भारतीय वन्यजीव संस्थान
Wildlife Institute of India

REGIONAL ACTION PLAN

for

Comprehensive Understanding & Management of HUMAN-ELEPHANT CONFLICT

IN SOUTH INDIA

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Project Elephant, Ministry of Environment, Forests and Climate Change
Government of India & Wildlife Institute of India

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PREFACE

The Asian elephant (*Elephas maximus*) is an integral constituent of the country's natural heritage and ecological security. As a keystone species and ecological engineer, the elephant plays a vital role in maintaining forest structure, enabling seed dispersal, conserving watersheds, and sustaining the ecological processes that support biodiversity across tropical forest ecosystems. The conservation of elephants, therefore, extends beyond the protection of a single species and contributes significantly to the long-term resilience and sustainability of forest ecosystems and landscapes.

Southern India, encompassing the States of Kerala, Karnataka, Tamil Nadu, and Andhra Pradesh, represents one of the most significant elephant landscapes in the country. The region encompasses twelve Elephant Reserves distributed across the Western Ghats, Eastern Ghats, and their associated forest complexes, supporting nearly 40 per cent of India's wild elephant population. These landscapes remain ecologically interconnected through a network of forests, protected areas, elephant corridors, and multiple-use landscapes, facilitating seasonal movements and genetic exchange among elephant populations. At the same time, these landscapes support millions of people whose livelihoods depend upon agriculture, plantations, forestry, tourism, and other natural resource-based activities.

Over the past few decades, rapid economic development, changing land-use patterns, expansion of agriculture and plantations, urbanization, and the proliferation of roads, railways, irrigation systems, transmission lines, tourism infrastructure, and other developmental activities have considerably altered the ecological character of these landscapes. Fragmentation of habitats, disruption of traditional elephant movement routes, degradation of corridors, and increasing human presence along forest interfaces have intensified Human-Elephant Conflict (HEC), resulting in loss of human lives, damage to crops and property, economic hardship for local communities, and mortality of elephants. These emerging challenges demand a coordinated, scientific, and landscape-level response that transcends administrative and State boundaries.

Recognizing the urgency and complexity of the issue, the Ministry of Environment, Forest and Climate Change (MoEF&CC), Government of India, constituted a Sub-Committee for the preparation of the Regional Action Plan (RAP) for Comprehensive Understanding and Management of Human-Elephant Conflict in South India vide Office Memorandum dated 19 February 2025. The Sub-Committee was chaired by Shri Sanjay K. Srivastava, Former Principal Chief Conservator of Forests (Apex), Tamil Nadu, and comprised Shri Anil Bhardwaj, Former PCCF & HoFF, Kerala; Shri Ajai Misra, Former PCCF, Karnataka; Shri Rakesh Kalva (Andhra Pradesh); Dr. D. Boominathan, WWF-India, Tamil Nadu; and Dr. Aju Mathew George, Scientist-C, Project Elephant Division, MoEF&CC, as Members, with Dr. Parag Nigam, Scientist-G & Nodal Officer, Elephant Cell, Wildlife Institute of India (WII), serving as the Coordinator.

The Action Plan adopts a comprehensive approach to understanding and managing HEC by integrating ecological assessments, habitat and corridor management, landscape-level planning, spatial risk assessment, community participation, institutional strengthening, technological innovation, and adaptive management. The document examines the drivers and pressures influencing elephant habitats and movement, identifies emerging conflict patterns, and proposes strategic interventions for conflict prevention, mitigation, emergency response, research, capacity development, and inter-State coordination. It further emphasizes the importance of balancing conservation objectives with sustainable development, recognizing that long-term coexistence between people and elephants can only be achieved through collaborative governance, scientifically informed land-use planning, and active participation of local communities.

This Regional Action Plan is intended to serve as a strategic guidance document for the Ministry of Environment, Forest and Climate Change, State Forest Departments, district administrations, research and academic institutions, conservation organizations, development agencies, and other stakeholders involved in planning and implementing measures for HEC mitigation. The recommendations contained herein are designed to complement existing national policies, Project Elephant initiatives, and State-level management programmes while promoting greater convergence among sectors whose activities influence elephant landscapes.

It is expected that the implementation of this Regional Action Plan will strengthen inter-State cooperation, promote evidence-based decision-making, enhance institutional preparedness, and facilitate coordinated management of elephant landscapes across southern India. More importantly, it seeks to promote a future where conservation and development objectives are pursued in harmony, ensuring the continued survival of the Asian elephant while safeguarding the lives, livelihoods, and well-being of people who share these landscapes.

The success of this Regional Action Plan will ultimately depend upon sustained commitment, adequate financial and institutional support, periodic review, adaptive management, and the collective efforts of governments, scientific institutions, civil society organizations, and local communities. It is hoped that this document will provide a strategic framework for reducing Human-Elephant Conflict and advancing the shared vision of safe elephant landscapes and resilient human communities across southern India.

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Addl. Director General (Wildlife),
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EXECUTIVE SUMMARY

Human-Elephant Conflict (HEC) has emerged as one of the most complex and persistent conservation and socio-economic challenges in South India. The region, encompassing the states of Kerala, Karnataka, Tamil Nadu, and Andhra Pradesh, supports one of the largest and most contiguous populations of Asian elephants (*Elephas maximus*), globally. While this landscape remains critical for long-term elephant conservation, rapid land-use changes, infrastructure development, and increasing human pressures have intensified interactions between people and elephants, often resulting in loss of human lives, livelihoods, and elephant mortality. This Regional Action Plan (RAP) provides a comprehensive, science-based, and coordinated framework to understand, manage, and mitigate HEC across the southern regional landscape through harmonized strategies, institutional strengthening, and stakeholder engagement.

Introduction to the Region

South India represents a mosaic of reserved forests (RF), protected areas (PA), revenue lands, agricultural landscapes, plantations, and rapidly expanding urban and industrial zones. The region includes globally significant elephant landscapes such as the Nilgiri-Eastern Ghats complex, Anamalai-Parambikulam-Periyar landscape, Brahmagiri-Nilambur landscape, and fragmented ranges of the Eastern Ghats. These landscapes facilitate seasonal and long-distance elephant movements driven by forage availability, water resources, and traditional migratory routes.

The interface between elephant habitats and human-dominated land uses is extensive. Agriculture-particularly paddy, banana, sugarcane, coconut, and arecanut-along with tea, coffee, and rubber plantations, has expanded into historical elephant ranges. Concurrently, linear and developmental projects & infrastructure such as highways, railways, irrigation canals, power transmission lines, mining operations, wind energy installations, and urban expansion have fragmented habitats and disrupted movement pathways. These factors collectively elevate the frequency and intensity of HEC, necessitating a regionally coordinated response and action.

