal risk patterns; and generate monthly enforcement reports.

Management Implications

- *Technological Integration*: SMART patrolling; drone surveillance in remote belts; camera traps in corridor bottlenecks; real-time communication network; and confidential tip-line system.
- *Capacity Building*: Training in wildlife crime investigation; forensic and evidence documentation workshops; intelligence-gathering techniques; and legal awareness for field officers.

3.7.5.4 Coordination & involvement of other enforcement agencies

Effective elephant protection in the NER depends on strong coordination with multiple enforcement and regulatory agencies beyond the Forest Department. Given the landscape's inter-division spread and high human-elephant interface, a structured multi-agency framework is essential to prevent poaching, electrocution, encroachment, and illegal wildlife trade.

- *Police Department*- plays a critical role in investigating wildlife crimes, arresting offenders, supporting intelligence gathering, and managing law-and-order situations during conflict incidents. Joint Forest–Police task forces, shared intelligence systems, and coordinated seasonal patrols strengthen deterrence and improve prosecution outcomes.
- *Electricity Department*- Coordination with the EB is vital to prevent elephant electrocution. Joint inspections of agricultural fringes, removal of illegal power tapping, installation of safety devices such as ELCBs, and pre-season safety audits reduce infrastructure-related mortality risks.
- *Revenue Department*- supports corridor protection by preventing encroachments, regulating land-use conversion, and integrating corridor maps into district planning processes. Joint verification drives help secure bottlenecks and movement pathways from fragmentation.
- *Wildlife Crime Control Bureau*- collaboration enhances intelligence sharing on ivory trafficking and organised wildlife crime networks. Inter-state coordination and joint enforcement operations are particularly important in eastern and border landscapes.
- *Transport Department*- contributes by enforcing speed limits, installing wildlife crossing signage, and regulating heavy vehicle movement in corridor stretches such as Hasanur and Masinagudi, thereby reducing collision risks.
- *District Administration & Disaster Management Authorities*- assist during large-scale elephant movement events, droughts, fires, or conflict escalation by coordinating emergency responses and resource mobilisation.
- *Judicial & Prosecution agencies*- strengthen deterrence by ensuring proper legal follow-through, expediting trials under the Wildlife (Protection) Act, and increasing conviction rates through effective case monitoring.
- *Inter-state forest authorities*- coordinate joint patrols and intelligence exchange to secure cross-border elephant movement routes and prevent wildlife crime displacement.
- *Local Panchayats & community institutions* involvement enhances grassroots vigilance. Village wildlife committees, reporting systems, and compliance incentives foster local ownership in protecting elephants and reducing illegal activities.

Overall, integrated enforcement, shared intelligence, and joint accountability across agencies form the foundation of effective elephant protection in the NER landscape.

3.7.5.5 Sustaining Anti-poaching operations

Sustaining anti-poaching operations in the NER envisages:

- *Institutional Continuity*: through a permanent Enforcement or Anti-Poaching Cell operating across all divisions. Dedicated officers, a clear command structure, and stability in staff postings are essential to maintain operational consistency and long-term accountability.
- *Grid-based & SMART-enabled Patrolling:* must continue systematically, ensuring geo-tagged coverage of core habitats, corridors, and high-risk eastern belts. Regular quarterly reviews help identify coverage gaps and maintain patrol intensity, particularly in vulnerable scrub and buffer landscapes.
- *Intelligence-led Operations*: are central to sustainability. Maintaining confidential informant networks, tracking repeat offenders, analysing crime patterns, and sharing intelligence across divisions and with enforcement agencies shift the approach from reactive response to predictive prevention.
- *Financial Sustainability*: is equally important. Dedicated budget allocations under Project Elephant or related schemes, convergence with other funding sources, timely maintenance of vehicles and communication systems, and incentives for frontline staff ensure operational readiness and morale.
- *Technology Integration*: strengthens surveillance and monitoring. Continuous use of camera traps, drone reconnaissance in remote belts, GIS-based hotspot dashboards, and early-warning systems enhances detection efficiency and strategic deployment.
- *Capacity building & Motivation*: of field staff sustain effectiveness. Regular training in wildlife crime investigation, legal procedures, and evidence handling, combined with provision of modern equipment and recognition of performance, improve professionalism and morale.
- *Preventive Drives*: targeting snaring and electrocution remain critical. Seasonal combing operations, inspections of illegal fencing, maintenance of mortality databases, and intensified enforcement during harvest periods reduce recurring threats.
- *Community Partnership:* strengthens long-term deterrence. Engagement through Eco-Development Committees, alternative livelihood support, village vigilance groups, and confidential reporting mechanisms reduces local drivers of wildlife crime.
- *Inter-agency Coordination:* ensures comprehensive enforcement. Regular meetings with police, electricity, revenue, and other departments, along with joint drives and shared data systems, improve enforcement reach and accountability.
- *Sustained Monitoring & Evaluation:* using measurable indicators- such as snare removal numbers, electrocution incidents, case detection rates, conviction rates, and patrol coverage- enable adaptive management and ensure that anti-poaching operations remain effective over time across the NER landscape.

3.7.5.6 Maintenance of Village level Crime Dossiers

Maintaining village-level crime dossiers in the NER is an important tool for intelligence-led elephant protection. By documenting wildlife crime patterns at the village scale, authorities can identify repeat offences, monitor electrocution and snaring hotspots, and detect emerging risks in corridor-edge and high-conflict settlements across Nilgiris, Gudalur, MTR, STR, Erode, Dharmapuri and Hosur divisions.

Each village dossier should contain a structured profile including basic geographic and livelihood details, past wildlife crime incidents, records of electrocution or poisoning cases, offender history based on legally documented cases, and seasonal conflict trends (Box-3.1).

Box-3.1: Documents kept in the Case File

- Personal file (dossier) of the offender; Photograph; and Name, Father's name and address;
- Personal descriptions, date of birth/ age, place of birth, sex, hair, colour of eyes, complexion, height, weight, built, citizenship, language spoken, identification marks;
- Important personal information, telephone/ mobile phone number, e-mail address, passport number, bank account details, Aadhaar No./identity card;
- Current/previous occupations list of properties owned; including of Associates/relatives;
- Crime history and brief cases of the wildlife, case(s) against him; and Crime modus operandi;
- Area of his activities; Victim and witness statement; and Medical and forensic reports;
- Legal and investigative document; and Previous acquittals/convictions;
- If declared proclaimed offender, details; and any other remarks.

Digitally integrating these dossiers into a secure database linked with GIS-based hotspot mapping allows periodic updating and spatial analysis of crime trends. Regular quarterly and annual reviews ensure that the information remains current and operationally useful, while strict legal and confidentiality safeguards prevent misuse or inclusion of unverified allegations.

Operationally, village crime dossiers support targeted patrolling, intelligence strengthening, enforcement prioritisation, infrastructure inspections, and focused community awareness campaigns. By shifting enforcement from reactive responses to preventive, data-driven action, village-level crime documentation enhances early detection of risks and strengthens long-term elephant protection across the NER landscape.

3.8 ELEPHANT HEALTH MONITORING, VETERINARY CARE AND CAPTIVE MANAGEMENT

Wildlife health monitoring in NER is essential for the early detection of diseases, identification of potential threats to the population, and the overall conservation of the ecosystem.

For the purpose of planning health monitoring strategies and also programs for their implementation, the population must be divided into free-range and captive elephants (which includes elephant camps, temples, privately owned animals and zoos).

3.8.1 Elephant Health Monitoring

Elephant health monitoring in NER is critical for ensuring long-term population viability, reducing unnatural mortality, and preventing disease outbreaks across a large, connected landscape. Given seasonal migration, high human-elephant interface in eastern belts, and livestock proximity in fringe villages, health surveillance must be systematic, landscape-wide, and preventive.

- *Objectives of Health Monitoring*: The primary objectives include early detection of disease, monitoring nutritional stress, investigating unnatural deaths, and preventing disease transmission at the livestock-wildlife interface.
- *Field-Based Visual Health Surveillance*: Routine field-based visual surveillance by frontline staff plays a crucial role. Observations of body condition, wounds, gait abnormalities, calf survival, and unusual behaviour help detect health issues early, especially in high-risk belts such as Masinagudi-Moyar, Hasanur, Palacode, and Denkanikottai.
- *Veterinary Rapid Response Mechanism*: A veterinary rapid response mechanism ensures timely intervention in cases of injury or illness. Division-level wildlife veterinarians, mobile treatment units, and clearly defined response protocols enable treatment of snare injuries, conflict-related trauma, and other emergencies, while tranquilisation is used only when necessary.
- *Disease surveillance & Sampling*: Disease surveillance is strengthened through systematic necropsies of carcasses and collection of biological samples where feasible. Monitoring for diseases such as anthrax, tuberculosis, parasitic infections, and haemorrhagic conditions is particularly important in dry belts and livestock interface zones, supported by linkages with veterinary laboratories.

- *Livestock Interface Management*: Managing the livestock interface is critical to prevent disease transmission. Vaccination drives, regulated grazing, separation of cattle from elephant-used water sources, and community-based disease reporting reduces cross-species infection risk.
- *Nutritional & Habitat-Linked Health Assessment*: Habitat-linked health assessment integrates ecological monitoring with health surveillance. Tracking forage availability, invasive spread, and drought conditions helps interpret changes in body condition and nutritional stress, guiding habitat restoration and water management interventions.
- *Mortality Investigation Protocol*: Systematic mortality investigation ensures every carcass is examined for cause of death, with forensic documentation and GIS tagging of hotspots. Annual trend analysis helps distinguish between natural and unnatural mortality patterns.
- *Monitoring Captured or Managed Elephants*: Health monitoring also extends to captured or managed elephants, including kumkis, through regular veterinary checks and post-intervention follow-up to ensure welfare and operational readiness.
- *Data Management& Emerging Risk Preparedness*: Integrating health data into a centralised database linked with conflict and habitat maps supports adaptive management. Monitoring climate-driven stress, emerging diseases, and drought impacts enhances preparedness and strengthens the overall resilience of elephant populations across the NER landscape.

3.8.2 Veterinary surveillance and disease monitoring

Veterinary surveillance and disease monitoring across all divisions of the NER, aims to safeguard elephant populations.

- *Objectives of Veterinary Surveillance* - The primary objectives are early disease detection, prevention of livestock–wildlife transmission, investigation of mortality causes, and maintenance of a long-term health database for adaptive management.
- *Active Field Surveillance* - involves routine visual assessments by frontline staff and veterinarians, including body condition scoring, observation of wounds or swelling, respiratory or neurological abnormalities, and monitoring of calf survival. High-risk belts such as Masinagudi–Moyar, Hasanur–Bhavani, Palacode, and Denkanikottai receive focused attention due to higher human interface and dispersal activity.
- *Passive Surveillance* - is conducted through systematic investigation of all elephant mortalities. Each carcass is inspected promptly, followed by necropsy, sample collection, forensic examination where required, geo-tagging, and documentation in a central mortality database to detect emerging patterns.
- *Target Disease Monitoring* - prioritises conditions such as anthrax in dry belts, tuberculosis at livestock interfaces, hemorrhagic septicemia, parasitic infestations, and potential viral infections. The emphasis is on early warning indicators to prevent outbreaks rather than reactive containment alone.
- *Livestock-Wildlife Interface Control* - Managing the livestock–wildlife interface is critical to disease prevention. Coordination with the Animal Husbandry Department supports livestock vaccination, regulated grazing, separation of shared water sources, and village-level disease reporting, especially in eastern NER divisions.
- *Laboratory and Institutional Linkages* - with veterinary universities and diagnostic facilities enable scientific sample analysis, standardised protocols, and periodic review of disease trends, including molecular diagnostics where feasible.
- *Health Monitoring of Managed Elephants* - also extends to managed elephants such as kumkis, with routine veterinary checks, vaccination and deworming schedules, and post-capture or post-conflict assessments to ensure welfare and operational readiness.
- *Climate and Habitat-linked Risks* - are incorporated into surveillance by monitoring drought-related congregation, parasite load fluctuations, and nutritional stress associated with forage

decline or invasive spread. Integrating ecological indicators with veterinary data strengthens predictive capacity.

- *Data Integration & Reporting* - all health data are integrated into division-wise databases and consolidated in annual veterinary status reports, with GIS overlays of disease and mortality hotspots. This structured, preventive, and science-based approach enhances early detection, rapid response, and long-term resilience of elephant populations across the NER landscape.

Expected Outcomes: Early containment of disease outbreaks; reduced unnatural mortality linked to infection; better livestock–wildlife disease management; improved resilience of elephant populations; and strong scientific basis for long-term health planning

3.8.2.1 Veterinary facilities and Equipment

Effective elephant health management in NER requires well-distributed veterinary infrastructure, trained personnel, mobile response capability, diagnostic access, and field-ready equipment. Given the landscape scale and varying terrain (montane plateau, river valleys, dry scrub forests), facilities must be decentralised yet networked.

Veterinary Facility Structure in NER

- Veterinary facilities in the NER must be decentralised yet coordinated across Nilgiris, Gudalur, Mudumalai Tiger Reserve, Sathyamangalam Tiger Reserve, Erode, Dharmapuri Forest Division and Hosur Forest Division.
- *Central Wildlife Veterinary Unit (NER Level) & Division-Level Wildlife Veterinary Units*: A central veterinary unit (CVU) should function as a referral and coordination centre, while each division should have a dedicated wildlife veterinary officer, field assistants, and a mobile veterinary unit to ensure timely response across varied terrain.
- *Rapid Response Veterinary Teams:* are essential for handling emergencies such as injuries, snare wounds, conflict-related trauma, and disease outbreaks. These teams must be capable of field-based tranquilisation, treatment, and stabilisation within 24-48 hours, particularly in high-risk belts like Masinagudi, Hasanur, Palacode, and Denkanikottai.

Essential Veterinary Equipment

- *Field diagnostic equipment* includes portable diagnostic tools such as ultrasound units, blood and faecal sampling kits, microscopes, and monitoring devices.
- *Tranquilisation equipment* includes dart guns, sedatives, reversal drugs, and monitoring instruments, which is necessary for safe immobilisation when required.
- *Emergency treatment kits* with IV fluids, antibiotics, anti-inflammatory drugs, and surgical instruments support field-level interventions.
- *Carcass examination and forensic kits* are required for systematic necropsy, sample preservation, and documentation of mortality causes, including electrocution or poisoning.
- *Adequate transport and mobility* - such as 4x4 vehicles, motorbikes, communication radios, and portable equipment - ensure access to remote and rugged landscapes.

Institutional Capacity Development

- *Infrastructure requirements* at divisional headquarters should include basic treatment rooms, secure drug storage, cold storage for biological samples, power backup, and reliable communication systems.
- *Laboratory & Institutional linkages* with veterinary institutions enable scientific diagnostics and disease confirmation.
- *Health monitoring* also extends to managed elephants such as kumkis, requiring routine veterinary check-ups, vaccination and deworming schedules, and detailed record maintenance.

- *Capacity building Infrastructure* through training workshops, simulation exercises, and standard operating procedures strengthens professional competence.
- *Data & communication system* envisages a centralised digital health database linked with GIS-based disease mapping and incident reporting systems, ensuring coordinated surveillance and trend analysis. Overall, decentralised field readiness combined with centralised data coordination forms the foundation of effective veterinary infrastructure for elephant conservation in NER.

Centralised Veterinary Unit (CVU): The equipment required for CVU include (Box-3.2):

Box-3.2: Equipment required for Central Veterinary Unit

- *Restraint equipment*: Elephant Restraint Device (ERD) restricts the elephant's movements while allowing handlers access for routine husbandry and medical care. Safe methods for immobilizing during medical procedures, such as padded stocks or restraint chutes may be maintained.
- *Diagnostic Equipment & Services*: may be equipped with equipment such as X-ray machines, ultrasound scanners, blood analyzers, endoscopy equipment and thermography cameras which help to assess the health status of elephants, diagnose illnesses, and monitor treatment
- *Necropsy and Disposal facility*: The necropsy facility entails on sharp and blunt dissection tools, bone saws, scales, with adequate safety measures, ventilation systems & refrigeration facilities. Disposal options include burial, cremation, or composting with due environmental regulations.
- *Sedation and Anaesthesia Equipment*: includes specialized equipment for administering anaesthesia, monitoring vital signs, and ensuring safety of both the elephants and staff.
- *Surgical facilities*: includes injectable anaesthetics, reversal agents, inhalant anaesthetic agents and vaporisers, oxygen, sterilized surgical packs, surgical preparation solutions, intravenous fluids, fluid administration equipment, pulse oximetry, ECG, and emergency drugs.
- *Medications and Pharmaceuticals*: includes antibiotics, anti-parasitic drugs, pain relievers, and other medications. Besides, a safe for narcotics that meets the standards may be maintained.
- *Weighing Scale*: Each elephant facility should acquire a scale to routinely weigh the elephants to attain accurate weights, monitor growth, and provide a precise means of dosing medications.
- *Transportation Equipment*: Elephant facilities need specialized transportation equipment for safely moving elephants between enclosures, veterinary clinics, and other locations. This may include transport trailers, crates, or specialized vehicles equipped with hydraulic lifts or ramps.
- *Specialised Orphan Care facility*: includes specially designed enclosure with barriers; facilities for preparing specialized milk formula and feeding stations or bottles for feeding calves along with feeding supplements (hay, grass, or browse); veterinary care; and socialization areas.
- *Quarantine facility*: includes designated area with sturdy fencing; equipment like shelters or barns providing protection; secure feeding/watering stations; bedding materials; facilities for bathing, cleaning, socialization and enrichment.
- *Foot and Hoof Care Tools*: Veterinary facilities should have tools for trimming and maintaining elephant hooves, such as hoof knives, rasps, and foot-care products.
- *Dental Care Equipment*: includes dental picks, mirrors, drills, and specialized instruments for performing dental procedures on elephants.
- *Emergency Response Equipment*: may include first aid supplies, intravenous fluids, oxygen therapy equipment, and emergency transport units.
- *Training and Enrichment Tools*: includes tools for positive reinforcement, as well as enrichment items such as puzzle feeders, toys, and environmental enrichment structures.
- *Monitoring and Record-Keeping*: Software or systems for managing and documenting elephant health information & monitoring devices in the form of cameras and sensors may be maintained.

By providing comprehensive veterinary facilities and tools, captive elephant facilities can ensure that elephants receive the medical care, attention, and support they need to thrive in captivity.

3.8.3 Captive Elephant Management

3.8.3.1 Elephants under the control of Govt Department

There are about 2675 captive elephants in the country of which 28% are in the custody of the Forest department housed in elephant camps, rescue and rehabilitation centres and in zoos.

- The welfare of camp elephants is the main priority of the Forest department and this is ensured by the presence of conspecifics, natural physical environments such as river/water-bodies/ forest cover, and veterinary intervention.
- The camp elephants are almost in free-ranging condition; have the opportunity to interact with the other camp elephants, bathe in rivers and streams and breed with both camp and wild elephants; for exercise walk 5-7 km per day, bring fodder from the forest and are provided nutrition as per the diet chart. The elephants are either chained in the night or free range in adjoining forests, forage in the forest and also stall fed with a prescribed diet in the camp.
- The camp elephants under government control may be used for wildlife conservation activities, such as patrolling vulnerable areas; in elephant rides; monitoring wildlife, participating in anti-poaching efforts; forestry operations, such as timber extraction, habitat restoration, removal of weeds etc; managing human-wildlife conflicts, translocation and rescue operations, participating in koomkie operations; and ecotourism related activities, such as elephant safaris.
- The camp elephants are observed for any behavioural symptoms of illness and disease and regularly screened for diseases; the common ailments are related to eye, foot, or leg problems, formation of abscesses, and other medical problems (anaemia, gastric / urinary / respiratory problems, worms and wounds); including welfare, and overall well-being of camp elephants.
- The government has specific rules and guidelines related to the management of captive elephants, known as the "Captive Elephant Management Guidelines 2008 and Captive Elephant (Transfer or Transport) Rules, 2024."

Captive elephant management in the NER

Presently, Elephant camp exists at **Theppakadu, MTR**. It has 29 captive elephants with 21 males and 8 females, which includes 5 calf and 5 pensioners. Of the 19 working elephants, 15 are adult males and 4 females which are used in various forestry operations.

- *Objectives of Captive Elephant Management*: is strategic and regulated; primarily to assist in driving back wild elephants, supporting rescue operations, and handling high-conflict situations.
- *Housing & Camp Infrastructure*: Proper housing infrastructure is essential, including secured camps with adequate space, shade, water access, sanitation, and resting areas. Camps must comply with national welfare standards and ensure safe, hygienic, and stress-free environments for captive elephants and elephant camp at Theppakadu, MTR meets all the standards.
- *Nutrition & Feeding Management*: Nutritional management focuses on providing a balanced diet as prescribed by the forest veterinary officer (FVO) / forest veterinary assistant surgeon (FVAS) consisting of fodder grass, browse, supplements, along with continuous access to clean drinking water. Seasonal adjustments & regular monitoring of body condition help maintain optimal health.
- *Veterinary Care*: Veterinary care includes routine health check-ups, vaccination and deworming schedules, foot care, dental and tusk examinations, and prompt treatment of injuries sustained during operations. Detailed health records are being maintained for each individual elephant.
- *Behavioural & Welfare Management*: Behavioural and welfare management emphasises humane handling practices, limiting prolonged chaining, ensuring adequate rest, reducing operational stress, and promoting positive reinforcement training. The MTR camp is recognized for its humane treatment as mahouts don’t use bill-hooks or ‘ankush’ to control the elephants.

- *Operational Deployment Protocol*: Operational deployment of kumkis must follow approved plans, with trained mahouts and veterinary supervision. Risk assessment before conflict operations and post-operation recovery monitoring help minimise stress and injury.
- *Record Keeping & Documentation*: Comprehensive record keeping is required, including identification profiles, operation logs, veterinary records, feeding schedules, and behavioural observations to ensure transparency and accountability.
- *Compliance with Legal Framework*: Management must comply with legal provisions under the Wildlife (Protection) Act and related national guidelines, with periodic inspections and proper documentation of capture and use.
- *Capacity Building*: Capacity building through mahout training, first-aid instruction, and refresher courses strengthens professional handling standards and operational safety.

Fig-3.17: Theppakadu Elephant Camp, Mudumalai Tiger Reserve

Overall, captive elephant management in NER at Theppakadu, MTR follows the principle of humane care, minimal intervention, and strategic deployment, ensuring welfare while supporting effective conflict mitigation and conservation objectives.

3.8.4 One Health Approach

One Health approach in the NER recognises the interconnected health of elephants, other wildlife, livestock, humans, and environment across all divisions in the region.

- *Conceptual Framework*: It integrates wildlife health, livestock management, public health, and ecosystem integrity into a unified framework for disease prevention and ecological resilience.
- *Wildlife-Livestock Interface Management*: Managing the wildlife-livestock interface is a key priority, particularly in eastern NER divisions where grazing overlap is high. Coordinated livestock vaccination, regulated grazing in corridor areas, and monitoring of shared water sources help reduce cross-species disease transmission risks.
- *Integrated Disease Surveillance System*: An integrated disease surveillance system links Forest, Veterinary, and Public Health departments for early detection of unusual mortality events and zoonotic threats (Box-3.3). Shared data platforms, laboratory support, and GIS-based disease mapping strengthen coordinated response and preventive action.
- *Water, Sanitation & Environmental Health*: Environmental health measures focus on protecting water sources, preventing agricultural runoff contamination, and restoring wetlands and riparian

zones. Maintaining healthy ecosystems reduces pathogen persistence and improves overall resilience of elephant habitats.

- *Climate Change & Emerging Disease Risk*: Climate change considerations are incorporated through monitoring drought-driven congregation, nutritional stress, and parasite dynamics. Adaptive planning helps prepare for emerging disease risks linked to environmental variability.
- *Community Health Integration*: Community engagement is essential to the One Health framework. Awareness programmes on zoonotic diseases, safe carcass disposal, and coordinated response to elephant movement enhance both public safety and wildlife protection.
- *Institutional Coordination Mechanism*: Institutional coordination may be achieved through a dedicated One Health committee involving Forest, Animal Husbandry, Public Health, District authorities, and research institutions, supported by regular reviews and annual assessments.
- *Data Integration, Research & Capacity Building*: Integrating ecological and health data into a centralised monitoring system, combined with cross-disciplinary research and staff capacity building, ensures early detection, rapid response, and long-term sustainability of elephant conservation and public health within the NER landscape.

Box-3.3: What is Zoonosis

- *A 'zoonosis' is an infectious disease that can be transmitted between animals and humans. More than 200 zoonoses range widely across different pathogen classes, including bacteria, viruses, fungi, parasites, and prions and they may be transmitted through direct contact with infected animals, consumption of contaminated food or water, inhalation of airborne particles, or through vectors such as mosquitoes or ticks. Zoonoses can pose significant public health risks, as they have the potential to cause outbreaks or pandemics in human populations.*

Understanding/ controlling zoonotic diseases is important for protecting both human and animal health.

Key risk factors include:

- Livestock grazing within forest corridors.
- Shared water sources between wildlife and cattle.
- Handling of wildlife carcasses.
- High human–elephant interface in eastern belts.
- Drought-driven congregation at limited water points.

Common zoonotic concerns include anthrax, tuberculosis, parasitic infections, and certain bacterial diseases in dry deciduous landscapes.

Zoonotic Disease Risk Assessment Matrix

The matrix assesses zoonotic disease risk across divisions (Table-3.13) based on livestock-wildlife interface intensity, grazing overlap, shared water sources, human density, drought vulnerability, and past mortality patterns. Risk categories are indicative for planning and surveillance prioritisation.

- *High Risk*: Frequent livestock grazing inside forest, shared water sources, high HEC interface, drought-prone, history of livestock/wildlife mortality.
- *Medium Risk*: Moderate grazing overlap, seasonal interface, partial corridor disturbance.
- *Low Risk*: Core protected habitats, limited livestock access, strong protection regime.

Table-3.13: Division-Wise Zoonotic Disease Risk Matrix

Division/ Landscape Unit	Interface Intensity	Key Risk Drivers	Priority Diseases	Risk Level
Dharmapuri (Palacode-Morappur)	Very High	Grazing, scrub-agriculture mosaic, drought stress	Anthrax, TB, HS, parasitic infections	HIGH
Hosur (Denkanikottai-Thally)	Very High	Industrial-peri-urban fringe livestock-water overlap	TB, parasitic load, bacterial infections	HIGH
STR (Hasanur-Bhavani east)	High	Grazing corridors, riverine congregation	Anthrax, HS, parasitic infections	HIGH-MEDIUM
Erode (Bhavani Valley)	Moderate-High	Irrigated agriculture near riverine belts	Parasitic infections, bacterial spillover	MEDIUM-HIGH
Gudalur	Moderate	Estate boundaries, limited livestock interface	TB (localized), parasitic infections	MEDIUM
Nilgiris (Plateau)	Low-Moderate	Limited grazing, estate influence	Parasitic load, occasional spillover	LOW-MEDIUM
MTR (Core & Buffer)	Low	Strong protection, limited livestock entry	Sporadic parasitic load	LOW

In the **high-risk zones** of the NER, particularly in eastern divisions such as Dharmapuri, Hosur, and eastern stretches of STR, control measures should prioritise intensive livestock vaccination, strict regulation of grazing within corridors, monitoring of shared water sources, rapid carcass investigation, and strong community awareness on zoonotic risks. These areas require frequent active surveillance and immediate response capability.

In **medium-risk zones**, such as Erode riverine belts, Gudalur, and parts of the Nilgiri slopes, the focus should be on seasonal health screening, periodic inspection of livestock-wildlife interface areas, NDVI-based drought monitoring, and preventive veterinary outreach. Surveillance can be conducted quarterly with emphasis on early detection and habitat-linked stress indicators.

In **low-risk core protected areas**, including the interiors of MTR, control efforts should maintain routine disease surveillance, preserve strong protection measures, and monitor occasional tourism-related or dispersal-linked risks. These areas require periodic review rather than intensive intervention, ensuring that low risk is sustained through consistent monitoring.

3.8.5 Major Elephant Diseases: Clinical Signs and Control Measures

Although wild elephants generally possess strong natural immunity, they remain susceptible to infectious, parasitic, nutritional, metabolic, traumatic and environmental diseases. Disease occurrence is influenced by habitat degradation, drought, nutritional stress, increasing human-elephant interface, contact with domestic livestock, and climate variability.

Emerging and Zoonotic Disease Concerns in NER

NER lies within a landscape where elephants, livestock, wildlife, and people interact extensively. Consequently, there is an ongoing risk of pathogen spillover and spillback involving diseases such as anthrax, tuberculosis, hemorrhagic septicemia, leptospirosis, salmonellosis, herpesvirus, and other emerging infections (Table-3.14).

Table-3.14: Aetiology, Clinical Signs, Prevention and Control Measures of Major diseases

Disease	Etiology	Clinical Signs	Prevention and Control Measures
Hemorrhagic Septicemia (HS)	*Pasteurella multocida* (bacterial infection)	High fever, swelling of throat and neck, respiratory distress, salivation, sudden death	Restrict livestock grazing in elephant habitats, disease surveillance in cattle and buffaloes, prompt carcass disposal, laboratory diagnosis, vaccination of livestock in fringe villages, biosecurity measures
Anthrax	*Bacillus anthracis*	Sudden death, bleeding from body openings, absence of rigor mortis, rapid bloating	Immediate quarantine of affected area, no post-mortem on suspected cases, deep burial/incineration of carcasses, vaccination of livestock in endemic areas, soil decontamination, PPE for field staff
Tuberculosis (TB)	*Mycobacterium tuberculosis* complex	Chronic weight loss, weakness, chronic cough, respiratory distress, reduced appetite	Routine surveillance in captive elephants, screening of handlers, isolation of infected animals, strict hygiene, One Health surveillance, molecular diagnostics
Elephant Endotheliotropic Herpesvirus (EEHV) (mainly calves)	Elephant herpesvirus	Sudden lethargy, facial swelling, tongue cyanosis, oral ulcers, haemorrhage, sudden death	Early diagnosis through PCR, intensive supportive care, antiviral therapy where feasible, close monitoring of calves, rapid veterinary intervention
Foot Rot / Pododermatitis	Mixed bacterial infection associated with prolonged wet conditions, trauma or poor foot hygiene	Lameness, swelling of feet, cracked pads, foul-smelling lesions	Regular foot inspection (especially captive elephants), drainage improvement, wound cleaning, antibiotics when indicated, dry resting areas
Trypanosomiasis (Surra)	*Trypanosoma evansi* transmitted by biting flies	Fever, anaemia, oedema, weakness, weight loss	Vector control, surveillance, early diagnosis, antiprotozoal treatment in captive elephants, monitoring of domestic animals that may act as reservoirs
Gastrointestinal Parasitism	Strongyles, roundworms, tapeworms and other helminths	Weight loss, diarrhoea, poor body condition, anaemia	Periodic faecal examination, strategic deworming of captive elephants, improved sanitation, habitat management to reduce contamination
Liver Fluke Infection	*Fasciola* spp.	Progressive emaciation, anaemia, weakness	Control of intermediate snail hosts where feasible, deworming of captive elephants, surveillance in livestock sharing wetlands

Disease Surveillance Strategy for NER

A comprehensive disease surveillance programme should include routine health monitoring of wild and captive elephants, systematic necropsy of all elephant mortalities (elephant death audit framework), laboratory confirmation of suspected infectious diseases, GIS-based mapping of disease occurrences, periodic screening of livestock in fringe villages, monitoring of water quality and environmental health, and maintenance of wildlife health database. The Veterinary Teams should be equipped to investigate disease outbreaks, collect diagnostic samples, and implement emergency containment measures.

Preventive Health Measures

Preventive disease management should prioritise habitat improvement, protection of perennial water sources, reduction of livestock grazing within elephant habitats, strict biosecurity during capture and rehabilitation operations, regular health screening of captive elephants and their handlers, strategic deworming, vaccination of livestock against endemic diseases, scientific carcass disposal, and capacity building of frontline staff in disease recognition and outbreak response.

Management Principle

The most effective strategy for managing elephant diseases in the NER is prevention through habitat security, early disease detection, integrated wildlife-livestock surveillance, and rapid veterinary intervention under a One Health framework. Such an approach not only safeguards elephant populations but also reduces the risk of disease transmission to livestock, other wildlife, and human communities, thereby strengthening the long-term ecological resilience of the Nilgiri landscape.

3.9 SUSTAINABLE WASTE MANAGEMENT & SAFE SANITATION AROUND ELEPHANT HABITAT

‘Garbage’ is known to attract elephants, and when garbage dumps are on the periphery or inside a village/town they create potential for accidental encounters between humans and elephants.

Sustainable waste management and safe sanitation around the NER are essential to reduce elephant attraction to settlements, prevent zoonotic risks, and protect water sources across all divisions.

Solid Waste Management in Fringe & Corridor Villages

- *Key Risks*: Open dumping, organic waste, and plastic litter in fringe villages and corridor areas often attract elephants and escalate human-elephant conflict.
- *Recommended Measures*: In corridor-edge and fringe villages, solid waste management must prioritise segregation at source, installation of elephant-proof community bins, secure waste collection points away from forest boundaries, door-to-door collection systems, and strict prohibition of dumping near forest edges. These measures reduce food-based attractants and wildlife ingestion of plastics.
- *Tourism-Linked Waste Management*: Tourism-heavy belts such as Masinagudi, Hasanur, and Ghat roads require stricter waste control through zero-waste policies for resorts, bans on single-use plastics, regulated roadside waste stations, and regular enforcement inspections. This prevents roadside litter from drawing elephants into high-risk areas.

Safe Sanitation Infrastructure

- *Risks*: Open defecation near water sources; improper septic tank construction; and effluent discharge into streams.
- *Recommended Measures*: Safe sanitation infrastructure is equally important. Ensuring universal toilet coverage, promoting bio-digester or twin-pit systems, maintaining septic tanks, and preventing untreated effluent discharge into streams reduce contamination of water sources used by both wildlife and communities.

- *Wastewater & Water Source Protection*: Protection of springs, vayals, and riverine systems through soak pits, vegetative buffer strips, and water-quality monitoring helps safeguard shared water bodies such as the Moyar and Bhavani basins from pathogen spread and nutrient pollution.
- *Preventing Waste-Driven Elephant Habituation*: Preventing waste-driven habituation requires immediate removal of fruit and market waste, prohibition of intentional feeding, fencing of waste yards, & awareness campaigns highlighting the dangers of food-based conditioning of elephants.
- *Community Engagement & Behavioural Change*: Community engagement through village sanitation committees, integration with rural sanitation schemes, and incentive-based “Clean Corridor Village” initiatives strengthen behavioural change and local accountability.
- *Institutional Coordination*: Institutional coordination among Forest, Panchayat, Municipal, Pollution Control, and Tourism departments may ensure quarterly sanitation audits, enforcement of regulations, and monitoring of key indicators such as open dump elimination, sanitation coverage, litter density, and waste-linked elephant incidents.

Overall, removing attractants, improving sanitation infrastructure, protecting water quality, and engaging communities collectively reduce conflict risk, safeguard public health, and support sustainable elephant conservation across the NER landscape.

3.10 INVOLVEMENT OF STAKEHOLDERS, SECTORAL COORDINATION, AWARENESS CREATION AND FORGING PARTNERSHIPS

The involvement of various stakeholders in the protection of the NER requires the existence of a coordination and collaboration mechanism. There is a need for standing orders and instructions in the form of guidelines for mutual cooperation and assistance, whenever required.

In the management of NER, involving various stakeholders, sectoral coordination, & creating awareness are crucial aspects for sustainable conservation efforts.

- *Stakeholder Identification & Engagement*: Key stakeholders include forest-dependent communities, farmers, estate managers, panchayats, enforcement agencies, tourism operators, NGOs, and research institutions. Structured engagement through Eco-Development Committees and village-level platforms promotes inclusive decision-making and shared responsibility.
- *Sectoral Coordination Mechanism*: Sectoral coordination is essential to address the multi-dimensional nature of elephant conservation. A formal coordination mechanism involving Forest Department and other Line Departments viz. Animal Husbandry, Public Health, Electricity, Revenue, Rural Development, and Disaster Management departments, enable joint planning, data sharing, and periodic review. Shared GIS dashboards and quarterly meetings improve transparency and operational efficiency.
- *Community Participation & Co-Management*: Community participation and co-management strengthen coexistence. Participatory corridor monitoring, alternative livelihood support, Village Elephant Response Teams, and conservation-linked income opportunities help reduce retaliatory actions and build local ownership of conservation efforts.
- *Awareness Creation & Behavioural Change*: Awareness creation must be continuous and targeted. Campaigns in high-conflict villages, school education programs, farmer workshops on safe practices, and dissemination of legal provisions through local-language materials foster behavioural change and compliance.
- *Private Sector & CSR Partnerships*: Partnerships with the private sector, particularly industries and tourism operators in Hosur and Erode belts, can mobilise CSR funding for fencing, habitat

restoration, sanitation, and monitoring initiatives. Responsible tourism practices further support corridor safety and waste reduction.

- *Research & Academic Collaboration*: The collaborations provide scientific backing for management decisions. Long-term ecological studies, zoonotic disease research under the One Health framework, and telemetry-based corridor mapping enhance evidence-based planning.
- *Inter-State & Landscape-Level Partnerships*: They are crucial, given the transboundary nature of elephant movement. Joint patrols, intelligence sharing, and coordinated corridor management ensure continuity across administrative boundaries.
- *Conflict Resolution Platforms*: The CR platforms, including grievance redressal mechanisms and timely compensation processes, help prevent escalation and maintain trust between communities and authorities.
- *Monitoring & Evaluation Framework*: M&E through stakeholder feedback, conflict trend analysis, and periodic performance assessments ensure adaptive management and sustained collaboration across the NER landscape.

3.10.1 Convergence of cogent programmes, clouts and skills

Convergence of cogent programmes, institutional clout, and technical skills in the NER involves strategically aligning conservation schemes, departmental mandates, financial resources, and specialised expertise to achieve integrated elephant and habitat management across all divisions. This convergence integrates initiatives such as Project Elephant, Tiger Conservation Plans, CAMPA, rural development schemes, sanitation missions, livestock vaccination programmes, and disaster management frameworks to address habitat restoration, corridor security, conflict mitigation, and zoonotic risk reduction in a coordinated manner.

By leveraging administrative authority (land-use regulation, enforcement powers), financial mechanisms (central/state schemes and CSR funding), and specialised skills (wildlife biology, veterinary science, GIS, legal enforcement, community mobilisation), NER can avoid duplication of efforts and optimise resource utilisation. Such convergence ensures that infrastructure planning, waste management, livestock control, water conservation, and enforcement actions collectively support elephant conservation objectives. Ultimately, coordinated programme integration enhances institutional efficiency, strengthens accountability, and promotes sustainable, landscape-level management of elephants and their habitats in NER.

3.10.2 Addressing gaps in understanding linkages between actions and their impacts

Addressing gaps in understanding linkages between management actions and their ecological and social impacts in the NER requires a structured, evidence-based monitoring and evaluation framework across the region. It involves systematically assessing whether interventions such as corridor restoration, solar fencing, anti-poaching patrols, invasive removal, water augmentation, and awareness campaigns are producing measurable reductions in conflict, mortality, habitat degradation, and disease risk.

Bridging these gaps demands clear baseline data, defined performance indicators, GIS-based impact mapping, and periodic ecological and socio-economic evaluations. Integrating scientific research, community feedback, and field-level monitoring helps trace cause-effect relationships and identify unintended consequences, such as habitat shifts or conflict displacement. By strengthening adaptive management-where strategies are refined based on monitoring results-NER can ensure that conservation investments lead to tangible improvements in elephant population stability, corridor functionality, ecosystem health, and community coexistence outcomes.

3.10.3 Seeking coordination through the existing structures

Seeking coordination through existing institutional structures in the NER involves strengthening and better utilising already established administrative, legal, and sectoral platforms across all administrative divisions rather than creating parallel mechanisms. This includes leveraging Tiger Conservation Plan committees, Project Elephant frameworks, district-level disaster management authorities, Eco-Development Committees, and inter-departmental coordination meetings to address habitat restoration, corridor protection, conflict mitigation, zoonotic risk management, and enforcement challenges.

By aligning conservation objectives within these existing governance systems - such as district planning boards, revenue land-use authorities, electricity safety committees, and law enforcement coordination forums - NER can ensure that elephant conservation priorities are mainstreamed into broader development and administrative processes. Strengthening communication channels, regular review meetings, shared data platforms, and clearly defined roles within these structures enhances accountability, reduces duplication of effort, and promotes integrated, landscape-level management without institutional fragmentation.

3.10.4 Sharing knowledge, technology, awareness and participation

Sharing knowledge, technology, awareness, and participation in the NER is essential for strengthening landscape-level elephant conservation across the region. Knowledge sharing involves disseminating research findings, monitoring data, and best practices among forest staff, researchers, communities, and policymakers to support evidence-based decision-making and adaptive management.

Technology sharing - such as GIS dashboards, camera-trap data, early-warning systems, SMART patrolling tools, and veterinary surveillance platforms - enhances transparency, improves response time, and enables coordinated action across divisions. Regular training workshops and cross-division exposure visits strengthen technical capacity and operational consistency.

Awareness creation through schools, community meetings, farmer workshops, and media outreach fosters behavioural change and promotes safe coexistence practices, while participatory platforms such as EDCs and Village Response Teams ensure active community involvement. Together, the exchange of knowledge, application of appropriate technology, and inclusive participation build trust, improve compliance, and enhance long-term resilience of elephant conservation efforts in the NER landscape.

CHAPTER 4: HUMAN ELEPHANT CONFLICT (HEC) AND PLANNING MITIGATION STRATEGY

4.1 SPECIFIC CONDITIONS OF CONFLICT AND OPERATIONAL REQUIREMENTS

*"**Human Elephant Conflict (HEC)** refers to the negative interaction between humans and elephant, leading to adverse impacts such as injury or loss of human lives, crop, livestock and other properties, or even their emotional well-being, and equally negative impacts on elephant and or its habitat".*

The intensity of HEC is highly flexible and depends on the density of elephant populations; nature of the interface between human areas & elephant habitat; irregular and diffuse boundary with a long perimeter; highly fragmented habitat interspersed with human use areas; dispersing herds; road/rail tracks passing through forests with large elephant populations etc. HEC can be effectively addressed by understanding the type of conflict, the site of occurrence, and its overall impact on humans and elephants (Box-4.1).

Box-4.1: Addressing HEC in three broad zone categories

- ***Elephant Conservation Zone*** (occurring inside the forest): envisages habitat management, minimizing forest use, capacity development etc.
- ***Elephant Human Co-existence Zone*** (occurring at the interface): envisages early warning system, deployment of RRT / PRT, capacity development, barriers and deterrents etc
- ***Elephant Human Management Zone*** (occurring deep inside human use areas): envisages capture and translocation, release and rehabilitation, capacity development etc.

4.1.1 Specific Conditions of Conflict in NER

Human-elephant conflict (HEC) varies spatially across NER due to ecological gradients, land-use patterns, corridor bottlenecks, and socio-economic factors. Effective response requires division-specific operational planning and landscape-scale coordination (Table-4.1).

Table-4.1: Specific conditions of conflict and operational implications

Specific Conditions	Characteristic Features	Operational Implications
Dry-season resource Compression	Elephants descend from Nilgiri into Moyar/ Bhavani valleys, increasing congregation	Pre-season preparedness and intensified monitoring in valley
Eastern Dispersal & Expansion	Increasing movement in Palacode-Morappur & Denkanikottai-Thally scrub-agri. mosaics	Strengthened RRTs & fencing audits in eastern divisions
Corridor Bottlenecks	Narrow movement strips (Moyar valley, Hasanur highway, Palacode interface)	Traffic regulation, corridor restoration, & land-use control
Crop Pattern Attractiveness	High-value crops (banana, sugarcane, millets) attract elephants during harvest time	Crop planning advisories and crop-guarding support systems
Electrocution & Illegal Fencing	Improvised high-voltage fencing in fringe villages causes elephant mortality	Joint Forest–Electricity enforcement drives.
Waste-Driven Habituation	Open garbage dumps and market waste attract elephants to settlements	Waste management in tourism & corridor villages.
Crowd Aggression & Social Tension	Human casualties trigger crowd reactions and retaliatory actions	Conflict mediation, crowd control support from police
Climate Variability	Drought and erratic rainfall alter movement patterns and stress habitats	Water augmentation and forage restoration

4.1.2 Operational Requirements in NER

Operationally, division-specific Rapid Response Teams (RRT) with round-the-clock readiness, early warning systems (EWS), and clear Standard Operating Procedures (SOP) are essential. Conflict mitigation infrastructure such as solar fencing, steel rope fencing, trenches where appropriate, underpasses, and secure waste systems must complement enforcement and rapid compensation mechanisms to maintain community trust.

Veterinary preparedness, intelligence-led enforcement against illegal fencing and snares, GIS-based conflict mapping, and annual adaptive reviews are necessary to respond effectively to conflict patterns.

Priority operational zones include Masinagudi-Moyar, Hasanur-Thalavadi, Palacode-Morappur, Denkanikottai-Thally, and Bhavani valley settlements. Overall, proactive seasonal planning, rapid response capability, corridor protection, attractant management, and community engagement form the core operational requirements for managing conflict in the NER landscape.

4.2 APPROACHES IN CONFLICT IDENTIFICATION

Identifying conflict zones between elephants and humans involves understanding the dynamics of their interaction, including crop raiding, property damage, and human injuries. Effective conflict mitigation begins with accurate identification and understanding of the conflict scenario; particularly in places where the interface between elephant habitats and human settlements is complex and dynamic, conflict identification involves both ecological and socio-spatial analysis.

This includes spatial mapping of conflict hotspots, identification of the elephant/s in conflict, analyzing elephant movement corridors, and identifying crop raiding patterns (Box-4.2). Methods encompass community-based reporting, field surveys, camera trapping, and use of technologies like GIS and remote sensing. Engaging local communities in data collection facilitates contextual understanding, while integrating traditional ecological knowledge with scientific approaches, enhances conflict identification accuracy. Understanding socio-economic vulnerabilities and ecological drivers, aids in developing targeted mitigation strategies, ultimately informing effective interventions for reducing HEC.

HEC management approaches range from using traditional methods like guarding crops and fencing to employing advanced technologies like AI-powered sensor systems and drones. Molecular techniques and satellite imagery analysis are also used to pinpoint conflict hotspots and understand the behaviour.

Box-4.2: Sequence of Conflict Identification and mitigation

Step 1.	Collection of daily elephant movement and conflict data (crop damage, human and elephant casualty data and news reports.)
Step 2.	Over a period of time identify conflict hotspots
Step 3.	Analyse and see if there is a temporal/spatial pattern to conflict in the landscape
Step 4.	Profiling individual elephants and identify problem elephants using the Pareto Principle
Step 5.	Initiate mitigation strategies by looking into the hotspots
Step 6.	Work towards immediate resolution of conflict, while simultaneously focusing on long term prediction and conflict resolution.

As the elephant is a long ranging species, a landscape level perspective must always be kept in view to avoid shifting of HEC from one location to another. Holistic approach addresses local concerns while protecting the interests of other stakeholders elsewhere.

4.2.1 Identification of animal/s in conflict

Identification of individual or group of elephants-in-conflict, to be characterized into casual (opportunistic) or repeated (obligatory) crop foraging individuals/groups, may result from elephants with their natural movement adjoining the periphery of the forest, or elephants which exclusively move within the crop lands due to the attractions, resulting in their localization. The following steps may be taken for identifying the elephant, that causes conflict:

- Movement area of the elephant in conflict may be demarcated or mapped.
- Follow the track marks and other distinct signs to confirm the presence and absence of elephants.
- Examine all conflict-related incidents within the region.
- Deploy a number of cameras at strategic locations depending on their predictable movement.
- Investigate the camera trap database, if available, and identify the individual based on the distinct morphological features.

Accurate identification of specific elephants involved in repeated conflict is essential to ensure targeted intervention rather than broad, disruptive measures. Given the landscape spread across divisions, conflict often involves a small number of habitual or dispersing individuals rather than entire herds.

Categories of Conflict Elephants

- *Habitual Crop-Raiding Bulls*: Adult solitary bulls repeatedly entering agricultural fields, especially during harvest seasons.
- *Dispersing Young Bulls*: Sub-adult males exploring new territories in eastern divisions.
- *Splinter Groups*: Small breakaway groups from larger herds.
- *Injured/Stressed Individuals*: Elephants with wounds/health issues exhibiting abnormal behaviour
- *Habituated Elephants*: Individuals attracted to waste dumps or human settlements.

Identification Methods

- *Direct Visual Identification*: Tusk shape, length, and symmetry; ear tears, holes, or distinct folds; tail hair pattern and tail length; and body scars and pigmentation marks.
- *Camera Trap Records*: Photo comparison database; time-stamped movement pattern analysis.
- *Community Intelligence*: Farmer reports cross-verified with patrol logs; and village-level reporting.
- *GPS/Radio Collaring* (Selective Cases): Used for high-conflict habitual individuals; and movement monitoring for early warning.

Conflict Profiling System

- Each identified individual should have- Unique ID code; physical description record; conflict history log; movement range map; and risk level categorisation (low / medium / high).

Division-Specific Conflict Profiles (Illustrative)

- Masinagudi-Moyar: Solitary tuskers and seasonal herd incursions.
- Hasanur-Bhavani East: Dispersing bulls.
- Palacode-Morappur: Young male expansion.
- Denkanikottai-Thally: Crop-raiding solitary bulls.

4.2.2 Identifying conflict hotspots

"HEC hotspots" are areas with actual or predicted repeated occurrence of HEC incidents resulting in crop-loss, livestock death, human death and injury, elephant death and injury over temporal and spatial scales. It can be static (repeated in the same place or time) or dynamic (shift in space and time over the years). In addition, the magnitude of the incidents is subjected to interpolation or extrapolation techniques to define the hotspots in space and time.

Identifying conflict hotspots that could also provide a direction towards the drivers of conflict, is critical to provide site-specific solutions to mitigate human-elephant conflict. Conflict hotspots of HEC can be mapped through geo-spatial assessments and predictive modelling, using both primary data and secondary data including time-series data. The hotspots can be identified and mapped as follows:

a. *Incident hotspot:* Frequency of occurrence of incidences over past specific years such as previous five or ten years, mapped over the target area. The data include number of incident of injury and death, attack/ killing of domestic animals.

b. *Vulnerability Hotspot:* Cumulative index by overlaying past incidents, vulnerability of local community and potential risk of the area.

Characteristics of Hotspots in NER: Located along elephant corridors; high crop attractiveness (banana, sugarcane, millets); open grazing and scrub-agriculture mosaic; shared water sources; narrow forest bottlenecks; and seasonal congregation during drought (Table-4.2).

Table-4.2: Human-Elephant Conflict (HEC) Hotspot Intensity Ranking

Division	Location	Seasonal Pattern	Key Drivers
A. High Intensity Hotspots			
MTR	Masinagudi-Moyar	Peak in summer	Corridor bottleneck, tourism pressure
STR	Hasanur-Thalavadi	Dry season peak	Grazing overlap, riverine congregation
Dharmapuri	Palacode-Morappur	Post-monsoon	Eastern dispersal, scrub-agri. mosaic
Hosur	Denkanikottai-Thally	Harvest season	Crop attractiveness, peri-urban interface
Erode	Bhavani riverine belt	Summer peak	Irrigated agriculture near forest
B. Medium Intensity Hotspots			
Gudalur	Cherambadi-Devala	Monsoon & harvest	Estate-forest interface
STR	Germalam-Bannari	Seasonal	Highway corridor
Erode	Anthiyur-Kadambur	Seasonal	Agriculture-fringe overlap
C. Emerging / Expanding Hotspots			
Dharmapuri	Harur-Pennagaram	Increasing trend	Range expansion of dispersing bulls
Hosur	Anchetty-Jawalagiri	Irregular but rising	Scrub restoration & movement expansion
Nilgiris	Kotagiri slopes	Localised	Habitat compression

Seasonally, conflict peaks during summer (March-June) due to water scarcity-driven congregation, followed by post-monsoon harvest periods (October-January) when crop raiding intensifies in eastern divisions. Monsoon months typically see moderate movement through slopes and estate belts.

Operationally, Tier 1 (critical zones) require round-the-clock RRTs and EWS; Tier 2 areas (moderate) need seasonal deployment and infrastructure audits; and Tier 3 (emerging zones) require close monitoring and proactive awareness measures to prevent future escalation across the NER landscape.

The high conflict locations as per the incidences recorded in the NER are detailed in the Fig-4.1.

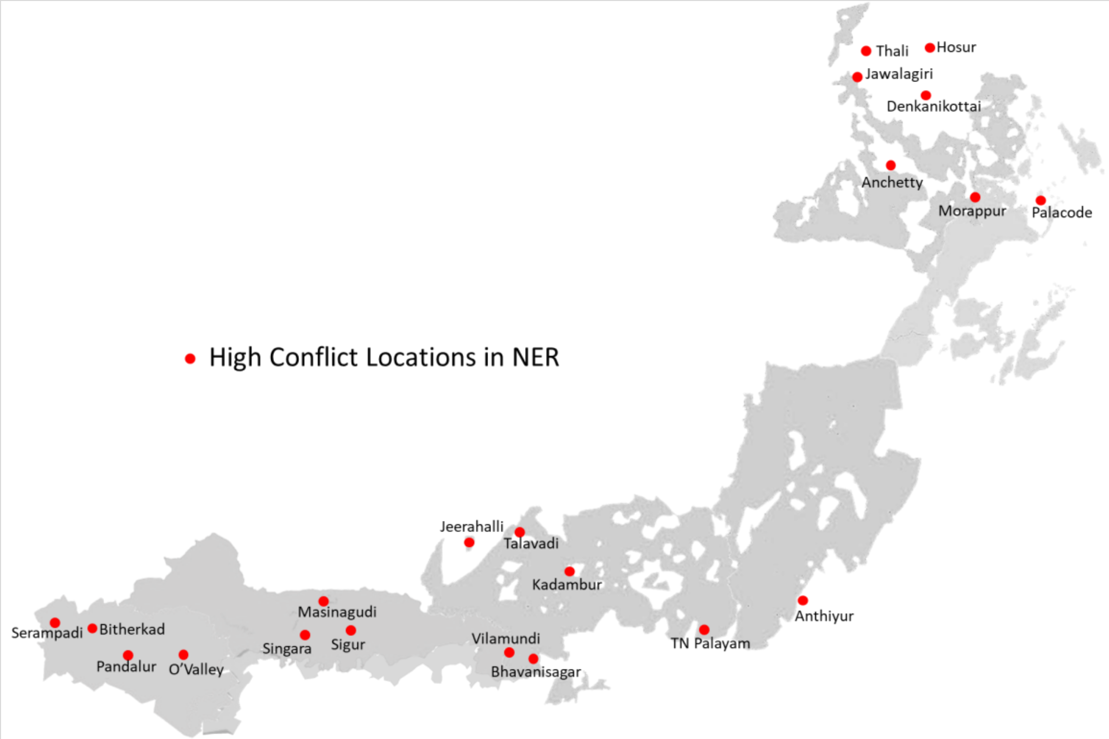


Fig-4.1: High Conflict Locations in the NER

4.3 ESTABLISHING SYNERGISTIC MITIGATION STRATEGY

There are three key elements in conflict situations: the elephant, humans (settlement) and the attractant for the elephant (palatable crop). Sometimes removal of one of these elements is required to resolve an intractable situation. To manage HEC there needs to be a holistic, landscape-based framework that integrates ecological understanding, administrative coordination, and active community involvement. The mitigation measures for controlling HEC can be divided into three categories (Fig-4.2) viz.

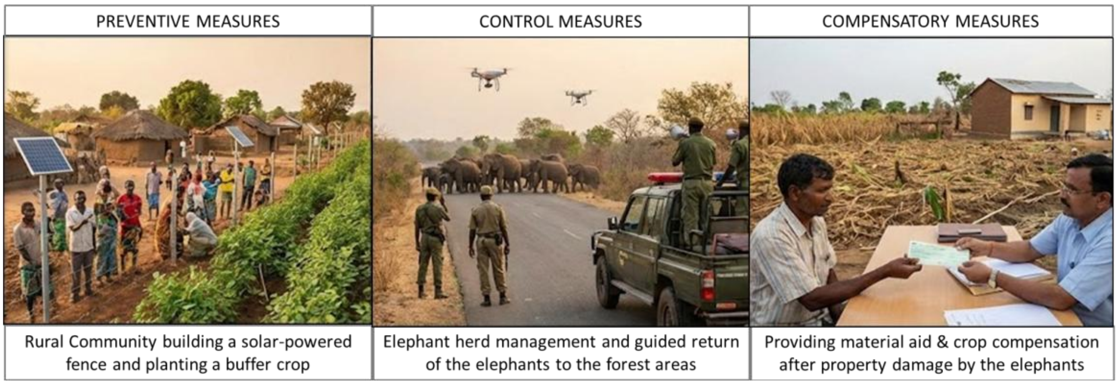


Fig-4.2: The three categories of controlling HEC

In each of the measures, the divisions of NER have used a combination of traditional, industrial and technological backed mitigation measures. As regards short term measure, no single method is found to be effective against all elephants.