Context and Situation

The southern region supports a substantial proportion of India's elephant population, with varying density and distribution influenced by habitat quality, protection status, and human pressures. Elephants exhibit both resident and dispersing movement patterns, frequently traversing PAs, RFs, corridors, and human-use landscapes. Habitat quality varies significantly, with well-protected forests supporting higher forage diversity and degraded forests showing signs of invasive species proliferation, reduced water availability, and anthropogenic disturbance.

HEC in the region manifests through crop depredation, property damage, human injuries and fatalities, elephant injuries and deaths, and social unrest with more than 80% elephant mortality due to the electrocution. Also, Tamil Nadu and Karnataka account for the maximum HEC cases in terms of human and elephant deaths as well as crop raiding and property damage cases. The underlying causes include habitat fragmentation, loss of corridors, high dependence of local communities on forest-edge agriculture, ineffective or poorly maintained mitigation structures, and gaps in early warning and rapid response mechanisms. Emerging challenges include increasing conflict in non-traditional landscapes, climate-induced resource stress, and growing intolerance among affected communities.

Spatial and temporal risk assessments reveal identifiable conflict hotspots, seasonal peaks linked to crop cycles and water scarcity, and recurrent conflict-prone individual elephants. The vision of this RAP is to introduce sustainable coexistence between humans and elephants. Its goal is to reduce human and elephant mortality and socio-economic losses while ensuring landscape-level connectivity and elephant population viability. The objectives focus on prevention-oriented management, scientific decision-making, community participation, and institutional coordination, implemented through adaptive and evidence-based strategies.

Drivers and Pressures

The elephant-habitat relationship (EHR) in South India is shaped by ecological requirements, landscape permeability, and human interventions. Disturbance regimes such as habitat degradation, spread of invasive alien species, human settlement expansion, livestock overgrazing, forest resource extraction, and high traffic volumes along linear intrusions disrupt elephant behavior and movement patterns. Seasonal scarcity of water and forage further pushes elephants into human-use areas.

Elephant corridors-critical for genetic exchange and dispersal, are under varying degrees of threat from land-use change, and infrastructure development. Effective identification, legal protection, restoration, and management of corridors are central to long-term conflict mitigation. Managing dispersing and solitary elephants, particularly adult males, requires specialized strategies that balance safety, animal welfare, and public tolerance.

Meaningful involvement of stakeholders-including forest departments, district administrations, police, local governments, line departments, research institutions, civil society organizations, and affected communities-is essential. Sectoral coordination, public awareness, and cross-border collaboration between states form the backbone of a regional approach to HEC management.

Human-Elephant Conflict and Mitigation Strategy

The RAP adopts a multi-tiered approach to conflict identification, integrating ecological monitoring, socio-economic assessments, conflict databases, and spatial risk mapping. Emphasis is placed on developing synergistic mitigation strategies that combine preventive, early-warning, and reactive measures rather than isolated interventions.

Institutional capacity development includes strengthening frontline staff, rapid response teams, veterinary support systems, and incident documentation protocols. Emergency response mechanisms are designed to address acute conflict situations, crowd management, and media engagement while ensuring human safety and animal welfare.

The Plan prioritizes reducing the impacts of HEC on people through timely compensation, livelihood diversification, community-based crop protection, and insurance mechanisms. Simultaneously, it addresses impacts on elephant health by improving veterinary care, monitoring stress and injury, minimizing harmful interventions, and adopting humane management practices. Economic analyses guide the selection of mitigation measures to ensure cost-effectiveness, sustainability, and site-specific appropriateness.

Management Capacity Development

Applied research forms a core pillar of the RAP, focusing on elephant movement ecology, habitat quality assessment, conflict drivers, effectiveness of mitigation measures, and socio-economic dimensions of coexistence. Capacity development initiatives include structured training programs for field staff, managers, veterinarians, and community volunteers.

The Plan promotes the use of innovative technologies such as GPS telemetry, drone-based monitoring, AI-assisted early warning systems, mobile-based reporting platforms, and decision-support tools for spatial planning. A clear organizational and institutional framework is proposed to ensure coordination across administrative levels, facilitate inter-state collaboration, and integrate scientific inputs into management decisions.

Regional Assessment and Proposed Activities

A comprehensive assessment of the southern regional landscape highlights priority conflict zones, critical corridors, high-risk infrastructure segments, and capacity gaps. Based on this assessment, the RAP outlines targeted activities including habitat restoration, corridor management, strengthening of early warning systems, community engagement programs, applied research projects, and institutional strengthening initiatives.

The proposed activities are supported by indicative financial implications, emphasizing phased implementation, resource convergence, and suggested alignment with existing government schemes and conservation programs. The Plan underscores the need for sustained investment, monitoring, and adaptive management to ensure long-term effectiveness.

Conclusion

This Regional Action Plan provides a holistic, integrated, and forward-looking framework for understanding and managing Human-Elephant Conflict in South India. By combining ecological science, socio-economic considerations, institutional strengthening, and stakeholder participation, it aims to transform conflict management from a reactive response to a proactive coexistence strategy at a regional scale.

PLANNING PROCESS

The preparation of the Regional Action Plan (RAP) for Comprehensive Understanding and Management of Human-Elephant Conflict (HEC) in South India followed a structured, consultative, and evidence-based planning process. The process was designed to ensure regional coherence, scientific rigor, inter-state coordination, and alignment with national conservation priorities. The key milestones in the planning process are outlined below.

1. Constitution of the Sub-Committee for Regional Action Plan

In pursuance of the directions of the Ministry of Environment, Forest and Climate Change (MoEF&CC), Government of India, a Sub-Committee for preparation of the Regional Action Plan for Southern India Range States was constituted vide MoEF&CC Order No. **14-1/2022-PE (IV) dated 19. 02. 2025**. The Sub-Committee comprised representatives from the Ministry, Wildlife Institute of India (WII), State Forest Departments of Kerala, Karnataka, Tamil Nadu, and Andhra Pradesh, and subject-matter experts. The Committee was mandated to guide, oversee, and coordinate the formulation of the RAP for the southern region.

S. No	Name and Designation	Member
1	Sh. Sanjay K Srivastava, Former PCCF (Apex) Tamil Nadu	Chairman
2	Sh. Anil Bhardwaj, Former PCCF (HoFF), Kerala	Member
3	Sh. Ajai Misra, Former PCCF, Karnataka	Member
4	Sh. Rakesh Kalva, Conservationist, Andhra Pradesh	Member
5	Sh. D Boominathan, WWF-India, Tamil Nadu	Member
6	Dr. Aju Mathew George, Scientist-C, PE, MoEF&CC	Member

Besides, Nodal Officers were appointed by all the States *viz.* Kerala, Karnataka, Tamil Nadu, and Andhra Pradesh, for consultation and assistance in the draft preparation.

2. Committee Meetings and Development of RAP Framework

Subsequent to its constitution, a series of Committee meetings were convened on 28th Feb, 29th Apr, 6th Jun, 18th, 21st & 29th Jul 2025 to deliberate on the rationale, scope, and objectives of the RAP. These discussions focused on understanding the scale and complexity of HEC in South India, identifying regional commonalities and state-specific issues, and agreeing on the need for a harmonized planning approach. Based on these deliberations, a comprehensive RAP Framework was developed, outlining thematic chapters, data requirements, analytical approaches, and expected outputs for the Report.

3. Submission of State-specific Reports

In accordance with the approved RAP Framework, state-specific reports were prepared and submitted by the Nodal Officers of the four States. These reports provided detailed information on elephant distribution, habitat status, conflict patterns, mitigation measures, institutional arrangements, and challenges specific to each State. The inputs formed the core empirical and contextual basis for the regional synthesis.

4. Field Visits to Selected Elephant Reserves

Of the twelve Elephant Reserves in South India, field visits were undertaken in one short-listed Elephant Reserve in each of the four States as under:

1	Kerala	19-22 May 2025	Wayanad ER
2	Andhra Pradesh	08-11 July 2025	Rayala ER
3	Karnataka	22-25 July 2025	Mysuru ER
4	Tamil Nadu	03-06 Aug 2025	Anamalai & Coimbatore ER

These visits facilitated first-hand assessment of conflict scenarios, mitigation interventions, corridor conditions, habitat quality, and institutional capacities. Interactions were held with field officers, frontline staff, local communities, and other stakeholders to validate data, understand ground-level challenges, and document best practices and gaps.

5. Presentation of Interim Findings

Key interim findings emerging from the analysis of state reports and field observations were compiled and presented on the occasion of World Elephant Day at Coimbatore on 12th Aug 2025. The platform enabled wider dissemination of preliminary insights, stakeholder interaction, and constructive feedback, which were subsequently incorporated into the drafting process of the Regional Action Plan.

6. Preparation and Circulation of Draft Report

Based on the consolidated inputs, analyses, and field findings, a Draft Regional Action Plan Report was prepared. The draft was circulated among all Committee members and relevant experts for their comments, observations, and suggestions. This step ensured technical scrutiny, inter-state consensus, and consistency with national policy and legal frameworks.

7. Final Committee Meeting at WII, Dehradun

A final Committee meeting was convened at the Wildlife Institute of India (WII), Dehradun, to deliberate in detail on the draft Report. The Committee reviewed thematic chapters, proposed strategies, implementation mechanisms, and financial implications, and provided consolidated guidance for finalization of the document.

8. Finalization and Circulation to States

Incorporating the deliberations and recommendations of the Committee, the Final Regional Action Plan has been prepared for sharing with the Chief Wildlife Wardens of Kerala, Karnataka, Tamil Nadu, and Andhra Pradesh for their comments and suggestions. This step ensures state ownership, practical feasibility, and readiness for implementation.

9. Implementation of the Regional Action Plan

Following the final acceptance, the Regional Action Plan is envisaged to be implemented through coordinated action by the State Forest Departments, with guidance from MoEF&CC and technical support from relevant institutions. Implementation will involve phased execution, convergence with existing schemes, periodic monitoring, and adaptive management to ensure effective reduction of HEC and promotion of long-term coexistence in South India.


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01

INTRODUCTION TO THE REGION

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1.1. DESCRIPTION OF THE REGION

Southern India represents one of the most significant strongholds of the Asian elephant in the world. The region spans the Western Ghats, Eastern Ghats, and adjoining plateaus, encompassing a wide variety of habitats ranging from wet evergreen forests and montane sholas to dry deciduous woodlands and thorn scrubs. Together, these landscapes support more than half of India's elephant population, making them critical to the long-term survival of the species. Of the 33 elephant reserves in India, 12 are notified in South Indian states of Tamil Nadu, Kerala, Karnataka and Andhra Pradesh.

Elephants occur widely across the region, not only within protected areas (PAs) but also in reserved forests, tea estates, coffee plantations and mango orchards. The region is characterized by high ecological connectivity, with elephants regularly moving across state boundaries in search of forage and water. This trans-boundary movement links multiple forest divisions, elephant reserves, and PAs into functional landscapes, underscoring the need for interstate coordination. Also, the human footprint is extensive as agriculture, plantations, villages, roads, railways, dams and tourism infrastructure are interspersed with forests, creating a complex interface.

The major crops cultivated adjacent to elephant habitats in South India include banana, maize, ragi, paddy, sugarcane, areca nut, coconut, rubber, mango, coffee, tea, cardamom, and vegetable crops. Most of these crops are highly palatable to elephants, which makes agricultural fields an attractive foraging ground consequently leading to severe human elephant conflict (HEC) situations. The western portion of the Western Ghats, characterized by higher elevations and rainfall, have large areas under coffee, tea, and cardamom plantations. In contrast, the eastern portion of the Western Ghats and the adjoining Eastern Ghats predominantly support millet crops, areca nut, coconut, banana, ginger, turmeric, mango orchards, and a variety of vegetables.

The topographical attributes of the region contribute significantly to the overall habitat and ecological dynamics within the region, and include mountainous terrain, valleys, ravines, plateaus, rivers, waterways, caves, caverns *etc.* The major rock comprises of Archaean crystalline rocks with the Western Ghat composition predominantly of charnockite, khondalite, and gneiss formations whereas Nilgiri-Eastern Ghat transition is mostly of granitic and metamorphic rocks.

The climate type is tropical monsoon to subtropical highland, which varies with the altitude and the region has annual precipitation between 600-5000mm; influenced by both southwest and northeast monsoons. The Western Ghats predominantly benefit from the southwest monsoon, while the Eastern Ghats receive the majority of their rainfall from the northeast monsoon. Vegetation patterns in these landscapes are largely shaped by these rainfall regimes (Fig-1).

The forest type in the region is represented by tropical wet evergreen forests, semi-evergreen forests, moist deciduous forests, dry deciduous forests, montane shola-grasslands, and plantations & secondary growth. Elephants prefer dry deciduous, moist deciduous, and dry thorn forests. Their seasonal migrations are influenced by the availability of resources within their home ranges. Traditionally, when cultivation was seasonal and rain-fed, elephant movements aligned with natural cycles of vegetation and water. However, the shift to year-round crop cultivation has altered these patterns, drawing elephants more frequently into agricultural areas.