The strategy for conflict mitigation for the compensatory measure is more or less universal, where the focus is towards ease of submitting applications as well as timely and just distribution of compensation. Control measures are implemented in the co-existence and management zone, whereas preventive measures are more in the conservation zone.

Preventive/Protective Measures: aim at removing the factors responsible for elephant depredation and at creating ideal living conditions for elephants within forests while protecting their lives (Box-4.3).

Box-4.3: Steps envisaged in Preventive/ Protection Measures

Step 1.	A detailed land-use classification and vegetation mapping is to be done including mapping of invasives.
Step 2.	Overlaying the land use classification with elephant movement data to help to identify bottlenecks and vulnerable areas of HEC.
Step 3.	Prepare a landscape level Restoration Plan.
Step 4.	Design Mitigation Plan/Management Plan to reduce the effect of bottlenecks.

Control Measures: aim at controlling conflict through physical structures, translocation and other technological interventions to keep elephants away from human habitations (Box-4.4).

Box-4.4: Steps envisaged in Control Measures

Step 1.	Identification of key areas of entry of elephants and regular conflict
Step 2.	Predicting animal movement once the entry is stopped i.e. potential movement of the animals is to be studied.
Step 3.	Choosing apt barrier or combination of them based on factors like substrate, terrain and funds availability including procurement and installation.
Step 4.	Monitor the effectiveness of the barrier using direct methods like camera traps and indirect data like number incidences of crop damages, number of human deaths, etc,
Step 5.	Monitoring the elephant movement after installation of the barrier to see how the elephant movement has changed.

Compensatory Measures: aims to alleviate economic losses suffered by communities due to elephant-related damage, such as crop depredation or property destruction.

Mitigation strategies require integration of ecological, technological, and community-based approaches to ensure coexistence between people and elephants. Such a strategy combines habitat management, with innovative early warning systems using sensors, drones, or AI-based monitoring, physical barricades at critical locations and community engagement.

4.3.1 Early warning and rapid response system (EWRRS) at conflict hotspots

EWRRS is a set of tools, processes and personnel needed for the timely and meaningful generation and dissemination of alert information to individuals, communities and establishments at risk, for optimal preparedness and response; and to reduce the likelihood of injury, death or crop damage.

EWRRS structurally includes a HEC Mitigation Hub/ Control Room; and a system of three-tiered response teams, viz, Division-level Rapid Response teams (Division RRT), range-level Rapid Response Teams (Range RRT) and village/ward level Primary Response Teams of community (Community PRT).

EWRRS in the NER is designed to anticipate elephant movement, alert vulnerable communities in advance, and deploy trained teams quickly in high-conflict belts such as Masinagudi-Moyar, Hasanur-Thalavadi, Palacode-Morappur, Denkanikottai-Thally, and Bhavani valley settlements.

- *Movement Detection Mechanisms*: The early warning component relies on movement detection through camera traps in corridor bottlenecks, watch towers in agricultural fringes, GPS collars for select habitual individuals, drone surveillance during peak seasons, & community-based trackers.
- *Alert Dissemination Channels*: These detection inputs feed into a structured alert mechanism that disseminates location-specific advisories through SMS groups, WhatsApp networks, public address systems, siren towers, and division control rooms.

- *Rapid Response System*: The rapid response component involves division-level RRT operating on a 24/7 rotational basis in high-intensity divisions. Each team may include trained forest personnel, local watchers, mobility support through 4x4 vehicles and motorbikes, communication equipment (VHF sets), non-lethal deterrence tools (torch-lights, portable PA-system), veterinary backup, when required. For night operations, high-lumen searchlights, thermal binoculars handheld sirens would be useful. Clear SOPs ensure verification of alerts, timely mobilisation, safe crowd management, controlled driving of elephants, and post-incident documentation.
- *Seasonal scaling:* During summer, deployment intensifies in valley belts due to water scarcity-driven congregation, while harvest seasons require heightened alert networks in eastern divisions where crop raiding peaks. Monsoon months involve moderate patrol intensity focused on corridor slopes and estate interfaces.
- *Technology integration*: through GIS dashboards, live conflict heat maps, centralised control rooms, and incident reporting systems enhances transparency and predictive capacity.
- *Performance indicators*: such as response time, reduction in human injuries, decrease in crop damage severity, and community satisfaction may be used to evaluate effectiveness.

Conflict Hotspot-Specific Requirements

- Masinagudi-Moyar (MTR): Continuous night patrols; and tourism-linked alert integration
- Hasanur-Thalavadi (STR): Highway traffic control; and corridor-focused drone monitoring
- Palacode-Morappur (Dharmapuri): Intensive harvest-season alert; cluster solar fencing support
- Denkanikottai-Thally (Hosur): Village-based alert; industry coordination for night lighting/patrol

Tier-Based Deployment Model

Tier	Divisions	Deployment Level
Tier 1 (Critical)	Masinagudi, Hasanur, Palacode, Denkanikottai	Full-time RRT
Tier 2 (Moderate)	Gudalur, Erode	Seasonal RRT
Tier 3 (Emerging)	Nilgiris Plateau	Monitoring-focused

Overall, the system operates on the principle of “Predict, Inform, Respond Quickly, Prevent Escalation,” aiming to reduce casualties, limit crop losses, strengthen community trust, and promote safer coexistence across the NER landscape.

4.3.2 Monitoring elephant behaviour and movement at the hotspot

Monitoring elephant behaviour and movement at conflict hotspots in the NER is crucial for anticipating incursions and reducing human-elephant conflict in the landscape. In high-intensity belts such as Masinagudi-Moyar, Hasanur-Thalavadi, Palacode-Morappur, Denkanikottai-Thally, and Bhavani valley settlements, systematic tracking supports proactive management rather than reactive response.

- *Objectives of Monitoring*: The primary objectives of monitoring are to identify habitual conflict individuals, understand seasonal and diurnal movement patterns, detect behavioural shifts due to drought or habitat stress; map corridor bottlenecks and congregation zones. This information strengthens early warning systems and guides deployment of Rapid Response Teams.
- *Behavioural Parameters to Monitor*: include direction and frequency of crop-field entry, timing of incursions (especially night-time and harvest season peaks), social structure such as solitary bulls or herd movements, splinter group formation, and stress indicators like repeated settlement visits or heightened aggression.
- *Monitoring Tools & Methods*: include camera trap networks for individual identification and time-stamped movement analysis, selective GPS or radio collaring of high-conflict bulls for real-time tracking, drone surveillance during peak seasons, patrol-based tracking of spoor and feeding signs, and verified community intelligence from village volunteers.

- *Hotspot-specific Monitoring*: focuses on corridor pressure in Masinagudi-Moyar, highway crossings and dispersing bulls in Hasanur-Thalavadi, expansion fronts in Palacode-Morappur, and crop-driven seasonal movements in Denkanikottai-Thally area.
- *Data Integration & Analysis*: Data from these methods are integrated into GIS-based heat maps, linked with rainfall and vegetation indices, and shared across divisions for landscape-level analysis. Monitoring outputs inform targeted mitigation measures such as fencing placement, corridor restoration, selective collaring, and improved response deployment.

Understanding elephant behaviour and movement patterns enhances prediction accuracy, reduces surprise incursions, lowers human injury risk, and supports more effective coexistence planning across the NER landscape.

4.3.3 Evolving integrated mitigation strategy for elephant/s in conflict

Male elephants in particular are prone to higher levels of conflict and some of them become habituated to humans and the different methods they use to protect crop.

An integrated mitigation strategy for elephant(s) in conflict in the NER must shift from reactive responses to a structured, evidence-based approach that combines individual profiling, hotspot management, habitat improvement, enforcement, technology use, and community participation across the landscape.

The strategy prioritises targeted action over blanket measures and may envisage:

- *Individual-based Mitigation:* focuses on accurately identifying habitual crop-raiding bulls or repeat offenders through camera traps and field profiling. Selective GPS collaring, targeted night patrolling along known entry routes, and controlled driving operations using trained kumkis may be undertaken where necessary, with translocation considered only as a last resort after behavioural assessment. Test aversion conditioning to train habituated males who have the ability to breach barriers to avoid human use areas through radio collaring of such males for systematic intervention.
- *Hotspot-based Landscape Mitigation:* essential in high-intensity belts such as Masinagudi-Moyar, Hasanur-Thalavadi, Palacode-Morappur, and Denkanikottai-Thali. Measures include cluster solar fencing, steel rope fencing, securing corridor bottlenecks, crop planning advisories, removal of waste attractants, and strengthening early warning and rapid response systems.
- *Selection of non-palatable Crops*: Identification of non-palatable crops by the farmers / agriculture department with due consideration to their socio-economic-cultural aspects. The low economic return from non-palatable crop needs to be considered by assured pricing mechanism, value addition and marketing linkages.
- *Habitat and Resource-based Intervention*: aims to reduce conflict drivers by improving forage and water availability within forest areas. Water augmentation during summer, grassland restoration, invasive species removal, and protection of traditional migratory routes help minimise elephant movement into agricultural lands.
- *Community-centric Measures*: These are central to sustainable mitigation. VFCs, preparedness training, transparent compensation mechanisms, crop insurance linkages, and livelihood diversification build trust and reduce retaliatory actions.
- *Enforcement and Regulation*: strengthens mitigation by controlling illegal electric fencing, conducting snare removal drives, regulating land-use conversion in corridors, and managing traffic in crossing zones. Reducing anthropogenic pressures directly lowers conflict triggers.
- *Technology Integration*: GIS-based conflict maps, real-time alert systems, drone surveillance, and division-level control rooms enables data-driven decision-making and faster response. (Gudalur has a well-developed EWRRS with drone and camera technology at **34 locations**).
- *Adaptive Management Framework*: Regular hotspot reviews, behavioural trend analysis, seasonal manpower scaling, and evaluation of mitigation effectiveness ensures continuous refinement of strategies.

The integrated approach rests on the principle of targeting conflict-prone individuals, securing hotspot landscapes, restoring habitats, and engaging communities to achieve long-term human–elephant coexistence in the NER landscape.

4.3.4 Establish anti-depredation squads and patrolling

Anti-depredation squads (ADS) generally are small groups of local community members also referred to as Primary response teams (PRT) comprising of villagers who voluntarily cooperate and assist the Forest department in the mitigation of conflict. The ADS are part of a community-based protection system, that can promptly reach the hot spot and site of conflict and assure the community that no harm will come to them till the Rapid response team (RRT) of the Forest department reaches the site of conflict.

In respect of NER, both Tiger Reserves (MTR and STR) have ADS in the following locations:

- MTR (Core) - 3 ADS (Mudumalai, Kargudi & Nellakottai)
- STR (Core) - 4 ADS (Hassanur, Germalam, Thalavadi, Jeerahalli)
- STR (Buffer) - 5 ADS (TN Palayam, Vilamundi, Talamalai, Sathyamangalam , Kadambur)

The duties of ADS include: monitoring the movement of strayed elephants close to their village and providing information on HEC incidents; driving elephants trying to breach barriers into the forest; prevent elephants from raiding agricultural crops and causing property damage; and prevent retaliatory action against the elephant from agitated community members.

Creating an anti-depredation squad for driving elephants away from human settlements and protecting both elephants and people requires a coordinated effort. Following measures could be envisaged:

- *Squad Composition*: ADS typically comprises a Forester as team lead, supported by forest guard/s, local watchers, a driver, and veterinary support on call. High-intensity divisions require 24/7 rotational coverage to ensure rapid mobilisation during peak conflict periods.

- *Equipment & Logistics*: ADS units are equipped with dedicated patrol vehicles, motorbikes for terrain access, searchlights for night operations, VHF communication sets, non-lethal deterrence tools, and safety and first-aid kits. Adequate logistics and communication infrastructure are essential for timely and coordinated action.

- *Patrolling strategies*: include preventive patrols in hotspot villages during evening and night hours, corridor surveillance during peak movement seasons, and reactive mobilisation upon receiving alerts. Seasonal scaling is critical, with intensified deployment during summer congregation and harvest seasons, particularly in eastern divisions.

- *Hotspot-Focused Deployment*: Deployment is prioritised in high-conflict belts such as Masinagudi-Moyar, Hasanur-Thalavadi highway stretches, Palacode-Morappur scrub interfaces, and Denkanikottai-Thally agricultural fringes, aligning patrol intensity with hotspot rankings.

- *Integration with Early Warning System*: ADS operations are integrated with early warning systems, village alert networks, GIS-based heat maps, and division control rooms to ensure coordinated response and real-time information sharing.

- *Community Interface*: Community engagement supports ADS effectiveness through trained local volunteers, awareness on safe behaviour during elephant presence, and early reporting mechanisms that reduce panic and crowd aggression.

- *Performance Indicators*: Performance is measured through response time, reduction in repeat crop damage and human injuries, balance between preventive and reactive patrols, and community feedback. Overall, the approach emphasises prevention, rapid response, safe dispersal, and maintenance of public trust to strengthen coexistence across the NER landscape.

Successful anti-depredation efforts require a combination of proactive measures, community involvement, and adaptive management strategies.

4.3.5 Managing straying and dispersing elephants outside the habitat

Managing straying and dispersing elephants outside traditional habitats in the NER requires a structured and preventive approach. Straying often results from drought-induced resource scarcity, crop attractiveness in eastern agricultural belts, young male dispersal, corridor fragmentation, and waste attractants near settlements.

- *Early detection* is critical and relies on camera traps, patrol observations, GPS collaring of high-risk individuals where justified, and community alert networks in newly affected villages. Mapping emerging range-use patterns helps anticipate movement and reduce emergency situations.
- *Immediate operational response* involves rapid mobilisation of trained teams, prevention of crowd escalation, controlled and non-aggressive driving of elephants toward safe forest entry points, and coordination with police for traffic and crowd management. Minimising stress during operations is essential to prevent injury or unpredictable behaviour.
- *Managing dispersing bulls* requires maintaining behavioural profiles of repeat strayers, monitoring seasonal trends, and deploying targeted deterrence along preferred routes. Translocation should be considered only as a last resort after scientific evaluation (Box-4.5).
- *Securing return pathways* is often more effective than forceful dispersal. This includes keeping corridors free from encroachment, removing illegal fencing, regulating traffic during crossing periods, and ensuring adequate water and forage availability within forest habitats.
- *Community-centric measures* such as awareness in newly affected villages, crop-guarding advisories, fast-tracked compensation, and formation of Village Elephant Response Committees reduce panic and build trust (THADAM Committees in Dharmapuri).
- *Long-term prevention* focuses on habitat restoration in degraded slopes, invasive removal, protection of migratory routes, and careful land-use planning to prevent further fragmentation.

Overall, the approach emphasises early detection, safe guidance back to habitat, corridor security, and community engagement to prevent permanent habitat shifts and reduce conflict across the landscape.

Box-4.5: Wild Elephant Translocation causing Crop Raiding and Human Conflict

Conservation Significance of Elephant Translocation

- *Context*: 'Vinayagan' and 'Chinnathambi' were the two adult wild male elephants, aged around 35 years and 26 years respectively, known for frequent crop-raiding and entering human habitations in Thadagam area of Coimbatore district. Due to repeated HEC, and public agitation, the Tamil Nadu Forest Department decided to translocate them.
- *Translocation*: In December 2018, Vinayagan was captured and translocated to the Mudumalai-Bandipur landscape in the **Nilgiri ER** and Chinnathambi was tranquilized and translocated to the deep forests in Varagliar area of the Anamalai ER in January 2019 as part of an effort to reduce HEC; both elephants were fitted with the radio-collars.
- *Post-Translocation Behavior*: Vinayagan continued to seek out familiar food resources, and raided crops near the translocation site before being driven back into forest areas; began feeding predominantly on natural vegetation but also continued to raid crops; eventually captured by the Karnataka Forest Dept in June 2023. On the contrary, Chinnathambi covered long distances- through forests, into farmlands & villages and took shelter 8-10 kms from RF, where he was captured again & taken to captivity.
- *Conservation Significance:* Translocation is one of the tools to address HEC, but evidence suggests it's not always effective at eliminating conflict and can sometimes shift it to other areas or only temporarily divert the problem. The crop-raiding behavior can be modified only as long as continuous monitoring and intervention are possible, otherwise, focus needs to be on the long-term solutions (habitat restoration, securing corridors, regulated land use in the ER, & community-based coexistence measures).

4.3.6 Site-specific barriers and other exclusionary measures

Site-specific barriers and exclusionary measures in NER are designed to reduce human-elephant conflict at identified hotspots while maintaining ecological connectivity. Across Nilgiris, Gudalur, MTR, STR, Erode, Dharmapuri and Hosur forest divisions, barriers must be strategically located in conflict-prone village clusters, crop fields, and settlement edges rather than across entire landscapes (Table-4.3).

Table-4.3: Principal types of barriers used against elephant in NER

Divisions	EPT	Solar Fence	Hanging Fence	Steel Rope	Rubble Wall
Hosur	309 km	130 km	48 km	51 km	2 km
Dharmapuri	249 km	69 km	-	-	-
Erode	4 km	-	-	-	-
STR	43 km	8 km	-	-	-
MTR	61 km	-	-	-	-
Gudalur	65 km	-	-	-	-
Nilgiris	-	-	-	-	-
Total	**731 km**	**207 km**	**48 km**	**51 km**	**2 km**

There could be different strategies to instal barriers as under:

i. Construction of barriers around forest areas to keep elephants inside the forest
ii. Barriers constructed across the landscape between two states / districts
iii. Barriers constructed around the settlement to be protected such as village / enclave

As regards the effectiveness of the barriers-

- Strategy (i) is not advisable around small forest blocks (few sq. kms in size) because such forests cannot provide all the space and food requirements and confines the elephant population; compromising their long-term genetic viability. It may be moderately useful around large forest blocks but extremely difficult to completely encircle forest blocks.
- Strategy (ii) is rather impossible to create effective barriers at landscape level ensuring movement of the elephants across ecological landscapes and not be confined to administrative units.
- Strategy (iii) is most effective for protection of crops but it can be used only in specific situations wherever there is a compact area but not so around large enclaves.

If barriers are to be created, a map must be prepared showing location of elephant groups, seasonal migration patterns of elephants and locations of elephant corridors including location of proposed elephant barriers. Barriers may be created only if the boundary is "hard" (clear and sharp demarcation between forest and human landscape), fairly straight without much convolution and not broken by roads, river or large stream for making them more effective.

Following measures may be envisaged:

- *Solar-Powered Fencing* (Cluster Model): Solar fencing is one of the most widely adopted mitigation tools in eastern NER divisions such as Palacode-Morappur and Denkanikottai-Thally. The cluster fencing model protects contiguous agricultural plots rather than individual farms, reducing maintenance burden and improving effectiveness. Proper earthing, voltage monitoring, and community-managed maintenance are critical to prevent failure.

- *Elephant-Proof Trenches* (EPTs): EPTs are used in selected dry deciduous belts where soil and slope conditions permit. They are suitable along forest–agriculture boundaries in Dharmapuri and parts of Sathyamangalam slopes. However, regular desilting and repair are required to prevent collapse, and trenches must not obstruct identified elephant corridors.

- *Bio-Fencing & Natural Barriers*: Planting unpalatable or deterrent species such as agave, cactus, or thorny hedges along village boundaries provides supplementary protection. Bio-fencing is particularly useful in estate and plateau areas of Nilgiris and Gudalur.

- *Rail & Road Mitigation Barriers*: In highway corridors such as Hasanur–Bannari and ghat sections, exclusion measures include speed breakers, signage, solar blinkers, rumble strips, and wildlife crossing signboards. Physical barriers should be avoided where they fragment corridors; instead, controlled crossing structures and traffic regulation are preferred.
- *Waste & Attractant Control Barriers*: Fencing around garbage dumps, market yards, and food storage facilities prevents elephants from associating settlements with food rewards. This is particularly relevant in Masinagudi tourism zones and peri-urban belts of Hosur.
- *Smart Barriers & Technology Integration*: In select high-risk villages, integration of motion sensors, alarm-triggered sirens, SMS alerts linked to fence disturbance, and solar-powered surveillance cameras enhances deterrence and early warning.
- *Temporary & Seasonal Barriers*: During harvest season, portable fencing and coordinated night watch systems are deployed in eastern divisions. These temporary measures help prevent seasonal crop raids without permanent landscape alteration.

Design Principles for Exclusionary Measures

- Avoid blocking natural corridors
- Focus on protecting settlements, not excluding elephants from habitat
- Ensure community participation in maintenance
- Conduct periodic performance audits
- Integrate barriers with early warning systems

Fig-4.3: Types of Physical Barriers adopted in the Region (Top L to R) - Traditional EPT; Modern Fences-Rail Girder (KAR); Hanging Power Fence (All States); Steel Rope Fence (TN); AI-Smart Fence (KER)

Steel rope fencing has proven to be effective with the ongoing design refinement in the NER and it is also expected that the same may lead to the reduced crop depredation, improved corridor functionality, reduced need for reactive driving operations and strengthened community confidence.

Assessment of the Fencing/ Barrier Requirement in the NER

The assessment of fencing and barrier requirements in the NER is based on a hotspot-driven and corridor-sensitive approach, focusing on protecting agricultural and settlement interfaces rather than creating continuous perimeter barriers.

Division-wise estimates indicate the highest requirement in eastern conflict belts such as Dharmapuri and Hosur divisions, followed by the eastern slopes of STR. Moderate requirements are estimated for MTR and Erode, while Gudalur and Nilgiris divisions require comparatively smaller stretches (Table-4.4).

Table-4.4: Estimated Barrier Requirement (Division-wise)

Division	Landscape Unit	Requirement (Approx)	Priority Level
Hosur	Denkanikottai-Thally-Anchetty	100-120 km	Very High
Dharmapuri	Palacode-Morappur	90-110 km	Very High
STR	Hasanur-Thalavadi belt	70-85 km	Very High
Erode	Bhavani-Anthiyur	50-65 km	High
MTR	Masinagudi-Moyar fringe	45-60 km	High
Gudalur	Estate fringes	35-45 km	Medium
Nilgiris	Plateau-Ghat slopes	25-35 km	Low

- The total estimated fencing and barrier requirement across NER ranges between approximately 415 - 520 km. Solar fencing could constitute the majority share (around 65-70%), followed by elephant-proof trenches in suitable dry belts, bio-fencing as supplementary protection, and limited pilot stretches of smart sensor-based systems.
- A phased implementation plan is recommended, with Phase-I focusing on critical eastern hotspots in Dharmapuri, Hosur, and Hasanur belts; Phase-II covering other high-conflict areas such as Masinagudi-Moyar and Bhavani-Anthiyur; and Phase-III addressing emerging zones in Gudalur and Nilgiris slopes.
- The strategy prioritises cluster-based fencing in high-conflict zones while ensuring that natural elephant corridors remain unobstructed. A buffer provision of 15-20% is included for future expansion and maintenance needs.

Design safeguards may emphasise maintaining corridor gaps at identified crossing points, integrating fencing with early warning systems, ensuring community-managed maintenance, and conducting annual review/ audits of functionality. The core principle is to protect people and crops without fragmenting elephant movement pathways.

4.3.7 Community based awareness building, cooperation and conflict management

Community-based awareness building and cooperation are essential for sustainable human-elephant coexistence in the NER. Since conflict often occurs at the agriculture-forest interface, long-term mitigation depends on informed communities and shared responsibility alongside physical and enforcement measures.

- *Community Awareness Programmes*: Regular awareness programmes in hotspot villages help people understand elephant behaviour, safe practices during encounters, and legal provisions related to wildlife protection. Seasonal campaigns before harvest and summer congregation periods, supported by local-language materials and school outreach, promote behavioural change and preparedness.
- *Awareness about Tamil Nadu Power Fences Rules 2023:* To focus on wildlife safety, particularly to reduce elephant electrocutions near forests, Govt of Tamil Nadu have enacted *Tamil Nadu Power Fences (Registration and Regulation) Rules 2023*. These rules apply within 5 km of a notified Reserved Forest boundary and no one is allowed to erect a power fence (including solar-powered or battery-powered) without prior permission from the DFO. This should invariably form the part of the 'community awareness program'.
- *Formation of Village Elephant Response Committees (VERC)*: strengthens local cooperation. Trained volunteers act as early informants, support safe crowd behaviour, and maintain communication with Rapid Response Teams. Inclusive participation, including women and youth, broadens outreach and trust. Members of VFCs could be part of VERC.

- *Participatory Conflict Preparedness*: such as training in crop guarding, proper maintenance of solar fencing, and mapping of entry points- enables communities to anticipate and manage risk more effectively. Village-level preparedness plans reduce panic and reactive actions.
- Transparent Compensation & Grievance Redressal: Transparent and timely compensation for crop damage is critical for maintaining confidence in authorities. Clear documentation procedures, grievance redressal mechanisms, and public disclosure of timelines reduce frustration and retaliatory tendencies.
- *Livelihood Diversification and Economic Incentives*: including promotion of less palatable crops, non-farm income options, eco-tourism initiatives, and recognition of conflict-resilient villages, enhance community resilience and reduce vulnerability to losses.
- *Youth Engagement*: through school programmes, nature camps, and citizen science initiatives builds long-term conservation values and fosters a culture of coexistence.
- *Cross-sectoral Collaboration:* Panchayats, rural development agencies, sanitation programmes, and health departments strengthen integrated management under a One Health framework.

Regular feedback mechanisms, village-level conflict tracking, and periodic review meetings ensure adaptive management and sustained cooperation, reinforcing trust and reducing conflict intensity.

4.3.8 Training and capacity building

Training and capacity building in the NER is essential to strengthen human-elephant conflict management, enforcement, health surveillance, and community cooperation across the landscape. Structured, role-specific training enhances professionalism, safety, and coordinated response.

- **Field Staff & Response Teams:** Training focuses on conflict response protocols, safe driving and dispersal techniques, crowd management, use of non-lethal deterrents, GPS and GIS-based monitoring tools, early warning systems, and documentation procedures. Capacity building also includes wildlife crime investigation, electrocution prevention audits, zoonotic disease awareness under the One Health framework, and seasonal preparedness drills to improve response time and decision-making.
- **Mahouts and Assistants:** Training emphasises humane handling of kumkis, behavioural understanding of elephants, stress management during operations, safety during tranquilisation or capture support, veterinary first aid, and welfare standards compliance. Refresher courses and exposure visits to best-practice camps improve operational effectiveness & elephant well-being.
- **Daily Wage Workers / Anti-Poaching Watchers:** Capacity building includes patrolling techniques, identification of spoor and movement signs, snare detection and removal, safe use of communication equipment, incident reporting formats, and personal safety during night operations. Basic training in first aid, zoonotic risk awareness, and conflict de-escalation strengthens their frontline role.
- **Local Population:** Community-oriented training programmes focus on safe behaviour during elephant presence, early reporting mechanisms, crop protection methods, proper maintenance of solar fencing, waste management practices, and awareness of legal provisions. Village-level mock drills and formation of local response committees enhance preparedness and reduce panic-driven escalation.

Targeted training across these stakeholder groups builds institutional strength, improves coordination, reduces operational risks, and supports sustainable human–elephant coexistence in the NER landscape.

4.4 INSTITUTIONAL CAPACITY DEVELOPMENT

Institutional capacity development in the NER involves strengthening organisational structures, human resources, technical systems, and inter-departmental coordination to support long-term elephant conservation and conflict management. It includes establishing dedicated enforcement and conflict management cells, strengthening veterinary and monitoring infrastructure, improving data management through GIS-based dashboards, ensuring adequate staffing & logistical support for frontline operations.

Capacity development also requires continuous training, standard operating procedures, knowledge-sharing platforms, performance monitoring systems, and convergence with allied departments such as Animal Husbandry, Revenue, Police, and Disaster Management. By institutionalising adaptive management, and evidence-based decision-making, NER can enhance operational efficiency, and resilience in addressing dynamic ecological and socio-economic challenges across the landscape.

4.4.1 Support structure for conflict management

An effective support structure for conflict management in NER must be multi-tiered, decentralised for rapid action, and centrally coordinated for strategic oversight across all divisions. The structure should integrate operational response, community engagement, technical monitoring, veterinary support, enforcement, and administrative coordination.

- **Field level:** Beat Guards and Anti-Depredation Squads (ADS) serve as the first line of response. They conduct preventive patrols, verify elephant presence, disseminate alerts, manage crowds, and undertake controlled driving operations. These teams require 24/7 mobility, communication equipment, and linkage to control rooms.
- **Range and Division level:** Rapid Response Teams (RRTs) operate under clear Standard Operating Procedures (SOP), supported by dedicated vehicles, GIS-based conflict heat maps, early warning systems, and veterinary backup. Division Control Rooms coordinate alerts, document incidents, and ensure inter-agency communication with Police, Electricity, and Revenue departments.
- **Landscape level:** a CF/CCF-led Elephant Coordination Cell should oversee hotspot prioritisation, seasonal manpower deployment, barrier planning, funding convergence, and emergency deployment. This cell integrates monitoring data, compensation records, fencing audits, and movement analysis for adaptive planning.
- **Veterinary Support Unit:** strengthens the structure by addressing injured elephants, managing stress-related health issues, conducting post-mortem investigations, and supporting safe tranquilisation where required. Integration with One Health surveillance systems ensures disease risk monitoring.
- **Community-based Structures:** including Village Elephant Response Committees and Eco-Development Committees, form the social support backbone. They enable early reporting, reduce panic, support fencing maintenance, and participate in awareness programmes.
- **Administrative and Financial Support Mechanisms**- such as fast-track compensation systems, grievance redressal platforms, and CSR convergence for mitigation infrastructure- ensure sustained community trust and operational continuity.
- **Technology and Data Integration**, including GPS tracking (where applicable), camera traps, drone surveillance, and centralised dashboards, strengthen predictive capacity and evidence-based decision-making.

Together, this layered support structure- field response, divisional coordination, landscape oversight, veterinary backup, community participation, and institutional integration- creates a resilient and adaptive framework for managing human–elephant conflict in the NER landscape.

4.5 EMERGENCY RESPONSE SITUATIONS

The emergency situation includes when elephants move far away from the habitats and enter in human use areas; when elephants attack humans; rescue and treatment of injured elephants; and elephant mortalities due to electrocution, train hit, road accident, crude bomb etc. (Fig-4.4).

In such situations, the skilled personnel to manage the crowds, avoiding disturbance to the animal, safe driving back into the forest or contain the elephant, tranquilize the animal if the animal is in agitated mood are needed to handle the situation successfully in a collaborative and coordinated efforts.

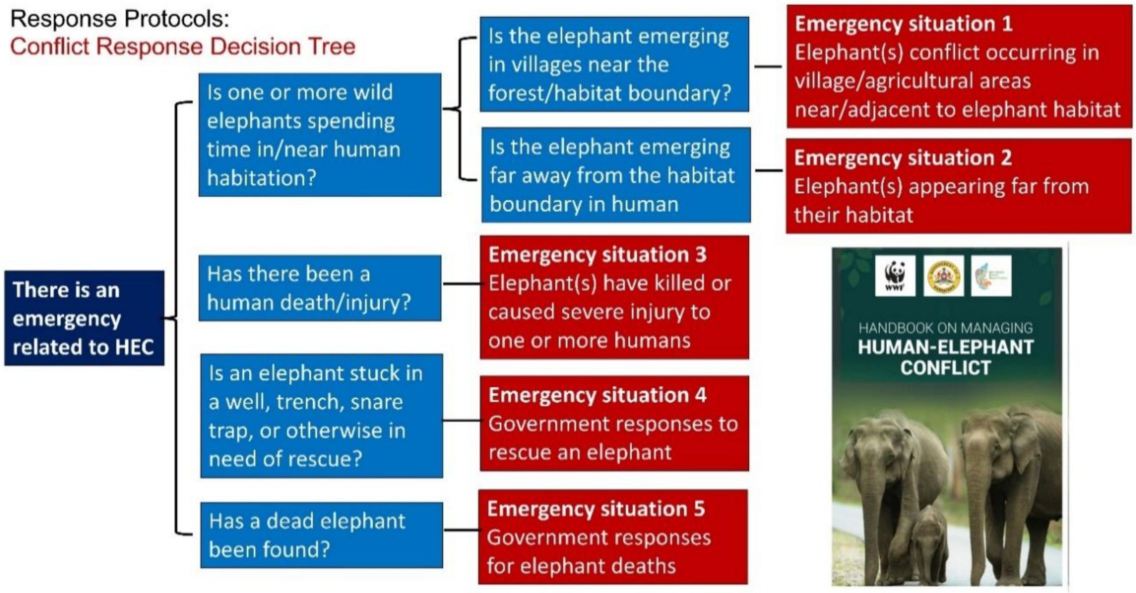


Fig-4.4: Flow Chart - Conflict Response Decision Tree (refer: Handbook on managing HEC)

The key emergency response procedures may include the following:

4.5.1 Pre-emergency situation

Pre-emergency preparedness for human-elephant conflict in the Nilgiri Elephant Reserve focuses on anticipating escalation and ensuring systems are in place before peak conflict periods such as summer congregation and harvest seasons. Across Nilgiris, Gudalur, MTR, STR, Erode, Dharmapuri and Hosur divisions, structured readiness reduces the likelihood of emergencies turning into crises.

- *Establishment of an Emergency Response Mechanism*: includes setting up 24/7 division control rooms, identifying and scheduling Rapid Response Teams (RRT), maintaining real-time early warning systems, updating hotspot maps, and enforcing Standard Operating Procedures for driving operations, crowd control, tranquilisation support, and casualty handling. Clear trigger thresholds- such as repeated crop raids, human injury, or elephant injury- ensure timely escalation and mobilisation of additional resources.
- *Key Operational Stages*: The synchronization of various activities to meet the emergency includes- monitoring and situational awareness; mitigation hubs/ control room/ helplines; RRT/ PRT personnel, veterinary team, drug/ equipment & mobility/ communication; anti-depredation squad (ADS) & koonkie elephants for elephant drives
- *Intra- and Inter-Agency Coordination & Cooperation*: Effective coordination is essential before emergencies occur. The Forest Department must maintain formal communication channels with Police, Revenue, Electricity, Animal Husbandry, Health, and Disaster Management authorities. Regular coordination meetings, updated contact lists, cross-border information sharing, and pre-season reviews of fencing and preparedness gaps strengthen collaborative response capacity.
- *Preparedness of Response Teams*: involves refresher training in safe driving techniques, crowd management, night operations, first aid, and proper documentation. Equipment audits of vehicles, communication systems, and deterrent tools must be completed before high-risk months. Mock drills in major hotspots such as Masinagudi-Moyar, Hasanur-Thalavadi, Palacode-Morappur, and Denkanikottai-Thally enhance coordination and operational readiness.

Overall, the pre-emergency framework emphasises anticipation, coordination, and rapid mobilisation to stabilise high-risk situations quickly, reduce panic and injuries, and strengthen institutional confidence across the NER landscape.

4.5.2 During emergency situation

Emergency situations of HEC arise in NER when elephants enter dense settlements, cause human injury or fatalities, repeatedly raid crops within a short span, or when crowd aggression escalates. In high-intensity belts such as Masinagudi-Moyar, Hasanur-Thalavadi, Palacode-Morappur, and Denkanikottai-Thally, immediate, coordinated action is essential to prevent escalation.

- *Identification of the Animal(s) in Conflict*: Accurate identification is the first priority. Field teams must confirm the number of elephants involved, assess behaviour (aggressive, defensive, stressed, or injured), and determine whether the individual is a known repeat offender. Distinctive physical features, camera trap records, and GPS collar data (if available) should be cross-verified. Behavioural assessment, including signs of musth or injury, helps categorise the threat level and ensures proportionate intervention.
- *Immediate Safety Measures*: focus on protecting human life. This includes clearing crowds, coordinating with police for perimeter control, temporarily managing power supply risks, and evacuating vulnerable households if necessary. Clear and verified communication to the public helps prevent panic and misinformation.
- *Controlled Management Actions:* depend on the assessed risk level. In low to moderate risk situations, gentle driving operations using coordinated teams, searchlights, and non-lethal deterrents guide elephants toward safe forest exit routes. In high-risk cases involving human injury or extreme aggression, senior officers, veterinary teams, and trained kumkis may be deployed, with tranquilisation considered only under strict supervision and defined protocols.
- *Medical & Relief Support*: This must be activated immediately in case of injuries or fatalities, including first aid, hospital coordination, and initiation of compensation procedures. Transparent handling of relief measures helps reduce community tension.
- *Monitoring & Stabilisation* continues even after the immediate threat subsides. Teams patrol probable re-entry points for 24-48 hours, update conflict maps, document the incident thoroughly, and review barrier gaps or attractant sources. Overall, the emergency response emphasises human safety, precise identification, proportionate action, and rapid de-escalation to stabilise conflict situations effectively in the NER landscape.

Operating procedures may be laid for stepwise key actions, for all emergency situations, media engagement, crowd management, addressing health emergencies, and post response operation.

4.5.3 Post emergency situation

Post-emergency management in the NER begins once the immediate human-elephant conflict threat has been stabilised and elephants have exited settlement areas. Structured follow-up actions are essential to prevent recurrence, restore public confidence, and improve future response systems.

- *Incident Review & Documentation*: A formal incident review should be conducted within a few days to analyse trigger factors such as crop stage, water scarcity, corridor obstruction, or crowd behaviour. Identification of the elephant(s) involved, updating of GIS-based conflict records, and assessment of response efficiency help refine operational protocols and correct systemic weaknesses.
- *Compensation & Relief Follow-Up*: Compensation and relief measures must be completed transparently and promptly. Damage verification, fast-track disbursement for crop and property losses, and sensitive handling of human injury or fatality cases are critical for maintaining trust and reducing resentment.

- *Infrastructure Audit & Gap Correction*: Infrastructure audits at the affected site are necessary to inspect solar fencing, trenches, and other barriers for breaches or malfunction. Attractants such as garbage dumps must be removed, and corridor bottlenecks identified for corrective intervention to reduce the risk of repeat incidents.
- *Monitoring of Conflict Individual(s)*: Monitoring should continue for several weeks after the incident, with intensified patrolling along re-entry routes of the identified conflict individuals. Behavioural reassessment or collaring may be considered if repeat involvement is observed.
- *Community Engagement and Confidence Building*: Community engagement through village meetings helps clarify actions taken, counter misinformation, reinforce safety guidelines, and encourage early reporting of renewed elephant movement. Transparent communication reduces panic and hostility.
- *Inter-Agency Debriefing & Learning*: Inter-agency debriefing among Forest, Police, Revenue, Electricity, and Veterinary authorities strengthens coordination and identifies manpower or equipment gaps for future improvement.
- *Combination of Relief Measures*: measures related to human safety, elephant welfare, psycho-social support and livelihood assistance may also be considered.
- *Adaptive Management Adjustments*: Measures such as revising hotspot classification, adjusting RRT deployment, and updating seasonal preparedness plan ensures continuous refinement of the human-elephant conflict management framework across the NER landscape.

4.6 ELEPHANT CAPTURE AND RELEASE OPERATION

Elephant capture with the assistance of kumkis in the NER should be undertaken only after all feasible non-invasive mitigation measures have failed. Capture operations must be legally authorised, scientifically justified, and guided by the principles of animal welfare, public safety, and conservation.

4.6.1 Protocols for Capture of Elephant in Conflict

The following protocol is suggested as part of Standard Operating Procedure (SOP) in respect of capturing elephants in conflict in the NER landscape

1. *Objectives:* The primary objective is to safely manage identified conflict elephants while minimising stress, injury, and mortality to both wild and captive elephants.
2. *Conditions Warranting Capture:* Capture using kumkis should be considered only when one or more of the following conditions are met:
    - Chronic involvement in severe human fatalities or repeated serious injuries.
    - Persistent crop raiding or settlement incursions despite sustained mitigation.
    - Elephant suffering from severe injury, illness or disability requiring intervention.
    - Elephant trapped or stranded where self-release is not feasible.
    - Elephant posing an immediate and unacceptable risk to public safety.
    - Capture authorised by the competent authority after technical evaluation.

Capture should not be undertaken solely because an elephant has entered agricultural land once or has caused isolated crop damage.

3. *Pre-Capture Planning:* Prior to any operation, following may be followed-
    - Confirm the identity of the elephant through field observations, camera traps, or telemetry.
    - Study movement patterns, behaviour, home range and preferred escape routes.
    - Conduct reconnaissance of terrain, vegetation, water sources and accessibility.

- Prepare a site-specific risk assessment.
- Develop an Incident Action Plan (IAP).

4. *Constitution of Capture Team:* A multidisciplinary capture team should be constituted under the leadership of an authorised Incident Commander and include experienced forest officers, wildlife veterinarians, trained kumkis with their mahouts and cavadies, Rapid Response Teams, forest frontline staff, police, medical personnel, and support staff.
5. *Kumki Selection:* Only healthy, experienced, and behaviourally stable kumkis certified fit by veterinarians should be deployed to ensure safe and controlled operations.
6. *Veterinary Preparations:* The veterinary team shall ensure clinical examination of kumkis, immobilisation drugs and antidotes, emergency medicines, IV fluids, oxygen support, monitoring equipment, and capture and treatment equipment etc. Drug dosage shall be calculated individually considering age, body condition, sex and estimated weight.
7. *Site Preparation:* Prior to capture, the operational area should be secured by establishing exclusion zones, regulating public access, deploying crowd-control measures, identifying evacuation routes, and ensuring uninterrupted communication among team members.
8. *Capture Operation:* The operation should proceed systematically.
    - *Phase I-* Locate and confirm the target elephant.
    - *Phase II-* Guide the elephant gradually into a safe operational zone using kumkis; avoid excessive chasing and avoid separating family groups unnecessarily.
    - *Phase III-* If required, immobilise under veterinary supervision. There needs to be continuous monitoring of respiration, pulse, body temperature and recovery time.
    - *Phase IV-* Kumkis assist in safely restraining the elephant after adequate sedation. Force should always be proportionate and kept to the minimum necessary.
9. *Human Safety Protocols:* Strict safety protocols should be followed throughout the operation. All personnel should wear appropriate protective equipment, maintain designated safety distances, and operate under a unified command structure. No unauthorised personnel should enter the operation zone.
10. *Elephant Welfare Protocols:* Simultaneously, elephant welfare should remain paramount by minimising pursuit time, reducing stress, preventing overheating, protecting the trunk and airway, reducing restraint duration, and providing immediate veterinary attention, hydration, and treatment whenever required.
11. *Crowd Management:* Create exclusion zones, restrict media access, prevent public interference, maintain public order' and facilitate emergency vehicle movement. Only authorised spokespersons should communicate with the media (also refer 4.7).
12. *Transport Protocol:* If transportation is necessary, the elephant should be moved using approved transport facilities under continuous veterinary supervision with adequate ventilation, secure restraint, and emergency medical support. Also, coordinate with destination facility.
13. *Post-Capture Care:* Immediately after capture there needs to be full veterinary examination, blood sampling, injury assessment, wound treatment, hydration, behavioural observation, and continuous monitoring until complete recovery.
14. *Rehabilitation and Future Management:* Depending upon veterinary and behavioural assessment, options include:
    - Short-term rehabilitation.
    - Long-term observation.
    - Retention in the zoo/ rescue centre/ managed elephant camp.

- Scientifically justified release or translocation where feasible and legally approved.

Each case should be decided individually based on welfare, conservation, and public safety considerations.

15. *Documentation:* Every capture operation should be thoroughly documented, including the reasons for capture, location, personnel involved, veterinary interventions, drugs administered, operational chronology, and post-capture outcomes.
16. *Post-Operation Review:* A multidisciplinary post-operation review should evaluate adherence to standard operating procedures, identify operational strengths and shortcomings, and recommend improvements. Such systematic review promotes adaptive management, enhances institutional learning, and ensures that future elephant capture operations in NER remain safe, humane, scientifically robust, and consistent with the objectives of long-term elephant conservation.

Guiding Principles

- Capture only when unavoidable and legally authorised.
- Human safety is the foremost operational priority.
- Elephant welfare must be protected throughout the operation.
- Kumkis should be used to facilitate calm and controlled restraint, not prolonged pursuit.
- All operations should be scientifically planned, transparently documented, and subjected to post-operation review to continuously improve capture protocols in the NER.

4.6.2 Protocols for Release (Translocation) of Conflict Elephants

In accordance with the Project Elephant-MoEFCC / WII Recommended Operating Procedure for Capture and Translocation of Elephants in Distress and Conflicts and the Framework for Preparation of Elephant Conservation Plans, conflict elephants that are approved for release should generally be translocated to a different elephant landscape located approximately 200 km or more from the capture site. This reduces the likelihood of the elephant returning to its original range and helps minimise recurrence of human-elephant conflict (HEC). The release site should be scientifically selected, located in the interior of suitable elephant habitat, and support an existing elephant population for successful integration.

1. *Criteria for Translocation:* Translocation should be undertaken only after approval by the competent authority and when capture has been deemed unavoidable. It should be reserved for identified conflict elephants that have repeatedly caused severe human casualties or persistent conflict despite sustained mitigation, and where release within the same landscape is unlikely to prevent recurrence. The decision should be based on veterinary, ecological, behavioural, and social assessments conducted by an expert committee.
2. *Selection of Release Landscape:* The release landscape should be located at least 200 km away, or farther where appropriate, so that the elephant is unfamiliar with the area and is less likely to attempt homing back to its original range. The site should be situated well inside a large contiguous forest, away from villages, agricultural lands, highways, railways, and other disturbance zones. Habitat quality, food and water availability, connectivity, carrying capacity, and the presence of a resident elephant population should all be evaluated before final selection. Ad hoc release-site selection should be avoided by identifying and approving potential release areas in advance at the landscape or Circle level.
3. *Veterinary and Behavioural Clearance:* Before translocation, the elephant should undergo a comprehensive veterinary examination to confirm physical fitness for transport and release. The animal should have recovered from capture-related stress or injuries and be capable of independent survival. Behavioural assessment should confirm that the elephant retains normal wild behaviour and does not exhibit excessive dependence on humans or captive elephants.
4. *Transport Protocol:* Transportation should be carried out using specially designed elephant transport vehicles under continuous veterinary supervision. Kumkis may be used to safely guide the elephant into the transport vehicle where necessary. Vehicle movement should minimise

travel time and unnecessary stoppages. During long journeys, the elephant should be monitored continuously for respiration, posture, body temperature, hydration status, and signs of stress. Water should be provided during prolonged transport, particularly under hot weather conditions.

5. *Soft Release:* Where operationally feasible, a soft release approach should be adopted. The elephant may be temporarily retained in a secure stockade at the release site for a limited acclimatisation period before being released into the surrounding forest. This allows recovery from transport stress and gradual familiarisation with the new environment, potentially reducing immediate dispersal and homing behaviour.

6. *Release Procedure:* The elephant should be released during favourable weather conditions and preferably during periods of adequate forage and water availability. The release should take place at a pre-identified off-loading point that allows the animal to move directly into secure forest habitat without encountering human settlements. Human presence should be restricted to essential personnel, and disturbance, noise, and media access should be minimised throughout the operation.

7. *Post-Release Monitoring:* Every translocated elephant should, wherever feasible, be fitted with a GPS or satellite collar before release to enable continuous monitoring of movement, habitat use, and potential return towards human-dominated areas. Monitoring should be undertaken by a multidisciplinary team comprising forest managers, wildlife biologists, and veterinarians using telemetry, camera traps, field observations, and community reporting. If the elephant re-engages in serious conflict, timely intervention, including recapture where necessary, should be considered.

8. *Community and Inter-State Coordination:* Where translocation involves another forest division or State, prior coordination between the respective Forest Departments should be completed. Local authorities, frontline staff, and Rapid Response Teams in the release landscape should be informed in advance. Public awareness measures and temporary surveillance around vulnerable villages should be strengthened during the initial post-release period.

9. *Documentation and Evaluation:* A complete translocation dossier should be prepared, documenting the justification for capture and translocation, veterinary findings, behavioural assessment, release-site evaluation, transport details, GPS collar information, monitoring protocol, and post-release observations. Periodic review of each translocation should assess survival, integration into resident elephant populations, recurrence of conflict, and operational lessons to improve future interventions.

10. *Adaptive Management:* Release should be regarded as part of an adaptive conservation strategy rather than the end of the intervention. Monitoring data should be used to refine release-site selection, improve capture and rehabilitation procedures, strengthen conflict mitigation measures, and guide future management decisions. If a released elephant repeatedly returns to conflict situations despite appropriate mitigation efforts, its case should be reassessed by an expert committee to determine the most suitable management option in the interest of both conservation and public safety.

Guiding Principles

- Release only after scientific, veterinary, behavioural, and legal clearance.
- Select a release site 200 km or more from the capture location within a different elephant landscape, in accordance with MoEFCC guidance.
- Release only into secure interior habitat capable of supporting long-term survival and integration with resident elephants.
- Prefer GPS-enabled post-release monitoring and adaptive management for every translocated elephant.

- Evaluate every translocation based on public safety, elephant welfare, conservation outcomes, and recurrence of conflict, ensuring that translocation remains an evidence-based management intervention rather than a routine response.

4.6.3 Protocols for the Capture, Handling and Rewilding of Orphan Elephant Calves

The management of orphan elephant calves in the NER should be guided by the principle that '*reunion with the natal herd is always the first and preferred option*'. If reunion is not feasible or the calf is genuinely orphaned, rescue, rehabilitation, and eventual rewilding should follow the Standard Operating Procedures issued by the Project Elephant Division, MoEFCC, together with the Tamil Nadu Forest Department's SOP on Orphaned Elephant Calf Management. Every intervention should maximise the calf's chances of surviving as a free-ranging wild elephant while minimising human imprinting.

1. *Confirmation of Orphan Status*: Before rescue, the field team should ensure that the calf is genuinely orphaned and not merely temporarily separated from its herd. Continuous monitoring for several hours, and longer where operationally feasible, should be undertaken to determine whether the mother or herd returns. Search operations using elephant trackers, drones where appropriate, camera traps, dung trails, and field intelligence should be undertaken before deciding on capture. Immediate reunion should be attempted whenever there is a reasonable likelihood of success.
2. *Rescue Team*: Rescue should be initiated only after careful assessment by an expert team and under the supervision of authorised forest and veterinary personnel, ensuring that intervention is justified and in the best interest of the calf's welfare and long-term survival.
3. *Safe Capture*: Capture should be calm and minimally stressful. Kumkis should gently secure and reassure the calf rather than physically overpower it. Immobilisation should be avoided unless essential for the calf's safety or transport. Handling time should be minimised, and excessive noise, crowding, photography, and public access should be prevented. The rescue operation should be led through an Incident Command System involving experienced forest officers, wildlife veterinarians, mahouts, Rapid Response Teams, and support staff.
4. *Immediate Post-Rescue Management*: Immediately after rescue, the calf should undergo a comprehensive veterinary examination to assess its health, age, nutritional status, dehydration, injuries, and disease risks. Appropriate treatment, fluid therapy, deworming, disease screening, identification through microchipping, and detailed documentation should be completed.
5. *Quarantine and Health Care*: The calf should then be housed in a secure quarantine facility under strict biosecurity protocols with continuous veterinary monitoring until it is medically stable. During quarantine, daily veterinary examination, disease screening, deworming, vaccination, nutritional assessment, behavioural observation should be carried out and strict hygiene protocols, maintained.

   Only designated caregivers should have access. The calf should preferably be cared for by one dedicated mahout, particularly during its earliest months, to reduce stress and disease risk. Calves younger than one year require continuous (24×7) supervision, and where possible should be housed with a tolerant adult female camp elephant acting as a foster mother. Exposure to unnecessary human contact should be avoided because of disease susceptibility and the need to minimise imprinting.
6. *Nutrition and Hand-Rearing*: Rehabilitation should focus on providing age-appropriate nutrition, veterinary care, and opportunities for normal behavioural development. Feeding should progressively transition from milk replacers to gradual introduction of browse, natural forage, mineral supplementation, fresh water at all times and feeding should progressively encourage independent foraging.
7. *Social Development & Behavioural Conditioning*: Wherever feasible, orphan calves should be raised alongside foster female elephants or compatible juvenile elephants to facilitate social learning, natural behaviours, communication skills, and gradual adaptation to life in the wild. Human interaction should be restricted to essential husbandry activities, and tourism or public

display should be strictly avoided. The calf should learn browsing behaviour, mud bathing, water use, social communication, predator awareness, and natural movement.

8. *Pre-Rewilding Assessment*: Before rewilding, each calf should undergo a multidisciplinary assessment to certify its physical fitness, behavioural competence, ability to forage independently, social integration skills, and natural avoidance of humans.
9. *Selection of Rewilding Site*: The release site should be located within suitable elephant habitat, with adequate food, water, habitat connectivity, and resident elephant populations, while remaining sufficiently distant from villages and other human disturbances. Whenever possible, reunification with the original herd should be attempted; otherwise, scientifically selected release sites should be used.
10. *Soft Rewilding Protocol*: Rewilding should follow a phased soft-release approach, beginning with acclimatisation in large forest enclosures, followed by supervised movement in natural habitats, gradual reduction of supplementary feeding, voluntary association with wild elephant herds, and progressive independence until complete release. This staged approach enables the calf to develop survival skills while reducing the risk of post-release failure.
11. *Post-Release Monitoring*: Following release, the calf should be monitored using GPS or satellite telemetry, camera traps, field observations, and community-based reporting to assess survival, movement, health, habitat use, and integration with wild elephant herds. Monitoring should continue for an extended period, with decreasing intensity as the animal establishes itself in the wild and should assess survival, feeding, social integration, home range, interaction with wild elephants, conflict behaviour, and health.
12. *Emergency Intervention*: Rapid intervention should be available if the calf becomes injured, ill, repeatedly approaches human settlements, or fails to adapt successfully. Continuous monitoring and periodic evaluation provide valuable information for adaptive management and improve future rescue and rewilding programmes.

Overall, the management of orphan elephant calves in NER should be guided by the principles of minimum intervention, maximum welfare, scientific rehabilitation, minimal human imprinting, successful reintegration into wild, and long-term monitoring, ensuring that every rescued calf has the greatest possible opportunity to survive and contribute to the conservation of free-ranging elephants.

4.7 PLANNING FOR CROWD MANAGEMENT AND MEDIA ENGAGEMENT

Planning for **crowd management** in human-elephant conflict situations in the Nilgiri Elephant Reserve requires systematic threat analysis and risk assessment. The process begins with verification of the incident by the control room, mobilisation of Rapid Response Teams, and immediate on-site risk assessment of both crowd behaviour and elephant condition.

- *Threat Analysis & Risk Assessment in Crowd Management*: Crowd-related risks arise from curiosity-driven gatherings, emotional reactions following crop damage or human injury, misinformation spread through social media, and night-time visibility constraints. Hotspots such as Masinagudi-Moyar, Hasanur-Thalavadi, Palacode-Morappur, and Denkanikottai-Thally must be mapped for crowd sensitivity and classified into low, moderate, or high-risk categories based on crowd size, aggression level, and incident severity.
- *Preparedness Framework & Development of Crowd Management Plan*: A preparedness framework should be established before peak conflict seasons. This includes developing a formal 'crowd management plan' with pre-designated safety perimeters, identified police support, clear Standard Operating Procedures for dispersal and communication, and village-level awareness programmes on risks of mob behaviour. Equipment such as barricades, public address systems, and communication tools must be pre-positioned, and mock drills conducted to test coordination between forest staff and law enforcement agencies (Fig-4.5 & 4.6).
- *Containment Measures including Control*: Containment measures during active incidents focus on immediate establishment of safety buffers, restricting access to the incident site, traffic

regulation, and calm, authoritative public communication. Police deployment ensures perimeter control and prevents mob aggression, while forest officials provide verified updates and technical guidance. Aggressive behaviour such as stone-throwing or use of firecrackers must be prevented to avoid provoking elephants. In high-risk scenarios involving fatalities or mob escalation, district-level intervention and temporary access restrictions may be necessary.

- *Role of Stakeholders in Crowd Management*: Stakeholder roles are clearly defined within the framework. The Forest Department leads technical response and communication, the Police manage crowd and traffic control, Revenue authorities facilitate relief and compensation communication, Panchayats and community leaders help calm residents and counter rumours, Village Elephant Response Committees support early reporting and local mediation, and media outlets are expected to report responsibly. Coordinated stakeholder involvement ensures orderly response, reduced panic, and safer resolution of conflict situations across the NER landscape.

Crowd Management SOP Flowchart

Step 1: Incident Alert Received
- Control Room verifies elephant presence
- Rapid Response Team (RRT) mobilised

Step 2: Initial Risk Assessment (On Arrival)
- Number of people gathered
- Behaviour of crowd (calm / agitated / aggressive)
- Elephant behaviour (calm / stressed / charging risk)
- Presence of casualty

Risk category assigned: Low / Moderate / High

Step 3: Immediate Safety Measures
- Establish safety perimeter (minimum 100–200 m buffer)
- Prevent further crowd accumulation
- Deploy police support
- Halt traffic in crossing zones
- Restrict media proximity

Step 4: Controlled Communication
- Public address announcement
- Clear instructions (stay indoors, avoid flash photography)
- Assign designated spokesperson
- Prevent misinformation

Step 5: Elephant Handling Operation

Low/Moderate Risk
- Gentle coordinated driving
- Controlled deterrence

High Risk
- Senior officer supervision
- Veterinary standby
- Kumki deployment (if required)

Step 6: Stabilisation
- Monitor area for 24–48 hours
- Patrol re-entry points
- Debrief & documentation

Crowd Escalation Matrix (Level 1–3 Framework)

Level 1 – Controlled Situation

Indicators:
- Small crowd
- No aggression
- No injury

Response:
- RRT handles independently
- Public advisory issued

Minimal police support

Level 2 – Elevated Risk

Indicators:
- Growing crowd
- Emotional reaction (crop damage)
- Minor injury

Response:
- Police deployment
- Barricade setup
- Senior Range Officer supervision
- Continuous public announcement

Level 3 – Critical Escalation

Indicators:
- Human fatality or severe injury
- Mob aggression
- Stone-throwing or provocation
- Obstruction of officials

Response:
- District-level escalation
- Full police control perimeter
- Senior forest & district officials present
- Media briefing by authorised officer
- Temporary suspension of civilian access
- Psychological counselling & immediate relief assurance

Fig-4.5: Crowd Management Flow Chart and Crowd Escalation Matrix

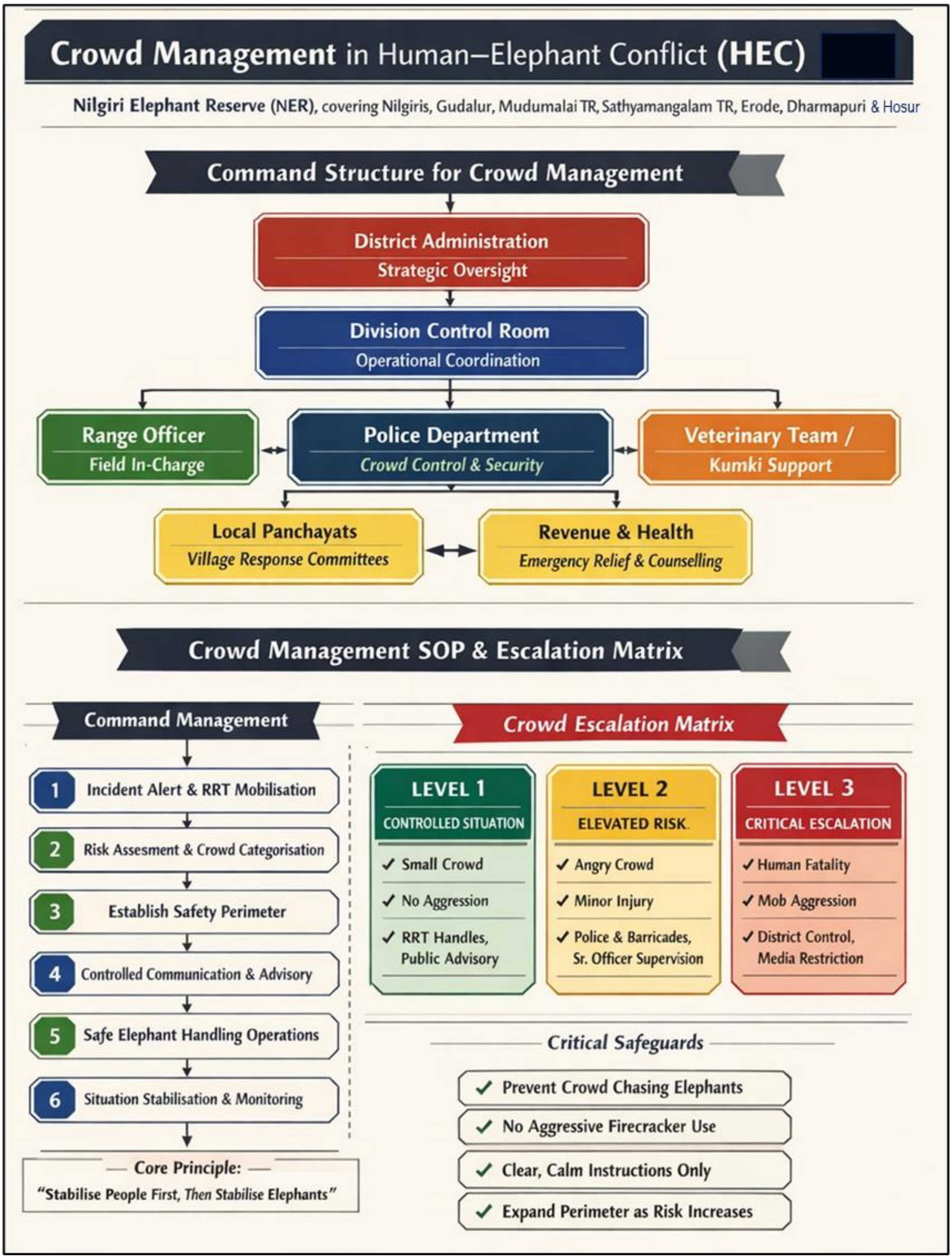


Fig-4.6: Suggested Crowd Management Plan

Effective crowd management in the NER rests on timely risk assessment, coordinated institutional response, disciplined communication, and community cooperation to ensure that human safety is prioritised while preventing escalation and safeguarding elephant welfare.

4.7.1 Identification of challenges in forest-media engagement & cooperation

Effective media engagement during human–elephant conflict (HEC) situations in NER is critical for maintaining public trust, preventing misinformation, and avoiding escalation. However, across the landscape, several structural and situational challenges complicate forest-media coordination.

- *Sensationalism & TRP-Driven Reporting*: In high-emotion incidents (especially involving human injury or fatality), media outlets may amplify dramatic visuals or unverified narratives. This can inflame public sentiment, trigger crowd aggression, & increase political pressure on field officers.
- *Real-Time Social Media Misinformation*: Unverified videos, old footage circulated as current events, and exaggerated claims spread rapidly through WhatsApp and social media platforms. This undermines official communication and complicates crowd management.
- *Premature or Incomplete Information Release*: During fast-moving incidents, field staff may not have complete facts. Media pressure for immediate statements can result in partial information being misinterpreted or later contradicted.
- *Physical Interference at Incident Sites*: Media personnel entering operational zones can obstruct RRT, distract personnel, and increase elephant stress due to camera flashes or noise.
- *Lack of Designated Spokesperson*: Absence of a clearly authorised communication channel may lead to inconsistent messaging from different officials, creating confusion and reputational risk.
- *Public Expectation of Immediate Resolution*: Media coverage often frames incidents as administrative failure, increasing unrealistic expectations for instant capture, translocation, or elimination of elephants.
- *Limited Media Sensitisation on Animal Behaviour*: Some journalists lack awareness of elephant ecology, legal constraints, and humane handling protocols, leading to oversimplified reporting.
- *Political & Local Pressure Amplified Through Media*: Local interest groups may use media platforms to criticise or demand extreme actions, placing field officers under additional stress.
- *Trust Deficit Between Field Staff & Media*: In some cases, lack of proactive engagement leads to suspicion or adversarial relationships between forest officials and journalists.
- *Balancing Transparency with Operational Confidentiality*: While transparency builds trust, certain details (tranquilisation timing, movement routes) must remain confidential to ensure safety.

Implications for NER: Addressing these challenges requires a structured communication protocol, designated spokesperson system, media sensitisation workshops, verified information channels, and controlled site access during active operations.

- *Addressing specific challenges that managers face with media on HEC issues*: Field managers often face pressure for instant updates, demands for extreme action (capture or translocation), and scrutiny during emotionally charged incidents. To manage this, a designated spokesperson system, timely factual briefings, unified messaging across divisions, and proactive dissemination of verified information are essential. Regular media sensitisation workshops on elephant ecology and legal constraints can also reduce misunderstandings and adversarial interactions.
- *Occupational safety and health, ethical issues, and other considerations*: Occupational safety, ethical considerations, and operational integrity must remain central during media engagement. Field staff and Rapid Response Teams require safe operational space free from interference, especially during driving operations or tranquilisation procedures. Ethical considerations include avoiding exposure of injured persons or deceased victims without consent, protecting the dignity of affected families, and ensuring humane treatment of elephants. Managers must also balance transparency with confidentiality, safeguarding sensitive operational details that could compromise safety or effectiveness.
- *Avoidance of Sensationalism in HEC in Media Reporting*: Avoiding sensationalism in HEC reporting is critical to prevent panic, mob aggression, and retaliatory attitudes toward wildlife. Media narratives that exaggerate danger or portray elephants as deliberate aggressors can inflame public sentiment. Encouraging responsible journalism through regular briefings, providing contextual ecological explanations, correcting misinformation promptly, and promoting balanced storytelling helps foster informed public understanding. Constructive forest–media

collaboration ultimately strengthens public trust, reduces conflict escalation, and supports sustainable coexistence in the NER landscape.

4.7.2 Measures to be implemented by both media and forest department

During human-elephant conflict (HEC) situations in the NER, coordinated measures by both the Forest Department and the media are essential to ensure public safety, prevent misinformation, and maintain operational effectiveness across the landscape.

- *Forest Department:* must ensure timely and transparent communication through a designated spokesperson system, providing verified updates and precautionary advisories during active incidents. Controlled access to incident sites is necessary to maintain safety perimeters and prevent interference with Rapid Response Teams. Pre-established crisis communication protocols and periodic media sensitisation programmes help promote accurate understanding of elephant behaviour and legal constraints.
- *Media*: must commit to responsible and verified reporting by cross-checking information with authorised officials and avoiding speculation. Sensational headlines, repeated broadcasting of graphic visuals, and portrayals of elephants as deliberate aggressors should be avoided. Media personnel must respect operational safety by maintaining appropriate distance from incident sites and not obstructing response operations. Ethical reporting standards, including protecting the dignity of affected individuals and providing ecological context, are equally important.
- *Joint collaborative measures:* such as establishing seasonal Forest–Media coordination mechanisms, sharing verified updates through official communication channels, and conducting post-incident reviews can strengthen mutual trust. Overall, transparent communication, responsible journalism, and coordinated engagement are critical to reducing panic, ensuring safe operations, and fostering balanced public understanding of HEC in the NER landscape.
- *Field visits help generate authentic reports*: Field visits by media personnel to conflict hotspots in the NER would help generate authentic, ground-based reporting and reduce speculation. When conducted under guided and safe conditions in divisions, such visits enable journalists to understand ecological context, operational constraints, and mitigation efforts. This promotes balanced narratives and reduces reliance on rumours or emotionally charged accounts.
- *Nodal person from forest department to be identified*: Identifying a designated nodal person from the Forest Department is essential for clear and consistent communication. The nodal officer should serve as the authorised spokesperson, provide verified updates, coordinate media briefings, and ensure unified messaging across divisions. A single communication channel prevents contradictory statements, builds media trust, and safeguards operational confidentiality during active conflict management.
- *Addressing challenges that media encounters during HEC reporting*: Media professionals also encounter challenges during HEC reporting, including limited access to real-time verified information, operational restrictions at incident sites, pressure to publish quickly, and emotional public reactions. Restricted visibility during night operations and safety constraints may limit on-site coverage. Addressing these challenges through structured briefings, timely updates, and pre-established communication protocols reduce frustration and promote cooperative engagement.
- *Key points in communication-message from the managers to the media*: Key communication messages from managers to the media should emphasise human safety as the top priority, the ecological and behavioural context of elephant movement, the proportionate and humane nature of response actions, and ongoing mitigation efforts such as fencing, early warning systems, and habitat management. Managers should also clearly outline legal constraints, discourage speculation, and request responsible reporting to prevent panic or escalation. Transparent, factual, and empathetic communication strengthens public confidence and supports sustainable coexistence in the NER landscape.

4.7.3 Execution of crowd management plan in emergency situations

Execution of the crowd management plan during emergency HEC situations in the NER is triggered in indicative scenarios such as elephant entry into dense settlements, human injury or fatality, repeated crop raids within a short period, mob gatherings near the incident site, obstruction of response teams, or emotionally charged public reactions amplified through social media. High-sensitivity belts require pre-defined activation protocols.

- *Activation of District Plan in the event of Occurrence of an Incident:* Upon occurrence of a serious incident, the district-level plan is activated under the coordination of the district administration. This involves immediate communication between the forest dept, police, revenue authorities, and local administration, escalation to senior officials where required, and mobilisation of additional manpower, medical support, and communication teams to stabilise the situation.
- *Creating Security Cordon at the Incident Site:* Creating a security cordon at the incident site is the first operational step. A safe perimeter is established to prevent public access, ensure operational space for RRT, and reduce stress to the elephant. Controlled entry points are designated, and media access is regulated to avoid interference with active operations.
- *Maintenance of Public order & Tranquillity (by the Magistrate):* This is overseen by the Executive Magistrate (Sec.144 CrPC), who ensures lawful enforcement of restrictions, addresses public grievances, reassures affected communities regarding compensation and relief, and prevents inflammatory gatherings or speeches that could escalate tensions.
- *Dispersal of the Crowd (by the Police):* This is carried out by the Police in a calibrated manner. Traffic is regulated, barricades are deployed, agitators are isolated if necessary, and public announcements are made to encourage voluntary dispersal. Objective is to de-escalate without provoking panic or confrontation that could further agitate both people and elephants.
- *Other Actions:* include issuing verified public advisories, providing immediate medical assistance and relief support, documenting the incident comprehensively, conducting post-event debriefings among agencies, and strengthening monitoring in the affected area for 24-48 hours. Together, these measures ensure orderly execution of the crowd management plan, prioritise human safety, and prevent escalation during HEC emergencies in the NER landscape.

4.7.4 Dealing with Media at the Incident Site

During HEC incidents, effective public outreach is essential to prevent panic, misinformation, and escalation. Clear advisories on safety measures, transparent updates on response actions, and reassurance regarding compensation and relief help stabilise emotions and maintain trust. Outreach should discourage rumour circulation, avoid speculative statements, and emphasise that human safety and humane wildlife management remain top priorities.

Coordination between the Forest Department and media during crisis situations should be structured and disciplined. By maintaining open yet controlled communication channels, both agencies can work collaboratively to ensure accurate coverage, operational safety, and reduced public tension during HEC incidents in the NER landscape (Box-4.6).

Box-4.6: Dealing with the Media at Incident site

General:

- In a crisis situation, it is advisable to not avoid the media. Do not say something like 'No Comments' as it may be misinterpreted or give the impression that there is something to hide.
- If a media person is asking for a comment at a HEC scene, a forest official trained in dealing with media could engage with the media persons enabling other members deal with the crisis.
- It may be effective to use multiple media outlets - print, TV, Radio/ FM, online, social media to broadcast messages, asking the public not to panic, not to leave the safety of their homes and come out, or attempt to attack the animal concerned during a HEC situation.
- In the absence of a designated spokesperson, media briefings are ideally addressed either by the senior-most member of the dept, or by anyone with regular interactions with the media.
- There is always a rush of media persons, photographers, and videographers trying to capture all the action during a HEC incident. This usually leads to chaos, and an altercation ensues. It's best to try and provide opportunities for photographers to get visuals, or in some cases, permit forest staff to shoot images and videos and later share it with media persons.

Public Outreach during Crisis

- Anticipate what the public wants to know. Primarily, they will want to know if any danger to human life persists, what is being done to secure their safety, when and what compensation is going to be paid to those affected, and how the conflict is going to be finally resolved.
- Anticipate the questions that the media will ask. The media will also ask the same questions that the public wants answered, as that is what they want to relay to the readers.
- Team members may be coached to direct all questions and queries from the media to the designated spokesperson, when available.
- It is always a wonderful idea to develop a decision chart on who will do what in a crisis, that includes how the media will be briefed. All the personnel in the forest department should be on the same page and not give out contradicting narratives of the incidence.

Coordination between forest department and media during crisis

- During a HEC situation, the media is bound to be around, to capture the news as it happens. To get to the action, media persons will try and get as close to the epicentre as possible. This could very well hinder the HEC mitigation operations. To ensure that the conflict situation is handled carefully, keeping both humans and animals' safety in mind, it is crucial that the forest department, apart from following the recommended standard OP for conflict mitigation, also follows the media management standard OP during the operations.
- During such crises, the Forest Department may involve and seek help from local press clubs, press associations and similar such bodies to ensure that the media persons do not take undue risks to themselves and should instil trust amongst media persons that they will have access to all relevant information, videos and photographs, and these will be shared in a timely fashion.

4.8 REDUCING THE IMPACT OF HEC ON PEOPLE AFFECTED

Reducing the impact of HEC on people in NER requires a comprehensive approach that combines immediate relief, preventive mitigation, livelihood resilience, and long-term coexistence planning across all division. The objective is not only to manage elephants but to reduce socio-economic vulnerability of affected communities.

- *Immediate measures* include rapid response to incidents, medical support for injuries, prompt damage assessment, and fast-track compensation for crop loss, property damage, or human casualties. Transparent and timely relief mechanisms are critical to maintaining public trust and preventing retaliatory actions.

- *Preventive mitigation* focuses on protecting crops and settlements through cluster-based solar fencing, maintenance of barriers, removal of waste attractants, early warning systems, and deployment of Anti-Depredation Squads. Seasonal advisories during harvest and summer congregation periods help communities anticipate and reduce risk.
- *Livelihood resilience strategies* play a major role in reducing long-term vulnerability. Promotion of less palatable crop varieties in high-risk belts, crop insurance coverage, diversification into non-farm income sources, eco-tourism opportunities, and value addition of non-timber forest produce can cushion economic shocks caused by HEC.
- *Community preparedness and awareness* are equally important. Village-level training on safe behaviour during elephant presence, formation of VERC, and participatory mapping of elephant entry routes enhance local capacity to manage risk calmly and effectively.
- *Infrastructure improvements* such as safe street lighting in fringe villages, secure grain storage facilities, and regulated land-use planning near corridors reduce attractants and exposure to risk. Integration of sanitation and waste management schemes further prevents elephants from associating settlements with food sources.
- *Psychological and social support* after severe incidents, particularly in cases of human injury or fatality, is necessary to address trauma and prevent escalation of hostility toward wildlife.
- *Adaptive management* through continuous monitoring of conflict trends, hotspot reassessment, and stakeholder consultations ensures that mitigation strategies evolve with changing movement patterns and socio-economic conditions.

Measures in the NER: which may encourage people to work towards harmonious co-existence, include participatory planning, awareness and communication for changing the threat perceptions, integrating HEC mitigation into poverty alleviation programs and community-based natural resource management, and other site-appropriate stakeholder engagement measures in the NER, such as

- *Compensation* for economic loss from damage to crops by elephant activities, or personal injury or risk from elephant encounters (meant to increase community tolerance towards elephants)
- *Insurance schemes* require participants to pay a premium, for insurance against economic loss. This premium is determined based on the risk associated with HEC. The challenges of high premiums charged (due to high risk) may be addressed by supplementing premiums with govt or non-govt funding support, community financing (through ecotourism), or better risk evaluation.
- *Performance payments* for community support for conservation may also be explored as an instrument, where the EDCs / VFCs can be provided funds for conservation-linked performance payments, and experiences/ learnings can be shared back, for further refinement of guidelines.
- *Conservation Easement* may be a good instrument for mitigation of conflict, which could be explored by incentivizing conservation to mitigation of conflict and as a good innovative mechanism, farmers can be compensated for keeping these areas fallow for part of the year for wild animals or no/reduced gain from the farming income (Jeerahalli Range in STR).
- *Community-based ecotourism* can generate enough resources to offset the cost of HEC.
- *Acquisition of private land* or encouragement of voluntary relocation to alternative site or long-term lease in the migration corridor can be explored.

Mobile application-based system may be developed (as in Karnataka) for compensation, survey and verification related to HEC when dealing with the injury and death cases; evaluating the loss of property and compensation paid to the owner; and collecting information and processing of claims of farmers, after crop losses, to ensure efficiency and transparency in the system.

Ex-gratia and Compensation Paid in the NER

Fig-4.7 summarizes the Ex-gratia and Compensation paid in the Nilgiri Elephant Reserve towards human deaths; human injury, crop damage; livestock damage; and property damage. The data includes mainly ex-gratia and compensation paid towards human-elephant conflict.

LEGEND		2022-23	2023-24	2024-25	Average
	Human Death	192.00	237.68	366.5	265.29
	Human Injury	14.38	21.73	20.58	20.13
	Crop Damage	316.74	576.41	284.13	394.28
	Livestock Damage	46.97	57.28	53.77	53.30
	Property Damage	5.87	7.31	5.89	6.32
	Total	**575.96**	**900.41**	**730.87**	**739.32**

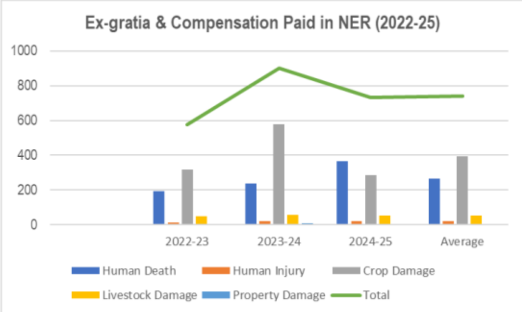
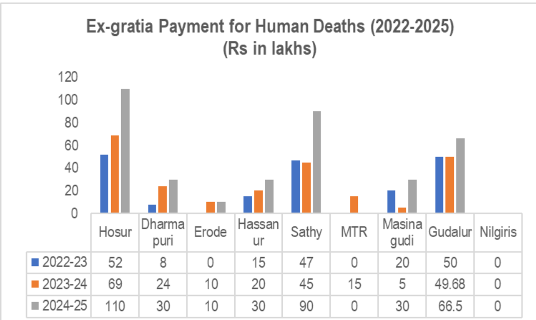


Fig-4.7: Ex-gratia and compensation paid towards human-wildlife conflict in NER

As per the above data, major compensation is towards crop depredation by the elephants and human deaths primarily due to the HEC in the landscape.

4.8.1 Addressing the situation of loss of human life (ex-gratia)

Loss of human life due to human-elephant conflict (HEC) in the NER (Fig-4.8) is the most sensitive and critical situation across the landscape. Immediate, compassionate, and well-coordinated action is essential to maintain public trust and prevent escalation or retaliatory violence.



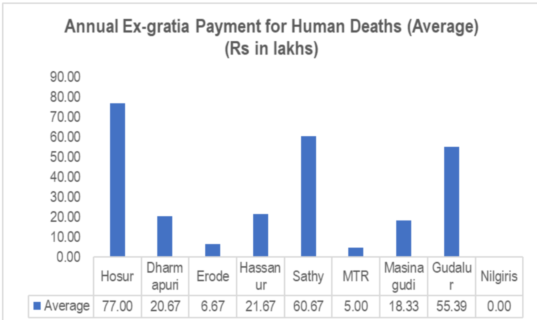


Fig-4.8: Division-wise payment in the last 3 years and Average payment in the landscape (Rs in lakhs)

Following measures are suggested in the NER as part of Ex-gratia payment:

- *Immediate On-Site Response*: The first response involves securing the site, preventing crowd aggression, informing senior officials, and coordinating with Police and Revenue authorities for lawful inquest procedures. The deceased must be handled with dignity, and communication with the public should remain factual, empathetic, and calm.
- *Verification & Documentation*: A structured verification process follows, including spot inspection by forest officials, preparation of incident reports and 'panchnama', post-mortem examination, confirmation of cause of death, and identification of legal heirs. Proper documentation ensures transparency and facilitates timely relief.
- *Ex-Gratia Relief Process*: Ex-gratia assistance, as per prevailing government norms, must be processed promptly. Immediate interim relief should ideally be provided within 24-48 hours, followed by final disbursement through Direct Benefit Transfer after completion of documentation. Avoiding procedural delays is crucial to prevent resentment and unrest.
- *Public Order & Community Assurance*: Public order and community assurance are equally important. The Executive Magistrate and district administration should communicate clearly

about compensation timelines, reassure affected communities about enhanced patrolling and mitigation measures, and counter rumours that could inflame tensions.

- *Psychological & Social Support*: Beyond financial compensation, psychological & social support for the bereaved family is necessary. Assistance with documentation, linkage to welfare schemes and engagement of Panchayat leaders help stabilize the situation socially and emotionally.
- *Post-Incident Review & Preventive Action*: Finally, a post-incident review must assess the circumstances of the event, strengthen local mitigation measures such as fencing or patrolling, intensify monitoring of involved elephants, and conduct village-level awareness meetings. This ensures that immediate tragedy leads to improved preparedness and reduced risk of recurrence within the NER landscape.
- *Elephant Conservation Foundation*: In the NER, a revolving fund could also be explored, at the regional-level, to ensure availability of funds for providing immediate relief to the victim/family. and for extending sustainable support to the victim. Life/ accident insurance coverage of local communities, in HEC hotspots, may be encouraged.

4.8.2 Addressing health and overall well- being of people affected

Addressing the health and overall well-being of people affected in the NER requires a holistic response that goes beyond immediate compensation. Across the region, affected communities often face physical injuries, psychological trauma, economic stress, and social insecurity following conflict incidents.

- *Immediate medical care* is the first priority. Injured persons must receive prompt first aid, emergency transport, and hospital referral where required. Coordination with district health authorities ensures timely treatment, trauma care, and follow-up support. In serious cases, long-term rehabilitation services and disability assistance may be necessary.
- *Psychological well-being* is equally important, particularly in cases involving human injury or fatality. Survivors and family members may experience anxiety, fear, sleep disturbances, or post-traumatic stress. Counselling services through district health systems, community health workers, and local administration help stabilise emotional distress and prevent long-term psychological impacts.
- *Economic well-being* must also be addressed, as any damage or loss of a family member can severely affect livelihoods. Prompt compensation, linkage to crop insurance schemes, access to social security benefits, and facilitation of alternative livelihood opportunities reduce financial vulnerability. Support for less risk-prone cropping in high-conflict zones enhances resilience.
- *Community health measures*, including safe sanitation, waste management, and clean water access, reduce attractants and improve overall living conditions in fringe villages. Integration with public health and rural development schemes strengthens long-term well-being and reduces indirect conflict stressors.
- *Social support* through Panchayats, Village Elephant Response Committees, and self-help groups fosters collective resilience. Community meetings following incidents help address concerns, rebuild confidence, and reinforce safe coexistence practices.

Ultimately, safeguarding the health and well-being of affected people in NER requires coordinated action among the Forest Dept, Health Dept, Revenue authorities, and local governance institutions. A people-centric approach that integrates medical care, psychological support, livelihood security, and community resilience strengthens both human welfare and long-term conflict mitigation in the NER landscape.

4.8.3 Addressing the situation of property damage

Property damage caused by HEC - such as destruction of houses, grain storage units, fencing, and other infrastructure- can significantly affect household security and livelihoods across the region.

Compensation for property damage does not generally consider the cost of repairing and the costs of temporary fixes that are needed prior to repairs. The poor are affected more as their houses are of low value and damages do not consider the fact that the main costs is actually labour that the family provides in reconstruction and not the cost of materials themselves.

Prompt, transparent, and structured response is essential to prevent escalation and restore public confidence. Measures include:

- *Site Verification:* by forest officials in coordination with local authorities. Damage assessment must be documented through photographs, GPS-tagged records, and field inspection reports. Clear categorisation of damage- minor, moderate, or severe- ensures consistency and fairness in compensation processing.
- *Preventive Measures:* must follow every major damage incident. This includes reviewing fencing gaps, strengthening barriers, securing grain storage facilities (in 'pucca' or secured structures), improving lighting in settlement fringes, removing waste attractants, and reassessing hotspot classification. Where repeated damage occurs, cluster-based mitigation strategies may be introduced. Brewing of indigenous liquor, which attract wild elephants to village should be completely stopped in the HEC areas.
- *Property insurance:* Awareness and adoption of options regarding property insurance may be given priority. However, till the system is fully established, present system of payment of compensation to be continued and enhanced by factoring in the hidden costs and losses.

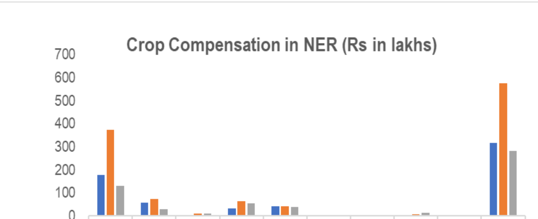
4.8.4 Addressing the situation of loss of livestock

Loss of livestock due to HEC in NER, though less frequent than crop damage, can severely impact household income. The cattle tethered near or in elephant movement paths may be at risk.

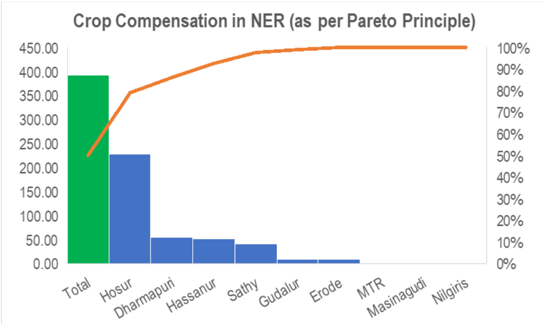
- *Preventive measures* include strengthening cattle sheds near forest fringes, installing solar lighting, promoting stall feeding in high-risk zones, regulating open grazing in elephant corridors, and encouraging night-time enclosure of livestock. Awareness programmes should educate livestock owners about safe grazing practices and early reporting of elephant movement.
- *Integration with Animal Husbandry Department schemes*- such as livestock insurance, vaccination programmes, and improved breed support- can enhance resilience. Veterinary surveillance under a One Health approach also ensures monitoring of potential disease transmission risks between wildlife and livestock.

4.8.5 Addressing the situation of crop damage

Crop damage is the most frequent and economically significant impact of HEC in NER, particularly in agricultural-forest interface belts across the region (Fig-4.9). The long-term impacts of assessment of crop compensation are complex. Inadequate compensation to farmers may lead to resentment, leading to adverse impact on elephant conversation like retaliatory killings.



	Hosur	Dharmapuri	Erode	Hassanur	Sathy	MTR	Masinagudi	Gudalur	Nilgiris	Total
2022-23	177.24	58.49	4.23	32.37	41.22	0.04	0	3.15	0	316.74
2023-24	374.91	74.96	10.09	65.43	41.8	0.12	0.4	8.7	0	576.41
2024-25	132.31	30.44	10.24	55.35	40.87	0.81	0.27	13.84	0	284.13



Addressing crop damage requires a combination of rapid relief, preventive infrastructure, crop planning, and community preparedness to reduce economic vulnerability and social tension.

- *Verification & Assessment*: Field inspection, GPS-tagged documentation, photographic evidence, and crop type and damage assessment of the crop by forest officials in coordination with revenue authorities must be completed promptly. Transparent and standardised damage assessment ensures fairness and consistency in compensation processing. Mobile apps may be used for collecting the information and processing of claims of farmers.

- *Compensation Process*: It should be processed without delay as per prevailing Government norms. Interim relief may be provided in high-loss cases, particularly during harvest seasons. Timely Direct Benefit Transfer to affected farmers is critical to prevent resentment, protests, or retaliatory actions. Clear communication of compensation procedures and timelines enhances public trust.
- *Preventive measures:* are central to long-term mitigation. Cluster-based solar fencing, maintenance of elephant-proof trenches where suitable, removal of waste attractants, and strengthening of early warning systems reduce repeated incursions. Seasonal advisories during harvest and summer congregation periods help farmers prepare for high-risk periods.
- *Crop pattern management*: in high-conflict zones can significantly reduce vulnerability. Promotion of less palatable or low-risk crops, diversification of cropping systems, and staggered harvesting reduce attraction. Integration with crop insurance schemes and agriculture extension services strengthens financial resilience. Ministry of Agricultural Cooperation and Farmers Welfare have included the crop loss by activities of wild animals under its flagship scheme *Pradhan Mantri Fasal Bima Yojana* (PMFBY), which can be used as an important HEC mitigation instrument.
- *Community participation* through Village Elephant Response Committees enhances early reporting and coordinated crop guarding. Night patrolling by Anti-Depredation Squads in hotspot belts further reduces damage intensity during peak seasons.

4.8.6 Addressing the situation of lost livelihood opportunities

HEC in NER not only causes direct losses such as crop damage or livestock death but also disrupts livelihood opportunities. Repeated elephant movement, fear of night-time work, damage to plantations, and restricted access to fields or forest resources can reduce income security across the region. Addressing livelihood disruption requires economic, social, and institutional support measures.

- *Assessing the Extent of Income Disruption*: Immediate steps include assessing the extent of income disruption in addition to physical losses. In high-impact cases- such as prolonged restriction from agricultural activity or repeated crop failure- special assistance packages or interim livelihood support may be considered through convergence with Rural Development and Social Welfare schemes.
- *Diversification of Livelihood Options:* Promotion of non-farm income sources such as eco-tourism services, handicrafts, value addition of non-timber forest produce (NTFP), small livestock rearing in safer zones, and skill development programmes reduces dependence on high-risk agriculture near forest fringes. Integration with self-help groups (SHG) & micro-credit institutions strengthens financial stability.
- *Agricultural Adaptation strategies:* Encouraging cultivation of less palatable crops, agro-forestry, multi-cropping systems, and seasonal crop planning can lower risk exposure. Crop insurance coverage and linkages with agricultural extension services help mitigate income volatility.
- *Community-based Initiatives*: such as “conflict-resilient village” programmes, cluster fencing cooperatives, and shared early warning systems reduce repeated loss and stabilise productivity. Employment opportunities within conservation programmes- such as watchers, eco-development workers, or habitat restoration activities- provide alternative income streams in affected areas.
- *Financial inclusion measures*: including access to banking, DBT, and government welfare schemes, ensure that affected households receive timely support. Where livelihood loss is linked to fatal HEC incidents, family members may be prioritised for social security schemes or skill development support.

Ultimately, addressing lost livelihood opportunities in NER requires an integrated approach that combines immediate relief, livelihood diversification, agricultural adaptation, financial security, and institutional convergence. Strengthening economic resilience reduces vulnerability, lowers hostility toward wildlife, and promotes sustainable coexistence in the NER landscape.

4.8.7 Providing insurance cover for damages due to HEC

Insurance coverage is an important complementary mechanism to government ex-gratia compensation for reducing the financial burden of HEC across Nilgiris, Gudalur, MTR, STR, Erode, Dharmapuri and Hosur division. While ex-gratia provides immediate relief, insurance offers structured financial risk-sharing and long-term resilience for affected households.

- A dedicated **HEC-linked insurance model** can cover crop damage, livestock loss, property damage, and accidental human injury. This may operate through public sector insurance schemes, crop insurance programmes, or specially designed wildlife conflict risk products developed in partnership with insurance companies and state government support.
- Premium support mechanisms are essential for inclusion of small and marginal farmers. The Forest Department and District Administration may facilitate partial premium subsidy in high-conflict zones, particularly Tier-1 hotspots. Community-based or cluster insurance models can reduce administrative costs and improve enrolment rates.
- For crop insurance, integration with existing schemes (e.g., seasonal agricultural insurance) should incorporate wildlife damage as a recognised peril. For livestock, insurance products can be aligned with Animal Husbandry Department programmes, ensuring that compensation complements government relief rather than duplicates it.
- A simplified claim procedure is critical. Verification by forest officials can serve as primary documentation, reducing bureaucratic burden on affected households. Digital claim submission and Direct Benefit Transfer improve transparency and reduce delays.
- Awareness campaigns must educate communities about the benefits and limitations of insurance coverage, claim procedures, and timelines. Panchayats, self-help groups, and Village Elephant Response Committees can support enrolment and grievance redressal.
- Insurance coverage should not replace government ex-gratia assistance but act as a **risk-buffering mechanism**, especially in areas experiencing repeated crop damage or livelihood disruption. Over time, structured insurance adoption can reduce dependence solely on compensation systems and enhance economic resilience.

Overall, providing insurance cover in NER strengthens financial security, encourages proactive risk management, and contributes to long-term coexistence by stabilising livelihoods in human-elephant interface zones.

4.8.8 Offsetting conflict costs

Offsetting the conflict costs of HEC in NER involves reducing the long-term socio-economic burden borne by communities living in elephant interface zones across the landscape. Conflict costs include crop loss, property damage, livestock mortality, injury, psychological stress, opportunity costs, and reduced livelihood productivity. A structured offset framework ensures that affected communities are not disproportionately burdened for conserving wildlife of national importance.

- *Direct Financial Offsets:* Timely ex-gratia payments for human injury or death, compensation for crop and property damage, and livestock loss reimbursements form the primary offset mechanism. Strengthening transparency, reducing processing time, and ensuring fair valuation help stabilise affected households and prevent escalation.
- *Insurance & Risk Pooling Mechanisms:* Supplementing compensation with crop, livestock, and property insurance schemes reduces repetitive financial shocks. Premium subsidies in high-conflict zones & community-based insurance models can further buffer recurring economic loss.
- *Livelihood Diversification & Incentive Schemes:* Promoting alternative income sources such as eco-tourism, agro-forestry, value-added non-timber forest produce (NTFP), skill development, and conservation-linked employment (watchers, eco-development workers) offsets indirect

opportunity costs. Incentive-based "conflict-resilient village" programmes can reward proactive coexistence measures.

- *Infrastructure & Preventive Investment:* Investment in solar fencing clusters, elephant-proof trenches (where appropriate), early warning systems, street lighting, safe grain storage, and corridor protection reduces recurring damage. Preventive capital investment serves as a long-term cost offset strategy.
- *Social Security & Welfare Convergence:* Linking affected households with social protection schemes- pensions, health insurance, crop insurance, and livelihood missions- reduces vulnerability and spreads risk across broader welfare mechanisms.
- *Payment for Ecosystem Services (PES) Approach:* Communities residing near critical corridors or high elephant-use areas may be considered for conservation incentives recognising their role in maintaining ecological connectivity.
- *Corporate Social Responsibility (CSR) & Development Convergence:* Mobilising CSR funds and district development resources for mitigation infrastructure, livelihood training, and insurance premium support can reduce fiscal pressure on the TNFD while improving community resilience.
- *Monitoring & Cost Assessment:* Periodic assessment of conflict intensity, compensation burden, & socio-economic impact helps refine offset strategies and prioritise investment in high-risk belts.

Communities living with elephants should not bear disproportionate economic costs of conservation.

Certain States have adopted the norms prescribed for State Disaster Response Fund (SDRF) for compensation (Box-4.7).

Box-4.7: Declaration of Human-Wildlife Conflict as a State Disaster in Kerala

- With steady rise in HWC incidents involving elephants, Govt of Kerala recognized that conventional departmental interventions were no longer adequate. In March 2024, Kerala became the first state in India to declare HWC as a State Disaster, marking a major policy and governance innovation in conflict management.
- This declaration brought a fundamental shift in the way conflict situations are addressed. Earlier, responsibility for managing incidents and providing compensation rested largely with the Forest Dept, often limiting the scope and speed of response, especially in cases requiring coordination with other district agencies. By bringing HWC under State Disaster Management framework, the issue was elevated to the highest priority level within Govt system.
- Under the new arrangement, actions related to conflict mitigation, relief, and compensation are directly monitored by the office of the Chief Minister, with regular reviews conducted by the Chief Secretary. At the district level, dedicated monthly review meetings on HWC, are held after District Development Council meetings. These meetings are chaired by the District Collector, with the local Divisional Forest Officer as Member Secretary, and involve all relevant line departments, law enforcement agencies, and elected representatives.
- This institutional mechanism has ensured mandatory participation of key agencies such as the police, revenue, agriculture, and local self-government institutions, enabling more effective handling of law-and-order situations, emergency responses, and relief operations. The disaster framework has also facilitated greater availability of funds, faster and more predictable compensation disbursement, and clearer accountability across departments.
- Kerala's experience offers an important policy model that other states (NER) facing escalating human-wildlife conflict may consider adapting to their own contexts.

4.9 REDUCING THE IMPACT OF HEC ON THE ANIMAL HEALTH

Reducing the impact of HEC on animal health in the NER requires preventive, veterinary, and landscape-level interventions. Conflict situations can lead to injuries from electrocution, gunshot wounds, crude explosives, vehicle collisions, and stress-related conditions caused by chasing or crowd aggression.

Capturing of elephants can be for different purposes, for example capture can be for radio-collaring to be used for research purposes, or for early warning and rapid response treatment of injured elephants or rescuing abandoned calves, or removal of elephant from conflict space for the purpose of translocation or bringing it into captivity.

Operating procedure (OP), providing step-by-step procedure and approach for tracking and capturing Elephant/s as a mitigation measure, have already been developed by the Forest Department; and separate '*Recommended Operating Procedure: Elephant Capture and Translocation for Mitigating HEC*' has also been developed by the WII, to ensure animal health and safety during such operations.

4.9.1 Post capture management of elephant

Post-capture management of elephant includes knowing the position of the captured animal (captured through immobilization), monitoring physiological parameters and transportation of the animal. Currently, most of the capture of elephants is done through immobilization.

Immediate Post-Capture Stabilisation:

After tranquilisation or physical restraint, the elephant must be closely monitored for respiration, heart rate, body temperature, and recovery from sedation. Veterinary teams ensure hydration, wound assessment, and treatment of any injuries. A quiet, low-stress environment is essential to prevent shock or trauma.

- The first & foremost thing after immobilisation of the elephant is to restrain it securely in a comfortable position to maintain airway.
- Following drug induction, the elephant should be approached (from the rear) keeping safety in mind.
- Post capture health examination and monitoring of the immobilized elephant is mandatory.
- The physiological parameters (temperature, respiration, pulse and colour of mucous membrane) need constant monitoring, as these are likely to be compromised during chemical capture.
- Any significant deviation in normal physiological parameters may be dealt with appropriately.

Health Assessment & Diagnostic Evaluation:

- Once the elephant is properly positioned, the veterinarian should examine its health status and monitor its vital signs (pulse, respiration rate, temperature, blood oxygen level etc). Accordingly, it may be decided whether the radio collaring or capture operation will continue or the animal needs to be revived due to some complication/health emergency, and released.
- A comprehensive veterinary examination should be done, including blood sampling, parasite screening, dental and foot examination, and assessment for underlying disease or stress-related complications. Documentation of body condition and behavioural status forms part of the record.

Decision on Management Category

Based on health and behavioural assessment, decision may be taken, whether the elephant will be:

- Released back in the same habitat/ area
- Translocated to another habitat/ area
- Retained further observation/ treatment
- Rehabilitated in a managed camp/ rescue centre

All decisions must comply with legal provisions and expert committee recommendations.

Transport & Handling Protocol:

If relocation to a camp is required, transport must follow animal welfare standards- adequate padding, minimal restraint stress, veterinary supervision, and avoidance of extreme temperatures. Movement should be planned during cooler hours.

- The animals may be transported in specially designed vehicles or large containers (for long distance) or on foot (for short distance).

- The vehicle may be designed considering the animal's weight, adequate ventilation options (containers), sound non-slippery floor, provision of drainage to facilitate disposal of waste etc.
- The animal needs to be appropriately secured in the vehicle and necessary transport considerations should be in place during transit.
- Alternatively, the animal can be hoisted on the vehicle using slings/ropes/belts taking due anatomical & physiological considerations strictly under veterinary supervision & using a skilled crane operator.
- Stops *enroute* may be pre-planned and identified well in advance aimed at achieving the shortest journey time possible and ensuring safety and wellbeing of the animal.
- The animal needs to be regularly monitored for signs of discomfort or stress during the entire journey period by veterinary professional, and the elephant maintained in a sedated state.
- Kumkis, could be used in moving / pushing the animal into the vehicle/ container.

Food and water during transportation:

- It is better to avoid provisioning of feed and water during overnight transport and efforts may be made to reach the destination (release site/ elephant camp/ designated facility) as early as possible taking due care of vehicle speed and halting destinations.
- Water should be made available to the animal during transportation especially on hot journeys exceeding 6 hrs and should also be at hand to control possible hyperthermia of recumbent animals.

4.9.2 Release essentials (housing & sanitation)

- Relocated elephants may be fitted with GPS-based collars to monitor their movement with the option of recapturing them in case they again come into conflict.
- The site of release to be at sufficient distance (typically of the order of 200-300 km or greater) such that it is unlikely that the elephant would be familiar with the new site and attempt to go back to the place of capture.
- "Soft release" options can also be experimented with; this would involve keeping the animal in a stockade for some limited time period at the proposed site of release before letting it free.
- The animals may be monitored for any transport injuries or any other health-related issues following release.
- The release sites should have proper off-loading facility and release to be done with the least possible stress on the elephants.
- Following release in native habitats, it is necessary to monitor the behaviour of the animal/s and its interaction with the other herbivores
- The animal should be monitored post-release, for injuries, wounds, ill-health and disease such as nervous, locomotive or digestive disturbance by team of veterinary professionals, biologist and manager during the initial period.
- There is also a need for long-term monitoring of the health of the released individual/ population.
- In some instances, the best option or the only option may be to retain the captured elephant or elephants in captivity, especially if the animal has killed people or the risks of release into the wild are too high.

Housing & Sanitation:

- Post-capture elephants require structured feeding schedules, gradual habituation, daily veterinary observation, foot care, bathing routines, and stress monitoring.
- Proper sanitation and hygiene should be maintained to avoid chances of infection.
- Adequate balanced food and water should be made available along with mineral and vitamin supplements as per the health status of the elephant.

Behavioural Monitoring:

- Continuous monitoring of temperament, aggression levels, and adaptation to captivity is necessary. Special care is required for adult bulls, especially those previously involved in conflict or in musth.

Health Screening:

- A general health screening once a week should be done and a thorough health examination to be done at least once in a month. Bi-monthly foot dip, foot care and nail trimming to be carried out to prevent foot problems. In case of suspicion of some serious health condition, samples to be collected and sent to Advanced Institute of Wildlife Conservation (AIWC) for advanced investigations.

4.9.3 Rehabilitation of the captured elephant

Rehabilitation of a captured elephant in NER may be undertaken only when scientifically justified and legally approved, typically in cases of chronic conflict behaviour, severe injury, or inability to survive independently in the wild. The rehabilitation process prioritises welfare, behavioural stabilisation, and long-term management suitability.

- In the case of elephants brought into captivity temporarily for treatment, their release post treatment should take into consideration their past record in conflict.
- Elephants that have a record of high conflict cannot be released back as they are more habituated to humans when compared to the elephants not causing serious conflict.
- *Stabilisation of the captured elephant*: Immediately after capture, the elephant is stabilised medically and shifted to a secure rehabilitation camp- often associated with the facilities at MTR. A structured veterinary protocol includes full physical examination, wound management, disease screening, deworming, nutritional correction, and regular monitoring of vital parameters. Special attention is given to stress reduction, hydration, and gradual recovery from sedation trauma.
- *Behavioural rehabilitation* focuses on reducing aggression, fear, and stress responses. If the elephant is designated for managed captivity, gradual habituation under trained mahouts is initiated using positive reinforcement and controlled interaction. The process is slow and closely supervised to prevent physical or psychological distress. Adult bulls, particularly those previously involved in conflict or musth cycles, require specialised monitoring and experienced handlers.
- *Soft release protocol*: If the elephant is considered suitable for return to the wild, a phased soft-release protocol may be adopted after recovery and behavioural assessment. This includes pre-release conditioning, health clearance, habitat suitability evaluation, and post-release monitoring. However, translocation or release is undertaken cautiously, based on ecological feasibility and conflict risk evaluation.
- *Long-term welfare management* in rehabilitation camp includes balanced diet planning, routine foot care, bathing schedules, exercise routines, and enrichment measures to maintain physical and psychological health. Periodic veterinary audits and compliance with wildlife and animal welfare regulations ensure accountability.
- *Transparent communication* with local communities regarding the rationale for capture and rehabilitation helps prevent misinformation and reinforces trust.

Ultimately, rehabilitation in NER must balance humane care, ecological considerations, public safety, and long-term conservation objectives within a scientifically guided framework.

4.9.4 Rescue and raising of orphaned/ strayed elephant in conflict

Rescue and rehabilitation of orphaned or separated elephant calves in NER is undertaken only under strict veterinary and legal supervision, as premature intervention can disrupt natural herd dynamics. Intervention is justified only when the calf is confirmed orphaned (mother deceased) or permanently separated and at risk of starvation, injury, or mob aggression.

- *Initial Assessment & Rescue:* Before capture, field teams attempt to reunite the calf with the herd by monitoring movement for 24-48 hours wherever feasible. Rescue is initiated only if reunion is impossible. Veterinary officers assess dehydration, injuries, stress levels, & age class. Safe restraint and transport are conducted under veterinary supervision to minimise trauma. The calves should not be exposed to humans as they have a weak immunity and may contract the diseases quickly.
- *Immediate Post-Rescue Care:* Upon arrival at a designated elephant camp commonly associated with facilities at MTR, the calf undergoes stabilisation. This includes fluid therapy, wound treatment, deworming, nutritional supplementation, and disease screening. Temperature regulation and stress minimisation are critical during the first few days.
- *Hand-Rearing Protocol:* Hand-rearing involves a structured feeding regime using milk substitutes appropriate for age, administered at regular intervals. Close monitoring of weight gain, digestive health, and immune response is essential. Hygiene protocols prevent disease transmission, and gradual introduction to solid food occurs as per age progression.
- *Socialisation & Behavioural Development:* Elephants are highly social animals; therefore, social bonding is crucial. Where possible, orphaned calves are integrated gradually with other rehabilitated calves or non-aggressive camp elephants to support behavioural development. Excessive human imprinting must be avoided to maintain natural behaviours. For young calves below the age of 1 year, the constant presence (24x7) of the mahout is critical as stress of separation can very adversely affect its survival. If there are adult female elephants in the facility and one of them is tolerant to the calf, then the calf should be raised in its presence as the female will act as a foster mother.
- *Long-Term Management Pathways:* Depending on age, temperament, and feasibility, long-term options include: retention in managed elephant camps under welfare protocols; training as future kumki (rare and case-specific); or considered rewilding in exceptional cases with structured monitoring (if ecological and behavioural criteria are met).
- *Welfare & Monitoring:* Continuous veterinary oversight, balanced diet planning, enrichment activities, foot care, and psychological well-being assessments are mandatory. Periodic review by expert committees ensures ethical compliance and welfare standards.

4.9.5 Radio collaring or tagging (RFID-microchip) the captured elephant

Radio collaring and RFID microchip tagging of captured elephants in the NER could be considered as the management tools used to strengthen monitoring, conflict mitigation, & research across all divisions.

- **Radio collars** equipped with GPS-satellite technology are primarily used to track movement patterns of conflict-prone elephants. The data help predict entry into settlement areas, trigger early warning alerts, assess corridor use, and evaluate post-capture relocation outcomes. Collaring is performed under controlled sedation, ensuring proper fit, minimal weight burden, and avoidance of skin injury. Post-fitting monitoring ensures the elephant recovers safely and resumes normal behaviour. Movement data transmitted from collars are analysed by divisional control rooms to update hotspot maps, deploy patrols strategically, and improve preparedness in fringe villages. Confidential handling of data is essential to prevent misuse and ensure operational security.
- Radio collars are important for HEC mitigation with the objective of understanding ranging behaviour and other studies. Ranging behaviour studies will help to better understand how and why certain elephants come into conflict and help the development of customized conflict mitigation measures including RRT deployment, aversion conditioning, barriers, community awareness about preventive behaviours/actions, etc. It is useful to radio collar an injured elephant to monitor it systematically for medical intervention over an extended period of time.
- **RFID microchips**, unlike radio collars, are used mainly for permanent identification of captive or camp elephants. Inserted under sterile conditions, they assist in maintaining health records, legal documentation, and welfare audits but do not provide real-time movement tracking. RFID microchips may be used for tagging of all captured wild elephants brought to captivity.

4.10 OCCUPATIONAL HEALTH SAFETY MEASURES & ADDRESSING HEALTH EMERGENCIES

Occupational Health and Safety (OHS) in the NER is critical due to the hazardous nature of duties performed by frontline staff across all divisions. Personnel operate in rugged terrain, at night, and during high-tension human-elephant conflict situations, making structured safety systems essential to protect staff welfare and ensure operational continuity.

The following elements are essential components of an effective occupational health and safety program:

4.10.1 Hazard and risk assessment

Understanding potential hazards that are inherent to HEC management such as likely injuries from handling animals, exposure to scheduled wildlife restraint drugs, allergens, or zoonosis and to ascertain the level of risk and determine preventive and control measures required in different HEC situation. Common risks include elephant encounters, mob aggression, vehicular accidents, electrocution hazards, forest fires, zoonotic disease exposure, and stress-related health issues. Mapping high-risk zones and conducting periodic risk reviews help reduce exposure and improve preparedness.

Team members participating in HEC mitigation may be assessed for their fitness based on the following: a) the extent and level of participation in occupational health and safety training programme for dealing with wild animals especially elephants; b) the susceptibility of the personnel; and c) the past history of occupational illness or injury when dealing with conflict.

- *Personal hygiene:* The team members should follow the personal hygiene protocol by maintaining cleanliness and hygiene; having suitable clothing, gloves, masks, head covers, coats, shoe etc. when dealing with the animal; hand-washing and changing clothes where ever necessary; and carrying out procedures so as to minimize risks of splashes, spills, and generation of aerosols.
- *Veterinary facility for treatment of injured animals:* Personnel involved in medical management in veterinary hospital or make shift field hospital must understand the chemical and biological dangers associated with the facility and keep the facility clean and ensure that emergency safety devices are easily accessible and in working order. While loading dart gun with chemicals and drugs, avoid spill over and careless handling; wash hands after handling infectious material; decontaminate all contaminated materials before disposal or reuse including surfaces following any spill of bio-hazardous materials.
- *Personal protection:* Use Personal Protective Equipment (PPE) including clothing, shoes, covers, gloves, arm protectors, masks, face shields, respirators and any other item that may be needed.
- *Medical evaluation and preventive medicine for personnel:* Comply with medical evaluations for high-risk positions and those with substantial contact with animals and comply with immunizations, and vaccinations for personnel dealing with HEC.
- *Personnel training:* Personnel must learn general safety rules, safe operating procedures, ergonomic hazards and training for specific protocols and must be aware of their specific role and duties and the hazards associated with those duties (such as zoonosis, chemical/physical hazards). Training must provide personnel with information about levels of risk associated with working with animals and personal health conditions including implementing safety precautions.
- *Record keeping:* Maintain record on medical history, past accidents, exposure and injuries and pre-existing health conditions of all personnel including reference materials.

4.10.2 OHS measures during pre-capture, capture and handling of animals

Capture and handling of elephants in NER is a high-risk operation requiring structured OHS protocols. Safety planning must begin at the pre-capture stage and continue through capture, transport, and post-capture handling.

Potential hazard situations

- The management of elephants in conflict with humans occurs in agriculture-horticulture-forest landscape, involving a variety of hazards ranging from diverse natural terrain (dense forest, marshland, rugged terrain etc) adverse weather conditions, exposure to disease and deployment of equipment.
- The potential hazard associated with HEC mitigation includes physical hazards, chemicals hazards, zoonosis, allergies from wild animals (elephants), ergonomics and infectious agents.
- During *pre-capture planning*, hazards include aggressive or stressed elephants, unpredictable herd behaviour, rugged terrain, poor visibility during night operations, and crowd interference.
- During *chemical immobilisation or physical restraint*, risks include charging elephants, darting misfire, accidental exposure to immobilising drugs, trampling, falling animals in uneven terrain, and vehicle-related accidents.
- During *handling and transport*, hazards include rope or chain recoil injuries, crush injuries during loading/unloading, sedation-related collapse, dehydration stress, and handler fatigue.
- Additional risks include electrocution from illegal fencing, zoonotic exposure during close contact, snakebite in forest terrain, and psychological stress among personnel.

Hazard analysis

Hazard analysis should follow a structured risk assessment approach:

- *Threat Identification* - Assess temperament (musth bull, injured animal, herd with calves), terrain constraints, proximity to settlements, and weather conditions.
- *Risk Probability Assessment* - Evaluate likelihood of charging, sedation complications, crowd escalation, or vehicle mishaps.
- *Impact Severity Assessment* - Determine potential consequences (fatal injury, multiple casualties, public disorder).
- *Mitigation Planning* - Assign roles clearly, define safe zones, ensure veterinary supervision, deploy adequate manpower, and pre-position emergency medical support.