Fig-1: Ecological, Geomorphological & Hydrological Value of an Elephant Reserve

Part of natural vegetation were historically converted into monoculture plantations of teak, eucalyptus, and wattle during the British period. In addition, invasive alien species such as Senna, Lantana, Neltuma, Chromolaena and Wattle have spread widely, outcompeting native vegetation. These changes have degraded forest quality and reduced the natural food resources available to elephants, further intensifying human-elephant interactions.

The elephant habitats occur in different forms like large contiguous forests without human habitation, forest areas interspersed with small settlements, fragmented patches of forest surrounded by human-use areas, and habitats adjoining extensive coffee and tea plantations. In addition to agricultural fields, activities such as stone quarrying and red soil mining are also found along the forest peripheries. Numerous temples located within and along the forest edges, attract innumerable pilgrims annually. Tourism is another major land-use activity in the elephant habitats. Several habitats are located in hilly terrain, with very limited plains along village interfaces, as valleys have been increasingly transformed for human use. Such developments, combined with the expansion of roads and other linear infrastructure like railway lines, have led not only to the fragmentation of habitats but also accidental collisions resulting in elephant deaths. One of the most significant natural discontinuities in the landscape is the 30 km wide 'Palghat Gap'.

The major tribal communities living in elephant habitats include the Irulas, Paniyas, Soligas, Betta Kurumbas, Jenu Kurumbas, Malasars, Malaimalasars, Kadars, Iravalars, Pulayars, Kanis, Mudhuvars, Hill-Pulaya, Mannans, Palliyans, Uralis, Malaryans and Todas. Traditionally, these communities have depended on forest resources for their livelihoods. Cattle grazing is another traditional livelihood activity. Practices such as cattle grazing and resource collection are often linked to the occurrence of forest fires, with significant portions of habitat being burnt annually.

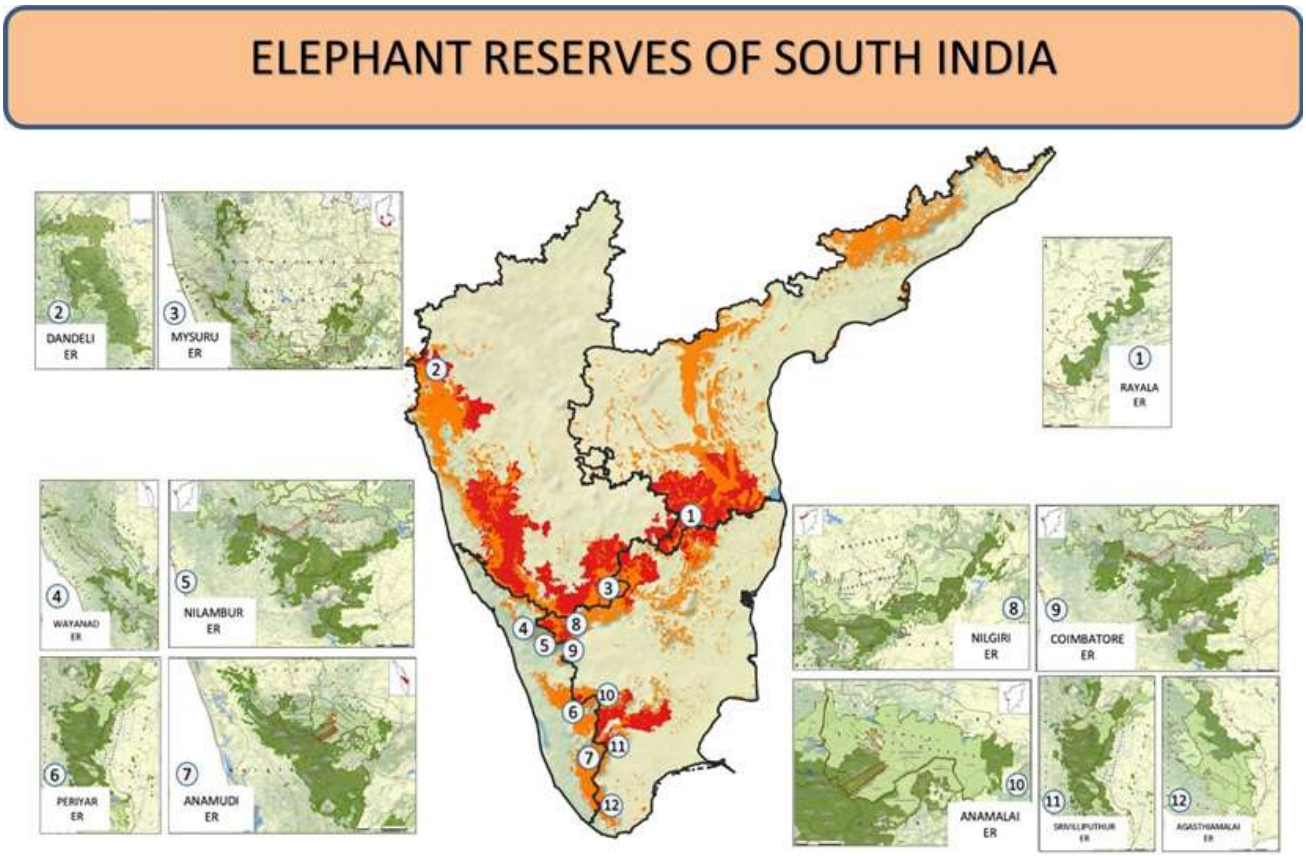

Fig-2: Elephant Reserves of Southern Region (AP, Karnataka, Kerala & Tamil Nadu)

1.2. ELEPHANT RANGE AND MOVEMENT

The elephant habitats of South India, spanning Karnataka, Tamil Nadu, Kerala, and Andhra Pradesh, form one of the most significant strongholds of the Asian elephant (Fig-2). The region encompasses a mosaic of PAs, RFs, Govt lands, plantations, agrarian landscapes, and urbanizing zones, which collectively shape the patterns of elephant range and movement. The elephants seasonally migrate and move over a large area and return utilizing a large habitat to meet its food and water requirements. 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.

In Karnataka, elephants occupy extensive landscapes ranging from Bannerghatta-Hosur-Kolar and Ramnagar-Mandaya-MM Hills-BRT to the large contiguous habitats of Bandipur-Nagarhole-Kodagu. Over 40% of the state's elephant population is concentrated in Bandipur and Nagarhole, with spillover into adjoining coffee estates of Kodagu, where 'elephants in coffee estates' contribute to persistent conflict. Movements are also observed across Kodagu, Hassan, and Chikkamagalur, influenced historically by irrigation projects that disrupted natural corridors. Populations in Bhadra-Shimoga are beginning to reconnect northwards towards Dandeli, while elephants in Yellapur-Dandeli occasionally disperse as far as Belagavi and even cross into Maharashtra (Fig-3). These patterns highlight both the resilience of elephant movement and the pressures from habitat fragmentation, dams, and expanding agriculture.