Operational briefings before the event must outline evacuation routes, communication protocols, sedation dosage safeguards, and contingency plans in case of dart failure or partial sedation.

HEC Mitigation Personnel - Vulnerability to Hazard and Risks

The HEC mitigation involves a large number of personnel with pre-assigned tasks, requiring coordination amongst team members supported by adequate training and capacity building to perform tasks. The HEC mitigation team are grouped below according to the specific function and duties and their vulnerability to the hazards and risks:

- *Administration team*: (personnel manning administrative offices and control rooms) who do not have direct/substantial animal contact in their daily task and functions, but who may need to visit field operations in the course of their duty are placed in low-risk category and should report of any medical condition for which medical examination and treatment are required.
- *Wild animal tracking and surveillance teams:* (frontline HEC mitigation workers) are vulnerable to animal attack (high risk) while tracking and surveillance of animal and the injuries could take the form of bites, sprains, scratches and in extreme case body disfigurement, bone fracture and deep grievous injuries and sometimes death. The infectious agents from animal fluids and faeces can cause exposure to bacteria, fungi, parasites, protozoa, rickettsia, viruses, bloodborne pathogens.
- *Veterinary team*: (veterinarians, paramedics, biologist, animal keeper) who do have direct/ substantial animal contact in their task and functions are vulnerable (high risk) to bites, sprains,

scratches from animal handling, burns, skin irritations, inhalation, ingestion from chemical agent's zoonotic diseases acquired from animals, allergies from animal urine, contaminated litter, dander, hair & exposure to bacteria, fungi, parasites, protozoa, rickettsia, viruses, blood borne pathogens.

- *Logistics team*: (handling transport, communication, equipment) are also vulnerable to animal attack (medium risk) and have direct/moderate animal contact in their task and functions relating to capture of animals, placing them in cages/kraal and transport to rescue facility and release location. They are moderately prone to all hazards as given above for veterinary team.

4.10.3 OHS measures for human health & safety during handling and transport

Occupational Health and Safety (OHS) during handling and transport of elephants in the NER is essential to protect veterinarians, mahouts, drivers, and support staff involved in high-risk operations.

Following measure may be implemented for avoiding, reducing, or eliminating exposure to hazards/risks:

- *Pre-Transport Safety Planning*: Safety planning must begin before transport with a structured briefing that assigns roles, identifies hazards, confirms sedation stability, and outlines emergency procedures and evacuation routes.
- *Personal Protective Equipment* (PPE): Use of appropriate personal protective equipment- such as helmets, gloves, steel-toe boots, reflective jackets, and eye protection- is mandatory. Veterinary personnel must follow strict drug-handling protocols to prevent accidental exposure to immobilising agents and ensure safe storage and disposal of syringes and antidotes.
- *Safe Handling Procedures*: Safe handling practices include maintaining adequate distance from the elephant's trunk and legs, avoiding blind spots, using coordinated commands, restricting access to trained personnel only, and preventing crowd interference.
- *Loading & Vehicle Safety*: Loading procedures must ensure reinforced vehicles with non-slip flooring, adequate ventilation, secure but humane restraints, and minimal onboard personnel.
- *Sedation & Drug Safety*: Sedation safety is critical throughout transport. Veterinary teams must monitor respiration, body temperature, and stress levels, with reversal agents readily available.
- *Traffic & Route Management*: The routes should be pre-assessed, and coordination with police ensures controlled traffic movement, particularly on narrow or high-risk roads.
- *Fatigue & Psychological Safety*: These are equally important, as transport operations may be prolonged and stressful. Adequate rest, hydration, rotation of staff, and post-operation debriefing reduce errors and improve resilience.
- *Emergency Response Preparedness*: This may include onboard first-aid and trauma kits, clear contingency plans for sedation failure or animal distress, and immediate access to medical facilities if personnel are injured.

Overall, structured OHS measures ensure that elephant handling and transport operations in NER prioritise human safety while maintaining humane wildlife management standards.

4.10.4 Addressing human health emergencies

Human health emergencies in NER may arise during human–elephant conflict (HEC) response, capture operations, night patrols, forest fire control, or crowd management across Nilgiris, Gudalur, Mudumalai Tiger Reserve, Sathyamangalam Tiger Reserve, Erode, Dharmapuri Forest Division and Hosur Forest Division. A structured emergency health response system ensures timely intervention and minimises morbidity and mortality.

- *Identification of Health Emergencies:* Health emergencies may include elephant attack injuries, trampling, fractures, head trauma, snakebite, electrocution, drug exposure during tranquilisation, vehicular accidents, heat stroke, dehydration, cardiac events, and stress-related collapse. Early recognition of symptoms- such as severe bleeding, loss of consciousness, breathing difficulty, chest pain, or altered mental status- is critical for rapid response.

- *Addressing Health Emergencies:* Upon identification, the first responder must ensure scene safety before assisting the victim. Immediate actions include bleeding control, stabilisation of airway and breathing, immobilisation of fractures, administration of basic life support (if trained), and urgent communication with emergency services. Clear escalation protocols should activate medical evacuation and notify division control rooms and district authorities.
- *On-Site Support:* All response teams should carry trauma kits, first-aid supplies, stretchers, and communication devices. At high-risk operations such as capture or large-scale conflict response, ambulance support should be pre-positioned. Trained personnel in first aid and cardiopulmonary resuscitation (CPR) must be part of Rapid Response Teams. Safe evacuation routes must be identified before field deployment.
- *Special Case Medical Emergencies:* During Crowd Management: Crowd-related health emergencies may include stampede injuries, fainting due to stress, mob violence, or cardiac events triggered by emotional distress. In such cases, police must secure space around the victim, prevent further crowding, and facilitate rapid evacuation. Public announcements should discourage crowd clustering and ensure access for medical teams. Coordination between forest officials, police, and district administration is vital.
- *During Transportation:* During ambulance or vehicle transport, continuous monitoring of vital signs is essential. Injured persons should be secured properly to prevent further trauma. Communication with the receiving hospital must occur in advance to ensure preparedness. For remote areas, designated safe halting points and alternative routes should be pre-identified.
- *Off-Site Support:* At the hospital level, trauma care, surgical intervention, and specialist treatment should be prioritised. Post-treatment follow-up, rehabilitation services, and psychological counselling may be necessary in severe cases. Documentation of the incident and review of response efficiency should be conducted to strengthen future preparedness. Integration with district health systems ensures long-term care continuity.

4.10.5 Addressing elephant health and veterinary emergencies

Elephant health emergencies in NER can arise from HEC capture operations, electrocution, vehicle collisions, disease outbreaks, poaching injuries, or stress-related complications. A structured veterinary emergency framework ensures rapid intervention while maintaining animal welfare and public safety.

Identification of Wildlife Health Emergencies:

- Wildlife health emergencies may include gunshot wounds, electrocution burns, snare injuries, fractures, severe lacerations, poisoning, dehydration, prolapse, abscesses, foot infections, or acute stress following crowd aggression. Disease-related emergencies may present as abnormal gait, lethargy, respiratory distress, abnormal discharge, emaciation, or unusual herd behaviour. Early detection through patrol observations, camera traps, GPS collar alerts, and community reporting is essential. Rapid field verification by trained veterinary officers confirms the severity and urgency of intervention.

Addressing Wildlife Health Emergencies On-site:

- Once identified, the first step is to secure a safe operational perimeter to prevent crowd interference and minimise stress to the elephant. Veterinary teams assess the animal’s condition from a safe distance before deciding on intervention- whether remote treatment, chemical immobilisation, or close examination is necessary.
- On-site management may include: controlled sedation under veterinary supervision; wound cleaning, suturing, and administration of antibiotics or analgesics; fluid therapy for dehydration; removal of snares or foreign objects; and stabilisation of fractures (if feasible).

- For minor injuries, remote monitoring may be preferred to avoid unnecessary immobilisation risk. All drug administration must follow strict dosage protocols with reversal agents readily available.

Addressing Veterinary Health Emergencies during Transportation

- If relocation to a treatment facility or rehabilitation camp is required- often associated with facilities near MTR- transport must prioritise physiological stability and stress minimisation. Continuous monitoring of respiration, body temperature, and sedation depth is essential.
- Transport protocols include: ensuring adequate ventilation and padding in transport vehicle; humane restraint without restricting circulation; availability of emergency drugs and oxygen support; minimising transport duration and avoiding extreme temperatures and pre-coordination with receiving veterinary facility.
- In case of sedation complications, immediate administration of reversal agents and supportive care must be undertaken.

4.10.6 Zoonosis and One health approach

The Nilgiri Elephant Reserve represents a complex interface of wildlife, livestock, and human populations across various divisions. Increasing HEC, livestock grazing in forest fringes, and habitat overlap elevate the risk of zoonotic disease transmission. A One Health approach- integrating wildlife, livestock, human health, and ecosystem health- is essential for long-term resilience.

Key Stakeholders

The One Health framework in NER requires coordinated participation of:

- *Forest Dept*- health monitoring/ surveillance of elephant morbidity/mortality, habitat management
- *Animal Husbandry*- Livestock vaccination, disease reporting, veterinary outreach in fringe villages
- *Public Health*- Surveillance of human zoonotic infections, outbreak response, health awareness
- *District Administration & Revenue*- Emergency coordination and community engagement
- *Research Institutions*- Disease diagnostics, epidemiological studies, laboratory support
- Local Panchayats & Village Committees- Community reporting and awareness dissemination
- *Police & Disaster Management Authorities*- Support during outbreak containment
- *Non-Governmental Organisations (NGOs)*- Capacity building and public awareness

Inter-sectoral coordination among stakeholders forms the backbone of effective zoonotic risk mitigation.

Key Measures to be implemented to Operationalise the One Health Approach

- *Integrated Disease Surveillance:* Establish a shared surveillance mechanism that tracks wildlife morbidity, livestock disease incidence, and human health alerts. Regular reporting from forest beats, veterinary units, and primary health centres should feed into a centralised dashboard.
- *Joint Field Investigations*: Suspected disease outbreaks in elephants or livestock should trigger joint field visits by forest veterinarians, animal husbandry officers, and public health officials. Sample collection, laboratory diagnosis, and epidemiological tracing must follow standard biosafety protocols.
- *Livestock Vaccination & Health Coverage:* Routine vaccination against diseases such as anthrax, foot-and-mouth disease (FMD), haemorrhagic septicaemia, and other regionally relevant pathogens reduces spillover risk. Controlled grazing policies in sensitive corridors further minimise interface risk.
- *Safe Carcass Disposal & Biosecurity:* Rapid and scientific disposal of livestock and wildlife carcasses prevents pathogen spread. Use of protective gear and disinfectants during post-mortem examinations is mandatory.

- *Community Awareness & Hygiene Practices:* Awareness programmes in fringe villages should promote safe livestock handling, sanitation, clean water use, and reporting of abnormal animal deaths. Early reporting mechanisms reduce outbreak amplification.
- *Veterinary Preparedness & Infrastructure:* Mobile veterinary units equipped with PPE, diagnostic kits, and emergency drugs must be available for rapid deployment. Training in biosafety and zoonotic protocols for field staff is essential.
- *Data Sharing & Inter-Departmental Coordination:* Regular coordination meetings at district level ensure data exchange among departments. Periodic review of disease trends enables adaptive management.
- *Research & Risk Mapping:* Epidemiological studies, mapping of livestock density near corridors, and seasonal risk assessment help identify high-risk zones. Integration of ecological data strengthens preventive planning.

4.10.7 Competency-Development of Personnel Responsible for Health Emergencies

Effective management of human and wildlife health emergencies in NER requires structured competency development of frontline staff, veterinarians, Rapid Response Teams, mahouts, and coordination personnel across all divisions. Competency development must combine technical skills, safety awareness, coordination capacity, and psychological resilience.

- *Core Medical & First Aid Competency:* All field personnel should be trained in basic life support (BLS), CPR, bleeding control, fracture immobilisation, snakebite management, electrocution response, and trauma stabilisation. Regular refresher courses and mock drills in high-conflict zones improve response time and confidence.
- *Wildlife Veterinary Skills:* Veterinary officers must receive advanced training in wildlife anaesthesia, tranquilisation protocols, drug dosage calculation, emergency sedation reversal, wound management, disease surveillance, and necropsy procedures. Exposure visits and collaboration with specialised wildlife institutions enhance technical proficiency.
- *One Health & Zoonotic Preparedness:* Personnel must be sensitised to zoonotic disease risks, biosafety protocols, sample handling procedures, and inter-departmental coordination mechanisms under the One Health framework. Use of PPE, safe carcass handling, and disinfection procedures must be standard practice.
- *Crisis & Incident Command Training:* Health emergency managers should be trained in incident command systems, rapid risk assessment, decision-making under stress, communication hierarchy, and coordination with Police, Revenue, and Health Departments. Structured command clarity reduces confusion during emergencies.
- *Equipment Handling & Safety Training:* Competency must include safe use of tranquiliser guns, drug storage protocols, trauma kits, oxygen cylinders, transport cages, and communication equipment. Regular equipment audits and hands-on drills ensure operational readiness.
- *Psychological Resilience & Stress Management:* Repeated exposure to fatalities, severe injuries, and conflict situations can impact mental health. Training in stress management, peer support systems, and access to counselling services enhances long-term resilience and morale.
- *Documentation & Reporting Skills:* Accurate medical documentation, post-incident reporting, digital data entry, and coordination with surveillance systems are essential for legal compliance and adaptive management.
- *Continuous Professional Development:* Periodic refresher training, certification updates, inter-division knowledge exchange workshops, simulation exercises help maintain high competency standards. Evaluation metrics should track skill retention and response effectiveness.

Strengthening competency of personnel in NER enhances preparedness, improves survival outcomes during emergencies, safeguards both human and elephant health, and reinforces institutional resilience in managing dynamic conservation challenges.

4.11 ECONOMICS AND EFFICACY OF HEC MITIGATION MEASURES

HEC mitigation in NER must be evaluated not only ecologically but economically to ensure optimal allocation of resources across the landscape.

- There is a need to evaluate the relative merits of alternative approaches to HEC, ranging from ameliorative measures, such as ex gratia payments, to measures that reduce conflict; in particular, efficacy of physical barriers, elephant capture, and behaviour-based initiatives to influence the movement of elephants away from human settlements.
- The goal should be to develop a framework to assess and evaluate the ecosystem services delivered by elephants and their habitats at various degrees of degradation including developing ratio of benefits to costs in using physical barriers to reduce HEC and also knowing whether the ratio differs substantially across geographical territories.

4.11.1 Socio-economic impact and calculation of areas affected

Peoples' responses to HEC in different regions is not independent of their social processes. The overall responses depend a great deal on not just their fear or love of elephants but also on whether they have the economic and social ability to take steps to avoid that conflict. These differences become quite critical when we consider that the areas under consideration are very different socially and economically.

- The boundaries of areas that are expected to be protected by physical barriers should be arrived at by using evidence of conflict such as ex-gratia payments by the forest department to the farmers affected by crop raid. It is known that the conflict, quite predictably, declines as we move away from the forest boundaries and the intensity and frequency of crop raid incidents is more in farms that are closer to the forest boundaries.
- After demarcating areas expected to be protected by physical barriers, the probability of elephant human conflict occurring in any village on a given day needs to be calculated. Probabilities may be calculated for time periods before and after the construction of the barriers.

HEC imposes direct costs (crop damage, livestock loss, property damage, human injury compensation) and indirect costs (lost labour days, psychological stress, reduced productivity, opportunity cost of guarding fields). Economic assessment requires:

- Mapping of affected agricultural interface (village-wise GIS analysis).
- Calculation of annual crop loss value (based on yield and market rate).
- Estimation of compensation payouts per division.
- Household-level vulnerability assessment in hotspot villages.
- Estimation of opportunity cost (night guarding, migration, productivity decline).

Tier-1 hotspots (e.g., Masinagudi-Moyar, Hasanur-Thalavadi, Palacode-Morappur, Denkanikottai-Thally belts) typically show higher per-hectare economic loss compared to interior forest villages.

4.11.2 Status of physical barriers

NER employs multiple barrier types as under:

- Solar-powered electric fencing (cluster-based).
- Elephant-proof trenches (in suitable dry belts).
- Bio-fencing and live hedges.
- Stone walls in select terrain.
- Early warning sensor-based pilot systems.

Barrier distribution is uneven, with higher density in eastern divisions such as Dharmapuri and Hosur. Functionality audits often reveal maintenance gaps, vegetation short-circuiting fences, trench siltation, or breakage due to elephant pressure.

- There are several reasons for these barriers being ineffective, such as: poor maintenance of EPTs and solar fences; EPTs not conducive to high rainfall areas, where they routinely get filled up and many a time the sides collapse, creating tracks for elephants to easily cross over; elephants attempt to push the side walls and fill up trenches; and elephants have also figured out how to breach electric fences, by pushing trees and logs over fences, or using tusks and foot pads, which are poor conductors, to push and snap the wires.

- Factors such as substrate type, topography, ownership, annual precipitation, local density of elephants, local peoples' dependence on the forest, and other factors, may influence the type of barrier for a locality.
- Breaches and breaks in physical barriers could potentially render them permeable to elephants, thus defeating their very purpose. Breaches in barriers are bound to occur due to a suite of induced and natural reasons. For effective management of HEC, it is crucial to periodically assess the breaches in the barriers and mend them.

The efficacy of barriers has been mixed, as observed from the increase or decrease in the compensation paid by the Forest Department in areas where barriers have been implemented.

4.11.3 Evaluation of costs and benefits of barriers

In order to see whether the costs of effective physical barriers are justified by the benefit of reduced human-elephant conflict, we need to estimate both the costs of physical barriers as well as the benefit of avoiding the costs of HEC that have been prevented by the barriers.

- **Costs include**: Capital installation cost; Annual maintenance cost (5–10% of capital); Monitoring and manpower deployment; Repair after breaches.
- **Benefits include**: Reduction in crop damage frequency; Lower compensation payouts; Reduced human injury risk; Reduced retaliatory aggression; Improved farmer confidence and productivity.

Effectiveness depends heavily on maintenance quality, community participation, & strategic placement.

- In calculating the costs of physical barriers, we need to first take into account the cost of constructing these barriers. These costs will depend on a variety of factors, such as design (for instance, number of strands in an electric fence) and terrain (nature of soil and rock for excavating a trench), but an important consideration is the length of the barrier. The concern is both existence and effectiveness of the barrier. The effectiveness is not determined by its length alone. Some terrains may require a longer physical barrier to effectively keep elephants out of human habitations, while other terrains may be able to achieve the same result with shorter barriers.
- The effectiveness of the barriers would also depend on whether, and how frequently, they have been breached. The breaches need not be made only by elephants. Local people are often dependent on the forests for a variety of needs, from cattle grazing and firewood collection at one end and the pursuit of spirituality at the other extreme. People thus sometimes have reason to breach the barriers too.
- A meaningful unit for measuring the value of barriers/fences would then be the cost per kilometre of the barrier as well as the cost of protecting a square kilometre of area. In making this calculation, it must be recognized that the level of HEC is not static over time. Other factors, like growth in the elephant population and human encroachments into forests, also play their role.
- The relevant comparison after the barriers, then, is not with the levels of conflict before the barriers were put up, but with the levels of conflict that would have existed if no action was taken. Thus, we need to first extrapolate trends in HEC to the period after the physical barriers were created and then compare those levels of conflict with what actually exists to capture the effectiveness of the barriers. This probability-based estimate of the effectiveness of the barriers can be used through what we call an efficiency variable.
- Based on patterns of conflict, a spatial map of the likelihood of conflict for the region needs to be obtained, thereby generating the probability of conflict. Such probabilities are particularly useful

to evaluate the effectiveness of physical barriers, as it takes into account the whole range of possibilities, from the impossibility of conflict to a very high probability.

- The cost side of the benefit-cost equation is the total cost spent on construction of the fixed barriers divided by the area that the fixed barrier is expected to protect. On the benefit side, there is a need to look beyond monetary indicators of the costs of conflict and emphasize the larger economic, social and cultural contexts.
- Thus, the evaluation of these benefits is in terms of a larger set of ecosystem services. This is of importance, as an emphasis is placed on the negative impact of HEC on human well-being. Consequently, the removal or reduction of this conflict will be a positive ecosystem service. The task then is reduced to one of estimating the costs of HEC and treating the reduction of these costs as a positive benefit that can be compared with the costs of creating physical barriers.
- Total Economic Value (TEV) is a method that can be used to provide the economic value of both the material and non-material elements of HEC. As this method takes the economic model beyond the material, it can identify different types of economic values neglected by the market. The advantage of using a valuation of ecosystems approach is that it helps assess overall contribution of ecosystems to social and economic well-being.

4.11.4 Cost-Benefit ratio of barriers as a means of reducing HEC

- In considering the empirical reality of the field where the HEC occurs, the various variables can be modified to reflect the on-ground reality of the conflict. Thus, the factors that can be identified in the empirical reality of HEC are: (i) damage to crops and property; (ii) reduced access to forest produce and forest water; (iii) change in land value; (iv) costs of access to spiritual elements within the forest; (v) costs of moving away from a preferred proximity to the forest; (vi) costs associated with overall health; (vii) fear of elephants (as a net effect of existence, bequest, altruistic values, as well as fear of elephants); (viii) abandonment of farming; (ix) change in soil fertility; (x) tapping of alternate sources of income. The total sum of all these individual variables per square kilometre is the total benefit that is to be obtained from reducing HEC per square kilometre. But this is only the total value if the conflict were reduced to zero. Hence, only the proportion of conflict that has resulted from actual reduction is to be taken into consideration. The real benefit-cost ratio can be obtained through taking these variables into consideration and then multiplying them by the proportion of actual benefits of reduction in HEC.
- Cost-benefit evaluation should compare: Annualised installation + maintenance cost versus Average annual avoided crop compensation + reduced social cost.
- The final ratio obtained for the different regions highlights the specific localized nature of the HEC. What emerges from the final ratios is the level to which the whole exercise is sensitive to the extent to which ecosystem services are accounted for. Observing the conflict in terms of material benefits alone does not justify the costs of the physical barriers. Savings on consumptive costs are then very small when compared to the costs per kilometre of effective physical barriers. However, once the ecosystem services are brought in, this gets dramatically reversed. From this, it can be inferred that the benefits from other ecosystem services per square kilometre due to reduction in HEC is greater than the costs associated with construction of physical barriers. Such a conclusion, however, needs to be tempered by a more realistic consideration of which ecosystem services are meaningful in such evaluations, as well as more comprehensive cost analysis of the barriers themselves and their efficacy.

In high-intensity conflict belts, well-maintained cluster fencing often demonstrates favourable cost-benefit ratios within 3–5 years due to significant reduction in compensation burden. However, in low-intensity areas, standalone fencing may not be economically justified without complementary measures.

4.12 MONITORING AND EVALUATION

Monitoring and Evaluation (M&E) of HEC in the NER is essential for evidence-based management across the landscape. A structured M&E system enables tracking of spatial and temporal conflict trends, assessment of mitigation effectiveness, and informed adaptive decision-making.

- *Key monitoring indicators* include the number of crop damage incidents, area affected, livestock mortality, human injury or fatalities, and property damage. Elephant-related indicators such as movement patterns, corridor use, involvement of repeat conflict individuals, and unnatural deaths are also tracked. Mitigation performance indicators- such as fence functionality, response time of Rapid Response Teams, compensation processing timelines, and community participation- help measure operational efficiency.
- *Data collection* relies on beat-level incident registers, GPS-tagged records, GIS-based hotspot mapping, camera trap and telemetry data, and community reporting mechanisms. Standardised formats across divisions ensure consistency and comparability, while compensation records help assess economic burden.
- *Evaluation* should occur at multiple scales. Quarterly reviews assess recent trends and response efficiency; annual evaluations examine division-wise patterns, cost–benefit performance of barriers, and hotspot reclassification; and periodic long-term reviews analyse overall conflict trajectory and corridor functionality.
- *Monitoring outcomes* must directly inform adaptive management actions such as redeployment of mitigation infrastructure, strengthening of early warning systems, reallocation of budgets to high-conflict belts, and revision of patrol strategies. Institutional mechanisms, including division-level monitoring cells and centralised dashboards, support systematic review.
- *Community feedback mechanisms*- such as village meetings and satisfaction surveys—enhance transparency and trust. Overall, a robust M&E framework in NER ensures accountability, improves mitigation effectiveness, optimises resource use, and supports long-term reduction of human–elephant conflict across the landscape.

A robust Monitoring and Evaluation system in NER enhances transparency, improves efficiency of mitigation investments, strengthens community trust, and ensures long-term reduction of human–elephant conflict across the landscape.

CHAPTER 5: ECOLOGICAL SUSTAINABLE DEVELOPMENT

Ecological Sustainable Development in the Nilgiri Elephant Reserve (NER) covering protected areas and tiger reserves such as Mudumalai Tiger Reserve, Sathyamangalam Tiger Reserve, Thanthai Periyar Wildlife Sanctuary, Cauvery South Wildlife Sanctuary, and Cauvery North Wildlife Sanctuary focuses on conserving elephant habitats and corridors while improving livelihoods of fringe communities through participatory management. It integrates habitat restoration, invasive species control, watershed protection, and climate-resilient forest management with comprehensive human-elephant conflict mitigation measures such as early warning systems, crop protection, and timely compensation. The approach promotes sustainable nature-based enterprises, community co-management, strengthened law enforcement, scientific monitoring, and transparent benefit-sharing mechanisms to ensure long-term ecological integrity, social equity, and economic sustainability across the Nilgiri landscape.

5.1 TRIBAL CONSIDERATIONS AND OTHER FOREST DWELLERS IN THE ELEPHANT RESERVE

NER is home to a diverse array of tribal communities, each with its own distinct culture, and way of life. The situation and status of tribal communities vary widely across different regions, especially in Western Ghats and Eastern Ghats. Government policies and initiatives, as well as ongoing social and economic changes, continue to shape the lives of these communities.

5.1.1 Background information

- *Social Composition and Distribution*: Tribal and other forest-dwelling communities within the Nilgiri Elephant Reserve include indigenous groups such as the Toda, Kota, Kurumba, Irula, Paniya, Kattunayakan, and Soliga, along with other forest-dependent households living in buffer and fringe villages. Many of these settlements are located near ecologically sensitive habitats and elephant corridors, making them closely linked to both conservation outcomes and conflict risks.

- *Livelihood Systems and Forest Dependence*: Their livelihoods are traditionally based on collection of non-timber forest produce (NTFPs), small-scale agriculture, livestock rearing, wage labor, and forest-based skills. Forest access is central not only to subsistence income but also to cultural identity, traditional ecological knowledge, and community institutions. This dependence makes tenure security and sustainable resource use critical components of landscape management.

- *Legal and Policy Framework*: The legal framework governing their rights includes the Forest Rights Act (2006), the Wildlife (Protection) Act (1972), and applicable local governance provisions. Recognition of individual and community forest rights, particularly Community Forest Resource (CFR) rights, is essential to ensure tenure security and participatory conservation while balancing wildlife protection objectives.

- *Human-elephant conflict (HEC) Impacts*: HEC disproportionately affects these communities through crop loss, property damage, livelihood insecurity, and occasional human casualties. Effective mitigation requires early warning systems, crop protection measures, timely compensation, community-based response teams, and diversification of livelihoods to reduce vulnerability.

- *Cultural and Ecological Knowledge*: Indigenous knowledge systems provide valuable insights into elephant movement patterns, fire management, native species, and seasonal ecological cycles. Integrating this knowledge into restoration, corridor management, and monitoring strengthens both conservation effectiveness and community ownership.

- *Developmental Challenges*: Tribal and forest-dwelling populations often face developmental challenges such as limited healthcare, education access, infrastructure gaps, low-income diversification, and marginal representation in decision-making processes. Climate variability further increases their vulnerability.

- *Key Considerations for Sustainable Development*: Sustainable development in NER therefore requires a rights-based, participatory approach that ensures Free, Prior and Informed Consent (FPIC), inclusive governance structures, equitable benefit sharing from ecotourism or ecosystem services, gender inclusion, capacity building, and effective grievance redress mechanisms. Recognizing forest dwellers as conservation partners is fundamental to achieving long-term ecological resilience and social justice in the Nilgiri landscape.

The issue of tribal considerations within NER is dynamic and involves a multidimensional approach that seeks to address the rights, needs, and aspirations of tribal communities while ensuring the sustainable conservation of natural resources.

5.1.2 Forest Rights of forest dwelling ST&OFD in the NER

The Scheduled Tribes and Other Traditional Forest Dwellers (ST&OFD) (Recognition of Rights) Act 2006 (FRA) was enacted with the aim at addressing the "historic injustice" that was meted out to the forest dwellers by recognising forest land, resources, and resource management and conservation rights of the forest dwelling communities. However, the implementation of the Act in general and especially in the Protected Areas (PA) and Elephant Reserves (ER) has been delayed.

As regards implementation of FRA in the NER especially PAs, following issues need to be addressed-

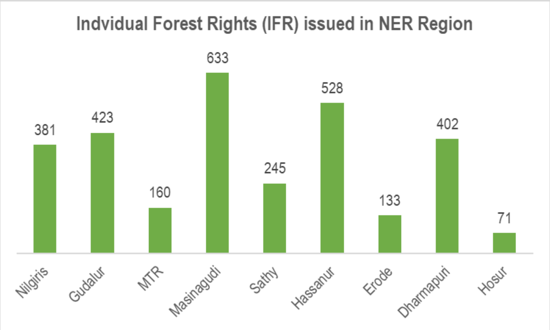
i. Extent to which Individual Forest Rights (IFR), Community Rights (CR) and Community Forest Resources (CFR) etc. have been recognised under Sec. 3(1) of FRA, 2006
ii. Extent to which Strategies have been planned under Sec. 5 of FRA, 2006 & Committee constituted under rule 4(e) of FR Rules 2007 for protection of wildlife, forests & biodiversity
iii. Extent to which rights in Sanctuaries under Sec. 24(2)(c) of WLPA 1972 have been recognised
iv. Extent to which provision of Sec. 38 V (4) (i) & (ii) of WLPA 1972 has been implemented
v. Extent to which provisions of Sec. 38 V (5) (i) to (vi) of WLPA 1972 & Sec. 4 (2) (a) to (f) of FRA 2006 have been implemented in the PAs of the ERs.

***Individual Forest Rights (IFR)**:* right to hold and live in the forest land under the individual or common occupation for habitation or for self-cultivation for livelihood by a member or members of a forest dwelling Scheduled Tribe or other traditional forest dwellers [Sec. 3 (1) (a)].

- IFR provide eligible STs & OFDs legal recognition over land under occupation for self-cultivation and habitation, with heritable but non-transferable tenure. In the NER, this tenure security is critical for livelihood stability and reducing disputes arising from unclear land status (Fig-5.1).

***Community Forest Rights (CFR)**:* community rights such as nistar; right of ownership, access to collect, use, and dispose of minor forest produce; other community rights of uses or entitlements; community tenures of habitat and habitation; rights of settlement and conversion; rights to protect, regenerate or conserve or manage any community forest resource; rights which are recognised under any State law or laws; right of access to biodiversity and community right to intellectual property and traditional knowledge; any other traditional right customarily enjoyed by the forest dwelling Scheduled Tribes or other traditional forest dwellers [Sec. 3 (1) (b), (c), (d), (e), (h), (i), (j), (k) and (l)]

- CFR allow communities to access, collect, use, and dispose of minor forest produce, graze livestock, access water bodies, and protect cultural and religious sites. These rights strengthen collective management and support sustainable livelihoods linked to forest resources.



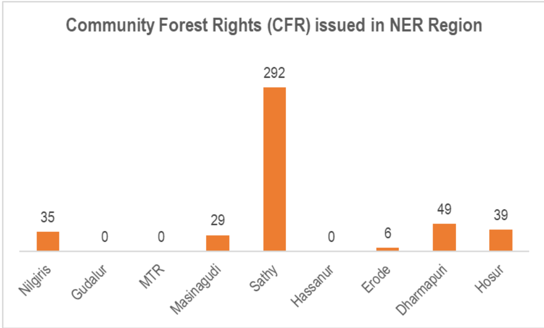


Fig-5.1: Individual (IFR) & Community Rights (CFR) issued in the NER

Community Forest Resource Management (CFRM): means customary common forest land within the traditional or customary boundaries of the village or seasonal use of landscape in the case of pastoral communities, including reserved forests, protected forests and protected areas such as Sanctuaries and National Parks to which the community had traditional access [Sec. 2 (a)]

- CFR rights empower Gram Sabhas to protect, regenerate, conserve, and manage customary forest areas. When effectively implemented in NER, these rights can align community stewardship with habitat restoration and biodiversity conservation objectives.

Rights in Protected Areas & Tiger Reserves: Within PAs & TRs such as MTR, STR, Thanthai-Periyar WLS, Cauvery North & South WLS, forest rights must be recognized before any relocation, and relocation from core areas must be voluntary, scientifically justified, and accompanied by fair compensation.

Use of satellite imagery: As per Rule 12A (1), officials of the Forest & Revenue depts shall remain present during the verification of the claims & evidences on the site; also, as per sub-rule (8), the land rights for self-cultivation recognised u/s 3 (1) (a) shall be within the specified limit, including forest lands used for allied activities ancillary to cultivation, such as, for keeping cattle, for winnowing, other post-harvest activities, rotational fallows, tree crops & storage of produce. *Use of satellite imagery would become relevant in raising objections in the area delineation for self-cultivation and for allied activities*.

5.1.3 Delineation of Critical Wildlife Habitat (CWH)

"Critical Wildlife Habitat" (CWH) as per Sec 2 (b) of the FRA means such areas of National Parks and Sanctuaries where it has been specifically and clearly established, case by case, on the basis of scientific and objective criteria, that such areas are required to be kept as inviolate for the purposes of wildlife conservation as may be determined and notified by the Central Government (MoEF&CC) after open process of consultation by an Expert Committee (jurisdictional CCF as Chairperson, representative of MoTA, one social scientist, two experts on life sciences, and concerned Panchayat President/ Sarpanch or representative as members with officer (i/c) of NP/WLS as member secretary), in determining such areas according to the procedural requirements arising from Sec 4 (1) and (2); thus implying CWH can be established only after completion of Sec 3 & 6 of FRA.

Criteria and Process for declaring CWH:

- Guidelines for notification of Critical Wildlife Habitats within National Parks & Wildlife Sanctuaries has been provided vide MoEF&CC F. No.1-23/2014WL dated 4-1-2018, and procedure for determining and notifying inviolate areas as required by the FRA 2006 has been detailed.

Recognition, Restoration and Vesting of Rights:

As per Recognition, Restoration and Vesting of Forest Rights and related matters [Sec. 4 (1) & (2)], Central Government recognises and vests forest rights in the forest dwelling Scheduled Tribes and the other traditional forest dwellers as mentioned in section 3. The forest rights recognised under this Act in CWH of PAs may subsequently be modified or resettled, provided that no forest rights holders shall be resettled or have their rights in any manner affected for the purposes of creating inviolate areas for wildlife conservation except in case all the following conditions are satisfied, namely: -

- the process of recognition and vesting of rights as per Sec 6 is completed;
- holders of forest rights shall cause irreversible damage; threaten the existence of species/ habitat;
- other reasonable option such as co-existence is not available;
- resettlement or alternative package has been prepared and communicated;
- free informed consent of Gram Sabha has been obtained in writing;
- facilities and land allocation at location site is complete as per promised package;

However, forest rights cannot continue in National Park as per Sec 35(3) read with 24(2)(c) of the Act.

Identification of CWH:

The criterion and indicators of CWH would vary in context of standalone PA or when part of TR or ER. Unlike Critical Tiger Habitat (CTH) where focus is only on tiger; CWH in respect of Wildlife would also include aquatic & land vegetation, besides animals (Box-5.1).

Box-5.1: Process for Identification of the Critical Wildlife Habitat

- The Expert Committee shall identify areas within the NP/WLS required to be kept inviolate for the purpose of wildlife conservation and the said Committee may conduct necessary field visits and undertake identification of CWH, based on scientific and objective criteria.
- The Expert Committee shall adopt an open process of consultations with, the forest rights holders, in their local precincts, to solicit their views on the proposed notification of CWH.
- The open process of consultation (public notice) needs to be structured based on the scientific & objective assessment; area(s) to be notified; implications on forest right; options on resettlement & rehabilitation; human wildlife conflict issues etc.
- Establishing CWH as ‘inviolate’ would involve delineating the area considering socio-ecological requirements of animals including its viability and dispersal without distorting the natural prey-predator ecological cycle in the habitat (*scientific assessment*).
- Consider the activities or impact of forest right holders upon wildlife and its habitat in terms of current pressures and future demands on forest resources as the same may cause irreversible damage and threaten the existence of species and its habitat (*objective assessment*).
- Consider the activities or impact of forest right holders in terms of present and future levels of human-wildlife conflict to evaluate the long-term viability of residing and earning livelihood within the area of the CWH by the local communities (*objective assessment*).
- No other option exists for mutual co-existence viz. grazing impact, ‘zoonosis’, space competition, biomass removal etc & would threat mitigation and incorporation in CFR Management Plan be sufficient to exclude areas from CWH (*scientific / objective assessment*).
- A CWH may extend to the entire area comprising a National Park or Wildlife Sanctuary, or only a part of it, The CWH has to be determined on case-to-case basis u/s 2(b) of FRA and therefore should be limited to forest right holders’ area.

Challenges and Way Forward:

- CWH can only be established after completion of Sec 3 & 6 of FRA and Gram Sabha constitutes Committee under Rule 4 (1) (e) & prepares a conservation and management plan under Rule 4 (1) (f) to regulate community forest resources as per Sec 5 (a) & (d) of FRA.
- As per NTCA order dt 28-3-17 no rights in Core or CTH under Sec 38V (4) (i) in the absence of guidelines for CWH. For Buffer or Peripheral area under Sec 38V (4) (ii), co-existence to be determined as per scientific and objective criteria in consultation with Gram Sabha and EC.
- Procedure for declaration of Core/ CTH & Buffer of Tiger Reserve in the ER needs to be followed as per 38-V (4) of WLPA and 4 (1) & (2) of FRA including voluntary relocation.
- CWH would vary in context of standalone PAs or when part of Tiger Reserve in the ER.

As a way forward, it is essential to strike a balance between conservation objectives and the rights of forest-dwelling communities when declaring inviolate areas. Action needs to be undertaken for the declaration of the CWH.

5.1.4 Relocation of Tribal settlements

Relocation of tribal settlements within the NER has primarily taken place in core areas of protected regions such as MTR to create inviolate habitats for wildlife conservation. The objective has been to reduce human pressure in critical tiger and elephant habitats and strengthen long-term ecological connectivity across the Nilgiri landscape. In respect of STR, the settlements have been excluded from the core area declaration and do not form the part of tiger reserve.

- Voluntary relocation should be on mutually agreed terms and conditions, and should satisfy the requirements laid down in Sec 38-V (5) of the WLPA and Sec 4 (2) of the FRA.
- No ST&OFD shall be resettled or have their rights adversely affected for the purpose of creating inviolate areas unless the process of recognition and determination of rights and acquisition of land or forest rights of the ST&&OFD persons is complete; establishes with the consent of the ST&OFD, that the activities or the impact of their presence upon wild animals is sufficient to cause irreversible damage and shall threaten wildlife and their habitat; that other reasonable options of co-existence, are not available; resettlement or alternative package has been prepared providing for livelihood for the affected individuals as per National Relief & Rehabilitation Policy including fair compensation; the informed consent of the Gram Sabha concerned, and free, prior and informed consent (FPIC) of the persons affected, to the resettlement programme has been obtained; and the facilities and land allocation at the resettlement location are provided under the said programme, otherwise their existing rights shall not be interfered with.
- Efforts should be made to assess and mitigate the potential impact of relocation on the cultural practices, traditions, and identity of the affected communities; rehabilitation measures should be in place to ensure that relocated communities have access to essential services, education, healthcare, housing and livelihood opportunities.
- Thorough social & environmental impact assessments should be conducted before any relocation to understand the potential consequences on both the affected community and the environment; involvement of experts and NGOs can contribute to a more comprehensive and equitable relocation process; and the post-relocation phase should be monitored to ensure that the rights and well-being of relocated communities are safeguarded.

5.1.4.1 Justification for Harmonious Co-existence rather than Tribal Relocation in NER

The NER represents one of the oldest and most culturally significant human-elephant landscapes, where indigenous tribal communities and elephants have coexisted for centuries. A coexistence-based approach is ecologically sound, socially just, legally consistent, and economically sustainable.

1. *Long History of Human–Elephant Coexistence*: The indigenous tribes of the Nilgiri landscape have traditionally lived in harmony with elephants through customary resource-use practices, seasonal mobility, and deep ecological knowledge. Unlike recent developmental pressures, these traditional settlements have generally coexisted with wildlife without causing large-scale habitat degradation or fragmentation.
2. *Indigenous Communities as Conservation Partners*: Tribal communities possess extensive traditional ecological knowledge relating to elephant behaviour, seasonal movement, wildlife habitats, water sources, medicinal plants, and forest management. Their active participation can substantially strengthen elephant conservation while reducing human-elephant conflict.
3. *Constitutional and Legal Safeguards*: The Recognition of Forest Rights) Act, 2006 and Panchayats (Extension to Scheduled Areas) Act, 1996, recognize customary rights, community participation, and informed consent. Relocation should therefore remain a voluntary, informed, and exceptional measure rather than a routine conservation strategy.

4. *Ecological Sustainability*: Scientific evidence increasingly demonstrates that indigenous-managed landscapes often maintain high levels of biodiversity and ecosystem integrity. Traditional livelihood systems generally exert relatively low ecological pressure compared to commercial agriculture, infrastructure expansion, mining, linear developments, or unplanned urbanization, which constitute far greater threats to elephant habitats and corridors.
5. *Addressing Drivers of HEC*: The increasing incidence of HEC is primarily associated with habitat fragmentation, expansion of agriculture and plantations, infrastructure development, highways, transmission lines, invasive alien species, reduction in natural forage and water availability, and climate-related changes. Addressing these underlying drivers through landscape-level planning is likely to yield more effective conservation outcomes than relocating tribal settlements.
6. *Livelihood Security and Cultural Preservation*: The identity, culture, spiritual values, and traditional knowledge of tribal communities are intrinsically linked to forests and wildlife. Harmonious coexistence enables communities to maintain their cultural practices & traditional livelihoods, while participating in conservation and sustainable development initiatives.
7. *Community-Based Conservation and Ecotourism*: Instead of relocation, tribal communities can become active stakeholders in community-based conservation through ecotourism, nature interpretation, handicrafts, sustainable harvesting of NTFP, and livelihood programs. Such approaches generate economic incentives that reinforce conservation objectives.
8. *Cost-effectiveness and Long-term Sustainability*: Large-scale relocation programs often involve substantial financial investments, long implementation periods, complex rehabilitation challenges, and uncertain outcomes. In contrast, investments in coexistence measures- habitat improvement, corridor restoration, EWS, community engagement, compensation mechanisms, and alternative livelihoods- are often more cost-effective and provide enduring conservation and social benefits.
9. *Landscape-level Conservation Approach*: Elephants require large, connected landscapes extending well beyond PAs. Conservation success therefore depends on integrated landscape management involving forests, community lands, agriculture, and other land uses. Strengthening coexistence across the broader landscape is more effective than focusing solely on relocation.
10. *Adaptive Conflict Mitigation*: Modern conservation increasingly emphasizes adaptive coexistence measures such as AI-enabled early warning systems, rapid response teams, participatory monitoring, crop protection strategies, community-based insurance, barrier improvement, habitat enrichment, and timely compensation. These interventions can substantially reduce conflict while allowing communities and elephants to coexist.

For the Nilgiri landscape, harmonious co-existence should be adopted as the primary conservation strategy, with voluntary relocation considered only in exceptional circumstances, such as where communities themselves seek relocation or where there are clearly demonstrated, severe, and persistent risks to human life that cannot reasonably be mitigated through coexistence measures.

5.1.5 Synergy between Forest Rights and Joint Forest Management

Sec 3 (1) (i) of the FRA provides for the rights to protect, regenerate or conserve or manage any community forest resource on all forest lands which the Scheduled Tribes and other traditional forest dwellers have been traditionally protecting and conserving for sustainable use.

As per Sec 5 of the FRA, the holders of any forest right/ Gram Sabha are empowered to protect the wild life, forest and biodiversity; ensure that adjoining catchments area, water sources and other ecological sensitive areas are adequately protected; ensure that the habitat of ST&OFD is preserved from any form of destructive practices affecting their cultural and natural heritage; and ensure that the decisions taken in the Gram Sabha to regulate access to community forest resources and stop any activity which adversely affects the wild animals, forest and the biodiversity are complied with.

Under Rule 12 (1) (g) of the FRA, the Forest Rights Committee shall, after due intimation to the concerned claimant and the Forest Department prepare a community forest resource map with recognizable land marks. The delineation of community forest resource may include existing legal boundaries such as Reserved Forests/ Protected Area and such delineation shall formalize and recognize the powers of the community in access, conservation and sustainable use of such community forest resources.

Synergy between FRA & JFM in NER: While there is potential for synergy, successful integration requires careful planning, and coordination to the principles of both FRA & JFM.

- *Conceptual Convergence:* The Forest Rights Act (FRA), 2006 and Joint Forest Management (JFM) are often viewed as parallel frameworks, but in NER they can be complementary. FRA legally recognizes tenure and governance rights of forest-dwelling Scheduled Tribes (STs) and Other Forest Dwellers (OFDs), while JFM provides a collaborative platform between communities and the Forest Department for protection, regeneration, and benefit sharing. When aligned, FRA strengthens community legitimacy, and JFM provides institutional support for implementation.
- *Institutional Integration:*Under FRA, the Gram Sabha is the statutory authority for Community Forest Resource (CFR) management. JFM committees (often Eco-Development Committees or Village Forest Committees) can function as operational arms supporting Gram Sabha decisions. In NER, aligning JFM micro-plans with CFR management plans ensures that restoration, fire control, and invasive removal are legally grounded and community-led.
- *Strengthening Habitat Protection:* NER includes ecologically critical habitats and corridors linked to areas such as Mudumalai Tiger Reserve and Sathyamangalam Tiger Reserve. Recognized CFR rights can empower communities to protect corridors and prevent encroachment, while JFM structures facilitate technical guidance, monitoring, and funding support for restoration activities.
- *Livelihood and Benefit Sharing:* FRA grants ownership over Minor Forest Produce (MFP), and JFM provides mechanisms for organized harvesting, value addition, and equitable sharing of proceeds. In NER, integrating the two can enhance income from honey, medicinal plants, bamboo, and eco-tourism initiatives. Transparent revenue-sharing arrangements through JFM committees, backed by legal rights under FRA, reduce conflict and improve accountability.
- *Conflict Mitigation and Co-management:* Communities with recognized rights are more likely to cooperate in wildlife protection and HEC mitigation. JFM platforms can coordinate community patrols, early-warning systems, and fire management efforts. This synergy builds trust and transforms forest dwellers into conservation partners rather than passive beneficiaries.
- *Governance and Safeguards:* For effective synergy, micro-plans must align with CFR management objectives; benefit-sharing mechanisms must be transparent and equitable; and capacity building should strengthen both community institutions and Department facilitation roles.

***Strategic Outcome**:* A harmonized FRA-JFM framework in NER can secure tenure, enhance ecological restoration, strengthen corridor protection, reduce human-wildlife conflict, and improve livelihoods. By combining legal empowerment with collaborative forest management, NER can advance a rights-based, community-driven conservation model that supports both biodiversity integrity and social justice.

5.1.6 Identify departments, agencies, institutions, NGOs to create a support system

Creating a support system for the effective implementation of the Forest Rights Act in NER involves collaboration among various departments, agencies, institutions, and non-governmental organizations.

The key entities that can contribute to the support system, include: MoTA: MoEF&CC; Adi-Dravidar & Tribal Welfare Department; TNFD; Forest Rights Committees; CBOs & NGOs; Revenue Department; Rural Development Dept; NTCA and State Wildlife Board; and media and communication agencies

A collaborative and multi-stakeholder approach involving these entities can contribute to the effective implementation of the Forest Rights Act in the context of NER, ensuring the recognition and protection of the rights of forest-dwelling communities while considering conservation goals.

5.1.7 Monitor FRA Implementation

Monitoring programmes related to the Forest Rights Act (FRA) in the NER aim to ensure legality, transparency, and alignment between tenure rights and 'conservation objectives'. Monitoring should assess compliance with statutory procedures, timeliness of claim processing, accuracy of land records and mapping, and the overall socio-ecological outcomes of recognized rights.

- Monitoring should also evaluate whether recognized Individual Forest Rights (IFR) and Community Forest Resource (CFR) rights contribute to livelihood security and responsible forest governance without undermining ecological integrity.
- Core indicators should cover process metrics (claims verified, titles issued, time taken), output metrics (area recognized under IFR/CFR), and outcome metrics (improvements in tenure security, reduction in disputes, community-led conservation activities). Regular socio-economic surveys and satellite-based monitoring can help assess ground realities and land-use changes.

Overall, a structured monitoring framework for FRA in NER should promote rights-based governance, reduce conflicts, and ensure that tenure security and biodiversity conservation progress together in a balanced and sustainable manner.

5.1.8 Planning Integrated Tribal Development in NER

Integrated Tribal Development (ITD) in the Nilgiri Elephant Reserve aims to improve the socio-economic well-being of tribal communities while strengthening their role in forest conservation. Tribal villages located around landscapes such as Mudumalai & Sathyamangalam Tiger Reserves (Fig-5,2) require a rights-based, conservation-compatible development approach that balances livelihood security with ecological sustainability.

- *Baseline Assessment*: Planning should begin with a comprehensive baseline assessment covering demography, forest rights status, livelihood patterns, infrastructure gaps, and vulnerability to human-wildlife conflict. Participatory methods and village-level consultations are essential to ensure that development priorities reflect community needs and aspirations.
- *Sustainable Forest-Based Livelihoods*: Livelihood development must focus on sustainable forest-based enterprises such as value addition of non-timber forest produce, bamboo and honey processing, native seed nurseries, and habitat restoration work.
- *Agriculture and Allied Activities*: Climate-resilient agriculture, traditional crop promotion, livestock support, and water harvesting structures can further strengthen income security.
- *Nature-Based Enterprises*: Community-led ecotourism, cultural tourism, handicrafts, and eco-guiding, can provide alternative income opportunities for youth and women. Skill development and market linkages are critical for long-term sustainability of these initiatives.
- *Social Infrastructure Development*: Improving social infrastructure including better access to healthcare, education, drinking water, sanitation, renewable energy, and digital connectivity is important. Strengthening service delivery enhances overall quality of life & reduces vulnerability.
- *Human-Wildlife Conflict Mitigation Support*: The conflict mitigation measures such as early warning systems, crop protection support, insurance schemes, and timely compensation facilitation must be integrated into development planning to safeguard livelihoods.
- *Institutional Strengthening*: Strengthening through empowered Gram Sabhas, Community Forest Resource committees, and SHGs ensures participatory governance and financial accountability.
- *Convergence with Government Schemes*: Convergence with government schemes like Tribal Sub-Plan, MGNREGA, and rural livelihood missions helps secure sustained funding.

Overall, Integrated Tribal Development in NER should create improved livelihoods, stronger community governance, reduced conflict vulnerability, enhanced infrastructure access, and a balanced relationship between conservation objectives and tribal welfare.

Fig-5.2: Enclave villages inside MTR and STR

5.2. ECOTOURISM, INTERPRETATION AND CONSERVATION EDUCATION

Ecotourism is defined as "responsible travel to natural areas that conserves the environment, sustains the well-being of the local people, and involves interpretation and education" (The International Ecotourism Society 2015).

The Ecotourism planning is essential as it will provide the broad framework for promotion and development of ecotourism in the NER in a planned and scientific manner. The plan envisages visit to natural areas with minimal impact, enriching the visitors' experience and provide livelihood opportunities to the local communities wherever feasible.

5.2.1 General Principles of Ecotourism in NER

Ecotourism in NER- covering landscapes such as MTR (Western Ghats) & STR (Eastern Ghats) must be conservation-led, community-inclusive, and ecologically responsible. The following general principles should guide planning and implementation:

- *Conservation First:* Ecotourism must support biodiversity conservation and habitat protection. Activities should not compromise wildlife corridors, breeding areas, or sensitive ecosystems. Revenue generated should contribute directly to conservation management and restoration.
- *Community Participation and Benefit Sharing:* Local tribal and forest-fringe communities must be active stakeholders in planning, operation, and revenue-sharing mechanisms (preferably through community-based ecotourism). Employment, enterprise opportunities, and capacity building should prioritize local households to ensure equitable benefits.
- *Carrying Capacity and Zonation:* Tourism activities must adhere to scientifically determined carrying capacities. Clear zonation- core, buffer, and tourism-use zones- should regulate visitor numbers, routes, and seasonal access to prevent ecological degradation.
- *Low-Impact Infrastructure:* Infrastructure such as nature trails, interpretation centres, and eco-lodges should use eco-friendly designs, renewable energy, minimal land alteration, and waste management systems to reduce environmental footprints.
- *Wildlife-Sensitive Operations:* Strict guidelines on noise control, vehicle speed, group size, and visitor behaviour should be enforced to minimize disturbance to wildlife, particularly elephants and other flagship species.
- *Environmental Education and Interpretation:* Ecotourism should provide meaningful interpretation about forest ecology, wildlife behaviour, tribal culture, and conservation challenges. Awareness fosters responsible visitor behaviour and long-term support for conservation.
- *Local Enterprise Development:* Encourage community-led enterprises such as homestays, handicrafts, eco-guiding, and value-added forest produce sales. Transparent financial systems and cooperative models enhance sustainability.

- *Compliance with Legal and Policy Frameworks:* Ecotourism operations must comply with the Wildlife (Protection) Act, Forest Conservation Act, Forest Rights Act, and TN Ecotourism Policy and TN Trekking (Regulation) Rules. All initiatives should align with approved TCPs and Management Plans.
- *Monitoring and Adaptive Management:* Regular ecological and socio-economic monitoring should assess impacts of tourism on wildlife, habitat quality, and community livelihoods. Adaptive management allows modification of activities if negative impacts emerge.
- *Risk Management and Safety:* Clear safety protocols for wildlife encounters, emergency response systems, trained guides, and visitor orientation are essential to prevent accidents and reduce human-wildlife conflict.

5.2.2 Goal of Ecotourism

The goal of ecotourism in the NER is to promote conservation-driven, community-based tourism that sustains biodiversity, supports local livelihoods, and enhances environmental awareness while maintaining ecological integrity.

5.2.3 Objectives of Ecotourism

- Support biodiversity conservation by generating sustainable revenue through identification, promotion and development of natural areas as ecotourism destinations and promote ecofriendly infrastructure in conformity with the guiding principles.
- Enhance community livelihoods by creating employment and enterprise opportunities for tribal and forest-fringe communities. Encourage sustainable local enterprises such as eco-guiding, homestays, handicrafts, and value-added forest products.
- Promote community participation through inclusive planning, capacity building, and equitable benefit-sharing mechanisms. Reduce human-wildlife conflict by providing alternative income sources and supporting conflict mitigation measures.
- Strengthen environmental awareness by providing high-quality interpretation and education on forest ecology and wildlife conservation and enhance visitor learning experience for conservation.
- Ensure low-impact tourism through adherence to carrying capacity norms, zonation, and eco-friendly infrastructure. Align with management frameworks to ensure compliance with wildlife protection laws and approved tiger reserve and protected area plans.
- Build institutional capacity within forest divisions and community institutions for professional and accountable ecotourism management and provide quality visitors' experience. Facilitate partnerships between all stakeholders to develop, promote and maintain ecotourism sites.
- Develop monitoring and evaluation protocols to assess ecological and socio-economic impacts of tourism and enable adaptive management and also gain insight on visitors' satisfaction.

5.2.4 Key Aspects of Existing Ecotourism in NER

The existing ecotourism in NER landscape is quite divergent when we observe the ecotourism resources and characteristics of the sites falling in the Western or Eastern Ghats divisions (Fig-5.3).

- Western Ghats divisions have more structured, and regulated ecotourism with higher visitation.
- Eastern Ghats divisions have emerging or low-intensity ecotourism with significant potential.
- Community-based ecotourism is still evolving and requires stronger institutional frameworks.
- Revenue generation is concentrated in Western Ghats; Eastern Ghats remain underdeveloped.
- Strong corridor value across STR-Gudalur-Nilgiris makes tourism planning ecologically sensitive.
- Infrastructure/ visitor management systems are more mature in MTR compared to other divisions.

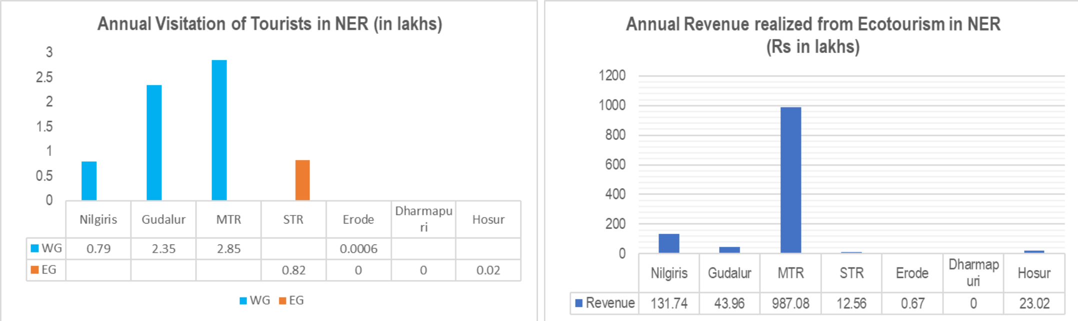


Fig-5.3: Annual Visitation & Revenue realized (Rs in lakhs) in the Western and Eastern Ghat divisions

In the **Western Ghats divisions-** including Mudumalai Tiger Reserve, Nilgiris and Gudalur forest divisions- ecotourism is relatively well-established and structured. It is largely safari-driven, supported by regulated jeep and bus safaris, interpretation centres, trekking routes, and elephant camps. These areas experience higher visitor footfall due to strong tourism circuits (e.g., Ooty-Mudumalai). Revenue generation is comparatively strong, and tourism operations are more regulated with defined zonation and carrying capacity norms. However, there is a degree of dependence on wildlife-viewing tourism, with growing need for diversification and stronger community enterprise participation.

In contrast, the **Eastern Ghats divisions-** including Sathyamangalam Tiger Reserve, Erode, Dharmapuri and Hosur forest divisions- have emerging or low-intensity ecotourism models. Infrastructure is limited, safari systems are less developed, and visitor numbers are lower. Activities are more focused on trekking, viewpoints, riverine landscapes, and dry deciduous forest experiences. These areas have high ecological significance as elephant corridors and transition zones between the Western and Eastern Ghats, but tourism development remains modest, presenting significant potential for carefully planned, community-led, low-impact expansion.

Overall, Western Ghats ecotourism within NER is mature, high-visibility, and revenue-generating but requires consolidation and impact management, while Eastern Ghats ecotourism is nascent, low-density, and holds strong potential for balanced, sustainable growth with greater emphasis on community-based and conservation-sensitive development (Table-5.1).

Table-5.1: Comparative Status of Ecotourism: Western vs Eastern Ghats Divisions

Parameter	W. Ghats (Nilgiris, Gudalur, MTR)	E. Ghats (STR, Erode, DPI, Hosur)
Tourism Maturity	Well-established, structured	Emerging / low-intensity
Visitor Footfall	High	Moderate to low
Safari Infrastructure	Strong (regulated jeep/bus safaris)	Limited / developing
Interpretation Facilities	Available & functional	Limited in many ranges
Revenue Generation	High and structured	Comparatively low
Community Participation	Moderate (EDCs active in MTR)	Limited but high potential
Carrying Capacity	Better regulated	Needs strengthening
Market Visibility	High (linked to Ooty circuit)	Low awareness outside region
Ecological Sensitivity	High (core tiger habitat)	High (elephant corridors)
Development Potential	Quality enhancement	Planned expansion opportunity

Major gaps in ecotourism across the NER differ between the Western and Eastern Ghats divisions.

In the **Western Ghats divisions**, including MTR and Nilgiris district, key gaps include over-dependence on safari-based tourism, seasonal visitor congestion, limited diversification of tourism products, and the need for stronger community ownership in tourism enterprises. There is also a growing requirement to enhance waste management, visitor regulation, and ecological impact monitoring to prevent overuse of sensitive habitats.

In the **Eastern Ghats divisions**, such as STR, Thanthai-Periyar WLS Erode, and Cauvery WLS, Dharmapuri & Hosur, major gaps include underdeveloped infrastructure, low market visibility, limited interpretation facilities, weak institutional capacity, and minimal community enterprise development. Carrying capacity assessments and structured tourism guidelines are also less established, indicating the need for planned and ecologically sensitive expansion.

While Western Ghats divisions require consolidation and impact management, Eastern Ghats divisions need foundational strengthening, infrastructure development, and community-centric planning to ensure balanced and sustainable ecotourism growth across NER.

5.2.5 Ecotourism Resources

The NER, spanning the Western and Eastern Ghats, is one of India's most ecologically diverse and culturally rich landscapes. Its ecotourism resources can be understood under natural attractions, cultural attractions, and eco-destination characteristics.

A. Natural Attractions

- *Forest Ecosystems:* NER encompasses diverse habitats including tropical evergreen forests, moist and dry deciduous forests, thorn forests, riparian systems, and montane grasslands. Landscapes within MTR and STR represent critical transition zones between the Western and Eastern Ghats, offering exceptional biodiversity.
- *Flagship Wildlife:* NER is renowned for Asian elephants, tigers, leopards, gaur, sloth bears, dholes, and rich birdlife. It is one of the largest contiguous elephant habitats in India, making wildlife viewing a major ecotourism attraction.
- *Elephant Corridors and Landscape Connectivity:* The reserve forms a crucial ecological corridor linking multiple protected areas across Tamil Nadu, Karnataka, and Kerala. The landscape-scale movement of elephants and other megafauna enhances its global conservation significance.
- *Scenic Landscapes and Topography:* The region features rolling hills, river valleys (Bhavani and Moyar rivers), waterfalls, grasslands, and panoramic viewpoints across Nilgiris and Eastern Ghats ranges, offering trekking and nature-based tourism opportunities.
- *Biodiversity Hotspot Value:* Being part of the Western Ghats biodiversity hotspot, NER supports endemic flora and fauna, rare medicinal plants, and unique ecological transitions, adding strong conservation tourism appeal.

B. Cultural Attractions

- *Indigenous Tribal Heritage:* NER is home to tribal communities such as Todas, Kotas, Kurumbas, Irulas, Kattunayakans, and Soligas. Their traditional lifestyles, handicrafts, pastoral systems, music, and sacred landscapes form important cultural tourism components (Tribal Eco-cultural village near Bannari Amman Koil, STR).
- *Traditional Ecological Knowledge:* Indigenous knowledge related to medicinal plants, honey collection, fire management, and wildlife behaviour enriches interpretive ecotourism experiences.
- *Cultural Landscapes:* Sacred groves, traditional settlements (*hattis*), and forest-linked rituals represent living cultural landscapes that complement natural attractions.
- *Local Handicrafts and Forest Produce:* Bamboo crafts, honey products, traditional textiles, and herbal products provide opportunities for community-based ecotourism enterprises.

C. Eco-destination Characteristics

- *Landscape-Scale Conservation Area:* NER is not a single park but a connected mosaic of protected areas, reserve forests, and corridors, offering a landscape-level ecotourism experience.
- *Wildlife-Centric Experience:* The reserve offers structured safari tourism (MTR), guided treks, elephant camps, and interpretation centres, positioning it as a wildlife-focused eco-destination.
- *Transition Zone Between Ghats:* NER uniquely connects Western & Eastern Ghats ecosystems, offering visitors contrasting forest types and ecological experiences within a single landscape.

- *Conservation Governance Framework:* Presence of tiger reserves, wildlife sanctuaries, and eco-development committees ensures regulated and conservation-oriented tourism management.
- *Potential for Community-Based Ecotourism:* With strong tribal presence and forest dependence, NER has high potential for CBET models integrating livelihood and conservation goals.
- *Accessibility and Tourism Circuits:* Proximity to major tourism hubs such as Ooty and Coimbatore enhances visitor access while allowing integration into broader eco-circuits.

These attributes make NER a high-value eco-destination capable of supporting conservation-driven, community-inclusive, & low-impact ecotourism development.

5.2.6 Ecological Concerns and Carrying Capacity

The NER, spanning landscapes such as MTR and STR, is ecologically sensitive due to its role as a major elephant habitat and wildlife corridor system. Ecotourism planning must therefore address ecological concerns and scientifically determine tourism carrying capacity.

Ecological concerns: Key concerns associated with the ecotourism development in NER include:

- *Wildlife Disturbance*: High safari vehicle density, noise, and uncontrolled visitor movement- particularly in sensitive zones of MTR and STR- can disrupt feeding, breeding, and resting behaviour of elephants, tigers, and other fauna.
- *Habitat Degradation*: Repeated trampling along trekking trails, off-road driving, and unregulated visitor movement can lead to soil compaction, trail erosion, vegetation damage, and long-term habitat alteration, particularly in fragile riparian and grassland ecosystems.
- *Elephant Corridor Sensitivity*: Tourism infrastructure, increased vehicular traffic, and night-time disturbances near movement routes may obstruct migratory paths and elevate the risk of road accidents involving wildlife.
- *Waste Generation & Pollution*: Improper disposal of plastic waste, food waste, and sewage may contaminate water sources, attract wildlife to human-use areas & alter natural behavior patterns.
- *Tourism Expansion*: Tourism expansion and growth near forest-fringe villages may also intensify human-wildlife conflict. Increased traffic and food availability can draw animals closer to human settlements, raising risks to both wildlife and communities.
- *Resource Consumption:* Ecotourism infrastructure, such as hotels, resorts, and transportation, can place a strain on local resources such as water, energy (Masinagudi area of MTR). Improper waste disposal and resource extraction can have long-term negative effects on the environment.
- *Seasonal Ecological Vulnerability*: During dry months, wildlife congregates around limited water sources, making them more susceptible to disturbance, while fire-prone seasons demand stricter regulation of visitor access and activities (Feb-March period closure of MTR / STR).

These ecological concerns highlight the need for regulated, science-based tourism planning to ensure that conservation objectives in NER are not compromised by increasing visitor pressure.

Tourism Carrying Capacity in the NER refers to the maximum number of visitors or vehicles that can be accommodated without causing ecological degradation, wildlife disturbance, or decline in visitor experience. It must be assessed separately for safari routes, trekking trails, viewpoints, camps, and interpretation centres.

A. Physical Carrying Capacity (PCC)

The first step is calculating Physical Carrying Capacity (PCC), which estimates the maximum number of visitors that can physically fit into a defined tourism area. It is based on the total usable area, the space required per visitor or vehicle, and the number of rotations or time slots available per day. For example, in safari zones, this may be expressed as the number of vehicles permitted per route per rotation multiplied by the number of rotations per day.

PCC = (A x R) / S

Where, (A = Total area available for tourism use (sq. m. or km)
R = Rotation factor (number of time slots per day)
S = Space required per visitor (or vehicle)

PCC for Safari Tourism (Vehicle-Based)

In safari routes of NER (e.g., in landscapes like MTR or STR), PCC is calculated based on:

Step 1: Determine Route Capacity:

- Assuming Safari route length = 20 km;
- Safe vehicle spacing = 1 km between vehicles.
- Therefore, maximum vehicles per route per rotation = 20 vehicles

Step 2: Determine Rotations per Day

- If: 3 safari slots per day (morning, mid-day, evening)
- Then PCC = 20 vehicles x 3 rotations = 60 vehicles per day
- If each vehicle carries 6 visitors, then PCC = 60 x 6 = 360 visitors per day

PCC for Trekking Trails

PCC = Trail Area x Rotations / Space per Visitor

- If trail length = 5 km & usable width = 2 m; then total usable area = 5,000 m × 2 m = 10,000 sq.m
- Space required per visitor = 10 sq.m and 2 trekking batches per day
- PCC = (10000 x 2) / 10 = 2000 visitors / day

(This number is purely physical and must later be reduced using ecological correction factors.)

PCC for Viewpoints / Interpretation Centres

PCC = (Area x Rotations) / Space per Visitor

- If Viewpoint platform area = 500 sq.m; Space per visitor = 5 sq.m; and 5 time slots per day
- PCC = (500 x 5) / 5 = 500 visitors / day

PCC for Eco-Lodge / Camp

PCC = Beds × Occupancy Cycles

- If nos. of rooms = 20; average occupancy = 2 persons/ room/ day
- PCC = 20 x 2 = 40 visitors / day

Key Considerations for NER

- PCC does not account for wildlife sensitivity or corridor disturbance. It only measures spatial and time-based capacity.
- In ecologically sensitive elephant corridors, real allowed capacity may be 40–70% lower after applying correction factors.
- Separate PCC must be calculated for each tourism node (Western vs Eastern Ghats divisions).
- Calculate PCC for Safari routes - Trekking trails - Camps & lodges - Viewpoints; and then convert PCC → Real Carrying Capacity (RCC) using ecological correction factors.

B. Real Carrying Capacity (PCC)

The next step is determining the Real Carrying Capacity (RCC), which adjusts the physical capacity using correction factors. These factors account for ecological sensitivity, seasonal restrictions, wildlife movement intensity, weather limitations, and corridor vulnerability. By multiplying the physical capacity by these ecological and management correction factors, the allowable number of visitors is reduced to a more realistic and sustainable level.

RCC = PCC x (Cf_1 x Cf_2 x Cf_3 x….. Cf_n)

Where Cf = Correction Factors (values between 0 and 1)

- *Wildlife Sensitivity Factor* (0.5-0.8) - disturbance to wildlife/ breeding habitats; lower value (core)
- *Corridor Sensitivity Factor* (0.4-0.9) - where tourism overlaps elephant movement routes.
- *Seasonal Factor* (0.6-0.9) lower during summer (water scarcity), fire season' breeding season
- *Habitat Fragility Factor* (0.5-0.8) - soil erosion risk, forest vulnerability, riparian disturbance
- *Management Capacity Factor* (0.7-0.9) - trained staff, enforcement strength, monitoring systems

RCC for Safari Zone (NER)

- Assume: PCC = 400 visitors/day and Cf: Wildlife sensitivity= 0.65; Corridor sensitivity= 0.70; Seasonal factor= 0.80; Management factor= 0.85
- RCC = 400 x (0.65 x 0.70 x 0.80 x 0.85) = 400 x 0.309 = 124 visitors / day

RCC for Trekking Zone (Eastern Ghats)

- Assume: PCC = 1,000 visitors/day; Cf: Soil fragility = 0.50; Wildlife disturbance = 0.75; and Fire season restriction = 0.80
- RCC = 1000 x (0.50 x 0.75 x 0.80) = 1000 x 0.30 = 300 visitors / day

Table-5.2: Recommended RCC Benchmarks for NER

Zone Type	RCC as % of PCC
Core Safari Zones	40-50%
Elephant Corridors	30-40%
Buffer Trek Zones	50-60%
Viewpoints	60-70%

Key Considerations for NER

- RCC must be calculated division-wise (Western vs Eastern Ghats).
- Seasonal adaptive limits should reduce visitor numbers by 20-30% during peak ecological stress.
- RCC should be reviewed annually using camera trap data; elephant movement data; vegetation monitoring; and visitor feedback
- Operational visitor limits may be set at the lowest ecological threshold identified, not at physical maximum capacity. This ensures protection of elephant corridors; reduced habitat stress; improved visitor experience; and long-term conservation sustainability

C. Ecological Carrying Capacity

Beyond this, Ecological Carrying Capacity considers wildlife density, breeding seasons, vegetation recovery rates, soil erosion thresholds, and proximity to sensitive habitats. Scientific inputs such as camera trap data, GPS tracking of elephants, habitat assessments, and seasonal ecological studies are used to ensure tourism does not interfere with core conservation objectives.

ECC = RCC x Ecological Threshold Factor or **ECC = PCC x (Ecological Sensitivity Index)**

Where the Ecological Sensitivity Index (ESI) ranges from 0.2-0.6 in highly sensitive landscapes

Key Ecological Parameters for NER

- *Wildlife Disturbance Threshold:* Maximum acceptable vehicle frequency near elephant herds; minimum buffer distance from breeding or nesting sites; and camera trap data showing behavioural avoidance (Example: If wildlife avoidance behaviour begins when vehicle density exceeds 15 vehicles per hour, then daily tourism must be adjusted accordingly).

- *Elephant Corridor Functionality:* Maintain minimum 1-2 km undisturbed stretch; and restrict tourism intensity in high-use corridors. Corridor ecological factor: 0.4-0.6

- *Vegetation & Soil Recovery Rate:* Dry deciduous forests with highest fragility (factor 0.5); moist forests with moderate fragility (factor 0.7); and riparian zones with very high sensitivity (factor 0.4)

- *Water Stress Factor:* During peak summer, reduce tourism by 20-30% due to wildlife congregation near water sources.

ECC for Safari Zone in NER

- Assume: PCC = 400 visitors/day and RCC = 150 visitor/day
- Ecological Parameters: Corridor factor = 0.6; Soil fragility = 0.7; Water stress (avg.) = 0.8
- ECC = 150 x (0.6 x 0.7 x 0.8) = 400 x 0.336 = 50 visitors / day

Though RCC allows 150 visitors/day, true ecological limit may be only ~50 visitors/day in sensitive zones

ECC for Trekking Zone (Eastern Ghats)

- Assume: PCC = 1,000 visitors/day; and RCC = 300 visitors/day
- Ecological sensitivity: Soil erosion threshold = 0.5; and Fire risk zone = 0.7
- ECC = 300 x (0.5 x 0.7) = 300 x 0.35 = 105 visitors / day

Table-5.3: Typical ECC Range in NER

Zone Type	ECC as % of PCC
Core Tiger Habitat	10-25%
Elephant Corridors	15-30%
Buffer Zones	30-45%
Designated Tourism Zones	40-60%

Data Required for Accurate ECC in NER: Camera trap-based wildlife disturbance studies; GPS telemetry of elephants; soil compaction measurements; vegetation trampling plots; fire risk mapping; and seasonal water availability data

Recommended ECC for NER:

- Core zones: ≤20% of PCC
- Corridor areas: ≤25-30% of PCC
- Buffer tourism areas: ≤40-50% of PCC
- Adaptive seasonal reduction: 20-30% during ecological stress months

D. Social Carrying Capacity

Finally, Social Carrying Capacity evaluates visitor satisfaction and community tolerance levels. It considers overcrowding, quality of experience, and the extent to which local communities are comfortable with tourism intensity. Together, these layers- physical, real, ecological, and social- provide a comprehensive framework for determining sustainable tourism limits in NER.

SCC is determined by three main dimensions:

- *Visitor Experience Threshold* - Level of crowding beyond which satisfaction declines.
- *Community Tolerance Threshold* - Level beyond which local residents feel negatively impacted.
- *Management Threshold* - Level at which facilities and staff can no longer maintain quality service.

The lowest threshold among these determines SCC.

SCC = RCC x Social Acceptability Index

Where Social Acceptability Index (SAI) is derived from field surveys and typically ranges from 0.4 to 0.8.

Methodology for Estimating SCC in NER envisages following steps:

Step 1: Visitor Perception Survey

- Measure: Perceived overcrowding (Likert scale 1-5); acceptable number of vehicles per safari; and satisfaction index
- Example: If 70% of visitors report crowding beyond 20 vehicles per safari route, then acceptable vehicle density may be capped at 20 even if RCC allows more.

Step 2: Community Tolerance Survey

- Indicators: Perceived increase in noise and disturbance; traffic congestion; waste issues; and cultural intrusion
- Example: If 60% of surveyed villages report disturbance beyond 150 visitors/day near settlements, then social cap may be 150.

Step 3: Infrastructure & Service Capacity

- Assess: Parking capacity; Toilet facilities; Guide availability; Waste disposal capacity
- If facilities can handle only 200 visitors/day efficiently, then SCC cannot exceed 200.

SCC for Safari Zone (NER)

- Assume: PCC = 400 visitors/day; and RCC = 150 visitors/day
- Visitor satisfaction survey indicates crowding threshold at 120 visitors/day.
- Community tolerance survey indicates disturbance threshold at 100 visitors/day
- SCC = Minimum (150/ 120/ 100) = 100 visitors/ day

SCC for Trekking Zone

- Assume: PCC = 1000 visitors/day; and RCC = 300 visitors/day
- Visitor comfortable threshold at 250 visitors/day; community tolerance at 200 visitors/day; and service capacity at 220 visitors/day
- SCC = Minimum (300/ 250/ 200/ 220) = 200 visitors/ day

Indicators for SCC Assessment in NER

Dimension	Indicators
Visitor Experience	Crowding index, noise perception, waiting time
Community Impact	Traffic, livelihood benefit perception, cultural disruption
Infrastructure	Waste load, sanitation capacity, parking limits
Safety	Accident frequency, wildlife encounter incidents

The representative benchmarks of SCC in the NER, (Table-5.4) is as under:

Table-5.4: Typical SCC Benchmarks in NER

Zone Type	SCC as % of RCC
Core Safari Zones	60-80%
Corridor Areas	50-70%
Buffer Trek Zones	70-85%
Community Tourism Sites	Based on village tolerance

Final visitor limit in NER: Final Allowable Visitors = Minimum (PCC, RCC, ECC, SCC)

5.2.7 Guiding principles

All ecotourism activities shall be in conformity with the prevailing laws including the NTCA & MoEFCC guidelines. The following guiding principles shall be the basis for development of ecotourism in the NER.

5.2.7.1 Planning for Conservation of Natural and Cultural Diversity

Planning for conservation of natural and cultural diversity in ecotourism development within the NER, covering landscapes such as MTR in Western Ghats and STR in Eastern Ghats must ensure that tourism strengthens biodiversity protection and cultural heritage rather than undermining them (Box-5.2).

As a critical elephant landscape and a region inhabited by indigenous communities, ecotourism planning must balance ecological sensitivity with social inclusion.

Box-5.2: Key Issues in Conservation of Natural and Cultural Diversity

Conservation of Natural Diversity

- *Habitat Protection & Zonation*: Conservation of natural diversity requires strict zonation of core, buffer, and tourism-use areas, with no infrastructure in elephant corridors or breeding habitats.
- *Wildlife-Sensitive Tourism Operations*: Envisages regulated safari operations, seasonal closures in sensitive zones, speed restrictions and noise control norms, and mandatory services of trained guides for trekking routes and nature trails.
- *Ecosystem-Based Management*: Erosion control on trails, riparian protection, and habitat restoration using native species are essential measures.
- *Climate and Fire Risk Integration*: Ecotourism plans should also integrate climate adaptation and fire-risk management strategies to reduce ecological stress.
- *Scientific monitoring:* Wildlife disturbance assessments using camera traps, vegetation and soil health monitoring, and periodic ecological audits should guide adaptive management. Tourism limits must be aligned with ecological carrying capacity assessments to prevent habitat degradation and wildlife disruption.

Conservation of Cultural Diversity

- *Protection of Indigenous Heritage*: Conservation of cultural diversity requires safeguarding tribal heritage, sacred sites, and traditional settlements.
- *Community Participation*: Tourism initiatives near indigenous communities must follow FPIC principles, avoid commercialization of sensitive practices, and respect intellectual property associated with TEK. Tribal representatives should be included in ecotourism planning bodies, and transparent revenue-sharing mechanisms should ensure that local villages benefit directly.
- *Promotion of Cultural Interpretation*: Promotion of authentic handicrafts, local guides, and culturally sensitive interpretation enhances both livelihoods and cultural pride.
- *Safeguards Against Cultural Erosion*: Includes visitor code of conduct in tribal areas, limits on photography, commercial exploitation and controlled group sizes in community-based tourism.

Integrated Planning Framework:

The proposed integrated planning framework envisaging key issues in conservation of natural and cultural diversity dwells on the following:

- *Landscape-Level Ecotourism Zoning:* Western Ghats divisions may consolidate and regulate high-footfall zone and; Eastern Ghats to develop low-impact, community-led tourism models.
- *Carrying Capacity-Based Development:* Base tourism limits on ecological and social carrying capacity assessments and use adaptive management for seasonal regulation.
- *Benefit-Sharing & Livelihood Integration:* Allocate a fixed percentage of tourism revenue to community development funds and link tourism income to HEC mitigation support.
- *Institutional Mechanisms:* Strengthen EDCs, establish NER-level Ecotourism Steering Committee and ensure convergence with tribal welfare and forest conservation programs.

By treating natural & cultural diversity as core assets, ecotourism in NER can function as a conservation tool that supports ecological integrity, cultural resilience and sustainable regional development.

5.2.7.2 Developing Sustainable / Community-based Ecotourism

Developing sustainable, community-based ecotourism in the NER requires a conservation-led and rights-based approach that empowers tribal and forest-fringe communities while safeguarding biodiversity. Ecotourism must function as a tool for livelihood enhancement, HEC reduction, and long-term ecological governance across landscapes such as MTR and STR (Box-5.3).

Box-5.3: Guiding Principles for Sustainable CBET Model

- *Guiding Principle*: The initiative should be guided by principles of conservation priority, community ownership, equitable benefit sharing, low-impact infrastructure, cultural respect, and adaptive management based on carrying capacity assessments. Tourism development must remain wildlife-sensitive and ecologically compatible.
- *Institutional Framework*: Institutionally, strengthening Gram Sabhas, EDC, and community cooperatives is essential. Transparent governance structures, financial accountability, and representation of women and youth in decision-making processes will ensure inclusive and sustainable management.
- *Livelihood Components*: Includes eco-guiding, homestays, handicrafts, value-added forest produce enterprises, and culturally sensitive tourism experiences. Training and skill development in hospitality, marketing, and enterprise management are critical for long-term viability.
- *Infrastructure Development*: This must follow eco-friendly principles, including renewable energy use, waste management systems, minimal land alteration, and strict avoidance of elephant corridors and sensitive habitats.
- *Financial Model*: A clear financial model with defined revenue-sharing mechanisms should allocate a significant portion of tourism income to community development funds and habitat restoration efforts. Diversified funding sources, including government schemes and conservation grants, can enhance sustainability.
- *Carrying Capacity Assessments*: covering physical, ecological, and social dimensions- should guide visitor limits and seasonal regulation.
- *Monitoring & Evaluation*: Continuous monitoring of ecological indicators, visitor satisfaction, and community income levels is necessary for adaptive management.

Sustainable community-based ecotourism in NER: should enhance local livelihoods, strengthen conservation partnerships, reduce ecological pressures, and promote balanced tourism growth while preserving the natural and cultural diversity of the NER.

All ecotourism initiatives to be developed under the auspices of community institutions, usually EDCs (in and around PAs) or VFCs (in forest divisions) supplemented with SHGs. These institutions may be registered under the Societies Registration Act as ETMCs.

Sustainable community-based ecotourism in NER should function as a conservation-financing and livelihood-enhancement tool, ensuring that tourism strengthens ecological resilience, protects elephant corridors, and empowers indigenous communities as long-term conservation partners.

5.2.7.3 Community Participation

Community participation is central to the success of community-based ecotourism in the NER. In landscapes such as MTR & STR, meaningful involvement of tribal and forest-fringe communities ensures that ecotourism supports both livelihood enhancement and conservation objectives (Box-5.4).

Box-5.4: Measures and Approaches for Community Participation

- Participation may begin at the planning stage, with Gram Sabha & community representatives actively involved in decision-making, micro-planning, and approval of tourism initiatives.
- Village level groups like Eco tourism management committee (ETMC) and self-help groups may be formed to manage tourist services introduced or to produce the handicraft items etc.
- Communities should play a direct role in implementation by managing eco-guiding services, homestays, handicraft production, trekking operations, and interpretation programmes.
- Local youth and women's Self-Help Groups can be empowered to lead tourism enterprises, ensuring inclusive and diversified economic participation.
- Transparent revenue-sharing mechanisms are essential. A defined share of tourism income should support community funds, wage employment, and local infrastructure development.
- Capacity building is necessary to strengthen community participation. Training in hospitality, wildlife safety, enterprise management, and digital marketing enhances professionalism.
- Community involvement should also extend to conservation governance, including habitat restoration, HEC mitigation, waste management, and monitoring support.

Effective community participation in ecotourism within NER strengthens livelihoods, reinforces cultural identity, promotes equitable development, and facilitates long-term ecological governance across NER.

5.2.7.4 Building Infrastructural Support

Building infrastructural support for ecotourism in the NER must follow a conservation-oriented and low-impact approach. Infrastructure development should enhance visitor management and community livelihoods without disturbing wildlife habitats or elephant corridors (Box-5.5).

Box-5.5: Infrastructural Planning and Requirements in NER

- *Zonation-Based Infrastructure Planning*: Core zones should have no permanent tourism structures, buffer zones may support limited eco-trails and interpretation centres, and community or fringe zones can accommodate homestays and small tourism facilities.
- *Eco-Friendly Construction Principles*: Use of sustainable local materials, renewable energy systems, rainwater harvesting, and modular designs ensure reduced ecological footprint.
- *Visitor Management Facilities*: Facilities such as regulated safari routes, digital ticketing, controlled parking areas, and clear signage help manage tourism pressure.
- *Interpretation and Education Infrastructure*: Nature interpretation centres & trained eco-guides, enhances conservation awareness and promotes responsible tourism behavior among visitors.
- *Community-Based Infrastructure*: Homestays, training centres, handicraft units, and tourism information kiosks ensures local economic participation and equitable benefit sharing.
- *Waste and Sanitation Systems*: Effective waste management systems, zero-plastic policies, sanitation facilities, regular monitoring are necessary to prevent environmental degradation.
- *Safety & Emergency Systems*: Safety infrastructure, including first-aid facilities, communication systems, and fire management mechanisms, strengthens resilience in remote tourism areas.

Infrastructure in NER must remain minimal, wildlife-sensitive & community-inclusive, ensuring ecotourism development supports conservation goals while providing sustainable socio-economic benefits.

5.2.7.5 Partnership and Multi-Stakeholders approach

Given the ecological sensitivity of the landscape and the presence of tribal communities, coordinated collaboration among government agencies, local communities, private sector, civil society, and research institutions is necessary to balance conservation and development goals (Box-5.6).

Box-5.6: Role of Stakeholders in the NER

- *Role of Forest Department*: The Forest Department plays a central regulatory role by determining zonation, enforcing carrying capacity limits, safeguarding wildlife corridors, approving infrastructure, and ensuring compliance with conservation guidelines.
- *Role of Local Communities*: Their participation in managing homestays, eco-guiding, and local enterprises, along with representation in decision-making bodies, strengthens ownership and long-term conservation support.
- *Role of Local Governance Institutions*: District administrations, Panchayats, and Gram Sabhas contribute by convergence with schemes, supporting infrastructure, & addressing grievances.
- *Role of Private Sector*: Responsible private sector participation can provide investment, marketing expertise, hospitality management skills, and CSR funding.
- *Role of NGOs and Civil Society*: They support community mobilization, capacity building, enterprise development, and independent monitoring of social and environmental impacts.
- *Role of Academic & Research Institutions*: They contribute scientific inputs, including carrying capacity studies, ecological monitoring, and adaptive management recommendations.

A structured multi-stakeholder framework with clearly defined roles, can enable ecotourism in NER to function as a sustainable tool for conservation financing and community empowerment.

5.2.7.6 Creating Awareness & Capacity Building

In ecologically sensitive areas, informed stakeholders and trained personnel are critical to balancing conservation goals with livelihood opportunities (Box-5.7).

Box-5.7: Measures for Creating Awareness & Capacity Building in NER

- *Awareness among local communities* should focus on principles of sustainable tourism, wildlife conservation, elephant corridor sensitivity, and responsible visitor management.
- *Visitor awareness* through orientation briefings, interpretation centres, digital outreach can promote responsible behavior, minimize ecological disturbance, and enhance appreciation of biodiversity and tribal heritage.
- *Capacity building for community enterprises* should include training in eco-guiding, hospitality management, financial literacy, marketing, digital payments, and wildlife safety protocols. Empowering youth and women's Self-Help Groups enhances inclusive economic participation.
- *Forest & administrative staff* also require continuous training in visitor management, ecological monitoring, carrying capacity implementation, conflict resolution, and digital tourism systems.
- *Environmental education and school outreach programs* can facilitate conservation values among young people, creating future leaders and eco-guides.
- *Collaboration with NGOs, research institutions*, and other ecotourism models can support knowledge exchange and skill enhancement.

Systematic awareness creation and capacity building in NER will strengthen community ownership, improve service quality, enhance conservation compliance, and ensure that ecotourism evolves as a sustainable and professionally managed development model across the landscape.

5.2.7.7 Building Framework of Standards and Norms

Building a framework of standards and norms for ecotourism development is essential to ensure that tourism remains conservation-driven, regulated, and socially inclusive. In ecologically sensitive area, clear and uniform standards help prevent habitat disturbance and unregulated expansion (Box-5.8).

Box-5.8: Framework of Standards and Norms for NER

- *Conservation-centric standards* should include strict zonation, prohibition of infrastructure in elephant corridors and breeding habitats, seasonal restrictions in sensitive periods, and compliance with wildlife and forest laws. All tourism initiatives should align with approved management plans and undergo ecological screening.
- *Carrying capacity norms* must be central to the framework. Physical, real, ecological, and social carrying capacities should be calculated before approving tourism activities, and visitor numbers should be capped based on the most restrictive threshold. Annual reviews and digital visitor management systems can help maintain sustainable limits.
- *Infrastructure standards* should emphasize eco-friendly construction, renewable energy use, water conservation, waste management systems, and modular designs that minimize environmental impact. Zero-plastic policies and responsible site planning are critical components.
- *Community participation norms* should ensure representation of tribal communities in planning bodies, transparent revenue-sharing arrangements, priority employment for local residents, and adherence to Free, Prior and Informed Consent (FPIC) principles for tourism projects near settlements.
- *Operational standards* must regulate guide certification, vehicle speed limits, visitor conduct, safety protocols, and emergency preparedness. These norms help protect wildlife and ensure visitor safety and service quality.
- *Financial and governance norms* should mandate transparent accounting, annual audits, allocation of tourism revenue for conservation and community welfare, and regular multi-stakeholder reviews. Monitoring and compliance mechanisms, including ecological audits and grievance redress systems, strengthen accountability.

A structured standards framework ensures that ecotourism in NER operates as a science-based, community-cantered, and conservation-oriented model that safeguards biodiversity while promoting sustainable development.

5.2.8 The Strategies

The strategy may be in conformity with the guiding principles and is a means to achieve the objectives.

5.2.8.1 Identification of Ecotourism Zone and Zonation

Zonation, a management entity, allows a science-based and pragmatic approach to landscape level planning for conservation. Identifying an ecotourism zone involves a systematic assessment of natural, cultural, and recreational attributes to determine if an area has the potential for sustainable tourism development (Box-5.9).

Box-5.9: Key Aspects in the Zonation Identification Process

- *Biodiversity Assessment:* Evaluate the area's biodiversity, including plant and animal species, ecosystems, and unique natural features which can indicate ecotourism potential.
- *Landscape Features:* Assess the scenic beauty, geological formations, and other natural features that could attract visitors interested in nature-based experiences.
- *Cultural Heritage Assessment:* Sites with archaeological importance, traditional knowledge, or cultural practices may add value to the ecotourism experience.
- *Local Communities:* Assess the relationship between the area and local communities, including their traditions, lifestyles, and willingness to participate in ecotourism initiatives.
- *Accessibility:* Evaluate the ease of access to the area, considering transportation options and existing infrastructure. Accessible locations are more likely to attract visitors & support tourism.
- *Existing Infrastructure:* Examine the availability of infrastructure such as trails, accommodation, and visitor centres. Adequate infrastructure is essential for managing visitor flow.
- *Market Demand:* Analyse the market demand for ecotourism experiences in the region. Assess whether there is a potential market interested in nature-based, sustainable tourism activities.
- *Local Interest:* Examine the interest and support for ecotourism among local communities, businesses, and government authorities.
- *Land Use Planning:* Review existing land use, zoning regulations and identify areas with conservation value & potential for low-impact recreational activities/ ecotourism development.
- *EIA:* Conduct a thorough EIA to understand the potential effects of tourism on the ecosystem and identification of sensitive areas and development of sustainable management practices.
- *Community Consultation:* Engage with local communities, and other stakeholders to gather insights, address concerns, and ensure that the identification process is inclusive.
- *Economic Viability:* Assess the economic feasibility of ecotourism development and consider potential economic benefits, job creation, and revenue generation for local communities.

Criteria for Identifying Ecotourism Zones in NER: Identification must be based on ecological sensitivity, wildlife movement patterns, community presence, and carrying capacity assessments and envisages conservation-first approach; protection of elephant corridors and breeding habitats; avoidance of fragmentation in core wildlife zones; integration with Forest Working Plans and Tiger Conservation/ Protected Area Management Plans; and alignment with carrying capacity limits (PCC, RCC, ECC, SCC).

Criteria envisaged in respect of NER area as under:

- Distance from elephant corridors (minimum ecological buffer).
- Wildlife density and seasonal movement patterns.
- Soil erosion and habitat fragility assessment.
- Accessibility without habitat fragmentation.
- Community consent and participation.
- Infrastructure feasibility without ecological damage.

GIS-based mapping and wildlife telemetry data should guide final zone demarcation.

Western Ghats divisions (Mudumalai region) require stricter visitor regulation due to higher footfall and core habitat sensitivity whereas Eastern Ghats divisions (Sathyamangalam region) may allow controlled expansion in designated buffer and community zones, subject to corridor protection safeguards.

Proposed Zonation Framework for NER

The proposed zonation framework (Table-5.5) provides the characteristic features of various zones.

Table-5.5: Proposed Ecotourism Zonation of NER

Zone	Purpose	Characteristic Features	Remarks
Core Conservation Zone	Strict biodiversity protection	• Includes critical tiger habitat, elephant breeding areas, & high wildlife-use zones. • No permanent tourism infrastructure. • Only regulated safari routes permitted under management plans. • Strict visitor caps and seasonal closures.	This zone primarily overlaps with notified core areas of tiger reserves & wildlife sanctuaries.
Buffer Ecotourism Zone	Controlled nature-based tourism	• Located in buffer areas of protected region • *Activities*: guided trekking, safari routes, birdwatching, interpretation centres. • Limited eco-friendly infrastructure allowed. • Adherence to ecological carrying capacity.	This zone distributes visitor pressure away from core habitats.
Community-Based Ecotourism Zone	Livelihood-focused, conservation-compatible tourism	• Located in forest-fringe villages and revenue lands adjoining reserve forests. • *Activities*: homestays, cultural tourism, handicraft, NTFP-based enterprises. • Managed by Gram Sabhas and EDCs. • Revenue-sharing mechanisms in place.	The zone promotes community participation and reduces dependency on forest extraction.
Eco-Restoration & Conservation Education Zone	Environmental awareness and habitat improvement	• Degraded forest patches designated for restoration-linked tourism. • Nature camps, student eco-trails. • Demonstration sites for native species restoration.	The zone primarily promotes habitat restoration and serves as an education platform.

The Core zone lies in the Elephant Conservation Zone where limited or low-impact tourism is allowed (10% of the area as per NTCA guidelines) till the development of ecotourism facilities and infrastructure in the buffer zone. Whereas Buffer zone lies in the Elephant Human Co-existence Zone, which acts as a protective barrier to minimize human impact on the core area and infrastructure and visitor facilities are generally located in this zone.

5.2.8.2 Constitution of Ecotourism Management Societies/ Committees

- At the Division level, Ecotourism Management Societies (ETMS) may be established to promote, manage and regulate ecotourism sites through constitution of Ecotourism Management Committees (ETMC). The revenue generated from the ecotourism site in the Division may be ploughed back for development of the site and surplus may be used for the development of other sites and conservation related activities.
- The existing ETMCs may be integrated into the ecotourism federation at NER level. The federation may facilitate the development of ecotourism by implementation of the ecotourism guidelines and ecotourism plan, coordinate with other stakeholders and monitor the allocation of funds and revenue generation.

5.2.8.3 Development of Ecotourism Management Plan in Elephant Reserve

A management plan may be developed for Ecotourism site / destination in the Elephant Reserve, with detailed SWOT analysis, maintaining a fine balance between conservation and tourism. Besides, the

Ecotourism Plan may be made an integral part of the Management Plan of respective Protected Areas. In case of any conflict, the conservation of Protected Areas, Forests and Wildlife shall take precedence over ecotourism. For sites outside Protected Areas all ecotourism plans shall be in line with the prescriptions stated in the Working Plan.

A- Ecotourism in Tiger Reserves (MTR & STR)

In the Tiger Reserve, ecotourism development will be in conformity with the NTCA guidelines in F.No 15-31/2012-NTCA dated 15th October 2012 notified under section 38-O (1) (c) of the Wildlife (Protection) Act, 1972. These guidelines have distinct procedure for management of ecotourism and form part of approved Tiger Conservation Plan of the Tiger Reserves.

- Proposed strategy /activities to be undertaken should have minimal impact on the wildlife and its habitat, while generating sustainable benefits to the local communities in the fringe areas. All stake holders in and around Tiger Reserves (residing within the Zone of influence) would be involved in Eco tourism activities.
- The Tiger Conservation Foundation (TCF), established in the tiger reserves (MTR & STR) as per provisions of the Wildlife Protection (1972) Act, would be the sole organisation that would manage ecotourism infrastructure and running related facilities and gate receipts / income generated through the ecotourism activities, would be utilised for the specific conservation purposes.
- The Tiger Reserve shall have a Local Advisory Community (LAC), duly constituted by the State Government, for the purpose of advising State Government on issues concerning ecotourism, monitoring carrying capacity and facilities in the Tiger Reserve.
- Existing rights to visitations of the various places of worship located in the tiger reserves and the buffer areas would be recognized and regulated through the provisions as approved in the TCP, along with sharing of revenue generated through temple tourism with local communities.
- Tourism Plan for each Tiger Reserve shall identify and monitor the ecologically sensitive areas surrounding tiger reserves, in order to ensure the ecological integrity of corridor and buffer areas; assess carrying capacity of the tiger reserve, at three levels; physical, real and effective and permissible carrying capacity of visitors and vehicles as well as residential facilities in and around the tiger reserve; area to be designated as 'ecotourism zone'; develop a participatory community-based tourism strategy to ensure long-term local-community benefit-sharing, and promotion of activities run by local communities; develop monitoring mechanisms to assess impact of tourism activities on the wildlife and its habitat so as to minimise them; develop generic guidelines for environmentally acceptable and culturally appropriate practices for all new constructions; set up lists of Do's and Don'ts for visitors.
- It should be the endeavour of Tiger Reserve to shift maximum tourism activities out of Core area to Buffer area. Foundation would be the coordinating agency over organised ecotourism in Buffer areas of Tiger Reserves which involves private tour operators, tribal communities, and hospitality industry: latter shall get approval for their tourism activities from respective Foundation, which should be in line with these guidelines.
- Tourism activities should not be permitted along identified Corridors, so that, dispersal of tigers, movement of elephants and other wildlife is not hindered.
- Non-consumptive regulated, low-impact tourism, could be permitted within core or critical tiger habitat (CTH) without in any way compromising the spirit of core/critical tiger habitat for tiger conservation to a maximum of 20% of the core or critical tiger habitat usage (not exceeding the present usage).
- All facilities functioning within Core areas shall be administered only by the respective Tiger Reserve management. No core area in a tiger reserve from which relocation has been carried out, shall in any way be used for tourism infrastructure ('vayals' in MTR).

- All tourism facilities located within the eco-sensitive zone in the context of the tiger reserve shall adhere to pollution norms (noise, solid waste, air and water) under the respective laws or rules for the time being in force. Outdoor high intensity illumination shall not be utilized as it disturbs nocturnal habits of wild animals. The use of battery-operated vehicles may be encouraged to minimize pollution wherever terrain permits.
- Tourism infrastructure must conform to environment-friendly, low-impact, low height aesthetic architecture; renewable including solar energy, waste recycling, water management, natural cross-ventilation, no use of asbestos, discharge of only treated sewage, no air pollution, minimal outdoor lighting, and merging with the surrounding landscape.

B- Ecotourism in Protected Areas (Thanthai-Periyar WLS, Erode; Cauvery North & South WLS)

- As per Sec 33 (a) of the Wildlife Protection Act 1972, the Chief Wild Life Warden shall be the authority who shall control, manage and maintain all sanctuaries and for that purpose, within the limits of any sanctuary, may construct such roads, bridges, buildings, fences or barrier gates, and carry out such other works as he may consider necessary for the purposes of such sanctuary; provided that no construction of commercial tourist lodges, hotels, zoos and safari parks shall be undertaken inside a sanctuary except with the prior approval of the National Board.
- Each Wildlife Sanctuary shall have an Advisory Committee (AC), duly constituted by the State Government under the provisions of section-33(B) of the Wildlife Protection Act, 1972 for the purpose of advising on measures to be taken for better conservation and management of the sanctuary including participation of the people living in and around the sanctuary. Rendering advice on Ecotourism, monitoring the carrying capacity and creation of various facilities comes under the purview of the Advisory Committee.
- Ecotourism activities to be undertaken would be subject to the sanction of a specific ecotourism plan forming part of approved Management Plan of the Protected Areas or otherwise exclusive Ecotourism Plan.
- As suggested in respect of Tiger Reserve, tourism zone needs to be delineated for the Protected Area and all prescriptions relevant for the Tiger Reserve are also applicable in respect of the Protected Area.

C- Ecotourism in Forest Divisions (Nilgiris, Gudalur, Dharmapuri & Hosur divisions)

- As per the Explanation of Sec 2 (1) (b) (vi) & (vii) of the Forest Conservation (Amendment) Act 2023, establishment of zoo and safaris referred to in the Wild Life (Protection) Act, 1972, owned by the Government or any authority, in forest areas other than protected areas; and ecotourism facilities included in the Forest Working Plan or Wildlife Management Plan or Tiger Conservation Plan or Working Scheme of that area are works relating to or ancillary to conservation, development and management of forests and wildlife and therefore do not attract FCA.
- Ecotourism activities to be undertaken would be subject to the sanction of a specific ecotourism plan forming part of approved Working Plan of the Forest division or otherwise exclusive Ecotourism Plan.
- Unlike Tiger Reserve or Protected Area, here focus could be more on the development of community-based ecotourism (CBET) and all tourism prescriptions relevant for the Tiger Reserve/ Protected Area could also be made applicable here.
- CBET is characterized by small scale outfits in relatively remote scenic locations with rich landscapes where the mass tourism is not established. The visitors generally stay in the few eco lodges available or with the local families if the practice of home stay exits (Aiyur site @ Hosur)
- In CBET, the local communities are the care takers of the local environment. They organize accommodation for visitors, provide necessary services such as vehicles, boats for transportation, organize walking trails, prepare local foods, and produce unique handicraft items

for the visitors to sell as souvenirs, organize shows of traditional performing arts. This active participation ensures that the profits/benefits stay with the local communities.

- It is emphasized that if tribal communities reside in the area, they may be encouraged and supported in participating process and share responsibilities in the management of eco-tourism activities. By sharing their knowledge about the local terrain, ecology, and cultural practices with the visitors, the communities develop a sense of pride and respect to their culture.

5.2.8.4 Infrastructure Development and Visitor Services

Infrastructure development and visitor services for ecotourism in the NER must be conservation-oriented, low-impact, and aligned with zonation and carrying capacity principles (Box-5.10).

Box-5.10: Guidelines for Infrastructure Development including Visitor Services in NER

- *Zonation-based Development*: Infrastructure planning should follow a zonation-based approach. Core zones should avoid permanent tourism structures, buffer zones may accommodate eco-trails and limited facilities, and community or fringe zones can host homestays and small tourism enterprises. All infrastructure must be located away from sensitive habitats and wildlife movement routes.
- *Eco-Friendly Design Standards*: Use of sustainable materials in construction of lodges, renewable energy systems, rainwater harvesting, waste treatment, and modular designs helps minimize ecological impact while maintaining functionality and visitor comfort.
- *Sustainable Transport Infrastructure*: Designated routes with speed restrictions; controlled vehicle entry and parking zones outside core habitats; transition to electric safari vehicles; and defined trekking circuits to prevent habitat fragmentation minimizes impact on the habitat.
- *Visitor Services Framework*: Visitor services should include regulated entry and digital ticketing systems, visitor / interpretation centre, certified eco-guides, orientation briefings, and multilingual educational materials. These services enhance conservation awareness and ensure safe, organized tourism experiences.
- *Basic Amenities and Comfort Facilities*: Basic amenities such as clean drinking water, rest room and sanitation facilities, rest shelters, catering facilities and emergency response systems are necessary to maintain visitor comfort and safety while reducing environmental degradation.
- *Waste and Environmental Management*: Effective waste management systems, including zero-plastic policies, waste segregation, and regular monitoring, are crucial to prevent pollution and protect wildlife habitats.
- *Monitoring and Maintenance*: Regular monitoring, ecological audits, visitor feedback systems, and maintenance funding from tourism revenue are necessary to ensure infrastructure remains sustainable and aligned with the conservation objectives.

Well-planned infrastructure and visitor services in NER should enhance visitor experience, generate sustainable livelihoods, and strengthen conservation outcomes, while ensuring that ecological integrity and elephant corridor functionality remain uncompromised across the Nilgiri landscape.

5.2.8.5 Interpretation and Education Facilities

Interpretation and education facilities play a vital role in strengthening ecotourism in the NER by promoting conservation awareness and responsible visitor behaviour (Box-5.11).

Box-5.11: Developing Interpretation Facilities in NER

- *Nature interpretation centres* at major entry points should provide exhibits on elephant ecology, forest biodiversity, wildlife corridors, and tribal heritage. Interactive displays, audio-visual presentations, multilingual materials can improve visitor understanding of conservation values.
- *Guided interpretation services* are essential, with trained eco-guides leading safaris and treks while integrating traditional ecological knowledge. Thematic trails focused on birdlife, medicinal plants, or elephant habitats can enrich educational experiences.
- *Visitor orientation programs* should be mandatory before tourism activities, covering wildlife safety, speed regulations, waste management norms, and respect for local communities. Clear communication helps reduce ecological disturbance.
- *Educational outreach initiatives* like school eco-clubs, nature camps, citizen science programs, volunteer opportunities can facilitate long-term conservation awareness among youth/ visitors.
- *Interpretive signage* along trails, including digital QR-based information systems, helps educate visitors while reducing off-trail movement and habitat damage.
- *Cultural interpretation facilities* managed by communities can showcase tribal art, crafts, and traditional practices in a respectful manner, ensuring cultural preservation without commercialization of sacred elements (Tribal eco-village @ Bannari Amman Koil, STR).

Overall, strong interpretation and education facilities transform ecotourism in NER into a conservation learning platform that enhances awareness, strengthens community participation, and supports sustainable management of the Nilgiri landscape.

5.2.8.6 Organizational Strategy and Institutional Arrangements

An effective organizational strategy for ecotourism development in the NER must be conservation-driven and community-cantered and may envisage as under:

- *Vision and Strategic Direction*: The organizational strategy should adopt a conservation-first, community-centered model, where ecotourism serves as a tool for biodiversity protection, livelihood enhancement, and human–wildlife conflict mitigation. All institutional arrangements must align with approved management plans and carrying capacity limits.
- *Nodal Authority*: The Forest Department should act as the nodal authority responsible for zonation, infrastructure approval, visitor regulation, and ecological monitoring. Its role is central in aligning ecotourism initiatives with wildlife protection laws and approved management plans.
- *Ecotourism Steering Committee*: A multi-stakeholder Ecotourism Steering Committee at the NER level can provide policy guidance and coordination across divisions. Representation from forest officials, tribal communities, district administration, tourism departments, NGOs, and research institutions ensures inclusive and balanced decision-making.
- *Division-Level Ecotourism Committees*: At the operational level, division-wise ecotourism committees should oversee site-specific planning, implementation, visitor management, and revenue tracking. Coordination with the NER-level committee, strengthens accountability.
- *Community Institutions*: Community institutions such as EDCs/ VFCs/ ETMCs should play a central role in managing community-based tourism enterprises, supported by transparent revenue-sharing arrangements and participatory planning.
- *Public–Private Partnerships (PPP)*: Where appropriate, public–private partnerships may be adopted under strict ecological guidelines and clear contractual obligations to ensure conservation compliance and financial transparency
- *Financial Management Framework*: A dedicated financial management system, including an Ecotourism Fund with fixed allocations for conservation and community welfare, should be established, supported by annual audits and public disclosure.

A structured governance framework with clearly defined roles, transparency mechanisms, & stakeholder participation will ensure that ecotourism in NER contributes to sustainable regional development.

5.2.8.7 Product Development, Promotion, Publicity & Marketing

Product development, promotion, publicity, and marketing of ecotourism in the NER should be aligned with conservation priorities, carrying capacity limits and tourism promotion must emphasize sustainability rather than volume (Box-5.12).

Box-5.12: Product Development Strategy and Promotion in NER

- *Product Development Strategy*: Ecotourism products should be diversified and experience-based, including regulated wildlife safaris, guided treks, birdwatching trails, elephant corridor awareness tours, community homestays, cultural experiences, and conservation volunteering programs. Zonation-based differentiation between core wildlife tourism and community-based tourism in buffer areas is essential.
- *Branding and Positioning*: Branding should position NER as a premier elephant landscape and a unique ecological transition zone between the Western and Eastern Ghats, highlighting conservation values, authenticity, and responsible travel. The brand identity should reflect community participation and ecological integrity.
- *Promotion Strategy*: Promotion strategies should prioritize quality tourism through official digital platforms, social media storytelling, collaboration with eco-tour operators, conservation documentaries, and participation in tourism fairs. All promotional material must incorporate responsible tourism messaging.
- *Publicity and Awareness Campaigns*: Campaigns should focus on responsible visitor behavior, zero-plastic initiatives, wildlife-sensitive travel norms, and showcasing community success stories. Awareness outreach to schools and colleges can build long-term conservation support.
- *Market Segmentation*: Market segmentation should target wildlife enthusiasts, nature education groups, responsible domestic travellers, international eco-tourists, and student volunteers, while avoiding mass tourism segments that could strain ecological limits.
- *Community Branding and Local Products*: Community branding and certification of local products such as honey, bamboo crafts, and herbal goods can enhance income opportunities and strengthen the identity of “NER Community Ecotourism.”
- *Digital Integration*: Digital integration through centralized booking systems, visitor caps linked to carrying capacity, and mobile-based information services can improve visitor management.

Marketing efforts in NER should promote high-quality, conservation-oriented experiences that enhance local livelihoods while maintaining ecological sustainability and reinforcing the reserve’s identity as a responsible ecotourism destination.

5.2.8.8 Training and Capacity Building

Training and capacity building are fundamental to ensuring that ecotourism in NER is professionally managed, conservation-oriented, and community-driven. Skilled personnel and informed stakeholders are essential for balancing tourism growth with biodiversity protection.

- *Skill Development of Communities*: Capacity building should prioritize local tribal and forest-fringe communities, equipping them with skills in eco-guiding, hospitality management, interpretation techniques, and visitor handling. Training in financial literacy, digital payments, and marketing can strengthen community-based enterprises and ensure long-term economic sustainability.
- *Empowering Youth & Women’s SHGs*: Special attention should be given to empowering youth and women’s SHGs through entrepreneurship training and leadership. Exposure visits to

successful community-based ecotourism models can enhance confidence/ broaden perspectives.

- *Training to Forest Personnel*: Forest staff also require professional training in visitor management, carrying capacity implementation, conflict resolution, ecological monitoring, and digital ticketing systems. This strengthens institutional governance and improves service standards.
- *Thematic Training*: Structured training modules should cover wildlife behaviour, human–wildlife conflict mitigation, first-aid and emergency response, waste management practices, and responsible tourism norms. Certification of eco-guides and service providers can improve quality assurance and visitor confidence.
- *Educational Outreach*: Educational outreach through nature camps, eco-clubs, and conservation workshops can build long-term awareness among students and local youth, creating a pipeline of future eco-guides and conservation ambassadors.
- *Partnerships*: Partnerships with NGOs, research institutions, and tourism experts can support curriculum development, technical training, and periodic skill upgradation programs. Monitoring and evaluation of training outcomes- through performance assessments and income tracking- ensure that capacity-building efforts translate into tangible improvements.

Systematic training and capacity building in NER strengthen community participation, enhance visitor experience, improve conservation compliance, and contribute to the sustainable growth of ecotourism.

5.2.9 Participatory Assessment and Impacts of Intervention

The impacts of interventions in ecotourism can be both positive and negative (Box-5.13), and assessing them is essential for sustainable development.

Box-5.13: Positive and Negative Impacts of Intervention

- *Positive Impacts:* Ecotourism can contribute to the conservation of natural habitats and wildlife by creating economic incentives for their protection; Local communities can benefit from increased employment, income, and business opportunities; and ecotourism can support the preservation of local cultures and traditions by showcasing them to visitors.
- *Negative Impacts:* Increased human activity may lead to habitat disturbance and impact wildlife behaviour, breeding, and feeding patterns; popular destinations may experience overcrowding, resulting in environmental degradation & diminished visitor experience; over-commercialization and cultural insensitivity can contribute to the erosion of local cultures and traditions; littering or disturbing wildlife, can have negative consequences and contributes to carbon footprint; un-planned construction can lead to habitat fragmentation, and other environmental stressors.
- *Long-Term Sustainability:* Local communities may become overly dependent on tourism, making them vulnerable to fluctuations in visitor numbers or other external factors.