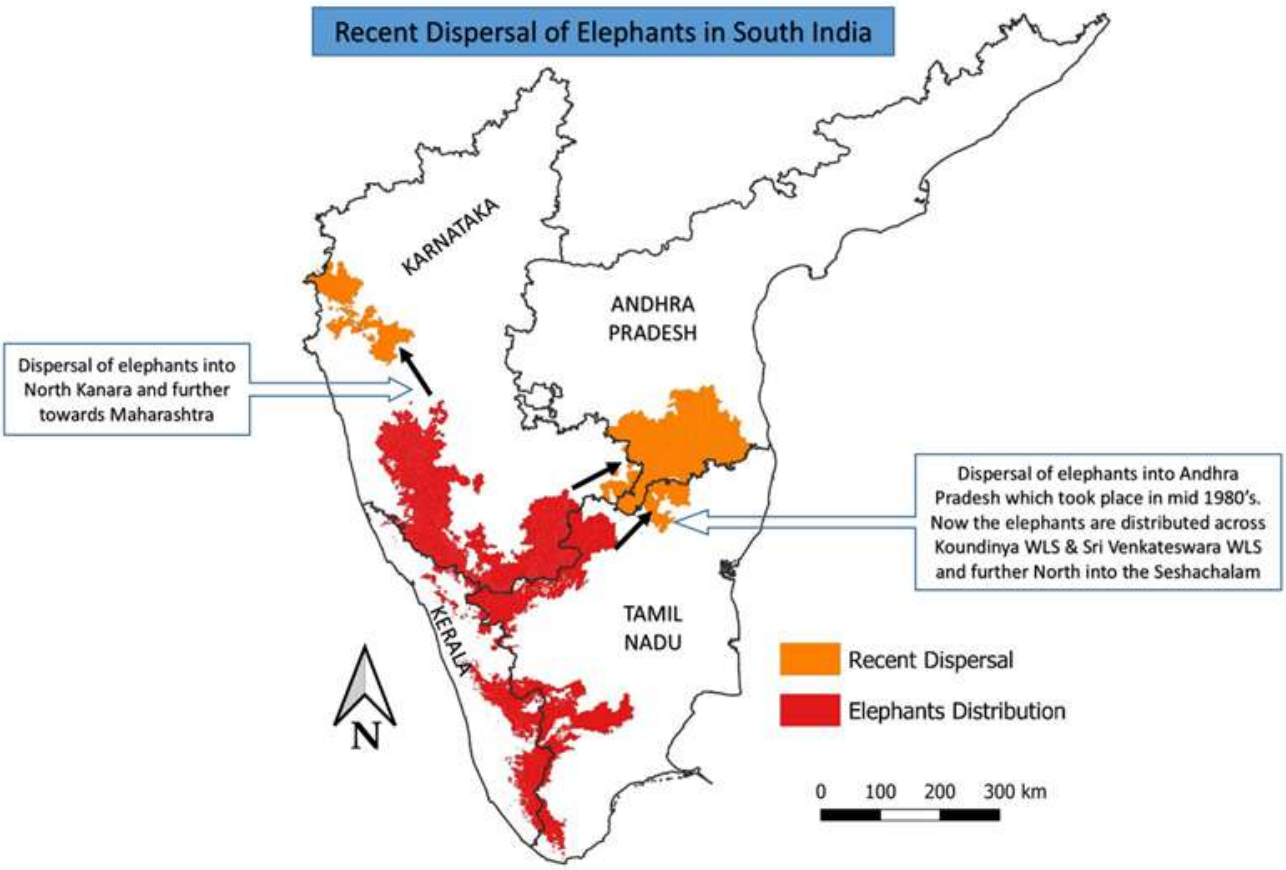

Fig-3: Recent Elephant dispersal: Mysuru ER-Dandeli ER and Mysuru-Nilgiri ERs-Rayala ER

In Tamil Nadu, elephant ranges are equally diverse, str*etc.*hing from the Nilgiri plateau, Gudalur region and Mudumalai TR in Western Ghats through Sathyamangalam TR, Thanthai Periyar Wildlife Sanctuary, Dharmapuri Forest Division and North and South Cauvery Wildlife Sanctuaries in Eastern Ghats. Radio-telemetry studies in the Nilgiri Biosphere Reserve (NBR) for clans have shown an estimated home range of 621 km^2, with movements shaped by seasonal monsoons, fruiting trees, and reservoir resources. Notably, herds move south through the Moyar valley into Coimbatore. In the South of Palghat gap, the elephant distribution extends to Anamalais landscape, and southwards into the Palani, Kodaikanal, Srivilliputhur-Megamalai ranges. Elephants from Anamalais disperse eastwards along the Palani foothills towards Dindigul. In the southernmost landscapes beyond the Shencottah Gap, elephants utilise fragmented patches interspersed with dams, cultivation, and human habitation, underscoring the adaptability of herds in mountainous terrains.

Kerala holds a critical ecological link, with its forests forming seamless continuity with Karnataka and Tamil Nadu. Seasonal migrations into Kerala are common, particularly during dry months, when elephants seek water and forage in the relatively moist forests of the Western Ghats. However, climate change-driven shifts in rainfall patterns are increasingly disrupting these traditional migratory routes, leading to altered movement dynamics and rising conflict at fringes. Of the four Elephant Reserves (ER) in Kerala, Anamudi and Periyar ERs are located south of the Palghat gap whereas Nilambur and Wayanad ERs are on its northern side. To the north of Palghat gap, the elephant range in different PAs and territorial Forest Divisions. These include Silent Valley NP, Wayanad, Aralam, Kottiyur and Malabar WLS and the territorial Forest Divisions of Palakkad, Mannarkad, Nilambur north, Nilambur south, Wayanad north, Wayanad south, Kozhikode, Kannur and Kasargod. These PAs and Forest Divisions are well connected with forests in Tamil Nadu and Karnataka. In the south of Palghat gap, the elephant range includes territorial Forest Divisions of Nenmara, Thrissur, Chalakudi, Vazhachal, Malayattoor, Kothamangalam, Mankulam, Marayoor , Munnar, and Kottayam and PAs of Parambikulam TR, Peechi Wildlife Division (comprising of Peechi Vazhani and Chimmony WLS), Idukki Wildlife Division (comprising of Thattekkad and Idukki WLS) and Munnar Wildlife Division consisting of Eravikulam NP, and Shola NPs (Mathikettan, Anamudi and Pampadum Shola NP), Chinnar and Kurinjimala WLS, Periyar TR, Shenduruny, Neyyar, Peppara WLS and Agasthyamalai Biological Park. Territorial Divisions of this landscape include Ranni, Konni, Achencoil, Punalur, Thenmala, and Thiruvananthapuram. Over the years an artificial gap known as Shencotta gap has come up due to the presence of a railway line and a road passing through Thenmalai Forest Division. This gap practically divides Periyar Elephant Reserve in two units with feeble connectivity.