In ecologically sensitive landscapes, inclusive and transparent assessment helps ensure that tourism supports conservation goals while benefiting local communities.

- *Purpose of Participatory Assessment*: Participatory assessment ensures that local communities, forest officials, tourism operators, and other stakeholders jointly evaluate the outcomes of ecotourism initiatives. It helps determine whether tourism is contributing to conservation goals, livelihood enhancement, and social equity, while identifying unintended negative impacts.
- *Ecological Impact Assessment*: Ecological impact assessment focuses on monitoring wildlife disturbance, habitat degradation, soil erosion, waste accumulation, and changes in vegetation. Community-based monitoring, supported by tools such as camera traps and periodic ecological audits, helps identify early signs of environmental stress.
- *Socio-Economic Impact Assessment*: Socio-economic assessment examines changes in household income, employment opportunities, benefit distribution, and impacts on traditional livelihoods. Participatory tools such as household surveys, focus group discussions, and Gram Sabha consultations ensure that tourism benefits are equitable and culturally appropriate.

- *Social & Cultural Impacts*: Social and cultural impact assessment evaluates community tolerance levels, effects on cultural identity and traditions, gender participation, and changes in social cohesion. This helps prevent cultural erosion and social imbalance.
- *Environmental Carrying Capacity Compliance*: Participatory monitoring also ensures compliance with physical, ecological, and social carrying capacity limits. Exceeding these thresholds should trigger adaptive management measures such as visitor caps or infrastructure adjustments.

Overall, participatory assessment strengthens transparency, improves benefit-sharing equity, enables adaptive management, and ensures that ecotourism interventions remain conservation-oriented and socially inclusive across the NER landscape.

5.3. ECODEVELOPMENT AND LIVELIHOOD IMPROVEMENT

Ecodevelopment and livelihood improvement refer to approaches that integrate conservation and sustainable development, aiming to enhance both environmental protection and the well-being of local communities. This approach recognizes the interdependence of ecological health and human welfare.

By promoting sustainable practices, community involvement, and economic diversification, these approaches aim to create a balance between human development and environmental conservation.

Ecodevelopment & livelihood improvement in NER provides a major opportunity to develop and establish community-centred programs that can harmonize conservation & development goals, using the approach of community mobilization, micro-planning and establishment of village-based livelihood programs.

5.3.1 Scope and Purpose

The scope and purpose of ecodevelopment within and around NER is to create a balanced relationship between conservation and community welfare. In areas adjoining MTR, STR, Thanthai- Periyar WLS and Cauvery North & South WLS, ecodevelopment aims to reduce dependency on forest resources while improving socio-economic conditions and strengthening community participation in conservation.

- ***Purpose***: The primary purpose of ecodevelopment is to provide sustainable livelihood alternatives that lower anthropogenic pressure on forests and wildlife habitats. By enhancing income opportunities, improving infrastructure, and promoting participatory governance, the program fosters community support for biodiversity conservation and reduces conflict between local communities and wildlife.
- ***Scope***: The scope of livelihood improvement includes promotion of non-timber forest produce value addition, climate-resilient agriculture, skill development in eco-guiding and handicrafts, support to SHGs, and development of community-based ecotourism enterprises. These initiatives diversify income sources and enhance economic resilience.
- *Infrastructure and Basic Services*: Ecodevelopment also focuses on improving basic infrastructure such as drinking water, sanitation, renewable energy, community facilities, and connectivity. Such improvements enhance quality of life and reduce vulnerabilities in forest-fringe villages.
- *Institutional Strengthening*: It is a key component, with emphasis on empowering Eco-Development Committees and Gram Sabhas through participatory micro-planning, transparent fund management, and community monitoring mechanisms to ensure equitable benefit sharing.
- *Conservation Linkages*: Ecodevelopment initiatives are directly linked to conservation outcomes by encouraging habitat restoration, awareness of wildlife protection, sustainable resource use, and participation in conflict mitigation measures.
- *Human-Wildlife Conflict Mitigation*: Livelihood improvement reduces economic vulnerability arising from crop damage or livestock loss. Diversified income sources, insurance schemes, and rapid compensation support improve resilience and tolerance toward wildlife presence.

Expected Outcomes: Ecodevelopment in NER serves as an integrated conservation and rural development strategy that enhances livelihoods, strengthens governance, reduces forest pressure, and promotes long-term ecological sustainability across the Nilgiri landscape.

5.3.2 Socio-economic and forest dependency survey

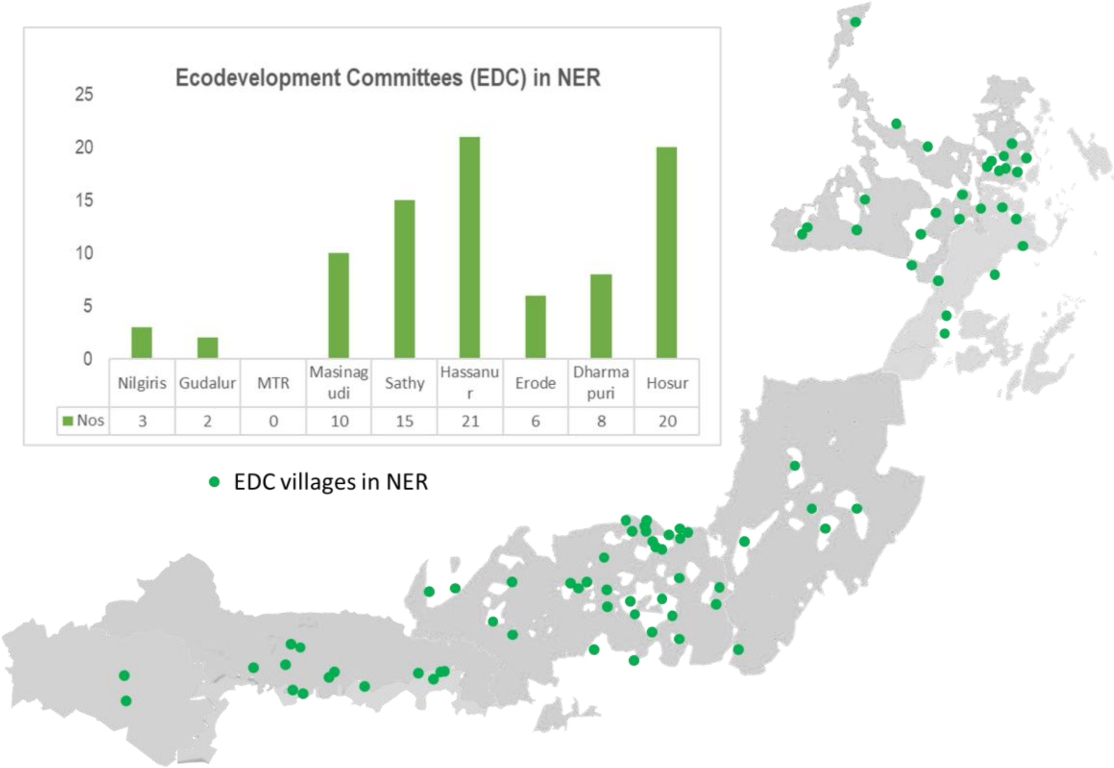


Fig-5.4: Distribution of Ecodevelopment Villages in the NER

A socio-economic and forest dependency survey is a comprehensive assessment designed to gather information about the relationship between local communities and forests.

- *Demographic and Socio-Economic Profile*: In areas adjoining MTR and STR, many households depend on small landholdings, wage labour, and forest-based activities for subsistence and income. Majority of households belong to ST and forest-fringe communities; small landholdings and rain-fed agriculture dominate livelihood patterns. Though literacy levels have improved, but higher education access remains limited. Women actively participate in SHGs and small enterprises and youth unemployment remains a concern in remote villages.
- *Income Sources:* are generally diversified but remain vulnerable to seasonal fluctuations. Common livelihood activities include agriculture, daily wage labour, livestock rearing, and collection of NTFP such as honey and medicinal plants. In some villages, ecotourism-related employment and Self-Help Group enterprises have begun contributing supplementary income.
- *Forest Dependency Patterns:* show continued reliance on firewood, fodder, grazing, and minor forest produce, particularly in villages lacking access to alternative energy or market opportunities. However, villages with active ecodevelopment initiatives have shown gradual reductions in extractive pressure on forests.
- *Human-Wildlife Conflict*: remains a socio-economic concern, with crop damage, livestock loss, and property damage affecting agricultural income. While compensation mechanisms exist, delays can increase vulnerability, prompting households to diversify income sources.
- *Impact of Ecodevelopment Interventions:* have contributed to improved community participation through EDCs, increased awareness of conservation practices, enhanced women's involvement in income-generating activities, and gradual adoption of alternative livelihoods.
- *Key Challenges Identified*: Despite these positive trends, challenges persist, including limited market access, seasonal unemployment, continued biomass dependency in some areas, and infrastructure gaps in remote settlements.

Overall, survey results indicate a gradual transition from heavy forest dependency toward diversified livelihoods, supported by ecodevelopment efforts. Sustained livelihood support, improved energy access, and stronger market linkages are essential for long-term socio-economic resilience and reduced pressure on forest ecosystems in NER.

5.3.3 Identification of key issues

Ecodevelopment villages located within and around the NER face a range of socio-economic, ecological, and institutional challenges that affect both livelihood security and conservation outcomes.

- *Continued Forest Dependency:* Despite livelihood interventions, many households remain dependent on forests for firewood, fodder, grazing, and minor forest produce. Limited access to alternative energy sources and market-based livelihoods sustains pressure on forest resources.
- *Human-Wildlife Conflict:* Crop damage by elephants and other wildlife, livestock depredation, and property damage significantly impact household income. Delays in compensation and limited preventive infrastructure increase vulnerability and reduce tolerance toward wildlife conservation.
- *Limited Livelihood Diversification:* Income sources are often seasonal and low-paying, with heavy reliance on wage labour and subsistence agriculture. Limited access to markets, skill training, and value addition opportunities constrains economic growth.
- *Infrastructure Deficiencies:* Many villages face gaps in drinking water supply, sanitation, renewable energy access, healthcare, education, and road connectivity. Poor infrastructure restricts enterprise development and access to services.
- *Institutional Weaknesses:* Eco-Development Committees (EDCs) in some villages face challenges such as limited financial management capacity, irregular meetings, insufficient transparency, and weak participation of women and youth.
- *Market Access Constraints:* NTFP collectors and handicraft producers often lack direct market linkages, branding support, and fair pricing mechanisms. Middlemen dominance reduces income.
- *Social and Cultural Pressures:* Younger generations may migrate due to limited local opportunities, leading to demographic shifts. Cultural erosion and reduced transmission of traditional ecological knowledge, are emerging concerns.
- *Energy and Biomass Dependency:* Continued dependence on fuelwood due to inadequate clean energy alternatives contributes to forest degradation & increases workload, especially for women.
- *Ecotourism Integration Gaps:* Not all ecodevelopment villages are effectively integrated into ecotourism value chains. Unequal benefit distribution may create intra-community disparities.
- *Climate and Environmental Stress:* Droughts, forest fires, and changing rainfall patterns affect agriculture, water availability, and forest productivity, increasing livelihood vulnerability.

Priority Ranking Matrix (Illustrative): The ranking of various issues indicating severity, frequency and impact on conservation (Table-5.6) is illustrated below:

Table-5.6: Priority Ranking Matrix of various issues and chaleenges

Issue	Severity	Frequency	Conservation Impact	Priority Level
Human-Elephant Conflict	High	High	Very High	1
Forest Dependency	High	High	High	2
Limited Livelihood Diversification	High	Medium	High	3
Infrastructure Gaps	Medium	High	Medium	4
Institutional Weakness	Medium	Medium	Medium	5
Market Access Constraints	Medium	Medium	Medium	6
Youth Migration	Medium	Medium	Indirect	7

Problem Tree Analysis: The root causes, direct effects & long-term consequences of the core problem (Table-5.7) 'high livelihood vulnerability and continued forest dependency in ecodevelopment villages'

Table-5.7: Problem Tree Analysis of the forest dependency in ecodevelopment villages of NER

Root Causes	Direct Effects	Long-Term Consequences
• Limited livelihood diversification • Seasonal and low agricultural productivity • Poor market access for NTFP and handicrafts • Inadequate renewable energy access (fuelwood dependence) • Weak institutional capacity of EDCs • Human-wildlife conflict losses • Infrastructure gaps (roads, water)	• Continued forest extraction • Crop damage vulnerability • Household income instability • Youth migration • Reduced tolerance toward conservation	• Habitat degradation • Increased human–wildlife conflict • Weak conservation compliance • Socio-economic marginalization • Reduced sustainability of ecotourism initiatives

Strategic Overview: Key challenges in ecodevelopment villages reflect a complex interaction between ecological sensitivity and socio-economic vulnerability. Addressing forest dependency, conflict mitigation, livelihood diversification, institutional strengthening, infrastructure gaps, and equitable benefit sharing will be critical for achieving long-term conservation and community resilience across the Nilgiri landscape.

5.3.4 Constitute EDCs and Executive Committees

Eco-Development Committees (EDCs) in villages within and around the Nilgiri Elephant Reserve serve as key community-based institutions that link conservation objectives with livelihood improvement. In areas adjoining PAs and TRs, EDCs facilitate participatory governance, reduce forest dependency, and promote sustainable development initiatives.

- There are nearly 85 EDCs in the NER of which 15 lie in Western Ghats and 70 in Eastern Ghats.
- EDCs prepare village-level micro-plans, prioritize livelihood interventions, manage ecodevelopment funds, and support conservation activities such as habitat restoration and conflict mitigation whereas EC oversees implementation of micro-plans, fund management, livelihood activities, and coordination with authorities.

Despite their importance, challenges include irregular meetings, limited financial management capacity, uneven participation, and the need for continuous training. Strengthening EDCs through capacity building, transparent systems, and inclusive leadership is essential for effective participatory conservation and sustainable development in NER.

5.3.5 Orientation and training of communities and field staff

Orientation and training are essential for strengthening ecodevelopment initiatives in villages within and around the Nilgiri Elephant Reserve. Capacity building helps communities and field staff effectively implement livelihood programs while supporting conservation objectives.

- *Community orientation programs* focus on the objectives of ecodevelopment, sustainable forest use practices, roles of EDCs, HWC mitigation measures, and financial transparency. Participatory workshops and Gram Sabha meetings build awareness and encourage ownership.
- *Livelihood skill development training* includes NTFP value addition, sustainable agriculture, agro-forestry, handicrafts, eco-guiding, enterprise management, and digital bookkeeping. Attention is given to empowering women's SHGs and youth to enhance inclusive economic participation.
- *Training in human-wildlife conflict management* equips communities with knowledge of safe practices in elephant-prone areas, crop protection techniques, reporting systems, and compensation procedures, thereby improving resilience and reducing conflict.

- *Field staff training* emphasizes participatory approaches, community engagement, conflict resolution, monitoring of forest dependency, financial oversight of EDC activities, and ecotourism regulation. This strengthens institutional effectiveness and accountability.
- *Joint workshops* between communities and forest officials promote mutual understanding, trust-building, collaborative problem-solving, alignment between conservation and development goals.
- *Regular monitoring and evaluation* of training outcomes, including assessment of sustainable practice adoption and income improvements, help ensure that capacity-building efforts translate into tangible conservation and livelihood benefits across the Nilgiri landscape.

Effective orientation and training in NER's ecodevelopment villages enhance institutional capacity, strengthen community participation, improve livelihood outcomes, and reinforce conservation compliance. Sustained capacity building ensures that ecodevelopment remains a dynamic and adaptive approach to balancing ecological protection with socio-economic development across the NER.

5.3.6 Participatory planning process and Ecodevelopment plans

The participatory planning process for developing ecodevelopment plans in the NER ensures that conservation goals are aligned with local livelihood needs (Box-5.14).

Box-5.14: Participatory Planning Process for Micro-plan Preparation

- *Preparatory Phase*: The process begins with community mobilization, awareness meetings, and baseline socio-economic and forest dependency surveys. Stakeholder mapping identifies tribal households, women's groups, youth, vulnerable sections to ensure inclusive participation.
- *Participatory Rural Appraisal*: PRA tools such as resource mapping, livelihood analysis, seasonal calendars, and problem ranking are used to understand forest dependency, conflict issues, infrastructure gaps, & income challenges.
- *Identification of Priority Issues*: Through Gram Sabha consultations and EDC meetings, communities prioritize key issues such as livelihood diversification, clean energy access, crop protection, water supply, and enterprise development.
- *Preparation of Village Micro-Plan*: Based on identified priorities, a village-level micro-plan is prepared outlining proposed interventions, budgets, timelines, and roles and responsibilities. The plan integrates conservation objectives with socio-economic development needs.
- *Technical Review and Approval*: The draft micro-plan is reviewed by Forest Department officials and technical experts to ensure ecological compliance and alignment with reserve-level management plans before final approval.
- *Implementation and Capacity Building*: Implementation is carried out through EDCs with support for capacity building and financial management.
- *Monitoring and Participatory Evaluation*: Regular monitoring and participatory evaluation help track progress and enable adaptive management.

Participatory planning in NER strengthens community ownership, improves livelihood outcomes, reduces forest dependency, and enhances conservation effectiveness across the Nilgiri landscape.

5.3.7 Implement Ecodevelopment activities

Implementation of ecodevelopment activities in villages within and around the NER should follow a participatory and conservation-linked approach. Interventions must address livelihood vulnerability, forest dependency, and human–wildlife conflict while strengthening community institutions.

- *Livelihood Diversification Interventions*: Livelihood diversification is a key focus, including promotion of non-timber forest produce value addition (honey processing, herbal products, bamboo crafts), agro-forestry, skill development (eco-guiding, handicrafts, hospitality, and small enterprises), support to SHGs, and integration with ecotourism where feasible. Market linkages and enterprise development help increase income and reduce reliance on forest extraction.

- *Human-Wildlife Conflict Mitigation Measures*: Conflict mitigation measures such as solar fencing, trench systems, crop protection strategies, awareness programs, and improved compensation mechanisms are essential to enhance community resilience and tolerance toward wildlife.
- *Renewable Energy and Biomass Reduction*: Reducing biomass dependency through clean energy distribution, solar lighting, community woodlots, and sustainable fuel-use awareness contributes to lowering forest pressure and improving environmental sustainability.
- *Infrastructure and Basic Services Support*: Infrastructure support, including improvements in drinking water, sanitation, community facilities, storage units, and digital connectivity, enhances quality of life and supports livelihood activities. Convergence with government schemes strengthens resource mobilization.
- *Institutional Strengthening*: Institutional strengthening of Eco-Development Committees through regular meetings, financial transparency, leadership inclusion of women and youth, and capacity building ensures effective implementation and accountability.
- *Conservation Participation*: Community participation in conservation activities such as habitat restoration, biodiversity monitoring, and awareness programs reinforces the link between livelihood improvement and ecological protection.
- *Monitoring and Adaptive Management*: Regular monitoring, socio-economic surveys, and adaptive management processes help track progress, reduce forest dependency, improve incomes, and ensure that ecodevelopment activities remain aligned with long-term conservation objectives across the Nilgiri landscape.

Strategic Outcome: Effective implementation of ecodevelopment activities in NER should lead to diversified livelihoods, reduced forest pressure, improved conflict resilience, stronger community institutions, and enhanced conservation outcomes. An integrated and participatory implementation strategy ensures that development and biodiversity protection reinforce each other across the NER.

5.3.7.1 Capacity building and Skill development of tribal youth

Capacity building and skill development of tribal youth in villages located within and around NER including areas adjoining PAs, is essential for strengthening livelihood resilience and reducing forest dependency. Empowering youth creates long-term socio-economic stability while reinforcing conservation (Box-5.15).

Box-5.15: Capacity Building & Skill Development Opportunities

- *Skill development initiatives:* should focus on conservation-linked livelihoods such as eco-guiding, wildlife interpretation, biodiversity monitoring assistance, and community-based ecotourism services. Training in hospitality, trekking leadership, nature education, and visitor management can create employment opportunities within regulated tourism frameworks.
- *Youth Training*: Youth can also be trained in NTFP value addition, bamboo and handicraft production, honey processing, digital marketing, and small enterprise management.
- *romotion of climate-resilient agriculture*: Agro-forestry, livestock management, and renewable energy maintenance (solar system installation/repair) can further diversify livelihood options.
- *Soft skills training*: Training in communication, financial literacy, digital payments, leadership, and conflict resolution strengthens employability and institutional participation within EDCs.
- *Exposure visits*: Exposure visits to successful community-based ecotourism and enterprise models, along with certification programs for trained youth, can enhance credibility and access to formal employment opportunities.
- *ntegration* with government skill development schemes, Tribal Sub-Plan programs, and rural entrepreneurship initiatives ensures sustainability and scaling of capacity-building efforts.

Systematic capacity building of tribal youth in NER contributes to income diversification, reduced forest extraction, strengthened conservation, and long-term socio-economic empowerment across the NER.

5.3.7.2 Soil and Moisture conservation (SMC) measures

SMC measures in villages located within and around NER are essential to improve agricultural productivity, reduce land degradation, enhance groundwater recharge, and support ecosystem stability.

These interventions also reduce vulnerability to drought and climate variability.

- Contour trenches, contour bunds, and graded bunding on sloping lands help reduce surface runoff, prevent soil erosion, and retain moisture in agricultural and forest fringe areas. These measures are particularly effective in undulating terrain common to the Nilgiri landscape.
- Check dams, percolation ponds, and gully plugs constructed across seasonal streams slow down water flow, enhance groundwater recharge, and improve water availability for irrigation and domestic use. Small masonry or earthen structures can be built through community participation and convergence with rural development schemes.
- Farm ponds and rainwater harvesting structures support moisture retention for crop cultivation & livestock needs. Rooftop rainwater harvesting systems in villages can improve water security.
- Vegetative measures such as planting native grasses, shrubs, and trees along contours stabilize soil, reduce erosion, and enhance biodiversity. Agro-forestry models combining trees with crops improve soil fertility and long-term land productivity.
- Mulching, cover cropping, crop rotation, and organic manure application enhance soil health and moisture retention in agricultural fields. These practices reduce dependency on chemical inputs and improve resilience.
- Community woodlots and fodder plots reduce grazing pressure in forest areas while improving biomass availability and soil stabilization in degraded lands.

Soil and moisture conservation measures in NER ecodevelopment villages contribute to improved agricultural livelihoods, reduced forest dependency, enhanced groundwater recharge, and strengthened ecological resilience across the Nilgiri landscape.

5.3.7.3 Preservation of Traditional knowledge

Preservation of traditional knowledge in ecodevelopment villages of NER is vital for sustaining cultural identity, strengthening conservation practices, and promoting community-led development. Indigenous communities possess rich ecological knowledge accumulated over generations, which contributes to sustainable resource management.

- *Documentation of traditional ecological knowledge* (TEK), including medicinal plant use, seasonal indicators, wildlife behavior and sustainable harvesting techniques. Participatory documentation through village elders, youth groups, EDCs helps ensure authenticity & intergenerational transfer.
- *Integrating traditional knowledge* into ecodevelopment and ecotourism enhances livelihood opportunities. Tribal youth as eco-guides can interpret forests using TEK, while community-based enterprises can promote traditional crafts, foods, & healing practices in a respectful manner.
- *Educational outreach programs* in village schools can include local ecological knowledge modules, storytelling sessions, and nature-based learning. Intergenerational learning platforms, such as community knowledge workshops, help preserve oral traditions.
- *Legal and ethical safeguards* are necessary to prevent misappropriation or commercialization of sacred knowledge. Recognition of IPR/ adherence to FPIC principles protect community interests.
- *Promotion of traditional sustainable* practices- such as sacred groves protection, and customary forest management norms- can complement formal conservation strategies within NER.
- *Support for cultural festivals*, traditional art forms, and indigenous crafts strengthens social cohesion and maintains cultural continuity.

Preservation of traditional knowledge in NER's ecodevelopment villages reinforces conservation ethics, empowers communities, safeguards cultural heritage, & supports sustainable development across NER.

5.3.7.4 Conservation of Heritage sites

Conservation of heritage sites in ecodevelopment villages in NER is essential for protecting cultural identity and integrating cultural values with biodiversity conservation. These heritage assets include sacred groves, traditional worship sites, burial sites, historic pathways & culturally significant landscapes.

- *Identification and documentation* of heritage sites through participatory mapping and consultations with village elders & tribal leaders. Recording oral histories, traditional practices, and cultural narratives ensures that intangible heritage is preserved alongside physical sites.
- *Protection measures* may include demarcation of sacred groves, fencing where necessary, regulation of visitor access, and integration of heritage zones into village micro-plans. Any infrastructure development must avoid disturbance to culturally sensitive areas.
- *Community-led conservation models* are central to effective heritage protection. EDCs can establish local guidelines for site maintenance, access control, and cultural event management.
- *Culturally sensitive heritage tourism*, where appropriate, can be developed under strict guidelines, ensuring FPIC of communities and preventing commercialization of sacred practices.
- *Convergence with heritage conservation schemes*, tribal welfare programs, and rural development initiatives can provide technical & financial support for restoration and maintenance.

Conservation of heritage sites in NER's ecodevelopment villages strengthens cultural resilience, reinforces traditional conservation ethics, and supports integrated landscape management across NER.

5.3.8 Participatory assessment of impacts of intervention

Participatory assessment of interventions in ecodevelopment villages in NER ensures that livelihood and conservation initiatives are evaluated jointly by communities and forest authorities (Box-5.16).

Box-5.16: Protocols for Participatory Assessment of Impacts of Intervention

- *Baseline Data Collection*: The assessment process begins with baseline data collection on socio-economic status, forest dependency, income levels, HEC incidence, infrastructure gaps. Post-intervention surveys/ consultations conducted to measure changes against baseline data.
- *Ecological Impacts:* are assessed through participatory monitoring of forest resource extraction, regeneration status, soil and water conservation outcomes, and wildlife disturbance levels. Community members can support data collection through resource mapping and observations.
- *Socio-economic Impacts*: are evaluated using household surveys, focus group discussions, and Gram Sabha reviews to assess income changes, livelihood diversification, SHG performance, market access improvements, and reduction in migration pressures.
- *HEC indicators*, including frequency of crop damage, compensation processing time, and community tolerance levels, are reviewed to determine the effectiveness of mitigation.
- *Institutional performance* of EDCs is also assessed, focusing on meeting frequency, financial transparency, participation of women and youth, and implementation efficiency.
- *Participatory Tools*: such as Participatory Rural Appraisal (PRA), community scorecards, social audits, and stakeholder workshops facilitate inclusive evaluation and collective learning.
- *Review & Revisions*: Findings from participatory assessments are used to revise village micro-plans, reallocate resources, strengthen weak components, and scale up interventions.

Participatory impact assessment in NER ensures that ecodevelopment interventions contribute to long-term conservation and socio-economic sustainability across the NER landscape.

5.3.9 Livelihood Support Initiatives through Village Micro-plans

Livelihood support initiatives in ecodevelopment villages of NER are implemented through participatory Village Micro-Plans. These micro-plans integrate livelihood enhancement with conservation objectives to reduce forest dependency and strengthen economic resilience.

- *Village micro-plans* are prepared through participatory rural appraisal exercises, household surveys, and Gram Sabha consultations. They identify priority needs such as income diversification, renewable energy access, crop protection, skill development, and enterprise support, ensuring that interventions reflect local realities and equitable benefit distribution.
- *Livelihood initiatives* commonly include promotion of non-timber forest produce (NTFP) value addition such as honey processing, herbal products, and bamboo crafts. Agro-forestry, climate-resilient agriculture, livestock improvement, and fodder development are also supported to enhance income while conserving natural resources.
- *Skill development* and entrepreneurship support are integral components of micro-plans. Training in eco-guiding, hospitality services, handicrafts, small enterprise management, digital marketing, and financial literacy helps create diversified income opportunities, particularly for youth and women's Self-Help Groups.
- *Clean energy interventions* such as LPG distribution, solar lighting systems, improved cookstoves to reduce fuelwood dependency and forest pressure are incorporated in the micro-plans.
- *Human-wildlife conflict mitigation* measures- such as solar fencing, trenching, early warning systems, and insurance facilitation- are included to safeguard agricultural livelihoods and enhance community tolerance toward wildlife.
- *Market linkage support and branding initiatives* are often integrated to ensure that local products receive fair pricing and wider market access, reducing dependence on intermediaries.
- *Implementation monitoring* is through regular EDC meetings, financial audits, and participatory review processes. Adaptive revisions of micro-plans allow for scaling up successful enterprises and addressing emerging challenges.

Livelihood support through village micro-plans in NER promotes income diversification, reduces extractive forest use, strengthens institutional capacity, and reinforces the linkage between sustainable development and biodiversity conservation across the Nilgiri landscape (Box-5.17).

Box-5.17: Indicative Activities and Development Works in Village Micro-Plans of NER

A- *Income generation activities:*

- Sustainable Agriculture; Eco-Tourism; Handicrafts and Artisanal Products; Beekeeping and Honey Production; Fisheries and Aquaculture; Water Harvesting and Management; Renewable Energy Initiatives; Carbon Trading and Forest Conservation; Community-Based Conservation Enterprises; Waste Management and Recycling; and Community-Based Seed Banks etc.

B- *Community development works:*

- Community-Based Natural Resource Management; Eco-Friendly Infrastructure Development; Community Forest Management; Water Conservation and Management; Health and Sanitation Programs; Cultural Preservation; Community-Based Ecotourism; Social Enterprises; and Disaster Preparedness and Resilience etc.

By integrating these elements into the development of Village Micro-plans, ecodevelopment initiatives can create a more comprehensive and sustainable approach.

5.3.10 Integration of Rural Development Programmes

Integration of rural development programmes into ecodevelopment villages of NER is essential to strengthen livelihood security while reducing pressure on forest resources. Convergence ensures optimal use of financial and institutional resources without duplicating efforts.

- *Village micro-plans serve as the foundation for identifying gaps* in infrastructure, livelihoods, and basic services. These priorities are then linked with appropriate rural development schemes at district and state levels to ensure targeted support.
- *Livelihood convergence* may include linking communities to employment schemes such as MGNREGS for soil and moisture conservation works, water harvesting structures, and land development activities. Agricultural extension services and tribal welfare programmes can support climate-resilient farming and livestock improvement.
- *Infrastructure-related schemes* can be leveraged to improve drinking water supply, sanitation, road connectivity, housing, renewable energy access, and digital connectivity in forest-fringe villages. Such improvements enhance quality of life and reduce socio-economic vulnerability.
- *Skill development and entrepreneurship programmes* under rural development and tribal sub-plan initiatives can support youth training, Self-Help Group strengthening, and micro-enterprise development, complementing ecodevelopment objectives.
- *Integration with clean energy programmes* promotes LPG connections, solar lighting systems, and improved cookstoves, reducing fuelwood dependency and forest degradation.
- *Financial inclusion schemes*, including access to banking services, insurance, and credit facilities, strengthen household resilience and reduce economic shocks from HEC or crop losses.
- *Coordination mechanisms* between Forest Department officials, district administration, Panchayats, and line departments are critical to ensuring smooth convergence and avoiding administrative overlaps.
- *Monitoring convergence* outcomes through participatory review meetings and EDC oversight ensures that rural development support contributes to both livelihood improvement and conservation goals.

Integration of rural development programmes (Box-5.18) in NER's ecodevelopment villages enhances socio-economic resilience, reduces forest dependency, improves infrastructure, and strengthens the long-term sustainability of conservation-linked development across the landscape.

Box-5.18: List of Common Rural Development Programs

Rural development programs vary widely based on the specific needs and challenges of a region. Common types of rural development programs include:

- Agricultural Development Programs; Livelihood Diversification Programs; Education Programs; Healthcare Programs; Infrastructure Development Programs; Social Welfare Programs; Natural Resource Management Programs; Sustainable Tourism Programs; Water and Sanitation Programs; Disaster Management and Resilience Programs; Women's Empowerment Programs; Digital and Information Technology Programs; Climate Change Adaptation and Mitigation Programs; and Cultural Preservation Programs.

By employing these strategies, rural development programs can be integrated in a way that maximizes their impact and contributes to the sustainable development of rural communities.

5.3.11 Monitoring and Evaluation

Monitoring and Evaluation (M&E) of ecodevelopment activities in NER is essential to assess progress, ensure accountability, strengthen linkage between livelihood improvement and biodiversity conservation.

- *Baseline Data:* M&E begins with establishing baseline data on socio-economic conditions, forest dependency, income levels, human-wildlife conflict incidence, and institutional performance of

Eco-Development Committees (EDCs). Clear indicators aligned with village micro-plans and reserve-level conservation objectives are defined at the outset.

- *Ecological monitoring:* focuses on changes in forest resource extraction, regeneration status, soil and moisture conservation outcomes, wildlife disturbance levels, and habitat restoration progress. Periodic field assessments and community-based monitoring help track environmental impacts.
- *Socio-economic evaluation:* measures improvements in household income, livelihood diversification, clean energy adoption, reduction in seasonal migration, and participation of women and youth in income-generating activities.
- *Human-wildlife conflict indicators:* such as reduction in crop damage cases, improved compensation processing time, and adoption of preventive measures—are assessed to evaluate effectiveness of mitigation strategies.
- *Institutional monitoring*: reviews frequency of EDC meetings, financial transparency, fund utilization efficiency, participation levels, and compliance with micro-plan implementation schedules.
- *Participatory tools:* such as household surveys, focus group discussions, Gram Sabha reviews, community scorecards, and social audits ensure inclusive evaluation and transparency.
- *Mid-term reviews* and annual performance assessments allow identification of gaps, scaling up of successful interventions, and corrective measures through adaptive management.
- *Documentation of best practices* and lessons learned supports replication across divisions and strengthens policy inputs for long-term conservation planning.

A structured M&E framework in NER ensures that ecodevelopment initiatives remain outcome-oriented, transparent, adaptive, and aligned with both community welfare and ecological sustainability goals.

5.4. MAINSTREAMING ZONAL MASTER PLAN IN ECO-SENSITIVE ZONE

5.4.1 Background

The Indian Board for Wildlife in its 'Wildlife Conservation Strategy-2002' envisaged 'lands falling within 10 km of the boundaries of NP and WLS should be notified as eco-fragile zones under section 3 (v) of the Environment (Protection) Act and Rule 5 Sub rule (vii) & (x) of the Environment (Protection) Rules'.

The purpose of declaring Eco-sensitive zones (ESZ) around Sanctuaries and National Parks is to create some kind of 'Shock Absorber' for the Protected Areas and they would also act as a transition zone from areas of high protection to areas involving lesser protection.

The Hon'ble Supreme Court of India in WP (C) No. 460 / 2004 (Goa Foundation vs Union of India) filed on 04-02-2006, had also directed for the notification of areas falling within 10 kms from the boundary of the Sanctuaries and National parks as ESZ with a view to conserve the forest, wildlife and environment.

The Union Ministry of Environment Forests and Climate Change, in pursuance to the decision taken by the National Board for Wildlife had requested site specific proposals for declaration of Eco-sensitive zone around National Parks and Sanctuaries and had also issued detailed guidelines vide its letter F. No. 1-9/2007-WL-1 (pt) dated 09-02-2011 to facilitate the zoning activities after due consideration of the LULC, ecological and socio-economic aspects (Box-5.19) (Fig-5.5).

Box-5.19: Considerations for declaration of ESZ around Protected Areas

- ***Area and Boundary of the ESZ***: Delineation of the physical boundaries on a topo-sheet with precise description in geographic terms together with a description of the significant features / attributes that would potentially qualify the area as eco-sensitive zone along with the list of villages with exception and exemption in the delineated buffer zone area.
- ***Climate and Natural features***: A description of a climate includes information on, e.g. the average temperature in different seasons, rainfall, and sunshine. Natural features mean components and processes present in or produced by nature, including, but not limited to, soil types, geology, slopes, vegetation, surface water, drainage patterns, aquifers, recharge areas, climate, flood plains, aquatic life, and wildlife.
- ***Demographic profile***: Demography profile examines the size, structure, and movements of human populations over space and time and details the population growth, sex-ratio, population density, household size, literacy rate, age-wise distribution of population, vital rates (birth/ death/ mortality) and migration.
- ***Major source of economy***: A description of the resource base indicating the economic potential and livelihood implication for the people residing in and around the proposed eco-sensitive area including an inventory of the existing legal status of rights, entitlements, privileges and obligations of the local communities.
- ***Importance of the ESZ***: A description of bio-diversity values including bio-geographical representatives, endemism, species richness, geo-morphological characteristics, and unique land use practices including aesthetic and cultural values.

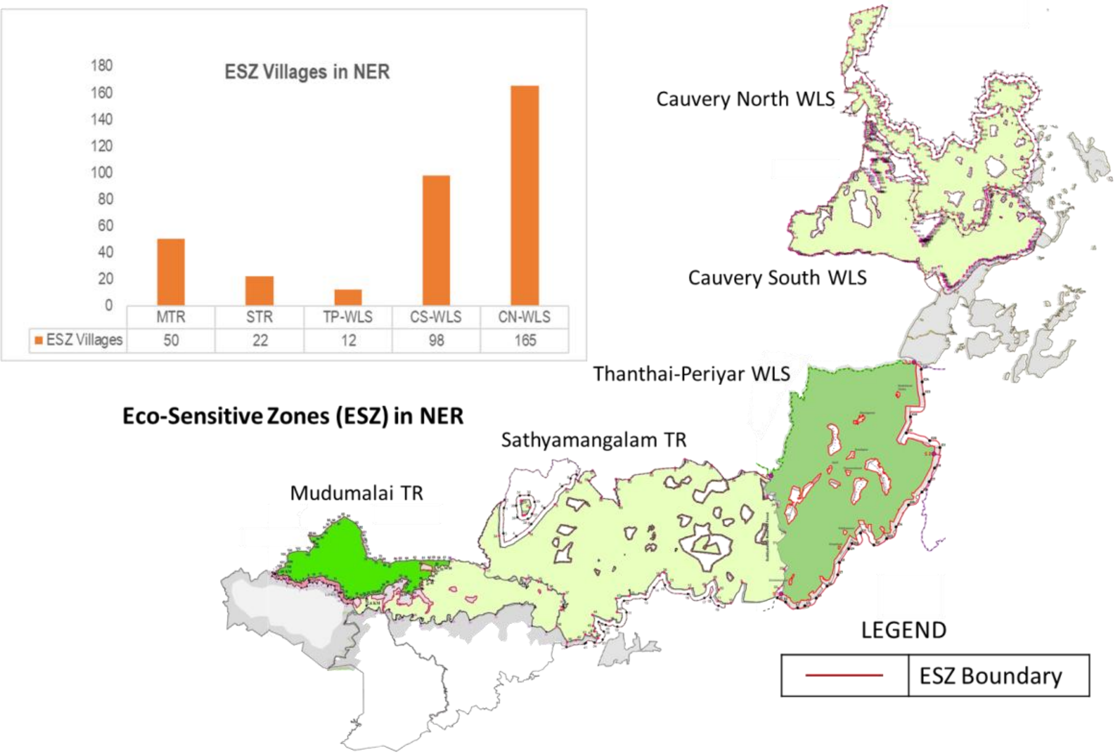


Fig-5.5: Map showing Eco-Sensitive Zone in NER with graph depicting ESZ villages in PAs

5.4.2 Integration of Zonal Plan

A Zonal Master Plan in an Eco-Sensitive Zone (ESZ) is a comprehensive planning document designed to guide land use, development activities, and conservation efforts within the designated eco-sensitive zone of the NER.

The primary goal is to strike a balance between environmental conservation and sustainable development, ensuring the protection of ecological values while meeting the needs of local communities.

Integration of Eco-Sensitive Zone (ESZ) Zonal Master Plans of protected areas within NER- including Mudumalai Tiger Reserve, Sathyamangalam Tiger Reserve, Thanthai Periyar Wildlife Sanctuary, Cauvery North Wildlife Sanctuary, and Cauvery South Wildlife Sanctuary- is essential for landscape-level conservation and coordinated development planning.

The zonal plans of the afore-mentioned PAs are to be prepared in consultation with al the stakeholders and since NER spans multiple forest divisions and ecological zones, harmonizing ESZ plans ensures ecological protection while guiding sustainable development in surrounding areas.

- *Alignment & Zoning*: The integration process should align land-use regulations, permissible and prohibited activities, infrastructure norms, and tourism guidelines across ESZs. Consistency in zoning categories- such as regulated development zones, agricultural areas, eco-restoration zones, and tourism-use zones- prevents fragmentation and policy conflicts.
- *Planning Framework*: A unified spatial planning framework using GIS-based mapping can help overlay ESZ boundaries, elephant corridors, watershed zones, and human settlements. This supports coordinated decision-making on infrastructure projects, road expansion, mining restrictions, and tourism development.
- *Environmental Safeguards*: Integration should also harmonize environmental safeguards, including building regulations, waste management standards, water extraction norms, and renewable energy promotion across ESZs. Common environmental compliance mechanisms reduce administrative duplication and improve enforcement efficiency.
- *Conflict Mitigation*: Human-wildlife conflict mitigation strategies within ESZs must be coordinated at the NER landscape level, particularly in corridor areas linking Western and Eastern Ghats habitats. Crop protection measures, compensation mechanisms, and land-use advisories should be standardized.
- *Ecotourism Planning*: Ecotourism within ESZs must align with carrying capacity assessments and zonation principles of the respective Tiger Reserves and Wildlife Sanctuaries. A unified ecotourism strategy prevents over-concentration of tourism pressure in sensitive zones.
- *Institutional Coordination*: Mechanisms- such as an inter-division ESZ coordination committee under the NER framework- can facilitate joint reviews, monitoring, and conflict resolution among forest divisions and district administrations.
- *Convergence*: Convergence with district-level development plans, Tribal Sub-Plan initiatives, and rural development schemes ensures that ESZ integration supports both conservation objectives and community welfare.
- *Adaptive Planning*: Periodic review and updating of Zonal Master Plans should incorporate ecological monitoring data, climate resilience considerations, and socio-economic trends to maintain adaptive and dynamic planning.

Integration of ESZ Zonal Master Plans within NER strengthens landscape-level governance, safeguards elephant corridors and biodiversity, harmonizes development regulations, and promotes sustainable growth across the landscape (Box-5.20).

Box-5.20: Considerations in the Preparation of Zonal Master Plan

Line Departments and Agencies:

- The Zonal Master Plan shall be prepared in consultation with the following State Departments, - Environment; Forest and Wildlife; Agriculture; Revenue; Urban Development; Tourism; Rural Development; Irrigation and Flood Control; Municipal; Panchayati Raj; Public Works Department; Highways; State Pollution Control Board and other relevant departments.

Integration of Environmental and Ecological considerations:

- The Zonal Master Plan shall not impose any restriction on the approved existing land use, infrastructure and activities, unless so specified and the Zonal Master Plan shall factor in improvement of all infrastructure and activities to be more efficient and eco-friendlier.

Restoration of Environmental and Ecological concerns:

- The Zonal Master Plan shall provide for restoration of denuded areas, conservation of existing water bodies, management of catchment areas, watershed management, groundwater management, soil and moisture conservation, wetland management needs of local community.

Demarcation & mapping of existing/proposed land use features:

- The Zonal Master Plan shall demarcate all the existing worshipping places, villages and urban settlements, types and kinds of forests, agricultural areas, fertile lands, green area, such as, parks, horticultural areas, orchards, lakes and water bodies and also with supporting maps.

Listing and Regulation of Activities:

- The Zonal Master Plan shall provide details on Prohibited/ Regulated/ Promoted Activities

5.4.3 Ecofriendly development and regulation of activities:

Eco-friendly development and regulation of activities within the ESZ of NER is essential to balance conservation with sustainable development. ESZs function as transition zones that buffer protected areas from high-impact activities while permitting regulated livelihood and development initiatives.

- The Zonal Master Plan shall regulate development in Eco-sensitive Zone and adhere to prohibited, regulated and promoted activities listed in the Table-5.8 and also ensure and promote eco-friendly development for livelihood security of local communities.
- All activities in the Eco sensitive Zone shall be governed by the provisions of the Environment (Protection) Act, 1986 and the rules made there under including the Coastal Regulation Zone (CRZ), 2011 and Environmental Impact Assessment (EIA) Notification, 2006 and other applicable laws- Forest (Conservation) Act 1980, Indian Forest Act, 1927, Wildlife (Protection) Act 1972.
- Eco-friendly development in ESZ areas should prioritize low-impact infrastructure, renewable energy adoption, sustainable agriculture, and community-based enterprises. Construction norms must limit building height, density, and land alteration, ensuring compatibility with local landscape and wildlife movement patterns. Use of eco-friendly materials, rainwater harvesting, wastewater treatment, and solid waste management systems should be mandatory.
- Regulation of activities within ESZs should clearly distinguish between prohibited, regulated, and permissible activities. Environmentally harmful activities such as mining, large-scale industry, and polluting operations must be restricted. Infrastructure projects, road expansion, tourism facilities, commercial establishments should undergo ecological screening and comply with the guidelines.
- Tourism within ESZ areas must follow carrying capacity norms, avoid sensitive habitats and elephant corridors, and adhere to waste management and noise control standards. Community-based ecotourism should be encouraged over large-scale commercial operations.
- Agricultural practices should promote organic farming, reduced chemical inputs, agro-forestry models, soil and moisture conservation measures to prevent land degradation & water pollution.

Table-5.8: Regulation of various Activities in the ESZ of NER

Prohibited Activities-9	Regulated Activities-20	Promoted Activities-10
• Commercial mining • Setting of industries causing pollution • Establishment of major hydroelectric project • Production/ processing of hazardous substances • Discharge of untreated effluents • Establishment of solid waste disposal site and incineration facility • Establishment of large-scale commercial livestock & poultry farms • Setting of new saw mills • Setting up of brick kilns	• Commercial establishment of hotels/resorts • Construction activities • Small scale non-polluting industries • Felling of Trees • Collection of Forest produce or NTFP • Erection of electrical/ communication tower & laying of cables and other infrastructures • Infrastructure civic amenities • Widening and strengthening of existing roads and formation of new roads • Undertaking other tourism activities (flying hot air balloon, helicopter, drone, microlite) • Protection of hill slopes and river banks • Movement of vehicular traffic at night • Ongoing agriculture/ horticulture practices (dairies, aquaculture, fisheries) • Discharge of treated waste water/effluents in natural water bodies or land area • Commercial extraction of surface/ GW • Open well, bore-well for agriculture usage • Solid waste management • Introduction of exotic species • Ecotourism • Use of polythene bags • Commercial sign boards and hoardings	• Rain water harvesting • Organic farming • Adoption of green technology • Cottage industries (village artisans, etc) • Use of renewable energy and fuels • Agro-forestry • Use of eco-friendly transport • Skill development • Restoration of habitats/ degraded land/ forests/ • Environmental awareness

Eco-friendly development and regulation in the ESZ of NER safeguard biodiversity, protect elephant corridors, guide responsible infrastructure growth, and promote sustainable livelihoods, ensuring long-term ecological stability across the NER landscape.

5.4.4 Regulatory framework and monitoring of the ESZ notification

- The Zonal Master Plan shall be co-terminus with the Regional Development Plan.
- Zonal Master Plan so approved shall be the reference document for the Monitoring Committee for carrying out its functions of monitoring in accordance with the provisions of this notification.

5.4.5 Mainstreaming of Zonal Master Plan

Mainstreaming the Eco-Sensitive Zone (ESZ) Zonal Master Plans within NER involves integrating ESZ regulations into day-to-day governance, sectoral development planning, and community-level decision-making across protected landscapes such as Mudumalai TR, Sathyamangalam TR, Thanthai Periyar WLS, Erode, Cauvery South WLS, Dharmapuri & Hosur and Cauvery North WLS, Hosur.

Rather than remaining as regulatory documents, ESZ provisions must actively guide land use, infrastructure, tourism, and livelihood interventions in NER.

- *Alignment with Development Plans*: Mainstreaming begins with aligning ESZ land-use categories with district and Panchayat-level development plans. Permissible, regulated, and prohibited activities identified in the Zonal Plans should be incorporated into planning processes, ensuring that infrastructure expansion, mining, road/ tourism projects comply with ecological safeguards.

- *Sectoral Integration*: Integration into sectoral departments- such as rural development, tourism, agriculture, energy, and public works- is critical. All project approvals within ESZ areas should undergo ecological screening consistent with ESZ norms, ensuring that development remains compatible with conservation objectives.
- *Spatial Mapping*: Spatial mainstreaming through GIS-based mapping of ESZ boundaries, elephant corridors, watershed zones, and settlement areas helps authorities visualize cumulative impacts & avoid fragmentation of critical habitats. This supports evidence-based decision-making.
- *Capacity Building & Awareness*: Mainstreaming should also involve awareness and capacity building among local governance bodies, Eco-Development Committees, line departments, and community institutions so that ESZ regulations are understood and implemented effectively.
- *Adherence to Ecotourism Principles*: Tourism and ecotourism initiatives within ESZ areas must adhere to carrying capacity limits, building norms, waste management standards, and renewable energy guidelines specified in the Zonal Master Plans.
- *Inter-departmental Coordination*: Institutional mechanisms such as an inter-departmental coordination committee at the NER level can facilitate regular review of compliance, resolve conflicts, and ensure harmonized implementation across divisions.
- *Monitoring and Compliance*: Monitoring systems should track compliance indicators, environmental impacts, and socio-economic outcomes, enabling adaptive management and periodic updating of Zonal Master Plans.

Mainstreaming ESZ Zonal Master Plans in NER strengthens landscape-level conservation governance, ensures sustainable development, protects elephant corridors and biodiversity, and integrates environmental safeguards into routine administrative processes across the region.

5.4.6 Developing Synergy in the Elephant Reserve

The establishment of ESZ can play a significant role in the conservation of elephants/habitats (Box-5.21).

Box-5.21: Role of ESZ in Elephant Conservation

- *Buffer to the Elephant habitat:* facilitates in migration & conflict reduction.
- *Preventing Habitat Fragmentation:* facilitates elephant movement between habitats.
- *Maintaining Ecosystem Integrity:* benefits not only elephants but also other wildlife.
- *Regulating Human Activities:* prevents adverse impacts on wildlife, including elephants.
- *Mitigating Human-Elephant Conflicts:* reduces conflict between elephants & human settlements.
- *Conserving Water Sources:* ensures reliable access to water.
- *Enhancing Connectivity:* promotes gene flow within populations.
- *Climate Change Adaptation:* enhances the resilience of ecosystems
- *Tourism Management:* without impacting the habitat by infrastructure development.

Synergistic measures in NER aim to integrate conservation, livelihood development, ecotourism, human-wildlife conflict mitigation, and institutional strengthening into a unified landscape-level strategy. Given the ecological connectivity between areas of Western Ghats & Eastern Ghats, coordinated actions are essential to balance biodiversity protection with socio-economic development.

Some synergistic measures include:

- *Conservation-Livelihood Linkages:* Ecodevelopment initiatives should be directly tied to measurable conservation outcomes. Livelihood diversification, clean energy distribution, agro-forestry, and skill development programs should reduce forest dependency and habitat disturbance. Incentives can be linked to conservation compliance and sustainable practices.

- *Integrated Human-Wildlife Conflict Mitigation:* Conflict mitigation measures such as solar fencing, crop protection systems, compensation mechanisms, and insurance coverage should be integrated with livelihood improvement and land-use planning. Corridor protection and habitat restoration must complement village-level interventions.
- *Ecotourism-Ecodevelopment Convergence:* Community-based ecotourism should be aligned with village micro-plans, ensuring revenue-sharing mechanisms strengthen EDCs and fund conservation activities. Tourism promotion must follow carrying capacity norms and zonation principles to prevent ecological stress.
- *Soil, Water, and Habitat Restoration Integration:* Soil and moisture conservation works, watershed development, and degraded land restoration should be implemented through convergence with rural employment schemes. These measures simultaneously improve agricultural productivity and ecosystem health.
- *Institutional Coordination:* Strong coordination between Forest Department, district administration, Panchayats, line departments, and Eco-Development Committees ensures efficient resource utilization and policy coherence. Regular inter-division review meetings promote landscape-level governance.
- *Mainstreaming ESZ and Development Planning:* Eco-Sensitive Zone (ESZ) regulations and zonal master plans should be integrated into local development planning to harmonize infrastructure growth with conservation safeguards. Spatial planning tools and GIS mapping can guide sustainable land use.
- *Capacity Building and Youth Engagement:* Training programs for tribal youth, women's Self-Help Groups, and field staff strengthen institutional capacity and promote community stewardship. Leadership development fosters long-term sustainability of conservation initiatives.
- *Monitoring, Evaluation, and Adaptive Management:* Integrated monitoring systems linking ecological indicators, socio-economic metrics, and institutional performance allow adaptive management. Periodic participatory assessments ensure transparency and course correction.

Strategic Perspective

Synergistic measures in NER create a coordinated framework where conservation, livelihood enhancement, ecotourism development, rural infrastructure, and institutional strengthening reinforce one another. By adopting an integrated landscape approach, NER can achieve sustainable biodiversity protection alongside socio-economic resilience across the Nilgiri Elephant Reserve.

CHAPTER 6: MANAGEMENT CAPACITY DEVELOPMENT

6.1 ACTIVATION OF RESEARCH ACTIVITIES

The Nilgiri Elephant Reserve (NER) represents one of India's most important elephant landscapes. Strengthening wildlife research across this multi-division mosaic is essential to address habitat fragmentation, human-elephant conflict, invasive species, climate pressures, and increasing anthropogenic disturbances through science-based management.

Research activation in NER aims to establish a coordinated landscape-level framework that generates robust ecological and socio-economic data to support adaptive management. The initiative would integrate elephant ecology, carnivore monitoring, habitat studies, conflict mitigation science, and climate resilience into a unified research programme across divisions.

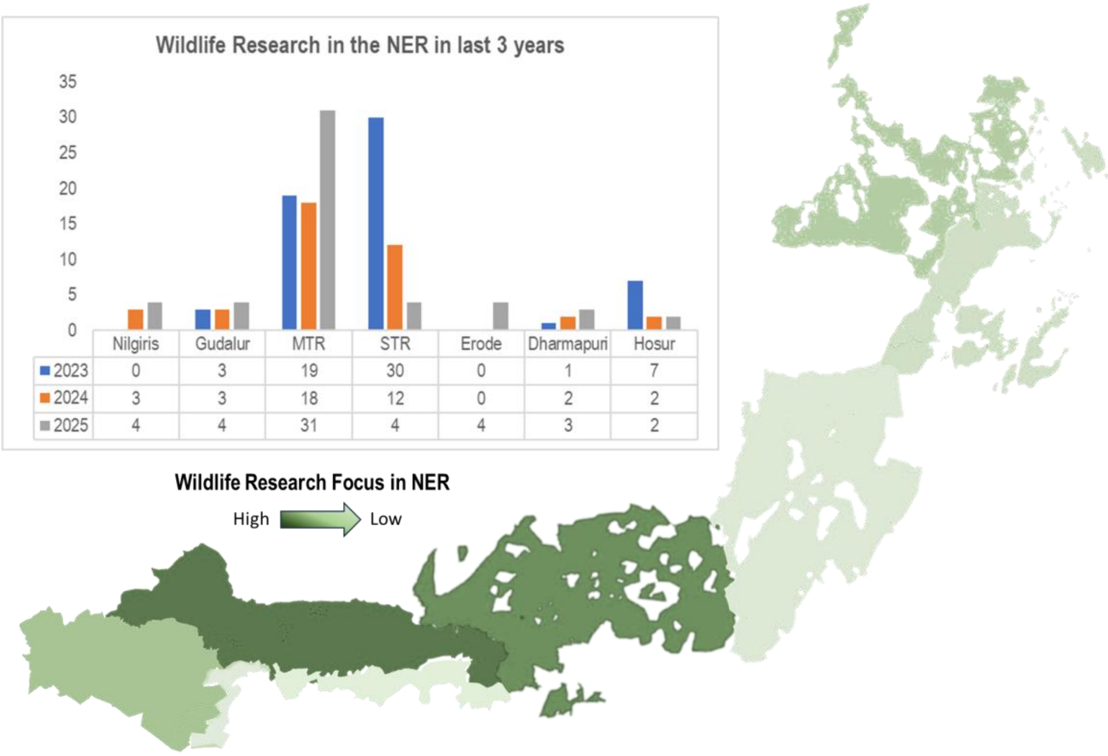


Fig-6.1: Division-wise Annual Research works undertaken in the NER

From the above graph (Fig-6.1), it is quite evident the majority of the wildlife research is focussed in the two tiger reserves, but the conflict issues are more prevalent in the adjoining divisions.

Key research themes include elephant population dynamics, GPS-based movement studies, corridor functionality, and genetic connectivity; spatial mapping and economic evaluation of human-elephant conflict mitigation measures; standardized camera-trap monitoring for carnivores; long-term vegetation and invasive species assessment; fire ecology studies; and climate adaptation monitoring. Disease surveillance under a One Health approach would also be incorporated in conflict-prone areas.

Institutionally, the programme proposes establishing an NER Wildlife Research Cell with divisional coordinators, centralized GIS and data management systems, and partnerships with national research institutions. Standardized research protocols, data-sharing frameworks, and annual review workshops would ensure quality and coordination.

Infrastructure strengthening, including field research stations, camera traps, GPS collars, drones, and staff training, would support systematic monitoring. Outputs would include annual wildlife status reporting, periodic landscape health assessments, and integration of research findings into management plans, ultimately improving corridor conservation, reducing conflict, and strengthening long-term biodiversity conservation in NER.

6.1.1 Short-term research

Short-term research can be particularly impactful when addressing urgent issues or specific challenges.

- Focus of the short-term research could be on a particular conservation issue or challenge that requires immediate attention viz. habitat loss, species decline, human-wildlife conflict, socio-economic aspects or any other pressing concern. The objectives should be specific, measurable, and achievable within the limited timeframe.
- Short-term research in conservation can contribute valuable insights and solutions to immediate challenges. By focusing on specific objectives and employing efficient data collection methods, short-term projects can make a meaningful impact on the conservation landscape.

6.1.2 Long-term research

Long-term research in conservation is essential for gaining a comprehensive understanding of ecosystems, species, and the impacts of conservation interventions over time.

- Approach to long-term research in conservation envisages clear and measurable objectives which are adaptable to changes in the conservation landscape over an extended period. We need to collect comprehensive baseline data to understand the current state of the ecosystem or species and this data would serve as a reference point for future comparisons.
- Develop and implement long-term monitoring programs to track changes in biodiversity, habitat quality, and other relevant parameters. Regular data collection ensures that trends and patterns are identified over time and embrace adaptive management principles, allowing for adjustments to conservation strategies based on ongoing research findings.

6.1.3 Indicative list of Research topics in Elephant Conservation in NER

The key aspects which drive the research in elephant conservation include: population dynamics; migration/ movement patterns; behavioural ecology & social structure; habitat quality assessment including invasives; feeding habits and nutritional studies; human-elephant conflict; health monitoring & disease surveillance; impact on habitat; habitat use; conservation genetics; and climate change impacts.

Within the NER, short-term and long-term research priorities may be envisaged as follows:

Short-Term Wildlife Research (1-3 Years)

- *Rapid Elephant Population Assessment*: Synchronized dung count and direct sighting surveys across divisions to establish baseline abundance and density.
- *Human-Elephant Conflict (HEC) Hotspot Mapping*: Spatial mapping of conflict incidents in Gudalur, Erode, Dharmapuri and Hosur divisions; identification of seasonal patterns.
- *Evaluation of Conflict Mitigation Measures*: Cost–benefit analysis of solar fencing, elephant-proof trenches, and early warning systems.
- *Rapid Corridor Functionality Assessment*: Ground-truthing and GIS validation of existing elephant corridors; identification of bottlenecks and encroachments.

- *Camera Trap Standardization*: Short-cycle occupancy and relative abundance studies for elephant, tiger, leopard, and prey species.
- *Invasive Species Mapping*: Division-wise mapping of Lantana, Senna, and other invasives affecting elephant habitats.
- *Water Resource & Drought Vulnerability Survey*: Seasonal monitoring of waterholes and artificial water sources.
- *Disease Surveillance (One Health Approach)*: Screening for zoonotic risks in elephants and livestock in high-conflict fringes.

Long-Term Wildlife Research (5-15 Years)

- *GPS Telemetry & Movement Ecology*: Collaring of elephants to study migration routes, corridor usage, home range, and response to infrastructure.
- *Genetic Connectivity & Meta-Population Studies*: Landscape genetics to assess gene flow between MTR-STR-Wayanad-Bandipur complexes.
- *Long-Term Vegetation & Habitat Monitoring Plots*: Permanent plots to track forest structure, forage dynamics, regeneration, and climate impacts.
- *Climate Change Impact Modelling*: Assessment of shifts in vegetation, phenology, and elephant movement under future climate scenarios.
- *Fire Ecology & Ecosystem Recovery Studies*: Monitoring fire frequency, intensity, and post-fire regeneration over decades.
- *Longitudinal HEC Trend Analysis*: Multi-year datasets to evaluate effectiveness of mitigation strategies and adaptive policy shifts.
- *Carnivore-Prey Dynamics Monitoring*: Integrated camera trap grids across divisions to study predator-prey balance and landscape-level connectivity.
- *Landscape-Level Land Use Change Analysis*: Remote sensing-based assessment of habitat fragmentation, linear infrastructure expansion, and restoration outcomes.
- *Socio-Ecological Resilience Studies*: Long-term tracking of community attitudes, livelihood shifts, and co-management outcomes.

Short-term studies generate baseline intelligence and immediate management inputs, especially for HEC and corridor protection. Long-term research builds landscape resilience models, supports policy reform, and strengthens NER as a globally significant elephant conservation landscape. Research in elephant conservation plays a crucial role in understanding the dynamics of elephant populations, their behaviour, and the challenges they face.

6.1.4 Outcome and management applications

Wildlife research in NER generates measurable ecological, social, and governance outcomes that directly inform field-level management and policy decisions.

- *Improved Understanding of Elephant Population Status:* Wildlife research in the NER strengthens scientific understanding of elephant population size, structure, movement patterns, and habitat use. These findings enable evidence-based revision of management plans and targeted protection of critical habitats and breeding areas.

- *Secured and Functional Elephant Corridors:* Research on corridor functionality and landscape connectivity identifies bottlenecks and priority movement routes, supporting legal protection of corridors, regulation of linear infrastructure, and habitat restoration to maintain gene flow and long-term population viability.
- *Reduction in Human-Elephant Conflict (HEC):* Studies on human-elephant conflict generates spatial risk maps and evaluate mitigation measures such as solar fencing and early warning systems. This allows focused deployment of rapid response teams, improved compensation mechanisms, and more efficient conflict reduction strategies across vulnerable divisions (Gudalur, Erode, Dharmapuri, and Hosur).
- *Climate-Resilient Habitat Management:* Habitat and climate-related research provides data on forage availability, invasive species spread, water resource dependency, and fire regimes. These insights guide grassland restoration, drought preparedness, artificial water provisioning, and fire management interventions to enhance ecological resilience.
- *Strengthened Law Enforcement & Protection Strategy:* Real-time monitoring through telemetry, camera traps, and patrol analytics gives focused anti-poaching patrols in movement corridors, data-driven deployment of frontline staff and integration of SMART patrolling and GIS-based surveillance.
- *Enhanced Genetic and Meta-Population Security:* Insights into gene flow between landscape units (MTR-STR-adjacent reserves) helps in prioritization of cross-border habitat connectivity, prevention of population isolation and strategic land acquisition or conservation agreements.
- *Integrated One Health & Disease Surveillance:* Early detection of zoonotic risks and disease outbreaks helps in envisaging veterinary interventions in conflict-prone fringes, livestock vaccination programmes near forest boundaries and reduced mortality risks to elephants.
- *Strengthened Community Participation & Policy Reform:* Socio-economic datasets on conflict impact and community attitudes assists in deploying community-based early warning networks, livelihood diversification schemes in fringe villages, evidence-based revision of compensation policies and inclusion of research findings in ESZ and landscape-level planning.

Strategic Impact: Wildlife research in NER transforms elephant conservation from reactive conflict management to predictive, science-based landscape governance, ensuring ecological connectivity, reduced conflict, climate resilience, and long-term population viability.

6.1.5 Research institutions/organizations/NGOs to garner support, expertise & participation

List of research institutions, conservation organizations, and NGOs that can provide support, expertise, and participation for elephant conservation research and action in the NER, include:

- *Research Institutions and Organizations:* Wildlife Institute of India (WII); Salim Ali Centre for Ornithology and Natural History (SACON); Centre for Wildlife Studies (CWS); Ashoka Trust for Research in Ecology and the Environment (ATREE); Advanced Institute of Wildlife Conservation (AIWC); World Wildlife Fund (WWF); Bombay Natural History Society (BNHS); Wildlife Trust of India (WTI); Wildlife Protection Society of India (WPSI); Asian Elephant Specialist Group (AESG); Bharathiar University; and Nilgiri College of Arts & Science.
- *NGOs and Community-Based Organizations:* Keystone Foundation; Nilgiri Natural History Society; Arulagam- Care Earth Trust; Community-Based Elephant Conservation (CBEC) etc.

6.2. MAP PREPARATION

In the NER landscape, map preparation is a critical decision-support tool for science-based management. The following thematic maps are considered, essential:

- *Elephant Distribution & Density Maps*: Show spatial distribution, herd concentration zones, and seasonal density patterns using census and dung count data (Application: Identifying high-use habitats and prioritizing protection).
- *Movement & Migration Corridor Maps:* Based on telemetry, field tracking, and local knowledge to delineate corridors and bottlenecks (Application: Corridor notification, acquisition and regulation).
- *Human-Elephant Conflict (HEC) Hotspot Maps:* Spatial plotting of crop raids, property damage, and human/elephant casualties (Application: Deployment of RRT, targeted mitigation measures).
- *Habitat & Land Use/Land Cover (LULC) Maps:* Forest type (forest-shola-grasslands), agriculture, settlements (Application: Habitat management, restoration planning, encroachment monitoring).
- *Forest Cover Change & Fragmentation Maps:* Multi-year satellite analysis to detect habitat loss, degradation, fragmentation trends (Application: Long-term landscape planning & intervention).
- *Water Resource & Seasonal Availability Maps:* Mapping natural streams, artificial waterholes, and seasonal drying patterns (Application: Drought mitigation and water augmentation planning).
- *Invasive Species Distribution Maps:* Spatial extent of Lantana, Senna, Prosopis, Eupatorium, etc (Application: Prioritization of invasive removal and grassland restoration).
- *Fire Incidence & Risk Zonation Maps:* Fire frequency, intensity, and vulnerable zones using remote sensing data (Application: Fire line planning and early warning systems).
- *Infrastructure & Linear Intrusion Maps:* Roads, railways, transmission lines, canals, and settlements overlayed with elephant movement paths (Application: Planning mitigation structures like underpasses, overpasses, speed regulation zones).
- *Protection & Patrol Intensity Maps:* SMART patrol data showing coverage gaps and vulnerable beats (Application: Optimizing anti-poaching and surveillance efforts).
- *Climate Vulnerability & Drought Risk Maps;* Projected rainfall variability, temperature rise, and water stress zones (Application: Climate-resilient habitat planning).
- *Genetic Connectivity & Meta-Population Maps:* Landscape genetics indicating gene flow between reserves (Application: Preventing population isolation & strengthening inter-reserve connectivity).

Strategic Value: Together, these maps create a comprehensive Elephant Conservation GIS Atlas for NER, enabling predictive conflict mitigation, corridor protection, habitat restoration, and climate-resilient management across divisions.

6.3 INFRASTRUCTURE AND MOBILITY

For effective elephant conservation in the NER, a coordinated strengthening of GIS, MIS, equipment, mobility, and built infrastructure is essential across all divisions.

6.3.1 GIS Enhancement

Strengthening infrastructure for elephant conservation in the NER requires establishment of a centralized GIS and remote sensing facility supported by divisional GIS units. This includes high-performance workstations, satellite imagery access, drone mapping systems, GPS devices, spatial databases, and map production facilities to support corridor mapping, habitat monitoring, and conflict hotspot analysis.

GIS Infrastructure Requirements:

A. Central NER GIS & Remote Sensing Lab (Landscape Level)

- High-performance GIS workstations (minimum 3–5 units).
- Licensed/ Open-source GIS & remote sensing software (ArcGIS/ERDAS/QGIS etc).
- High-resolution satellite imagery procurement.
- Drone mapping unit with RTK capability.
- Central spatial database server with backup system.
- Large-format plotter for thematic map printing.

B. Divisional GIS Units

- GIS workstation per division.
- Handheld GPS units (10-15 per division).
- Tablet-based field data collection system integrated with GIS.

Purpose: Corridor mapping, HEC hotspot mapping, forest cover change detection, Overlay analysis.

It is suggested that the following data layers may be created/procured.

- *Basic Data layer creation:* Village boundary map and administrative layers from SOI.
- *Baseline Geo-coded Data:* Field-based biodiversity survey/ management interventions etc

***Enhancing GIS in NER**:* involves leveraging spatial data & technology to better manage and protect the habitat and well-being of elephants in NER by preparation of afore-mentioned requisite thematic maps and plugging the data gaps (Table-6.1).

6.3.2 MIS Enhancement

A robust Management Information System (MIS) is essential for real-time elephant and humane-elephant conflict monitoring. The system should integrate village-level reporting, compensation tracking, patrol monitoring (SMART), telemetry data, and early warning alerts into a centralized digital dashboard with mobile-based field data entry and cloud backup support.

MIS (Management Information System) Requirements:

A. Elephant & HEC Monitoring MIS Platform

- Real-time conflict reporting dashboard (village-level inputs).
- Integration with compensation system.
- SMS-based early warning integration.
- Patrol tracking (SMART-based).

B. Data Management Infrastructure

- Centralized NER wildlife database.
- Cloud backup and cybersecurity protocols.
- Mobile app for field staff reporting (offline sync capability).

***Purpose*:** Data-driven decision making, predictive conflict management, and inter-division coordination.

***Enhancing MIS in NER**:* through data standardization and integration; digital data collection; real-time monitoring; GIS integration; incident reporting/response; population monitoring; community engagement.

Table-6.1: Division-wise GIS Infrastructure & Data Gap Assessment Matrix

Division	GIS Lab	Dedicated GIS Staff	GPS Devices	Drone Unit	GIS-MIS Integration	Gap Level
Nilgiri	No	No	Limited	No	No	High
Gudalur	Partial	No	Moderate	Moderate	Partial	Medium
MTR	Available	Yes	Moderate	Limited	Partial	Medium
STR	Partial	Yes	Moderate	Limited	Partial	Medium
Erode	No	No	Limited	No	No	High
Dharmapuri	No	No	Limited	No	Partial	High
Hosur	No	No	Limited	No	No	High

6.3.3 Equipment

Field equipment requirements include GPS collars, VHF tracking sets, camera traps, thermal drones, vegetation assessment tools, weather stations, and surveillance devices. Conflict mitigation equipment such as solar fencing units, elephant-proof trench maintenance tools, thermal sensors, public alert systems, and veterinary rescue kits, are critical for rapid response and disease surveillance.

An indicative list of equipment which could be used in the management of NER (Box-6.1), includes:

Box-6.1: Indicative List of Equipment for NER

- *GPS and Tracking Devices:* Collars or implants with GPS and tracking capabilities for monitoring the movements of individual elephants.
- *GIS Software and Hardware:* Geographic Information System (GIS) software, hardware and satellite images for mapping and analysing spatial data.
- *Communication Equipment:* Two-way radios, satellite phones, and other communication devices to facilitate real-time communication among reserve staff.
- *Camera Traps:* Motion-activated cameras placed in strategic locations to monitor wildlife activity, including elephant movements, and to detect illegal activities such as poaching.
- *Surveillance Drones:* Unmanned aerial vehicles (UAVs) equipped with cameras for aerial surveillance, mapping, and monitoring of large areas.
- *Field Monitoring Equipment:* Binoculars, spotting scopes, and camera equipment for field monitoring and research.
- *Medical and Veterinary Equipment:* Equipment for conducting health assessments on elephants, including veterinary supplies, tranquilizer darts, and equipment for immobilization if necessary.
- *Anti-Poaching Equipment:* Night vision goggles, thermal imaging cameras, and other surveillance equipment to support anti-poaching efforts (protective gears/ first-aid kits).
- *Weather Monitoring Tools:* Weather stations for monitoring environmental conditions, which is essential for understanding the impact of climate on elephant habitats.
- *Water Management Equipment:* Tools for monitoring and managing water sources, such as water quality testing equipment etc.
- *Educational and Outreach Materials:* Audiovisual equipment, educational materials, and community engagement tools.
- *Data Storage and Management Systems:* Computers, servers, and data storage devices for managing and storing research data, monitoring reports, and other relevant information.
- *Emergency Response Equipment:* First aid kits, emergency medical supplies, and evacuation equipment for responding to emergencies.
- *Community Engagement Tools:* Materials for community outreach, including brochures, signage, and audiovisual presentations.
- *Training Equipment:* Training materials, simulators, and other tools for educating reserve staff on wildlife management, conservation techniques, and emergency response procedures.

It's important to regularly assess and update the equipment to ensure that it meets the evolving needs of the NER. Proper training for staff on the use and maintenance of equipment is also critical. The division-wise infrastructure gap assessment matrix in respect of elephant monitoring & research equipment (Table-6.2) and conflict mitigation infrastructure (Table-6.3) is summarized below.

Table-6.2: Gap Assessment Matrix in respect of Elephant Monitoring & Research Equipment

Division	GPS Collars	Camera Traps	Telemetry Sets	Thermal Drones	Weather Stations	Gap Level
Nilgiri	None	Limited	None	No	Limited	High
Gudalur	Limited	Moderate	Limited	Moderate	None	Medium
MTR	Moderate	Adequate	Limited	Limited	Limited	Medium
STR	Moderate	Adequate	Limited	Limited	Limited	Medium
Erode	None	Limited	None	No	None	High
Dharmapuri	None	Limited	None	Limited	None	High
Hosur	None	Limited	None	No	None	High

Table-6.3: Gap Assessment Matrix in respect of Conflict Mitigation Infrastructure

Division	Solar Fencing	EPT Maintenance	EWS	RRT Equipment	Village Alert Systems	Gap Level
Nilgiri	Partial	Partial	Limited	Partial	Limited	Medium
Gudalur	Limited	Limited	None	Limited	None	High
MTR	Partial	Partial	Limited	Available	Limited	Medium
STR	Partial	Partial	Limited	Available	Limited	Medium
Erode	Limited	Limited	None	Limited	None	High
Dharmapuri	Limited	Limited	None	Limited	None	High
Hosur	Limited	Limited	None	Limited	None	High

6.3.4 Vehicles

Choosing appropriate vehicles for an Elephant Reserve is crucial for effective management, monitoring, and conservation efforts (Box-6.2).

Box-6.2: Types of commonly used Vehicles in Elephant Reserves

- *4x4 Vehicles:* Robust and versatile vehicles, such as SUVs or trucks with four-wheel drive
- *All-Terrain Vehicles (ATVs):* for patrolling in areas with rough or inaccessible terrain
- *Tracked Vehicles:* can be effective in dense vegetation and swampy areas
- *Utility Task Vehicles (UTVs):* suitable for transporting equipment, personnel, and supplies
- *Elephant Patrol Vehicles:* designed to allow a better view of elephants & surroundings
- *Electric or Hybrid Vehicles:* can be less disruptive to wildlife
- *Communication Vehicles:* equipped with two-way radios and satellite phones
- *Ambulance / Veterinary Vehicles:* for transporting injured/sick elephants to veterinary facilities
- *Educational and Awareness Vehicles:* equipped with audiovisual facilities

The exact number of vehicles and types to be procured may be decided keeping into consideration, the existing fleet and the site-specific conditions and the tasks required for conservation and management.

Mobility strengthening is necessary through provision of 4×4 patrol vehicles, rapid response vehicles, motorcycles for fringe beats, all-terrain vehicles in hilly terrain, telemetry tracking vehicles, and mobile outreach vans. Adequate fuel and maintenance support are essential for sustained field operations.

Strengthening the road network within NER:

The focus should be on upgrading existing forest roads (Fig-6.2) rather than creating new alignments, ensuring all-weather access to conflict hotspots, corridor bottlenecks, AP-camps & water-scarce beats.

- Strengthening includes gravel consolidation, proper drainage structures, culverts to prevent erosion, and slope stabilization in hilly terrain to maintain year-round patrol mobility.
- Strategic installation of wildlife crossing signages, speed-calming measures, and underpasses/ overpasses at identified elephant movement routes is necessary to reduce collisions.
- Improved internal road connectivity will enhance response time of RRTs, facilitate telemetry tracking, veterinary interventions, and coordinated patrolling across divisions.

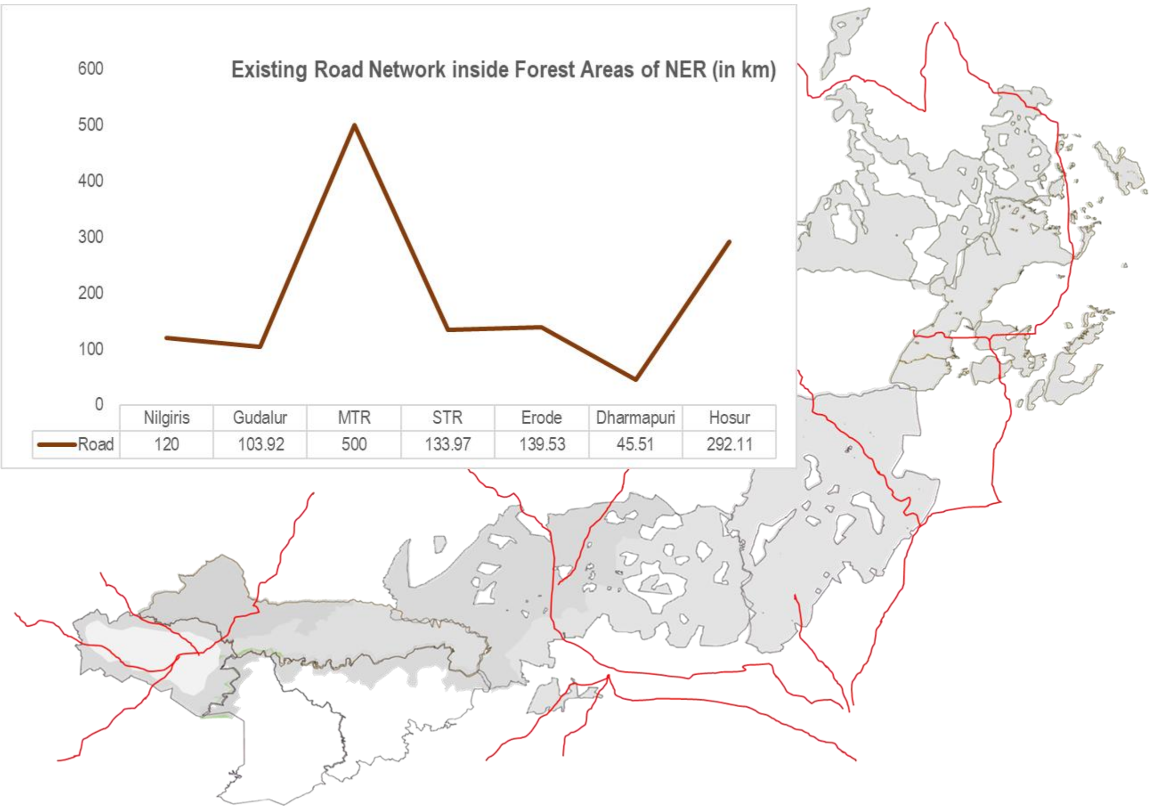


Fig-6.2: Road Length (in km) within Forest Areas of NER (graph) with surrounding Main Approach Roads

From the graph, it is quite evident that there exists a direct correlation between the existing length of the road-network and prevailing tourism in the NER (MTR) and the available roads could be maintained effectively for elephant protection and conservation.

6.3.5 Buildings

Buildings within an elephant reserve serve various purposes, ranging from research and monitoring facilities to infrastructure that supports conservation efforts and visitor education. The design and construction of these buildings could consider the unique needs of the reserve, as well as the safety and well-being of both wildlife and humans.

The types of buildings commonly found inside an elephant reserve, include - staff housing; ranger stations; research and conservation centre; visitor centre; visitor accommodations; training centre; veterinary clinic; communication hub; equipment storage store building; educational and interpretive centres; anti-poaching camps; guard posts and observation towers; emergency response centre.

The infrastructure in terms of availability of various buildings is limited in the NER (Fig-6.3) excepting MTR and STR. Most of the buildings relate to the offices and hosing facilities of the staff.

Building infrastructure should include an NER-level elephant conservation and research centre with GIS lab, control room, training facilities, and researcher accommodation, along with divisional monitoring control rooms, rapid response camps in conflict hotspots, staff quarters, watchtowers in corridor areas, and village-level early warning structures to enhance preparedness and coordination.

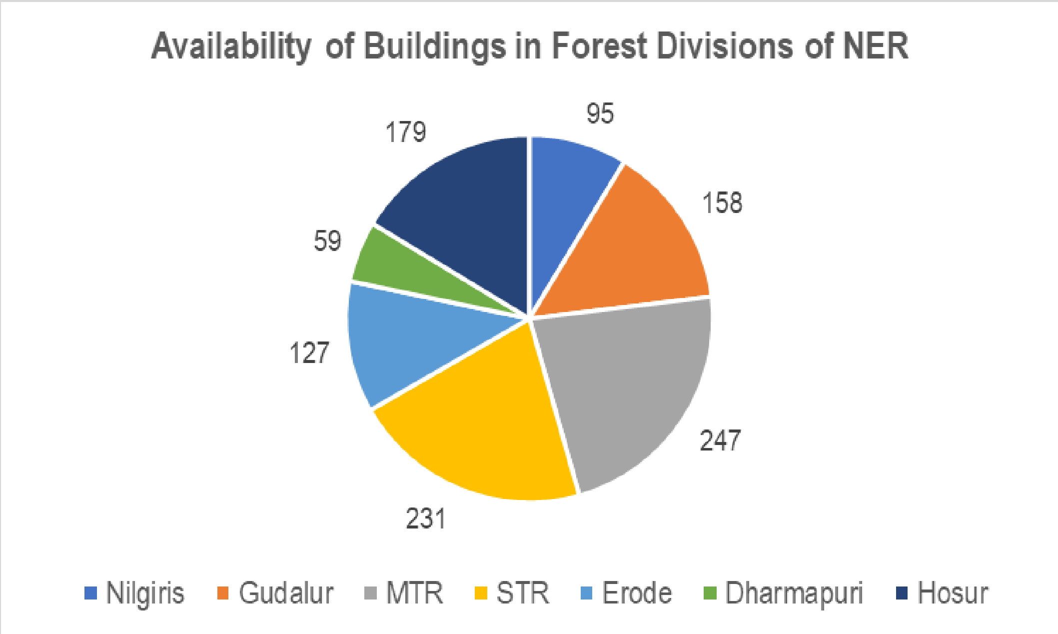


Fig-6.3: Availability of buildings in TRs, PAs and Divisions of NER

When planning and constructing any new buildings inside NER, sustainable construction practices and materials may be employed, and structures designed with the safety and conservation in mind.

Overall Gap Summary

- *High Infrastructure Gaps*: Nilgiris, Erode, Dharmapuri, Hosur (particularly in GIS, telemetry, early warning systems, and RRT mobility).
- *Moderate Gaps:* Gudalur, MTR, STR (require strengthening of MIS integration, telemetry, drones, and dedicated research facilities).
- *Landscape-Level Priority:* Establish a central NER Elephant Conservation & GIS Centre to integrate all divisions.

6.4 TRAINING

Training is necessary for introducing new technologies and for updating the existing manpower with knowledge and skills.

Training could envisage Training-of-Trainers (TOT) or conducted in-house through the master trainer. TOT envisages improvement of the technical capacity of the key resource persons who in turn will act as master trainers to train others. Before these trainings, the standard training manuals and SOPs need to be developed; and the target persons need to be selected as per experience and proficiency.

Critical themes- include elephant behaviour; habitat assessment; HEC mitigation; anti-poaching and crime investigation; population estimation; community outreach; elephant health/veterinary care; & GIS. Key training methods- include field workshops; on-site training; participatory learning; e-learning etc.

In NER, capacity building is critical for science-based elephant conservation, conflict mitigation, and landscape-level coordination and same is conducted regularly in all the divisions (Fig-6.4).

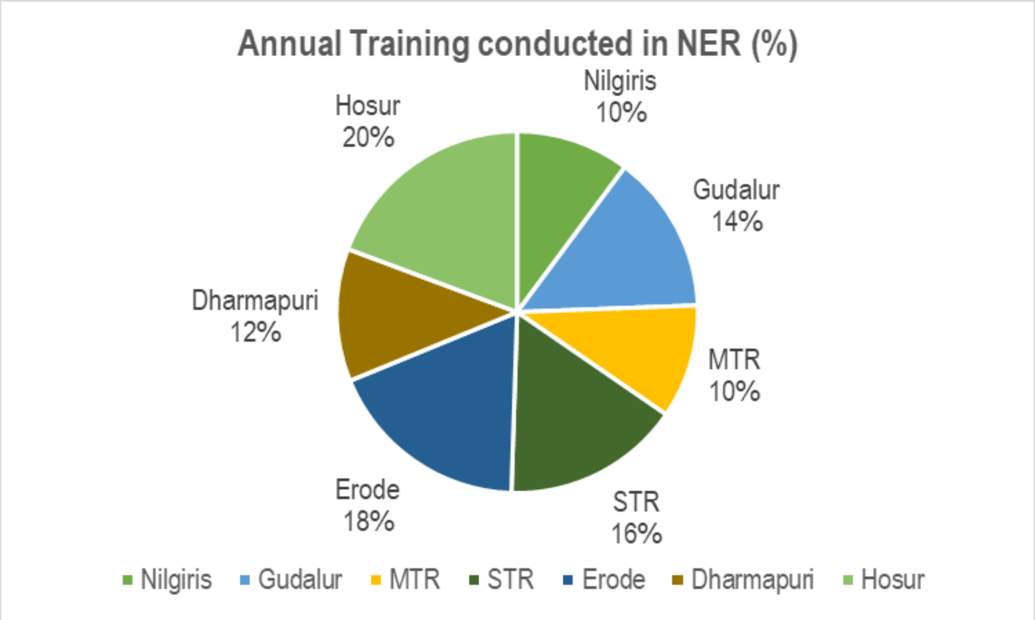


Fig-6.4: Annual training conducted in various divisions (in percent)

Structured and continuous training in NER will enhance field efficiency, reduce human–elephant conflict, improve safety of staff and communities, strengthen use of technology, and ensure adaptive, science-based elephant conservation across the landscape.

Field Staff Capacity Building

- *Target Group*: Forest Guards, Foresters, Range Officers, Anti-Poaching Watchers
- *Training Areas*: Elephant behaviour, herd dynamics, and risk assessment; Safe conflict response protocols; Crowd control and emergency handling during HEC incidents; Use of GPS, camera traps, and telemetry equipment; Fire management and habitat monitoring techniques
- *Outcome*: Improved safety, faster response, and evidence-based field decision-making.

Human-Elephant Conflict (HEC) Management Training

- *Target Group*: Rapid Response Teams (RRTs), Range Officers, Veterinary Staff
- *Training Areas*: Standard Operating Procedures (SOPs) for conflict mitigation; Installation and maintenance of solar fencing & EPTs; Early warning systems & community coordination; Compensation documentation and digital reporting; non-lethal deterrent techniques
- *Outcome*: Reduced escalation of conflict and improved community confidence.

GIS, MIS & Technology Training

- *Target Group*: Divisional GIS operators, Data managers, Young officers
- *Training Areas*: GIS-based corridor and hotspot mapping; SMART patrolling data entry and analytics; Drone operation & remote sensing basics; MIS dashboard management and reporting
- *Outcome*: Strengthened data-driven planning and predictive management.

Veterinary & Rescue Training

- *Target Group*: Forest veterinarians, frontline officers
- *Training Areas*: Tranquilization and immobilization protocols; Elephant rescue and rehabilitation techniques; Disease surveillance; Post-mortem procedures and forensic documentation
- *Outcome*: Reduced mortality, faster rescue response, improved disease monitoring.

Community & Outreach Training

- *Target Group*: EDC members, village volunteers, local youth
- *Training Areas*: Safe practices during elephant presence; Early warning communication networks; Crop protection methods; Coexistence awareness programs
- *Outcome*: Community participation and conflict prevention at source.

Officer-Level Strategic Training

- *Target Group*: DFOs, ACFs, Senior Officers
- *Training Areas*: Landscape-level elephant conservation planning; Climate adaptation strategies; Infrastructure impact assessment; Policy integration and inter-division coordination
- *Outcome*: Strengthened governance and long-term conservation planning.

Training in elephant conservation may be comprehensive, addressing a range of topics and employing diverse methods to cater to the needs and preferences of participants. Continuous learning, updates on emerging research, and networking within the conservation community are also crucial components.

6.4.1 On the Job Training

On-the-Job Training (OJT) is a practical, field-based capacity building approach that enhances real-time skills of frontline staff while performing regular duties.

- In NER, OJT involves hands-on mentoring of Forest Guards, Foresters, and Range Officers during patrols, elephant tracking, conflict response, and habitat monitoring. Staff learn to identify elephant signs, interpret movement patterns, assess herd behaviour, and make safe operational decisions in conflict situations under supervision of experienced officers.
- In conflict-prone divisions such as Gudalur, Erode, Dharmapuri, and Hosur, OJT strengthens Rapid Response Teams through live demonstrations of crowd control, safe driving during night operations, use of deterrents, documentation of damage, and coordination with local communities. This improves response time and reduces escalation during high-risk situations.
- Technology-based OJT includes field deployment of GPS devices, camera trap installation, telemetry tracking, drone-assisted monitoring, and real-time data entry into SMART/MIS platforms. Practical exposure ensures correct use of equipment and improves data accuracy.
- Veterinary and rescue OJT provides field-level exposure to tranquilization protocols, post-mortem documentation, carcass management, and disease surveillance procedures, ensuring preparedness for emergencies.

Structured OJT in NER builds confidence, enhances operational safety, standardizes field protocols, and bridges the gap between classroom training and real-world conservation challenges, leading to more effective and adaptive elephant management across the landscape.

6.4.2 Formal and Customised Training Courses

In the NER, a structured mix of formal and customised training programmes is essential to strengthen elephant conservation, conflict mitigation, and landscape governance.

Formal Training Courses

Formal training courses are standardized, curriculum-based programmes conducted at recognized forest training institutions or designated NER training centres. These courses may range from short-term (3-7 days) to certificate-level modules (2-4 weeks) and include classroom instruction, field demonstrations, and evaluation components.

Key formal courses may include:

- Elephant ecology and behaviour
- Human-elephant conflict management and SOPs
- Wildlife law enforcement and investigation
- SMART patrolling and GIS applications
- Fire management and habitat restoration
- Veterinary support and immobilization protocols

These programs ensure uniform knowledge dissemination, standardization of operational procedures, certification of trained personnel across Nilgiri, Gudalur, Erode, Dharmapuri, and Hosur divisions.

Customised Training Courses

Customised training courses are need-based, division-specific, and designed to address local challenges. These are shorter, problem-oriented modules developed after assessing field gaps.

Examples include:

- Conflict hotspot management in Gudalur and Hosur
- Corridor protection and infrastructure mitigation in STR landscape
- Community engagement strategies in high-conflict fringe villages
- Drone and telemetry operations for select research teams
- Data management and MIS strengthening for divisional staff

Customised modules allow flexibility in duration, participant profile, and content focus, ensuring relevance to local ecological and socio-economic conditions.

Implementation Strategy

A combination of annual formal training calendars and periodic customised workshops should be adopted. Landscape-level workshops can facilitate inter-division knowledge exchange, while refresher courses ensure updated skills in emerging areas such as climate resilience, early warning systems, and advanced monitoring technologies.

Strategic Impact

Integrating formal and customised training in NER will enhance technical competence, improve safety standards, strengthen data-driven decision-making, and build a cohesive, well-equipped workforce capable of implementing adaptive elephant conservation strategies across the entire landscape.

Annual Training Calendar (Proposed: 1 Year Cycle)

Quarter I (April-June)

1. Elephant Ecology & Behaviour (Formal Course - 5 Days)

- *Participants*: 25 (Foresters, Guards, Range Officers)
- *Divisions Covered*: Nilgiris, Gudalur, MTR
- *Focus*: Elephant biology, herd dynamics, risk assessment
- *Budget Heads*: Resource persons, training kit, TA/DA, accommodation, field visit

2. HEC SOP & Rapid Response Training (Customised - 3 Days)

- *Participants:* 30 (RRT members)
- *Divisions Covered:* Gudalur, Hosur, Dharmapuri
- *Focus:* Conflict response, crowd control, night operations
- *Budget Heads:* Demonstration equipment, mock drill logistics, vehicle use

Quarter II (July-September)

3. GIS, SMART & MIS Training (Formal - 5 Days)

- *Participants:* 20 (Data managers, young officers)
- *Divisions Covered:* All NER divisions
- *Focus:* Corridor mapping, hotspot analysis, data dashboards
- Budget Heads: Computer lab setup, software support, GIS resource person

4. Camera Trap & Telemetry Operations (Customised - 4 Days)

- *Participants:* 25 (Field staff)
- *Divisions Covered:* MTR, STR, Nilgiris
- *Focus:* Installation, maintenance, data retrieval
- *Budget Heads:* Field kits, equipment handling sessions

Quarter III (October-December)

5. Veterinary & Rescue Operations (Formal - 5 Days)

- *Participants:* 20 (Veterinary staff & senior officers)
- *Divisions Covered:* Landscape-level
- *Focus:* Tranquilization, immobilization, carcass protocol, One Health
- *Budget Heads:* Demonstration drugs (training use), safety kits, expert faculty

6. Community Engagement & Early Warning Systems (Customised - 3 Days)

- *Participants:* 40 (EDC members & frontline staff)
- *Divisions Covered:* Gudalur, Erode, Hosur
- *Focus:* Awareness, early warning networks, crop protection practices
- *Budget Heads:* IEC materials, village workshop logistics

Quarter IV (January-March)

7. Fire & Habitat Management (Formal - 4 Days)

- *Participants:* 30
- *Divisions Covered:* STR, Dharmapuri, Erode
- *Focus:* Fire control, invasive removal, water management
- *Budget Heads:* Field demonstration tools, protective gear

8. Landscape-Level Review & Knowledge Sharing Workshop (2 Days)

- *Participants:* 50 (Officers from all divisions)
- *Focus:* Experience sharing, adaptive management review
- *Budget Heads:* Conference arrangements, documentation, proceedings

Indicative Annual Participant Coverage & Financial Implication

- Total Coverage (NER-wide): ~200–250 personnel annually
- Small-scale implementation: Rs 40-50 lakhs
- Full-scale structured programme with expert institutions: Rs 60-75 lakhs

6.4.3. Establishing a Learning Centre

Establishing a dedicated Learning Centre in the NER would create a centralized institutional platform for strengthening elephant conservation through training, research integration, technology adoption, and inter-division coordination.

Rationale: A Learning Centre would function as a hub for science-based elephant conservation, bridging field operations, technology, community engagement, and policy planning.

Objectives: Following objectives may be envisaged as follows:

- Strengthen technical and operational skills of forest staff
- Institutionalize elephant conservation training and research dissemination
- Provide a platform for inter-division coordination and knowledge sharing
- Enhance community awareness and coexistence strategies
- Support GIS, MIS, and technology-driven management

Proposed Structure: Preferably centrally located within NER (MTR/STR) with connectivity to all divisions and proximity to elephant habitats for field demonstrations, the core facilities may include-

- Training Hall (50–60 capacity) with smart classroom with AV systems.
- GIS & Data Lab - High-performance systems for mapping and analytics.
- Elephant Monitoring Control Room - Telemetry and conflict dashboard integration.
- Demonstration & Simulation Area - Mock drills for HEC response.
- Library & Documentation Centre - Research publications and SOP manuals.
- Hostel/Guest Rooms (20–30 capacity) - For trainees and visiting experts.
- Conference Room - Inter-division and stakeholder meetings.

Functional Components: The Centre would focus on-

- **Training & Capacity Building:** Formal and customised training programmes; On-the-job refresher modules; and Rapid Response Team (RRT) skill enhancement workshops.
- **Research & Knowledge Integration:** Repository of elephant research data; annual “State of Elephants in NER” reporting; and corridor and conflict hotspot analysis updates.
- **Community Interface Wing:** Awareness workshops for EDC members and village volunteers; demonstration of early warning systems; and IEC material development and dissemination.
- **Technology & Innovation Hub:** Drone operations training; GIS-based planning exercises; and Pilot testing of mitigation technologies.

Staffing Pattern (Indicative): Staffing may include a Centre Director, GIS and data specialists, a training coordinator, IT/ MIS support, and field demonstration personnel.

Generally, the Learning Centre would institutionalize continuous skill development, improve conflict response efficiency, strengthen science-based management, enhance coordination across NER divisions, and position the landscape as a national model for elephant conservation governance.

6.5 MONITORING & EVALUATION

Systematic M&E may be carried out to monitor performance of various development and management interventions, and to ensure that lessons learned are replicated accordingly.

6.5.1 Developing M&E Protocols

For effective elephant conservation in the NER, a structured Monitoring & Evaluation (M&E) framework is essential to ensure science-based, measurable, and adaptive management across all divisions.

Objectives of M&E Framework

- Track elephant population trends and distribution changes.
- Monitor human–elephant conflict patterns and mitigation effectiveness.
- Evaluate habitat quality and corridor functionality.
- Assess protection efficiency and response time.
- Enable adaptive management through periodic review.

Key Monitoring Components

A. Elephant Population Monitoring

- *Indicators:* population size and density; age-sex ratio; mortality rates; and movement patterns
- *Methods:* synchronized census (dung count/direct sightings); camera trap sampling; GPS telemetry tracking; and mortality database documentation
- *Frequency*: every 1-2 years (census); continuous telemetry monitoring.

B. Human–Elephant Conflict (HEC) Monitoring

- *Indicators:* number of crop damage incidents; human/elephant casualties; compensation timelines; and conflict hotspot shifts.
- *Methods:* GIS-based conflict mapping; village-level reporting through MIS; and barrier performance evaluation
- *Frequency:* monthly reporting; annual hotspot analysis.

C. Habitat & Corridor Monitoring

- *Indicators:* forest cover change; invasive spread; water availability trends; corridor encroachment
- *Methods:* remote sensing & GIS analysis; permanent vegetation plots; ground truthing surveys
- *Frequency:* annual assessment; 5-year trend review.

D. Protection & Enforcement Monitoring

- *Indicators:* patrol coverage (km per beat); response time to conflict calls; poaching incidents; and infrastructure mitigation compliance
- *Methods:* SMART patrolling analytics; control room data logs; and field audits
- *Frequency:* monthly review; quarterly evaluation.

E. Community & Outreach Monitoring

- *Indicators:* community participation levels; awareness programme coverage; feedback on mitigation measures; and reduction in retaliatory actions
- *Methods:* structured surveys; EDC meeting records; and social perception studies
- *Frequency:* Biannual assessment.

Data Management Protocol

- Centralized NER wildlife database; standardized data collection formats; GIS integration; and periodic data validation.

Log frame-based Monitoring & Evaluation (M&E) Matrix: A standardized M&E protocol transforms elephant conservation in NER from reactive management to a data-driven, adaptive governance system, ensuring measurable conservation impact across all divisions (Fig-6.5).

Objective	Indicators	Means of Verification	Responsibility
Ensure long-term viable elephant population/ reduced conflict in NER	Stable/increasing elephant population; 20–30% reduction in HEC over 5 years	Synchronized census reports; MIS conflict database; annual NER report	PCCF / CCF / FD
Outcome	**Indicators**	**Means of Verification**	**Responsibility**
Improved corridor functionality	% of functional corridors secured; reduced bottlenecks	GIS corridor maps; field validation reports	NER GIS Cell / DFOs
Reduced conflict intensity	Annual decline in crop damage & casualty cases	HEC hotspot maps; compensation records	DFOs
Enhanced protection efficiency	Patrol coverage increased; faster RRT response time	SMART patrol data; control room logs	ACFs / RFOs
Improved habitat quality	Reduction in invasives; improved water retention	Remote sensing analysis; vegetation plots	Research & GIS Unit
Output	**Indicators**	**Means of Verification**	**Responsibility**
Standardized elephant monitoring	Common census protocol adopted across divisions	Circulars; field compliance reports	NER HQ
Functional MIS dashboard	Real-time data entry from all divisions	MIS dashboard reports	IT/GIS Officer
Trained frontline staff	≥70% staff trained annually	Training attendance & certification records	Training Centre
Active Rapid Response Teams	RRT operational in all high-conflict divisions	Deployment records	DFOs
Activity	**Indicators**	**Means of Verification**	**Responsibility**
Quarterly conflict review meetings	4 meetings conducted annually	Minutes of meeting	Divisional HQ
Annual elephant census	Census completed as per schedule	Census documentation	Field Directors
GIS corridor update	Annual map revision	GIS database update log	GIS Cell
Community awareness programs	No. of villages covered	IEC records & feedback forms	Range Officers

Fig-6.5: Development of M&E Log-Frame Matrix for NER

6.5.2 Operation and Effect Indicators

In the NER, Monitoring & Evaluation (M&E) indicators are structured into operational and effect indicators to measure both implementation efficiency and conservation impact.

Operation indicators focus on performance and process efficiency. These indicators assess whether planned activities are being implemented effectively. These include:

1. Elephant Monitoring Operations
- % completion of synchronized elephant census
- Number of functional GPS collars deployed
- Camera trap coverage (km² covered annually)
- Frequency of telemetry data downloads

2. Human–Elephant Conflict (HEC) Response
- Average response time of Rapid Response Teams (minutes/hours)
- % of conflict incidents recorded in MIS within 24 hours
- % of compensation cases processed within prescribed timeframe
- Number of early warning alerts issued per month

3. Protection & Patrolling
- Patrol effort (km per beat per month)
- % of beats covered under SMART monitoring
- Number of anti-poaching camps operational
- Night patrol frequency in high-risk zones

4. Habitat & Corridor Management
- Area treated for invasive species removal (ha/year)
- Number of waterholes maintained/created
- % of identified corridors monitored annually
- Number of mitigation structures installed (signages, speed breakers, underpasses)

5. Capacity Building
- % of frontline staff trained annually
- Number of OJT sessions conducted
- Training satisfaction score (feedback-based)

Effect indicators assess the impact and outcomes of a program or operation. These indicators measure ecological and socio-economic improvements resulting from interventions. These include:

1. Elephant Population Health

- Population trend (increasing/stable/declining)
- Calf recruitment rate
- Elephant mortality rate (natural vs unnatural causes)
- Genetic connectivity between landscape units

2. Conflict Reduction Outcomes

- % reduction in crop damage incidents (annual trend)
- % reduction in human/elephant casualties
- Reduction in high-intensity hotspot villages
- Decrease in retaliatory actions

3. Corridor Functionality

- Number of functional corridors secured
- Reduction in corridor bottlenecks
- Frequency of successful elephant crossings (telemetry data)

4. Habitat Quality Improvement

- Increase in native forage availability
- Reduction in invasive species spread (%)
- Improved water availability duration in dry season

5. Community & Governance Outcomes

- Increase in community participation in mitigation programmes
- Improved perception index (survey-based)
- Improved compensation satisfaction levels

Integrating Operation and Effect Indicators:

For the NER, integrating operational and effect indicators ensures that field performance is directly linked to measurable conservation outcomes. This integration transforms Monitoring & Evaluation (M&E) from activity tracking into a results-based adaptive management system.

Linking Process to Outcomes

- Operational indicators (e.g., patrol effort, response time, GPS collar deployment, invasive removal area) should be explicitly mapped to corresponding effect indicators (e.g., reduced poaching, conflict decline, improved corridor use, habitat recovery).

Cause-Effect Linkage

- Increased patrol coverage → Reduction in illegal activities → Lower unnatural elephant mortality.
- Faster RRT response → Reduced escalation of conflict → Fewer human/elephant casualties.
- Corridor monitoring & mitigation → Improved elephant movement → Strengthened connectivity.

An integrated matrix should align each operational activity with its expected ecological or socio-economic outcome (Table-6.4).

Table-6.4: *Integrated Indicator Matrix*

Operational Indicator	Linked Effect Indicator	Review Frequency
% Patrol Coverage	Decline in poaching & illegal intrusion	Monthly → Annual
RRT Response Time	% Reduction in casualties	Monthly → Annual
Area of invasive removal	Increase in native forage availability	Quarterly → 3-year
Corridor inspections	Increase in successful elephant crossings	Quarterly → Annual
Staff training coverage	Improved field compliance & reduced incidents	Annual

Strategic Significance for NER: Integrating operational and effect indicators ensures that investments in infrastructure, mobility, training, and conflict mitigation produce tangible ecological improvements. It enhances accountability, improves inter-division coordination, supports evidence-based budgeting, and strengthens long-term elephant conservation governance across NER.

6.5.3 M&E Activities

In the NER, a structured Monitoring & Evaluation (M&E) cycle should include baseline surveys, mid-term evaluations, and terminal evaluations, supported by continuous monitoring. This phased approach ensures measurable progress and adaptive management in elephant conservation.

Baseline Surveys (Year 0)

Purpose: To establish benchmark ecological and socio-economic conditions against which future progress can be measured.

Key Baseline Components:

- *Elephant Population & Ecology*: landscape-level population estimation (density, age–sex ratio); mortality data (natural vs unnatural causes); and initial telemetry-based movement mapping.
- *Human–Elephant Conflict (HEC):* 3–5-year historical conflict trend analysis; hotspot village mapping (GIS-based); and average compensation processing time.
- *Habitat & Corridor Status:* forest cover and fragmentation mapping; invasive species extent (ha); corridor functionality and bottleneck identification; and water resource status in dry season.
- *Protection & Governance:* patrol coverage baseline (km/beat/month); RRT response time benchmark; and infrastructure availability (vehicles, control rooms, barriers).
- *Community & Perception:* baseline community perception survey; and level of awareness on coexistence practices.

Key Considerations:

- Use standardized protocols across all divisions.
- Ensure GIS-based spatial documentation.
- Engage independent technical experts for credibility.
- Archive baseline data in centralized NER database.

Mid-Term Evaluation (Year 2–3)

Purpose: To assess implementation progress, identify bottlenecks, and recalibrate strategy.

Key Focus Areas:

- *Operational Performance Review:* patrol coverage improvement (%); training coverage (% staff trained); infrastructure deployment (vehicles, GIS units, early warning systems)

- *Early Effect Indicators:* trend in conflict frequency (increase/stable/decline); response time improvement; and mortality trend comparison with baseline
- *Habitat & Corridor Progress:* area restored or treated for invasives; reduction in corridor obstructions; and waterhole improvement status
- *Financial & Institutional Efficiency:* fund utilization rate; inter-division coordination effectiveness; and MIS functionality and reporting compliance

Key Considerations

- Conduct participatory review workshops.
- Compare against baseline benchmarks.
- Adjust mitigation strategies where outcomes are weak.
- Document lessons learned and best practices.

Terminal Evaluation (Year 5)

Purpose: To assess overall conservation impact and long-term outcomes.

Key Impact Assessment Areas:

- *Elephant Population Status:* population trend (increase/stable/decline); calf recruitment rate improvement; and reduction in unnatural mortality.
- *Conflict Reduction Impact:* % reduction in annual crop damage cases; % reduction in human/elephant casualties; and shift in hotspot intensity map.
- *Corridor & Habitat Integrity:* number of corridors legally secured; connectivity improvement (telemetry validation); and reduction in invasive species spread (%).
- *Governance & Sustainability:* institutionalization of M&E system; capacity built (staff competency levels); and community participation index improvement.

Key Considerations

- Independent third-party evaluation recommended.
- Use both quantitative data and qualitative interviews.
- Conduct cost-effectiveness analysis.
- Develop roadmap for next 5-year phase.

Continuous monitoring throughout the five-year period- through monthly reporting, quarterly reviews, annual landscape assessments, and GIS-based dashboards- ensures accountability, and data-driven adaptive management across the entire NER landscape.

Strategic Importance for NER: A structured baseline-midterm-terminal M&E cycle ensures that elephant conservation investments in NER are measurable, adaptive, and outcome-oriented. It strengthens transparency, supports evidence-based policy refinement, improves inter-division coordination, and ensures long-term ecological and socio-economic sustainability across the landscape.

6.5.4 Scientific spatial monitoring

Scientific spatial monitoring in the NER integrates GIS, remote sensing, telemetry, and field-based data to support landscape-level elephant conservation across divisions. It enables real-time, science-based decision-making by spatially mapping elephant movement, habitat condition, and conflict dynamics.

- *Elephant Movement & Range Mapping*: A key component is GPS telemetry and camera trap-based monitoring to track elephant home ranges, seasonal migrations, and corridor usage. This helps identify movement bottlenecks, validate corridor functionality, and guide mitigation measures such as underpasses and speed regulation zones.

- *Human-Elephant Conflict (HEC) Spatial Analytics*: Spatial analysis of human-elephant conflict involves GIS-based hotspot mapping of crop damage, casualties, and property loss, overlaid with land use and infrastructure layers. Monthly updates allow predictive deployment of Rapid Response Teams and targeted mitigation in high-risk villages.
- *Habitat & Land Use Monitoring*: Habitat monitoring uses satellite imagery and drone surveys to assess forest cover change, fragmentation, invasive spread, water availability, and fire incidence. The spatial layers support habitat restoration, drought preparedness, climate-resilient planning.

Technology Integration: Centralized NER GIS Lab with high-resolution satellite access; Drone-based mapping for micro-level assessments; Integration of SMART patrol data with spatial layers; Real-time telemetry dashboard linked to MIS and Spatial decision-support system for officers.

Key Spatial Indicators: Following indicators could be envisaged:

Category	**Key Spatial Indicator**
Elephant Ecology	Home range stability index
Conflict	Incidents per km² (monthly trend)
Habitat	Fragmentation index
Corridor	Corridor functionality score
Water Security	Dry-season water persistence index
Protection	Patrol intensity heat map

Monitoring Frequency

- Telemetry data - Continuous (real-time)
- Conflict hotspot mapping - Monthly updates
- Forest cover and habitat mapping - Annual review
- Corridor status assessment - Quarterly field validation
- Long-term landscape trend analysis - Every 3–5 years.

Governance & Review Protocol

- Monthly: Conflict & patrol spatial review (Division).
- Quarterly: Corridor & telemetry trend review (NER HQ).
- Annually: Habitat & landscape change analysis.
- 5-Year: Connectivity & climate resilience assessment.

Core Spatial Data Layers Framework

An integrated GIS-MIS framework at NER level links telemetry data, patrol logs, conflict reports, and habitat indicators into a unified dashboard (Table-6.5).

Table-6.5: Core Spatial Data Framework for NER

Data Layer	Purpose	Tools/Technology	Responsible Unit	Update Frequency
Elephant GPS Telemetry	Movement routes, home range, corridor	GPS collars, VHF, telemetry software	NER GIS Cell + Divisions	Real-time / Weekly
Elephant Census Density Map	Population distribution & trend	Dung count, camera traps, GIS	Division teams + NER HQ	1–2 years
Human–Elephant Conflict Hotspots	Identify high-risk villages/ seasonal shifts	MIS dashboard + GIS heat maps	Divisional HQ	Monthly
Corridor Boundary Bottlenecks	Connectivity and obstruction tracking	Satellite imagery + ground validation	GIS Cell	Annual review
Forest Cover & LULC	Habitat quality & fragmentation	Remote sensing (Sentinel/Landsat)	GIS Cell	Annual
Invasive Species Extent	Habitat degradation assessment	Drone survey + field plots	Range Offices	Annual
Water Resource Mapping	Drought preparedness planning	GPS mapping + seasonal monitoring	Beat/Range Officers	Pre- & post-summer
Fire Incidence Layer	Fire risk & recurrence	MODIS/VIIRS fire alerts	GIS Cell	Seasonal
Patrol Coverage (SMART)	Protection efficiency	SMART + GPS logs	Range Officers	Monthly
Infrastructure-Roads, Railways	Barrier impact analysis	GIS overlay	GIS Cell	Annual

Strategic Benefits for NER: Scientific spatial monitoring enables- Predictive conflict mitigation; Evidence-based corridor protection; Early detection of habitat degradation; Optimized deployment of patrol and Rapid Response Teams; and Climate-resilient landscape planning.

6.5.5 Concurrent evaluation and application

In the NER, concurrent evaluation refers to continuous assessment of implementation and outcomes while conservation activities are ongoing. Unlike mid-term or terminal evaluations, it provides real-time feedback to improve performance and ensure adaptive management.