In Andhra Pradesh, elephants are a relatively recent presence, having established populations in Chittoor, Tirupati, and Annamayya districts in the south, and smaller groups in the human-dominated forests of Srikakulam, Parvathipuram and Manyam in the north (Fig-3). The only designated elephant reserve, Rayala Elephant Reserve in Chittoor, lies at the Tamil Nadu border, reflecting the cross-boundary origins of these populations. Elephants are believed to have recolonized the state in the 1980s from the Hosur-Dharmapuri forests, and their home ranges vary widely, from 80-100 km^2 for some lone males to over 200 km^2 for herds in Tirupati. With sub-optimal habitat quality and high pressures from cattle grazing and fuel wood collection, these elephants are increasingly drawn into croplands, intensifying conflict and highlighting the urgent need for functional corridors and interstate management.

Taken together, the elephant range and movement in South India illustrate both the continuity of habitats across state borders and the challenges posed by fragmentation, agriculture, and urbanization. Seasonal migration remains a defining feature, yet fragmentation, changes in land-use and shifting climate conditions are reshaping traditional routes. Interstate cooperation and proactive corridor management are thus essential for sustaining the long-term viability of elephant populations in this region.

1.3. INTERFACE LAND USE SITUATION

Understanding interface land uses is important as it can influence elephant movement patterns, habitat quality, and human-elephant conflict and is crucial for effective conservation and management of elephant populations

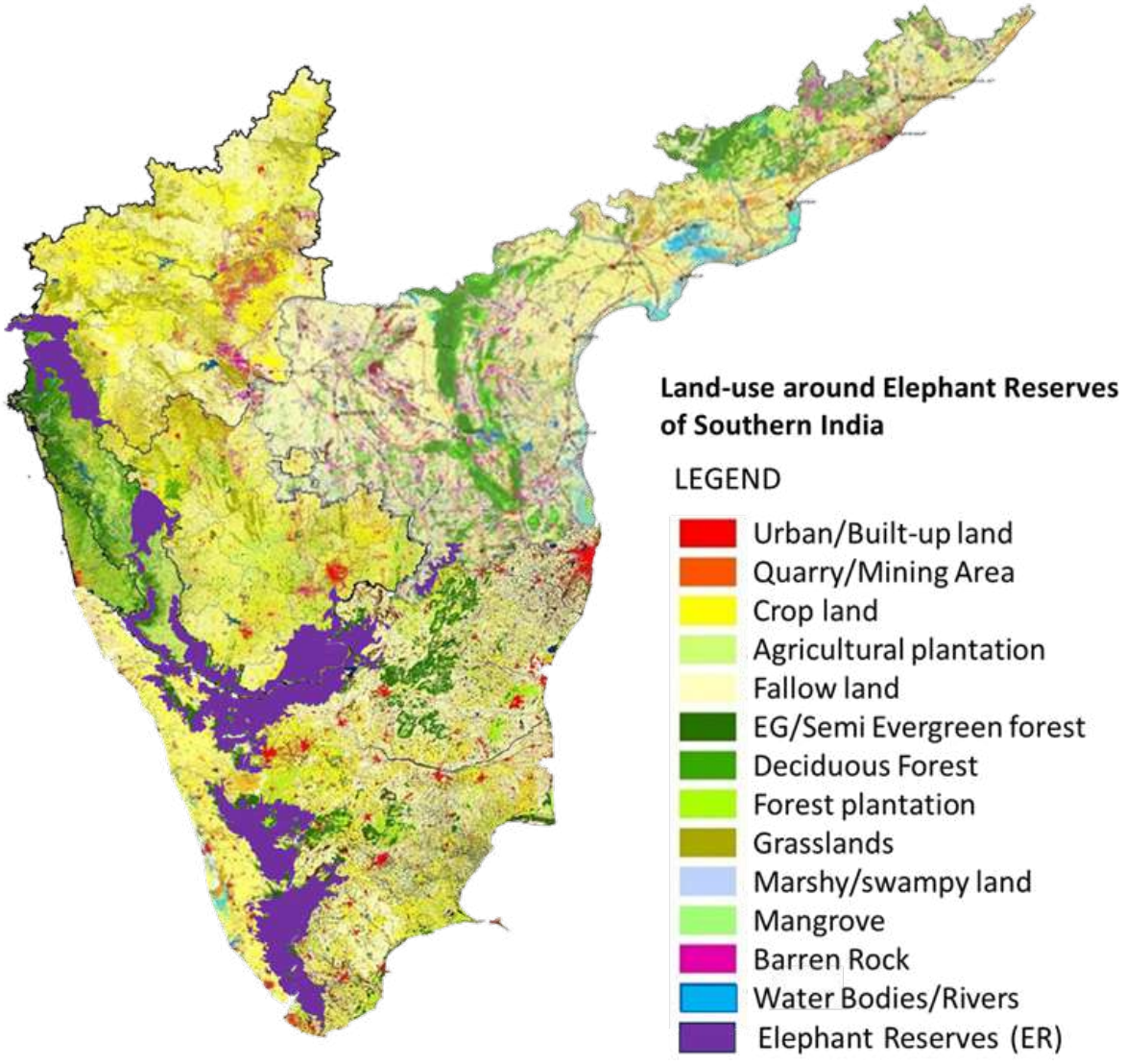

Fig-4: Land-use Land cover (LULC) classification around ERs of Southern India

The land use situation in the interface area is driven by the expansion of human activity and infrastructure development near biodiversity rich forest landscapes (Fig-4). The interface area adjoining forests including enclaves 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, railway lines and canals). Their expansion has vastly increased the extent of fragmented landscapes; the dispersing population into the adjoining agro-pastoral landscape has further increased the negative interaction between humans and wildlife. Linear infrastructure such as highways, railways, canals, and penstock pipelines frequently cuts across PAs, RFs, and key corridor areas. Additionally, the presence of dams and hydel projects have further fragmented habitats and restricted natural movements of elephants.

- Managing land use within an elephant reserve requires a delicate balance between conservation efforts and human activities. The interface of land use typically looks within an ER (Fig-5):
- Core Conservation Area/ Human Coexistence Area/ Human Management Area/ Corridors

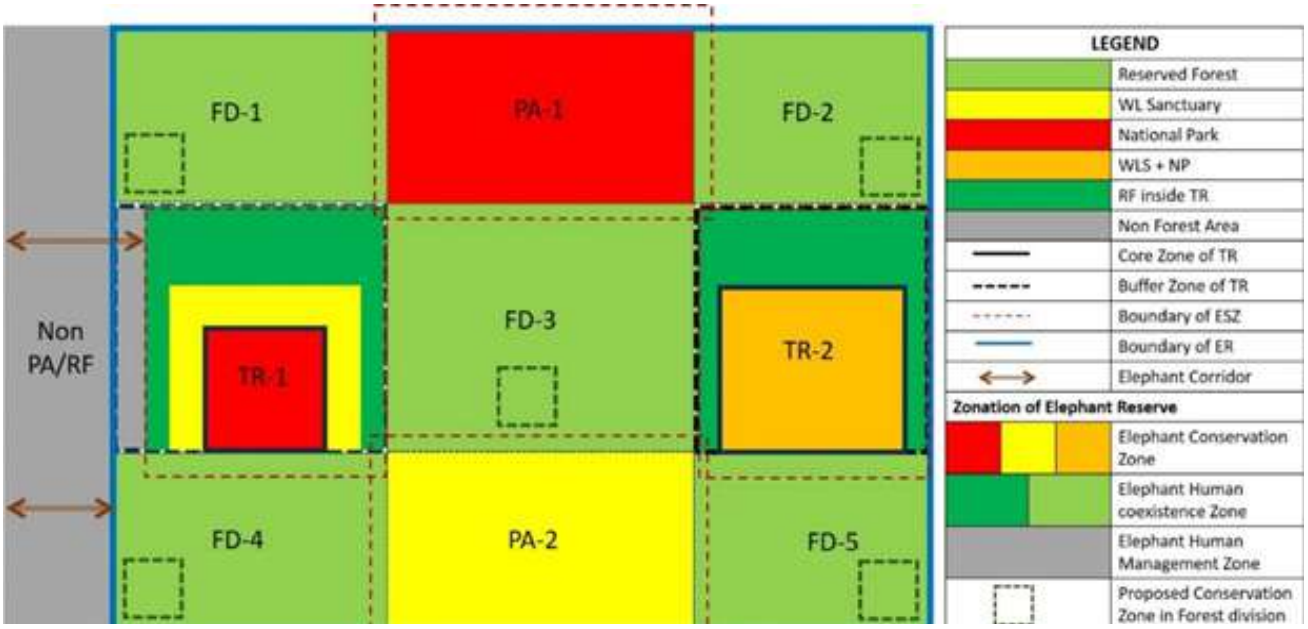

Fig-5: Zonation of ERs (FD-Forest Division; TR-Tiger Reserve; PA-Protected Area) as adapted from ECP Framework (Technical Report of PE- WII- MoEF&CC, Govt. of India, 2024)

- ***Protected Area and Interface situation***: The primary land uses surrounding PAs and elephant corridors include agricultural fields and human settlements. Over time, these areas have undergone significant transformation, particularly in cropping patterns. While the western regions along the Western Ghats are dominated by coffee and tea plantations, the eastern landscapes, which traditionally supported millet cultivation, are increasingly shifting towards high-value cash crops such as banana, mango, arecanut, and coconut including maize. This shift has not only altered traditional farming practices but also significantly modified the land-use matrix adjacent to elephant habitats.

- ***Managed Forests and Interface situation:*** A notable trend is the transition from rural-forest interfaces to urban-forest interfaces, driven by urban expansion. Fallow lands near forests are being rapidly converted into infrastructure developments such as institutions, ashrams, home stays, resorts, and real estate residential layouts. These developments increase human presence and activity near critical elephant habitats including tourism. In many forest peripheries, traditional dryland millet farming, once harmonious with wildlife movement, is now being replaced by more palatable and lucrative crops like banana and sugarcane, leading to increased crop raiding by elephants. Grazing pressure from domestic cattle further deteriorates habitat quality by impeding natural forest regeneration. Moreover, mining and sand quarrying sites in key elephant movement zones pose significant barriers and increase the risk of accidents & habitat fragmentation.

The interface of land use in an elephant reserve aims to strike a balance between conserving elephant populations and their habitats while addressing the needs of local communities and promoting sustainable development. Thus, interface is crucial for understanding the dynamics of human-elephant interactions, potential conflicts, and the overall impact on the conservation of elephants and biodiversity.

1.4. DEVELOPMENT PROJECTS IN THE REGION

In an Elephant Reserve, the 'Production sectors/ Development Projects' typically refer to the various economic activities and sectors that contribute to the region's development and livelihoods of the local communities. Some key development projects, that exist in ERs of Southern region include (i) Forestry and allied industries (ii) Agriculture & Horticulture (iii) Mining (iv) Eco-Tourism (v) Fisheries (vi) Tea/Coffee Estates (l) (vii) Road / Rail transport (viii) Industry (ix) Hydro-electric Project (x) Pilgrimage & Communication projects (Fig-6).

Fig-6: Development Projects viz. Road, Rail, Hydel and Tourism in Southern India

The Development Projects in Elephant Reserves can have 'direct or indirect impacts' on wildlife, particularly on elephant populations and other biodiversity. Direct impacts are often the result of habitat alteration, human-wildlife conflicts, and disruptions to ecological processes whereas indirect impacts are often associated with changes in the landscape, ecosystems, and human-wildlife interactions and may not involve direct physical harm to wildlife.

Development projects in the ERs of Southern region pose significant threats to elephant habitats and populations, causing habitat loss and fragmentation, human-elephant conflict, and elephant fatalities (Table-1). Infrastructure expansion, such as roads and dams, disrupt elephant migration routes and contribute to habitat fragmentation by dividing large habitats into smaller, isolated areas. This fragmentation disrupts wildlife movement (Fig-7); also, affects species' behavior, and reduces habitat quality, ultimately threatening biodiversity and ecosystem balance.

While infrastructure growth is essential for economic development, it is critical that these projects are planned and implemented through a wildlife sensitive lens, especially in biodiversity rich landscapes like the Western Ghats and Eastern Ghats. All new and upgraded linear infrastructure (roads, railways, transmission lines) in or near identified elephant corridors and dispersal routes shall comply with mandatory wildlife-sensitive design standards, including provision of underpasses/overpasses, safe crossing structures, speed regulation measures, context-specific fencing, and post-construction monitoring and compliance reporting.