- Concurrent evaluation integrates **operational indicators** (such as patrol coverage, response time, telemetry tracking, and conflict reporting) with **effect indicators** (such as reduction in conflict incidents, improved corridor use, and mortality trends). This linkage allows managers to immediately assess whether field efforts are translating into measurable conservation outcomes.
- Application of concurrent M&E in NER involves monthly divisional reviews of conflict data, patrol analytics, and infrastructure functionality, supported by GIS-based dashboards. Quarterly landscape-level assessments examine corridor integrity, hotspot shifts, and habitat condition. These reviews help identify underperforming strategies and trigger corrective actions, such as redeploying Rapid Response Teams, strengthening barriers, or adjusting patrol routes.
- Some key aspects in concurrent evaluation along with potential application includes ecological assessment, elephant population dynamics, human-elephant conflict, community engagement, enforcement & anti-poaching measures, and infrastructure and administrative aspects.
- A centralized MIS and GIS platform is critical for concurrent evaluation. Real-time data entry from field staff, telemetry feeds, and SMART patrol logs must be integrated into a unified

dashboard at NER headquarters. Standardized reporting formats and defined responsibility at beat, range, divisional, and landscape levels ensure accountability.

Key considerations include timely data validation, regular inter-division coordination meetings, transparency in reporting, and periodic external technical review. Confidential handling of sensitive spatial data, especially elephant movement information, is also essential.

By institutionalizing concurrent evaluation, NER can shift from reactive management to proactive, evidence-based governance- ensuring rapid problem identification, efficient resource deployment, and sustained improvements in elephant conservation outcomes across the landscape.

6.5.6 Review Meetings & Workshops

In the NER, regular review meetings and workshops are essential to ensure coordinated elephant conservation, effective conflict mitigation, and adaptive management across the landscape.

- *Monthly divisional review meetings* focus on operational performance, including HEC trends, patrol coverage, response time of RRT, telemetry updates, and mitigation infrastructure functionality. These meetings help address immediate field challenges and resource gaps.
- *Quarterly landscape-level reviews* at NER headquarters assess cross-division coordination, corridor functionality, elephant mortality trends, habitat condition, and budget utilization. These reviews enable strategic decision-making & alignment of conservation priorities across divisions.
- *Thematic technical workshops* conducted annually strengthen expertise in areas such as GIS and spatial monitoring, conflict mitigation strategies, veterinary rescue protocols, corridor protection, and climate-resilient habitat management. These forums promote knowledge exchange and standardization of best practices.
- *Community interface workshops* in high-conflict divisions enhance awareness on coexistence, EWS, and compensation processes, fostering local participation and trust. An annual NER-level conservation conclave can consolidate lessons learned, review performance, and refine strategies for the following year, ensuring transparency and sustained conservation impact.

6.5.7 Pilot studies

In the NER, covering Nilgiris, Gudalur, MTR, STR, Erode, Dharmapuri and Hosur divisions, pilot studies are essential to test innovative approaches before scaling them across the landscape. These pilots help evaluate feasibility, cost-effectiveness, ecological impact, and community acceptance.

Pilot studies play a crucial role in understanding and addressing specific challenges or testing new approaches within an elephant reserve. These studies are typically small-scale, experimental initiatives designed to gather information, assess feasibility, and inform larger-scale interventions.

Some suggested pilot studies in the NER include:

1. GPS Telemetry Pilot

- *Objective:* Track movement of elephants to validate corridors identify conflict-prone routes.
- *Location:* Gudalur-Nilgiris-STR interface.
- *Outcome:* Evidence-based corridor protection and predictive conflict mitigation.

2. Smart Early Warning System Pilot

- *Objective:* Test AI-based or sensor-based alert systems in high-conflict villages.
- *Location:* Hosur and Dharmapuri divisions.
- *Components:* Thermal sensors, SMS alerts, village siren systems.

- Outcome: Reduced response time and fewer crop damage incidents.

3. Solar Fencing & Barrier Effectiveness Study

- *Objective:* Compare performance of different mitigations (solar fencing, EPT, steel rope etc).
- *Location:* Erode & Gudalur divisions.
- *Outcome:* Cost–benefit analysis and best-practice recommendations.

4. Corridor Restoration Pilot

- *Objective:* Remove invasive species and restore forage in identified corridor bottlenecks.
- *Location:* STR-MTR connectivity zones.
- *Outcome:* Improved corridor functionality and elephant movement frequency.

5. Drone-Based Monitoring Pilot

- *Objective:* Use drones for rapid surveillance in inaccessible terrain and night monitoring.
- *Location:* Nilgiris and MTR landscapes.
- *Outcome:* Enhanced detection of elephant presence and illegal activities.

6. Community-Based Conflict Monitoring Pilot

- *Objective:* Train village volunteers to record and report elephant movement in real time.
- *Location:* High-conflict villages in Gudalur and Hosur.
- *Outcome:* Strengthened community participation and early intervention.

7. Climate Resilience & Water Security Pilot

- *Objective:* Monitor seasonal water availability and create climate-resilient water points.
- *Location:* Dharmapuri and Erode dry forest divisions.
- *Outcome:* Reduced dry-season elephant dispersal into agricultural lands.

Key Considerations for Pilot Implementation

- Clearly defined objectives and measurable indicators.
- Limited, well-defined geographic scope.
- Strong baseline data before implementation.
- Independent evaluation after 12–24 months.
- Scalability assessment before landscape-wide expansion.
- Community consultation and ethical safeguards.

Strategic Value: Pilot studies in NER provide innovation pathways, reduce financial risks, validate technologies, and generate scientific evidence for scaling effective elephant conservation strategies across the entire landscape.

6.5.8 Thematic studies and documentation

In the NER, thematic studies and systematic documentation are essential for strengthening evidence-based elephant conservation and long-term landscape governance. Thematic areas envisaged include:

1. Elephant Ecology & Population Dynamics

- Population structure (age–sex ratio, recruitment rate).
- Seasonal migration and home range studies.
- Mortality analysis (natural vs unnatural causes).
- Behavioural studies in conflict-prone landscapes.
- *Documentation Output:* Periodic "Status of Elephants in NER" report, technical monographs.

2. Human–Elephant Conflict (HEC) Studies

- Spatial and temporal trend analysis of conflict incidents.
- Economic valuation of crop loss and mitigation costs.
- Effectiveness of barriers (solar fencing, EPTs, early warning systems).
- Social perception and coexistence studies.
- *Documentation Output:* Conflict hotspot atlas, mitigation evaluation reports, policy briefs.

3. Habitat & Corridor Studies

- Corridor functionality assessment and bottleneck analysis.
- Forest cover change and fragmentation studies.
- Invasive species impact assessment.
- Water resource and forage availability analysis.
- *Documentation Output:* Corridor status reports, habitat restoration manuals, GIS atlases.

4. Climate Change & Resilience Studies

- Rainfall variability and drought impact analysis.
- Phenological shifts and vegetation response.
- Fire regime documentation.
- Climate vulnerability assessment for elephants.
- *Documentation Output:* Climate adaptation strategy document for NER.

5. Protection & Governance Studies

- Patrol efficiency analysis (SMART-based).
- Evaluation of Rapid Response Team effectiveness.
- Institutional capacity assessment.
- Cost-effectiveness of conservation investments.
- *Documentation Output:* Performance reports, governance improvement recommendations.

6. Community & Livelihood Studies

- Role of EDCs in conflict mitigation.
- Livelihood diversification and compensation efficiency.
- Participatory monitoring documentation.
- *Documentation Output:* Case studies, community engagement / best practice manuals

7. Technology & Innovation Documentation

- Telemetry and drone application studies.
- Early warning system performance documentation.
- GIS-based decision support system development.
- *Documentation Output:* Technical guidelines and SOP manuals.

Key Considerations

- Standardized data collection protocols across divisions.
- GIS-based spatial documentation for all thematic studies.
- Collaboration with national research institutions.
- Periodic publication and public dissemination of findings.
- Archival of data in centralized NER database.

Strategic Importance: Thematic studies and structured documentation in NER ensure continuity of knowledge, strengthen adaptive management, support funding, inform policy decisions, and position the landscape as a model for science-based elephant conservation at national & international levels.

6.5.9 Publications

In the NER, regular publications such as annual reports and newsletters play an important role in strengthening transparency, documentation, and stakeholder engagement in elephant conservation.

- *Annual Report:* An annual "State of Elephants in NER" report should provide a comprehensive overview of elephant population trends, mortality patterns, human-elephant conflict statistics, corridor functionality, habitat condition, protection performance, infrastructure development, training achievements, and financial utilization. GIS-based maps, comparative data, key recommendations, and policy-relevant summaries make the report useful for government authorities, research institutions, and funding agencies.
- *Newsletter:* Quarterly or biannual newsletters can provide concise updates on field activities, conflict mitigation efforts, community engagement initiatives, patrol highlights, technology use, and training programmes. These newsletters help maintain communication with forest staff, local communities, NGOs, and academic partners, while documenting field-level innovations and success stories.
- *Bulletins:* Thematic technical bulletins may also be published periodically to focus on specific subjects such as corridor status, conflict mitigation performance, habitat restoration, or climate resilience. A structured editorial system, standardized data reporting formats, GIS integration, timely publication schedules, and digital archiving are essential to ensure credibility and continuity of the publication system in NER.

Publishing annual reports and newsletters in local language is an effective method to communicate the activities, achievements, challenges, and important information related to an elephant reserve. These publications serve as valuable tools for engaging stakeholders, sharing knowledge, and raising awareness about conservation efforts.

6.5.10 Website and information dissemination

In the NER, a dedicated website and structured information dissemination system are essential to promote transparency, stakeholder engagement, and awareness in elephant conservation.

- *Web Portal:* A dedicated NER web portal should provide landscape information, conservation dashboards, HEC advisories, corridor and habitat updates, downloadable annual reports and newsletters, research documentation, training updates, and a citizen interface. A simplified public dashboard with aggregated GIS-based data can present conflict trends and conservation progress while ensuring confidentiality of sensitive movement information.
- *Information Dissemination:* Information dissemination should combine digital outreach- such as website updates, email newsletters, and SMS alerts- with community-level communication through IEC materials, awareness meetings, and local-language advisories in high-conflict villages. Media engagement and periodic press releases can further enhance public visibility and institutional credibility.

Regular content updates, bilingual presentation (English and Tamil), integration with GIS and MIS systems, and strong data confidentiality protocols are critical for effective implementation. A well-managed website and communication strategy will strengthen public trust, encourage research collaboration, and support evidence-based elephant conservation across NER.

6.6 USE OF INNOVATIVE TECHNIQUES/ TECHNOLOGIES

In the NER adoption of innovative technologies can significantly enhance predictive conflict mitigation, corridor protection, habitat monitoring, and governance efficiency. Several innovative approaches and technologies that can be applied in an elephant reserve, include:

1. GPS Telemetry & Satellite Tracking

- Deployment of GPS collars on select elephants.
- Real-time movement monitoring and home range mapping.
- Corridor validation and bottleneck identification.
- Early warning alerts when elephants approach villages.
- *Benefit:* Predictive conflict management and science-based corridor conservation.

2. Drone & Thermal Imaging Surveillance

- Drone patrols in inaccessible or high-conflict areas.
- Thermal cameras for night-time elephant detection.
- Rapid aerial assessment of forest fires or illegal activities.
- *Benefit:* Improved surveillance coverage and reduced response time.

3. AI-Based Early Warning Systems

- Motion and thermal sensor towers in conflict-prone villages.
- AI-powered image recognition to distinguish elephants from other wildlife.
- Automated SMS alerts and siren systems.
- *Benefit:* Reduced crop damage and improved community safety.

4. Integrated GIS & MIS Platforms

- Centralized dashboard integrating telemetry, conflict data, and patrol logs.
- Real-time hotspot mapping and spatial analytics.
- Decision-support tools for officers.
- *Benefit:* Data-driven, adaptive management across divisions.

5. SMART Patrolling & Mobile Apps

- GPS-enabled patrol tracking.
- Mobile-based conflict reporting by field staff.
- Beat-level digital documentation.
- Community-Based Mobile Apps
- *Benefit:* Enhanced protection efficiency and accountability.

6. Innovative Mitigation Technologies

- Solar-powered fencing with remote monitoring.
- Bee-hive fencing trials in selected villages.
- Low-cost chili rope deterrents.
- Elephant detection systems along roads and railways.
- *Benefit:* Cost-effective and locally adaptable mitigation measures.

7. Remote Sensing & Climate Analytics

- Satellite-based forest cover monitoring.
- Drought prediction and water availability mapping.
- Fire alert systems using MODIS/VIIRS data.
- Environmental DNA (eDNA) Analysis

- *Benefit:* Climate-resilient habitat management.

8. Data Analytics & Predictive Modelling

- Conflict prediction models based on seasonal trends.
- Risk zonation maps for vulnerable villages.
- Cost–benefit modelling of mitigation investments.
- *Benefit:* Optimized resource allocation and long-term sustainability.

Key Considerations

- Dedicated GIS & IT team at NER level.
- Standardized data protocols across divisions.
- Community consultation before technology deployment.
- Data security for sensitive elephant movement information.
- Pilot testing before landscape-wide scaling.

Fig-6.6: Drone-based Monitoring in Gudalur division

Strategic Impact

Innovative technologies enable NER to transition from reactive responses to proactive, intelligence-based elephant conservation. By integrating telemetry, AI, spatial analytics, and community-based early warning systems, NER can reduce conflict, secure corridors, enhance habitat resilience, and establish itself as a model elephant landscape in India.

6.7 COMPLIANCE OF MANAGEMENT EFFECTIVENESS EVALUATION

In the NER having key tiger reserves (MTR & STR); PAs (Thanthai-Periyar, Erode, Cauvery North & South WLS, Hosur & Dharmapuri) and forest divisions (Nilgiris & Gudalur), compliance with Management Effectiveness Evaluation (MEE) ensures that elephant conservation is systematically planned, implemented, monitored, and improved.

- Pilot-testing of the NER was done in Sept 2023 with the overall score of 81.82%

Compliance involves maintaining updated elephant conservation plan (ECP) that integrate corridor conservation, conflict mitigation, climate resilience, and landscape-level planning. Adequate staffing, trained personnel, functional GIS and MIS systems, SMART-based patrolling, and proper infrastructure support are essential to meet input and process standards under MEE.

Output and outcome compliance requires measurable conservation results, including stable or increasing elephant populations, reduced human-elephant conflict, secured corridors, improved habitat quality, and strengthened community participation. These outcomes must be supported by quantitative data and annual reporting.

Proper documentation- through annual reports, GIS-based monitoring records, review meeting minutes, and periodic third-party evaluations- ensures transparency & accountability. Strengthening coordination across divisions, standardizing reporting formats, and conducting regular internal audits can further improve MEE compliance in NER, reinforcing its role as a model elephant conservation landscape.

6.8 ORGANISATION AND ADMINISTRATION

In the NER, covering Nilgiris, Gudalur, MTR, STR, Erode, Dharmapuri & Hosur administrative divisions, a structured organizational and administrative framework is essential for coordinated elephant conservation and conflict management across the landscape.

6.8.1 Structure and Responsibilities

The NER is constituted into several administrative and functional units. Some lie under the PA network governed by the WLPA, 1972 and others are managed as forest divisions as per the National Working Plan Code, 2023, prescriptions emanating from the IFA, 1927 or/ and the State enacted Forest Acts and other environmental legislations.

As per the 'Framework of the Elephant Conservation Plan' (MoEFCC, 2024), organizational structure for NER, along with key responsibilities at each level for different functional units may be as follows:

1. ***Nilgiri Elephant Reserve Management Committee (NERMC)**:* Overseeing and coordination of all activities within the NER - develop and implement ER conservation policies; distribute fund; engage with stakeholders and partners; create functional units as per the requirements; and oversee the overall management effectiveness.
2. ***Nilgiri Elephant Reserve Coordinator (NERC)**:* Day-to-day management and coordination of NER activities - implement the conservation plan; coordinate with all administrative units; liaise with govt bodies and other organizations; and report to the NERMC. One of the Directors of the Tiger Reserve (MTR/STR) could be designated as the NERC. He may also be made responsible for constituting various functional units in the NER as per necessity and approved by NERMC.
3. ***Functional Units**:* The NERMC may have **one or more functional units** as per necessity:

   The indicative list of Functional Units is as under:

- ***Research and Conservation Unit**:* Conduct research and monitor conservation efforts - conduct scientific studies on elephants, flora, and fauna; monitor population dynamics and habitat health; implement conservation initiatives based on research findings; and contribute to the development of conservation plans.
- ***Law Enforcement Unit**:* Enforce wildlife protection laws and prevent poaching - conduct regular patrols to deter illegal activities; investigate and address instances of poaching; implement anti-poaching strategies; and collaborate with local law enforcement agencies.
- ***Community Engagement & Liaison Unit**:* Create positive relationships with local communities - facilitate communication between the reserve and local communities; implement community-based conservation initiatives; address human-elephant conflict issues; and organize educational programs and workshops.
- ***Habitat Management and Restoration Unit**:* Preserve and rehabilitate the natural habitat - monitor vegetation health and implement habitat management strategies; conduct ecological restoration works; collaborate with researchers to assess habitat changes; and integrate climate change adaptation measures.

- ***Visitor Services and Tourism Unit**:* Manage responsible eco-tourism activities - develop and maintain visitor facilities; educate tourists on responsible wildlife viewing; implement visitor guidelines to minimize impact; and generate revenue to support conservation efforts.
- ***Environmental Education and Outreach Unit**:* Raise awareness and promote conservation education - develop educational programs for schools and local communities; organize outreach events and workshops; collaborate with media for public awareness campaigns; and monitor and evaluate the effectiveness of educational initiatives.
- ***Technology and Data Management Unit**:* Utilize technology for data collection and analysis - implement Geographic Information System (GIS) and remote sensing technologies; manage databases for wildlife monitoring; integrate technology for anti-poaching efforts; and support research initiatives with modern tools.
- ***Legal Compliance and Policy Unit**:* Ensure adherence to conservation laws and policies - monitor legal compliance in all reserve activities; develop and update policies as needed; liaise with legal authorities; and conduct regular audits to ensure compliance.
- ***Emergency Response Unit**:* Plan for and respond to emergencies - develop emergency response protocols; coordinate with local authorities for disaster preparedness; ensure staff safety during emergencies; and conduct regular drills and training.
- ***Communication and Public Relations Unit**:* Manage communication and public relations - disseminate information to the public and media; manage the reserve's website and social media; organize public events and awareness campaigns; and respond to media inquiries.
- ***Monitoring and Evaluation Unit**:* To assess and improve management effectiveness - conduct regular evaluations of conservation programs; monitor the implementation of the management plan; collect feedback from stakeholders; and adapt strategies based on evaluation outcomes.

By establishing a well-defined structure and clearly assigning responsibilities, NER can optimize its efforts toward conservation, habitat management, and community engagement, ultimately contributing to the long-term sustainability of elephant populations and their ecosystems.

6.8.1.1 Constitution of the Elephant Conservation Foundation (ECF)

The proposed Elephant Conservation Foundation (ECF) could be established as an autonomous, not-for-profit institution under the Government of Tamil Nadu. The Foundation should complement, rather than duplicate, the existing Tiger Conservation Foundations (TCFs) of MTR and STR, which already manage conservation programmes within their respective Tiger Reserve jurisdictions.

- *Legal Status & Jurisdiction*: The ECF should be constituted as a public charitable trust with independent financial and administrative powers under the overall administrative control of the Tamil Nadu Forest Department. Its jurisdiction should be restricted to the territorial forest divisions and wildlife sanctuaries falling within the Nilgiri Elephant Reserve but outside the notified Tiger Reserves, including Nilgiris Forest Division, Gudalur Forest Division, Erode Forest Division, Dharmapuri Forest Division, Hosur Forest Division, Thanthai Periyar Wildlife Sanctuary, Cauvery North Wildlife Sanctuary, and Cauvery South Wildlife Sanctuary.
- *Objectives*: The primary objective of the Foundation should be to strengthen elephant conservation across the non-Tiger Reserve landscape through sustained financial support, scientific management, habitat restoration, corridor conservation, mitigation of human–elephant conflict, veterinary care, rescue and rehabilitation, research, monitoring, community participation, and capacity building. The Foundation should also promote innovative

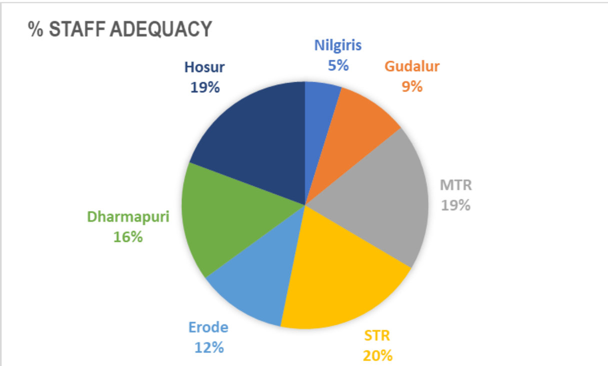
technologies such as GIS, remote sensing, artificial intelligence, telemetry, and early warning systems to improve conservation effectiveness and adaptive management.

- *Areas of Operation*: The Foundation should support a broad range of conservation interventions, including restoration of degraded habitats and elephant corridors, development of water sources, invasive species management, establishment of mobile veterinary units, disease surveillance under the One Health framework, GPS-based elephant monitoring, ecological research, strengthening of Rapid Response Teams, installation and maintenance of conflict mitigation infrastructure, community-based conservation programmes, livelihood improvement initiatives, and specialised training for frontline forest staff, veterinarians, mahouts, and local communities.
- *Governing Board*: The ECF should be governed by a multidisciplinary Board chaired by the Hon'ble Minister of Forests with Additional Chief Secretary (ECCF) as Vice Chairman and both Principal Chief Conservator of Forests, Head of Forest Force & Chief Wildlife Warden, Tamil Nadu as members and NER Coordinator as the Member-Secretary. There should be representation from the Forest Department, District Administrations, Animal Husbandry, Agriculture, Rural Development, Tribal Welfare, research institutions, universities, technical experts, EDCs, tribal communities, women's Self-Help Groups, farmer representatives, and conservation organisations, as in Tiger Conservation Foundations. An Executive Committee headed by the Conservator of Forests may function as the NER Coordinator (as nominated by the Government) and should be responsible for day-to-day administration, financial management, project implementation, and coordination among participating divisions.
- *Financial Resources*: Financial resources for the Foundation should be mobilised from Project Elephant, the Government of Tamil Nadu, CAMPA, Corporate Social Responsibility (CSR) initiatives, research grants, philanthropic donations, international conservation assistance (subject to statutory approvals), and other legally permissible funding sources. Like Tiger Conservation Foundation, ECF should also be authorised to have revenue from the ecotourism and other levies (like C-fees, fines etc). The ECF should maintain independent audited accounts, adopt transparent financial management practices, and ensure that its funds are utilised exclusively for activities within the non-Tiger Reserve jurisdiction. Funds allocated to the Tiger Conservation Foundations of MTR & STR should remain entirely separate.
- *Institutional Coordination*: To facilitate landscape-level conservation, the Foundation should coordinate closely with the Tiger Conservation Foundations of Mudumalai and Sathyamangalam on matters such as elephant corridor management, transboundary elephant movements, landscape-scale population monitoring, disease surveillance, research, climate resilience, and management of human-elephant conflict along reserve boundaries. Such coordination should be achieved through a Nilgiri Elephant Reserve Coordination Committee while preserving the financial autonomy and statutory responsibilities of each Foundation.
- *Monitoring & Evaluation*: The performance of the ECF should be evaluated through measurable indicators such as reduction in human-elephant conflict, improvement in habitat quality and corridor functionality, decline in unnatural elephant mortality, enhanced veterinary response, increased community participation, successful implementation of conservation projects, and effective mobilisation of financial resources. Independent periodic evaluations should be undertaken to assess conservation outcomes and strengthen adaptive management.

Overall, the Elephant Conservation Foundation should fill the existing institutional gap in elephant conservation across the territorial forest divisions of the Nilgiri Elephant Reserve by providing a dedicated mechanism for financing, planning, coordination, research, community engagement, and scientific management. Operating in close partnership with, but without overlapping the mandates of, the Tiger Conservation Foundations, the ECF would ensure comprehensive, landscape-scale conservation of elephants across the entire Nilgiri Elephant Reserve.

6.8.2 Staff Adequacy and Amenities

Ensuring adequate staffing in an elephant reserve are crucial components of effective conservation and management efforts. A well-supported and equipped staff contributes to the successful implementation of conservation programs, habitat management, and community engagement initiatives.



Division	Staff Nos	%
Nilgiris	76	**5**
Gudalur	148	**9**
MTR	304	**19**
STR	311	**20**
Erode	186	**12**
Dharmapuri	247	**16**
Hosur	305	**19**

Fig-6.7: Staff Adequacy in the various administrative units of NER

Staff Adequacy: envisages assessment of the current and future needs of the NER in terms of human resources; constitution of a multidisciplinary expert team and equipping staff members with diverse skills; implementation of training programs; establishment of frontline staff teams responsible for patrolling, anti-poaching efforts, monitoring; and constitution of various functional units as detailed under NERMC.

- From the data, it is evident that in respect of NER, Tiger Reserve (MTR & STR) as well as Protected Areas (CNWLS & CSWLS) are well supported by the sanctioned staff strength.

Amenities and Infrastructure: envisages well-maintained residential facilities for on-site staff; establishment of well-equipped office and technology infrastructure; creation of training facilities; acquisition of tools, equipment, vehicles, and communication devices; establishment emergency response facilities, research facilities, visitor facilities and information dissemination facilities etc.

6.8.3 HRD & Performance linked Incentives

In the NER, Human Resource Development (HRD) and performance-linked incentives are critical to enhance motivation, accountability, and effectiveness in elephant conservation and conflict mitigation.

1. Human Resource Development (HRD) Strategy

- *Capacity Building:* through regular formal and customised training programmes; On-the-Job training (OJT) for conflict response and telemetry tracking; GIS, SMART patrolling, and MIS skill development; and veterinary and rescue protocol training.
- *Skill Specialization:* through dedicated RRT members trained in conflict management; GIS/spatial analytics specialists at divisional level; elephant behaviour and corridor management experts.
- *Career Development:* through certification-based skill recognition; exposure visits to other elephant reserves; and participation in national workshops and conferences.

2. Performance-Linked Incentives Framework

- *Individual-Level Incentives:* by recognition for outstanding conflict response; awards for best patrol performance (SMART-based metrics); incentives for accurate and timely MIS reporting; and special commendation for innovation in mitigation measures.
- *Team-Level Incentives:* through annual award for “Best Performing Range” in conflict reduction; recognition for RRT teams with improved response times; division-level performance ranking.
- *Non-Monetary Incentives:* through public recognition during annual NER conclave; certificates of merit & commendation letters; and preference in training nominations and career advancement.

3. Performance Metrics for Incentives

Incentives should be linked to measurable indicators such as:

- Reduction in human–elephant conflict incidents.
- Patrol coverage and compliance rates.
- Timely compensation processing.
- Corridor monitoring and mitigation success.
- Community satisfaction index.

Strategic Importance: A structured HRD and performance-linked incentive system enhances staff morale, improves operational efficiency, reduces burnout in high-conflict zones, strengthens accountability, and promotes innovation. By linking performance with measurable conservation outcomes, NER can have a motivated workforce capable of delivering sustained and adaptive elephant conservation across the landscape.

6.8.4 Complaints monitoring

In the NER, a structured complaints monitoring system is essential to ensure transparency, accountability, and improved public trust in elephant conservation and conflict mitigation efforts.

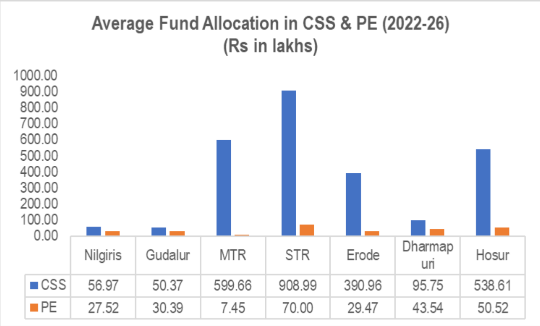
- *Types of Complaints*: The system should address grievances related to HEC incidents, delays in compensation, mitigation infrastructure failures, staff conduct, and corridor obstructions.
- *Complaint Registration Mechanisms*: Multiple complaint registration channels- such as toll-free numbers, mobile reporting, village-level registers, and online portals- should be made accessible.
- *Monitoring & Tracking System*: Each complaint should receive a unique ID, be digitally recorded in the MIS, and follow defined response timelines with escalation protocols for delays.
- *Review & Accountability*: Monthly divisional reviews and quarterly NER-level assessments should evaluate resolution efficiency, supported by documented Action Taken Reports.
- *Community Feedback*: Community feedback mechanisms, public display of grievance contacts, bilingual communication, and annual grievance summaries will enhance transparency.

Integration with conflict/ compensation databases, staff training in grievance handling, and confidentiality safeguards are key to ensuring fairness and effectiveness in complaints monitoring across NER.

6.9 THE BUDGET

The financial allocation or budgeting for NER would depend on various factors such as the size of the reserve, the number of elephants, conservation goals, and the specific activities undertaken for the management and protection of elephants and their habitat.

Allocation in CSS and PE Scheme (2022-26



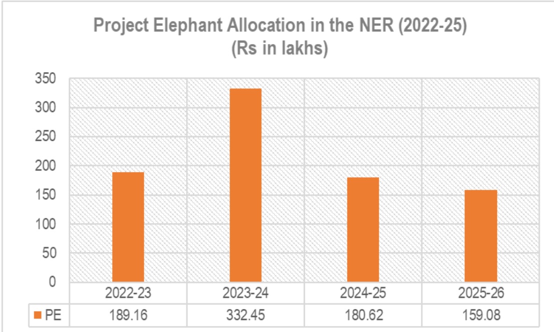


Fig-6.8: Annual Allocation of fund (Rs in lakhs) in CSS and Project Elephant Scheme (2022-26)

From the above graph, there appears to be decline in allocation of funds under Project Elephant Scheme in the Nilgiri Elephant Reserve, which needs to be further strengthened.

6.9.1 The Plan Budget

Typically, the budget for NER may include the following broad (indicative) components:

A. ***Habitat Improvement & Connectivity***: includes phasing out monocultures; eradication of invasives; development of grasslands; augmentation of water resources; corridor acquisition, improvement & restoration; forest fire management (Rs. XX crores).
B. ***HEC Mitigation Measures***: includes erection & maintenance of physical barriers; ex-gratia payment; human resource for managing conflict; early warning system; state/area specific conflict management (Rs. XX crores).
C. ***Elephant Protection & Anti-poaching Measures***: includes establishing and maintaining APC facilities; remuneration, equipment, technology to prevent poaching; elephant heath; veterinary care and elephant camps (Rs. XX crores).
D. ***Ecological Sustainable Development***: includes tribal development, ecotourism development, EDCs & ETMCs, eco-development activities; zonal development in ESZ (Rs. XX crores).
E. ***Infrastructure Development & Capacity Building***: includes establishment, and operation of control centre; procurement of all-terrain vehicles, drones, camera traps, drugs etc; capacity building; thematic trainings and skill development (Rs. XX crores).
F. ***Community/stakeholder's involved Conflict Management, Awareness & Education***: includes formation of committees; awareness creation; workshops, seminars, meetings; intelligence networks; awareness materials (Rs. XX crores).
G. ***Research, Monitoring & Inter State Coordination***: includes population estimation; understanding habitat fragmentation, corridors & bottlenecks; interstate coordination meetings; demographic structure; purchase of computers, GIS software (Rs. XX crores).

A **total allocation** of Rs **XX** crores has been proposed for the above 7 major components with each having 5 sub-components/ activities (***Annexure-1***) and with justification (***Annexure-2***).

Prioritization of Components & Sub-components:

All the activities (sub-components) have been prioritized into following 4 categories (represented by coloration) as under:

Priority	Colour Code		Number of Activities
Priority-I		Red	8
Priority-II		Orange	9
Priority-III		Yellow	9
Priority-IV		Grey	9

6.9.2 Operational cost

The operational costs in NER encompass various expenses associated with the day-to-day management, conservation efforts, and maintenance of the reserve. These costs are critical for ensuring the effective functioning and protection of the reserve.

- *Personnel Salaries:* includes salaries for the field and administrative staff, and other personnel.
- *Vehicles Maintenance:* includes fuel for vehicles including repairs and maintenance costs.
- *Stores and Equipment:* includes uniforms, boots, communication devices, medical supplies.
- *Infrastructure Maintenance:* includes costs for maintaining roads, office and residential buildings.
- *Upkeep of Camp Elephants:* includes food supplies, medicines and maintenance costs.
- *Administrative Expenses:* includes general administrative costs, including office supplies, utilities.

6.9.3 Resource mobilisation other than Plan (Project Elephant)

In the NER, resource mobilisation beyond regular Plan allocations is essential to sustain and scale elephant conservation initiatives. Diversifying funding sources enhances financial resilience and supports innovation, community engagement, and long-term habitat security.

- *Corporate Social Responsibility (CSR)* funding can support solar fencing, early warning systems, patrol vehicles, drones, training programs, and livelihood diversification in high-conflict villages.
- *National CAMPA, Climate adaptation funds, & Convergence with Rural development programs* (e.g., water conservation and invasive removal under employment schemes) can supplement core funding while promoting inter-departmental coordination.
- *Multilateral grants, & with Collaborations with Conservation Foundations*, can support landscape-scale research, corridor restoration, climate resilience initiatives, and technology pilots.
- *Public-private partnerships* may also facilitate AI-based early warning systems, SMS alert platforms, and infrastructure mitigation measures.
- *Additional avenues* include NGO partnerships, community-based contributions, eco-tourism revenue, innovative financial instruments such as green bonds or ecosystem service models.

Transparent fund management, clear MoUs, alignment with monitoring indicators, and a dedicated resource mobilisation mechanism at NER level are essential for effective implementation.

6.10 THE IMPLEMENTATION SCHEDULE

The Schedule of Operations for the NER, covering Nilgiris, Gudalur, MTR, STR, Erode, Dharmapuri and Hosur divisions provides a structured framework for implementing elephant conservation activities throughout the year. It aligns monitoring, conflict mitigation, habitat management, protection, and training with seasonal ecological and conflict patterns.

- Elephant monitoring activities such as telemetry tracking, mortality documentation, and conflict hotspot mapping are conducted year-round, while synchronized censuses and corridor validation surveys are undertaken periodically. Human-elephant conflict mitigation is seasonally intensified before and during peak crop seasons, with inspection of mitigation structures, deployment of Rapid Response Teams, and real-time MIS reporting, followed by post-season review and compensation audits.

- Habitat and corridor management activities are scheduled around seasonal cycles, including pre-monsoon waterhole maintenance, fire preparedness, invasive species removal, and post-monsoon vegetation and corridor assessments. Protection measures such as SMART-based patrolling, surveillance in crossing zones, and regulation of vehicular movement operate continuously across divisions.

6.10.1 The Schedule of Operations and Regulations

Creating a schedule of operations and regulations for NER aims to ensure the effective protection of elephants, conservation of habitat, and harmonious coexistence with local communities as under:

- *Daily Operations:* includes patrols and anti-poaching measures; wildlife monitoring; emergency response; and infrastructure maintenance.
- *Weekly Operations:* includes community engagement activities; and research and data analysis.
- *Monthly Operations:* includes health checks and veterinary care; and staff training.
- *Seasonal Operations:* includes habitat restoration activities; and tourism management.
- *Regulations:* includes on habitat protection; anti-poaching; tourism; community coexistence; research and data sharing; noise and disturbance; waste management; fire prevention and management; livestock grazing; and conservation easement and land use planning.

The regulatory framework complements operational activities by enforcing habitat and corridor protection, regulating linear infrastructure and tourism in sensitive areas, ensuring timely conflict response and compensation processing, mandating standardized reporting, and conducting periodic Management Effectiveness Evaluation reviews. Regular monthly, quarterly, and annual reviews ensure accountability, coordination, and adaptive management across NER.

6.10.2 Record of Deviations and Implemented Targets

Maintaining a structured record of implemented targets and deviations is essential for effective implementation of the Elephant Conservation Plan (ECP) in the NER. This system ensures accountability, transparency, and adaptive management across monitoring, conflict mitigation, habitat management, and protection activities.

- *Implementation Target Logs*: Records of implemented targets should document planned versus achieved outputs in areas such as elephant census completion, GPS collar deployment, conflict hotspot mapping, installation and maintenance of mitigation structures, invasive species removal, waterhole restoration, patrol coverage, and training programmes. Each entry should specify timelines, responsible divisions, supporting documents, GIS-based verification where applicable.

- *Deviation Logs*: Deviation records should clearly capture any shortfall, delay, or variation from planned targets, along with reasons such as funding constraints, climatic factors, staff shortages, or unexpected conflict escalation. Corrective actions, revised timelines, and responsible authorities must be documented to ensure follow-up and closure.

Regular monthly divisional reviews, quarterly NER-level assessments, and annual consolidated reporting help track progress and identify trends. Integration with the MIS dashboard, Action Taken Reports, and periodic Management Effectiveness Evaluation audits further strengthens transparency and ensures that conservation efforts remain measurable and outcome-oriented across NER.

Annexure-1

FINANCIAL OUTLAY FOR THE ACTION PLAN FOR NILGIRI ELEPHANT RESERVE (NER)

FINANCIAL OUTLAY FOR 5 years (Rs. In LAKHS)

No	Particulars	1st	2nd	3rd	4th	5th	Grand Total
A. HABITAT IMPROVEMENT & CONNECTIVITY							
1	To restore monoculture plantations (Acacia, Eucalyptus, etc.) into natural forests through phased ecological restoration approach	X	X	X	X	X	X
2	Eradication of Invasive Alien Species (Lantana, Senna, Eupatorium etc)	X	X	X	X	X	X
3	Fodder Availability through restoration of vayal's, development of grasslands	X	X	X	X	X	X
4	Augmentation of Water resources, solar borewell and other related activities	X	X	X	X	X	X
5	Special focus on investment for Corridor Acquisition, improvement & restoration	X	X	X	X	X	X
	Sub-total	X	X	X	X	X	X
B. HEC MITIGATION MEASURES							
1	Erection & Maintenance of Physical Barriers (EPT, Rail Barricade, Steel rope Fencing, Solar Tentacle Fence)	X	X	X	X	X	X
2	Ex-gratia payment for loss of life, injury, damage to property, crop, etc,	X	X	X	X	X	X
3	Human Resource for managing Conflict - Rapid Response Teams (RRT's), Veterinary units, Elephant Trackers, Anti-depredation squads, Elephant Task Force (ETF), Command Control Centre etc	X	X	X	X	X	X
4	Early Warning System (Primarily technology driven systems like APP based monitoring, AI cameras, Virtual fencing, Bulk SMS and other such methods)	X	X	X	X	X	X
5	Site-specific/Area-specific Conflict Management, Supporting activities and other related activities	X	X	X	X	X	X
	Sub-total	X	X	X	X	X	X

C. ELEPHANT PROTECTION & ANTI-POACHING MEASURES							
1	Study of the traditional migratory routes and mapping of the vulnerable areas in spatial domain	X	X	X	X	X	X
2	Developing anti-poaching measures by developing APC camps, supply of quality ration; sustaining anti-poaching operations	X	X	X	X	X	X
3	Developing Intelligence network and linkages, coordination with enforcement agencies; village crime dossiers	X	X	X	X	X	X
4	Developing protocols for elephant health monitoring, veterinary surveillance, disease monitoring including captive elephants	X	X	X	X	X	X
5	Undertaking measures for sustainable waste management and safe sanitation around elephant habitat and zones	X	X	X	X	X	X
	Sub-total	X	X	X	X	X	X
D. ECOLOGICAL SOCIAL DEVELOPMENT							
1	Developing integrated tribal development activities in the settlements for livelihood improvement	X	X	X	X	X	X
2	Developing community-based ecotourism in the forest divisions outside tiger reserves and PAs	X	X	X	X	X	X
3	Development of the Interpretation & Education facilities in such areas	X	X	X	X	X	X
4	Implement Community development works in the Ecodevelopment villages	X	X	X	X	X	X
5	Undertake Soil-moisture conservation activities in the ED villages	X	X	X	X	X	X
	Sub-total	X	X	X	X	X	X
E. INFRASTRUCTURE DEVELOPMENT & CAPACITY BUILDING							
1	Establishment, Maintenance and Operation of Control Room, Tooling Room and other Facilities at Division level, State Level and Field Level in all elephant ranging divisions	X	X	X	X	X	X
2	Procurement of All Terrain Vehicles for RRT, ETF and other teams	X	X	X	X	X	X

3	Procurement of Thermal Drones, Camera Traps, Tranquilizing kits, drugs, Radio Collars, Trackers, Satellite Phones and other related equipment.	X	X	X	X	X	X
4	Capacity building for Forest Department staff, Line Department personnel, Panchayat-level stakeholders, and exchange visits	X	X	X	X	X	X
5	Establishment and maintenance of Elephant Camps. Construction of Kraals, Tools and infrastructure for Veterinary Care Centre, Establishment of Soft Release centres, Training of Mahouts, Cavadis and other staff.	X	X	X	X	X	X
	Sub-total	X	X	X	X	X	X
F. COMMUNITY/STAKEHOLDER INVOLVED CONFLICT MANAGEMENT & AWARENESS							
1	Formation of Community Level HEC management Committees like Jan Jagratha Samithis (JJSs), Vana Samrakshana Samithis (VSS) or other similar community driven initiatives.	X	X	X	X	X	X
2	Awareness Creation Activities for the Forest Fringe Villages affected by HEC	X	X	X	X	X	X
3	Holding of workshops, seminars, meetings of the stake holders	X	X	X	X	X	X
4	Division-Level Intelligence Networks, Informers	X	X	X	X	X	X
5	Awareness Materials, Mobile Application and Meetings	X	X	X	X	X	X
	Sub-total	X	X	X	X	X	X
G. RESEARCH, MONITORING & INTER STATE COORDINATION							
1	Annual Population Estimation, Profiling of elephants and monitoring of elephant population	X	X	X	X	X	X
2	Detailed understanding of Habitat Fragmentation, Corridors and bottlenecks to elephant movement and Implication and strategies for HEC.	X	X	X	X	X	X

3	Annual Interstate Coordination Meetings at Ministerial-level, HoFF/ CWLW level, and regional-level meetings	X	X	X	X	X	X
4	Demographic Structure and Survival Trends of Wild Elephants and Implications for Long- term Conservation	X	X	X	X	X	X
5	Purchase of Work-stations, GIS software, colour printers, UPS, stationaries, internet charges, etc., including AMC.	X	X	X	X	X	X
	Sub-total	X	X	X	X	X	X
		X	X	X	X	X	X
	Grand Total	X	X	X	X	X	X

Colour Code Key:

Priority	Priority-I	Priority-II	Priority-III	Priority-IV
Colour Code				

Annexure-2

JUSTIFICATION FOR THE ACTION PLAN FOR NILGIRI ELEPHANT RESERVE (NER)

No	Particulars	Justification/Strategy
A. HABITAT IMPROVEMENT & CONNECTIVITY		
1	To restore monoculture plantations (Acacia, Mangium, Eucalyptus, etc.) into natural forests through a phased ecological restoration approach	Restoring natural forests in place of monoculture plantations is vital for elephant conservation and boosting biodiversity. Exotic plantations, dominated by species like Acacia, and Eucalyptus, were often established in former grasslands, shrinking the feeding grounds for wild herbivores. These plantations offer limited food and habitat for wildlife. A phased ecological restoration approach, replacing them with indigenous flora, can enhance habitat quality and ensure a sustainable food base for herbivores like elephants. Restored forests support diverse plant life, fostering a rich ecosystem of insects, birds, and mammals, and improving overall biodiversity. Natural forests also help maintain water resources, reduce human-wildlife conflict by providing better food sources for elephants, and ensure ecological stability.
2	Eradication of Invasive Alien Species Lantana, Senna, Eupatorium etc	The spread of invasive species like Lantana camara, Mikania micrantha, Senna spectabilis, and Eupatorium odoratum has degraded native elephant habitats in the region, outcompeting native plants and reducing food sources for elephants. This forces elephants into agricultural lands, increasing human-wildlife conflict. Systematic eradication and habitat restoration can help restore native flora and improve food availability for elephants. The long-term success of forest regeneration relies on ongoing efforts like removing invasive species, replacing casualties, and maintenance activities. Here's a possible phased approach: Year 1: Establish nurseries & clear existing monoculture plantations Year 2: Remove regenerating invasive species, plant indigenous species, and maintain the site Year 3: Continue removing invasive species, weed, replace casualties, and broadcast seed balls Years 4 & 5: Ongoing maintenance to support forest regeneration
3	Fodder Availability through restoration of Vayal's, development of grasslands	Restoring vayals (seasonal wetlands) and developing grasslands can boost fodder availability for elephants. This involves removing invasive species, reintroducing native vegetation, and implementing sustainable management practices. By doing so, we can increase nutritious food sources, reduce human-elephant conflict, and promote coexistence.
4	Augmentation of Water resources, solar borewell and other related activities	Ensuring reliable water sources in forests is crucial to prevent elephants from entering human settlements, especially during dry seasons. Regular maintenance of waterholes and check dams can provide a steady water supply, reducing stress on elephant populations and minimizing human-elephant conflicts. This also supports biodiversity, promotes habitat stability, and discourages elephants from venturing into agricultural areas.
5	Special focus on investment for Corridor Acquisition, improvement & restoration	Securing initial funding is crucial for acquiring wildlife corridors, enabling preliminary studies and initiating the acquisition process. This investment will support feasibility studies, ecological assessments, and stakeholder consultations, paving the way for a phased corridor acquisition strategy. By allocating these funds, we can proactively conserve vital wildlife corridors, mitigate habitat fragmentation, and achieve long-term conservation goals.
B. HEC MITIGATION MEASURES		
1	Erection & Maintenance of Physical Barriers (EPT, Rail Barricade, Steel rope Fencing, Solar Tentacle Fence)	To mitigate human-elephant conflict, strengthening preventive infrastructure is key. This includes physical barriers like EPT, Rail barricade, Steel Rope fence, solar power fences along vulnerable forest boundaries to deter elephants from entering human settlements and fields. These barriers are effective and non-lethal, reducing crop damage and human casualties. Regular maintenance and dedicated service centres are necessary to ensure these barriers remain effective
2	Ex-gratia payment for loss of life, injury, damage to property, crop, etc,	Fair and timely payment of ex-gratia or compensation is vital for mitigating human-elephant conflict. It acknowledges the losses faced by communities and encourages coexistence with elephants. Prompt compensation can reduce negative attitudes towards elephants and promote tolerance, fostering community support for conservation efforts.

3	Human Resource for managing Conflict - Rapid Response Teams (RRT's), Veterinary units, Elephant Trackers, Anti-depredation squads, Elephant Task Force (ETF); Command Control Centre etc	Establishing Primary Response Teams (PRTs) at range levels is crucial for swift action during human-elephant conflicts. Equipped with gear and mobility, these teams can quickly respond to elephant intrusions, preventing damage and loss of life. They manage crowds, drive elephants back to forests, and minimize retaliatory killings. Strengthening Rapid Response Teams (RRTs) with equipment, training, and mobility support will enhance their efficiency in managing conflicts, coordinating with communities, tracking elephant movements, and implementing mitigation measures.
4	Early Warning System (Primarily technology driven systems like APP based monitoring, AI cameras, Virtual fencing, Bulk SMS and other such methods)	AI-based early-warning systems are revolutionizing human-elephant conflict mitigation by enabling real-time tracking and proactive prevention. These systems use advanced sensors, cameras, and machine learning to detect elephant movements, alerting officials and communities instantly. This technology reduces casualties, economic losses, and stress on humans and elephants, while facilitating better wildlife management. Expanding these systems to high-conflict zones will enhance timely intervention, minimize conflicts, and foster coexistence. Scaling up this technology requires financial and logistical support for deployment, maintenance, and continuous improvement, ensuring long-term effectiveness in mitigating human-elephant encounters.
5	State/Area Specific Conflict Management, Supporting activities and other related activities	Other division-specific/ area-specific/ site-specific activities can be taken up to better manage human-elephant conflict.
C. ELEPHANT PROTECTION & ANTI-POACHING MEASURES		
1	Study of the traditional migratory routes and mapping of the vulnerable areas in spatial domain	Studying traditional migratory routes and spatially mapping vulnerable areas in the NER is essential to secure habitat connectivity, prevent corridor fragmentation and proactively reduce Human–Elephant Conflict. It provides a scientific basis for corridor protection, land-use regulation and targeted conservation interventions.
2	Developing anti-poaching measures by developing APC camps, supply of quality ration; sustaining anti-poaching operations	Strengthening anti-poaching measures through well-equipped Anti-Poaching Camps (APCs), quality rations and sustained field operations ensures continuous ground presence, boosts staff morale and effectively deters wildlife crime, thereby safeguarding elephants and their habitats in the landscape.
3	Developing Intelligence network and linkages, coordination with enforcement agencies; village crime dossiers	Developing intelligence networks, strengthening coordination with enforcement agencies and maintaining village-level crime dossiers enhance early detection of wildlife offences, improve prosecution success and create a strong deterrent against poaching and illegal activities in the NER
4	Developing protocols for elephant health monitoring, veterinary surveillance, disease monitoring including captive elephants	Developing standardized protocols for elephant health monitoring, veterinary surveillance and disease tracking—including captive elephants—ensures early detection of illnesses, prevents disease transmission across wild–captive–livestock interfaces and supports a One Health approach in the NER.
5	Undertaking measures for sustainable waste management and safe sanitation around elephant habitat and zones	Implementing sustainable waste management and safe sanitation around elephant habitats prevents unnatural attraction to garbage, reduces Human–Elephant Conflict and disease risks, and helps maintain ecological integrity in the Nilgiri Elephant Reserve.

D. ECOLOGICAL SUSTAINABLE DEVELOPMENT		
1	Developing integrated tribal development activities in the settlements for livelihood improvement	Integrated tribal development reduces forest dependency, enhances socio-economic resilience and builds community stewardship for elephant conservation in the Nilgiri Elephant Reserve (NER).
2	Developing community-based ecotourism in the forest divisions outside tiger reserves and PAs	Community-based ecotourism in non-PA divisions provides alternative livelihoods, incentivizes habitat protection and distributes conservation benefits across the broader NER landscape.
3	Development of the Interpretation & Education facilities in such areas	Strengthening interpretation and conservation education facilities promotes awareness, fosters positive attitudes toward elephants and supports informed coexistence among local communities and visitors.
4	Implement Community development works in the Ecodevelopment villages	Community development initiatives in Ecodevelopment villages reduce resource dependency, mitigate Human–Elephant Conflict and strengthen participatory conservation partnerships.
5	Undertake Soil-moisture conservation activities in the ED villages	Soil and moisture conservation improves water availability, enhances habitat productivity and reduces pressure on forest resources, thereby supporting both community livelihoods and elephant habitats in NER.
C. INFRASTRUCTURE DEVELOPMENT & CAPACITY BUILDING		
1	Establishment, Maintenance and Operation of Control Room, Tooling Room and other Facilities at Division level, State Level and Field Level in all elephant ranging divisions	Well-equipped tool rooms at Forest Range and Division levels are crucial for handling elephant-related emergencies and anti-poaching efforts. These tool rooms will stock essential equipment like tranquilization kits, GPS devices, drones, and deterrent tools, enabling swift response to conflicts and minimizing risks to humans and elephants. They'll also support anti-poaching operations, protecting elephant habitats. Establishing these tool rooms across the state will enhance conflict response and anti-poaching efficiency, with proper storage, maintenance, and upgrades ensuring operational readiness. This will significantly improve human-elephant conflict mitigation and elephant conservation efforts.
2	Procurement of All Terrain Vehicles for RRT, ETF and other teams	Elephant conservation requires rapid response teams to navigate difficult terrains, especially in forested landscapes and conflict-prone areas. Procuring ATVs improves mobility, allowing forest personnel to reach remote locations swiftly for rescue, patrolling, and conflict mitigation efforts.
3	Procurement of Thermal Drones, Camera Traps, Tranquilizing kits, drugs, Radio Collars, Trackers, Satellite Phones and other related equipment.	These tools enable real-time monitoring, tracking, and response, allowing authorities to anticipate and mitigate conflicts. Thermal drones and camera traps monitor elephant movements, while tranquilization kits and radio collars facilitate safe relocation. Trackers and satellite phones ensure timely communication and response, reducing human-elephant conflicts and promoting coexistence.
4	Capacity building for Forest Department staff, Line Department personnel, Panchayat-level stakeholders, and exchange visits	Training programs are essential for empowering Forest Department personnel, allied officials, and Panchayat stakeholders with the expertise needed for effective elephant conflict management. These programs boost understanding of elephant behavior, conflict resolution, and technology use, ensuring better coordination, quick response, and scientific approaches to mitigate human-elephant conflicts.
5	Establishment and maintenance of Elephant Camps. Construction of Kraals, Tools and infrastructure for Veterinary Care	Kumki elephants, trained captive elephants, play a vital role in managing human-elephant conflict. Managed in elephant camps, they chase away crop-raiding elephants and assist in training newly captured elephants, making rehabilitation more effective. Enhancing Kumki training facilities can improve conflict mitigation, reduce human-elephant encounters, and ensure safe handling of distressed wild elephants.

	Centre, Establishment of Soft Release centres, Training of Mahouts, Kavadi's and other staff.	
D. COMMUNITY/STAKEHOLDER INVOLVED CONFLICT MANAGEMENT AWARENESS		
1	Formation of Community Level HEC management Committees like Jan Jagratha Samithis (JJSs), Vana Samrakshana Samithis (VSS) or other similar community driven initiatives.	These Committees can play a significant role in community-based conflict management by spreading awareness and facilitating cooperation between locals and forest officials. Strengthening then ensures that communities are actively involved in early warning systems, reporting elephant movements, and adopting preventive measures. Their participation fosters coexistence, reduces panic-driven responses, and promotes sustainable conservation practices.
2	Awareness Creation Activities for the Forest Fringe Villages affected by HEC	To manage HEC, awareness initiatives will be implemented, including setting signboards & posters, screening documentaries and talks on wildlife, conducting talks and competitions for school kids on key dates, and deploying awareness vehicles and teams. These efforts will educate local communities about elephant conservation and promote coexistence, reducing conflicts and fostering a culture of tolerance and understanding.
3	Holding of workshops, seminars, meetings of the stake holders	Workshops, training, and awareness materials will significantly contribute to human-elephant conflict management by empowering local communities with knowledge on elephant behavior, conservation, and conflict mitigation strategies. This will foster a culture of coexistence, reduce negative attitudes towards elephants, and promote tolerance, ultimately minimizing conflicts and ensuring safe and effective management of human-elephant interactions.
4	Division-Level Intelligence Networks, Informers	
5	Awareness Materials, Mobile Application and Meetings	
E. RESEARCH, MONITORING & INTER STATE COORDINATION		
1	Annual Population Estimation, Profiling of elephants and monitoring of elephant population	Annual population estimation and profiling of elephants helps understand population trends, demographics, and habitat use. Monitoring elephant populations informs human-elephant conflict management by identifying areas of high conflict risk, tracking elephant movement patterns, and guiding mitigation strategies. This data-driven approach enables targeted interventions, reducing conflicts and promoting coexistence.
2	Detailed understanding of Habitat Fragmentation, Corridors and bottlenecks to elephant movement and Implication and strategies for HEC.	To address conflict or to better manage forest, a strong research base is vital. A dedicated team of researchers or a MoU with a conservation NGO/Researcher needs to be made for continues data collection and analysis. Management action/initiatives are to be backed up with proper research. Studies on Population viability, barrier assessment, corridor assessment, Radio coloring of elephants are some of the key research projects.
3	Annual Interstate Coordination Meetings at Ministerial-level, HoFF/ CWLW-level, and regional-level meetings	Interstate coordination is vital for managing elephants that move across state boundaries. Ministerial, HoFF, and regional-level meetings enable policy decisions, improve coordination, and ensure a unified approach to human-elephant conflict mitigation. This cooperation aligns conservation strategies, shares data, and plans joint action, keeping elephant corridors functional and reducing conflict in border areas.
4	Demographic Structure and Survival Trends of Wild Elephants and	Monitoring elephant demographics, including birth rates, mortality, and age distribution, helps assess Kerala's elephant population health and viability. This informs conservation efforts, enabling proactive measures to support population stability and genetic diversity, ensuring a thriving elephant population.

	Implications for Long-term Conservation	
5	Purchase of Work-stations, GIS software, colour printers, UPS, stationaries, internet charges, etc., including AMC.	GIS and satellite imagery can significantly aid human-elephant conflict management by providing spatial data on elephant habitats, movement patterns, and conflict hotspots. This information helps identify high-risk areas, inform land-use planning, and guide mitigation strategies, such as habitat restoration and elephant corridors. Real-time monitoring enables early warning systems, allowing for proactive measures to prevent conflicts and promote coexistence.

FOREST DEPARTMENT