Table-1: Impacts of Major Development Projects

State	Major Development Projects	Observed / Potential Impacts
Andhra Pradesh	• National highway expansion (NH-716 Tirupati-Kadapa, NH-71, Bangalore-Chennai expressway). • Railway line doubling (Renigunta-Balepalli, Tirupati-Pakala-Katpadi).	• Fragmentation of newly colonized elephant ranges. • Risk of elephant deaths from train collisions and road kills. • Movement disrupted; mitigation needed through overpasses/ underpasses.
Karnataka	• Large dam and reservoir projects established in the past (Tunga, Bhadra, Hemavati, Linganamakki, Supa). • Upgradation of the NH-75 (Bangalore-Mangalore).	• Submergence of elephant habitats and obstruction in traditional routes. • Highways fragment corridors; need for wildlife underpasses • Increased traffic intensity; mitigations attempted like night traffic regulation in Bandipur and Nagarahole TRs.
Kerala	• National and State highways crossing elephant habitats. • Railway lines through forested areas. • Hydropower and irrigation projects. • Tourism infrastructure, resorts and expanding pilgrimage sites	• Habitat fragmentation & corridor disruption • Train collisions and vehicle hits causing elephant deaths; • Increased conflict risk as elephants are forced into settlements and farms. • Increased HEC due to disturbance, habitat fragmentation and pollution
Tamil Nadu	• Upgradation of existing Highways passing through the elephant habitats and corridors. • Tourism based infrastructure development in & around elephant habitats (resorts/ homestays) • Existing contour canals, flume channels, and penstock pipes	• Obstruction on elephant movement. Overpass/ underpasses needed. • Rising disturbance from tourism traffic; mitigations attempted like night traffic regulation in Mudumalai and Sathyamangalam TRs. • Accidental elephant deaths in canals.

Fig-7: Disruption in the Elephant Movement due to the Linear Projects in Southern India


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02

CONTEXT & SITUATION

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2.1. DISTRIBUTION PATTERN AND ABUNDANCE STATUS OF ELEPHANTS

Elephant distribution in South India showcases their adaptability across Karnataka, Tamil Nadu, Kerala, & Andhra Pradesh, highlighting habitat continuity and fragmentation challenges (Fig-8). The region supports an estimated 10, 000-12, 000 elephants which is nearly 25 to 30% of total wild population and also harbours a split population in Andhra Pradesh.

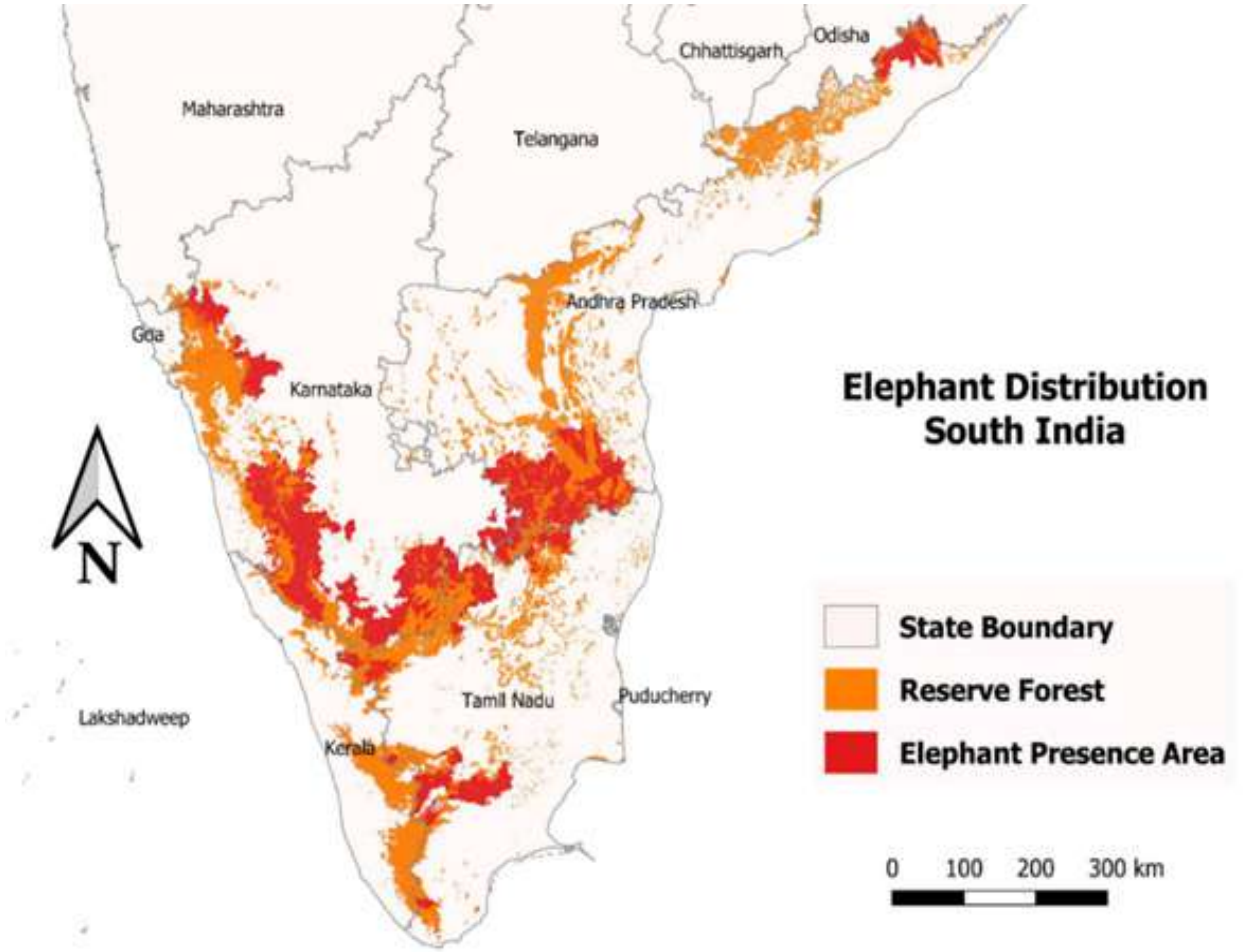


Fig-8: Map showing Elephant Distribution in Southern Region

At present, elephants are found in five major landscapes in south India (Fig-9) in 12 Elephant Reserves, as under:

- **Uttara Kannada** and crestline of the ghats, mainly in forests of Dandeli as the important elephant habitat, that includes a few elephants that move into Maharashtra and Goa.
- **The Malnad plateau**, in particular the Bhadra Wildlife Sanctuary, to the east of the ghats holds an isolated population.
- **The Brahmagiri-Nilgiri-Wyanad-Mysore landscape** with the Nagarahole, Bandipur, Wyanad and Mudumalai complex of reserves harbours one of the highest elephant densities (about 2 individuals/ km^2), followed by significant numbers in the Biligiri angans and the hilly tract along the Cauvery River of the Eastern Ghats. This landscape is estimated to support over 9, 000 elephants. A small population of elephants that dispersed from here in the 1980s now ranges as scattered groups over isolated hills to the east in Andhra Pradesh and Tamil Nadu.
- **Anamalai-Nelliyampathy-High Ranges landscape** with Anamalai, Parambikulam, Malayattur and Vazahchal Forest Divisions being the most important elephant habitats supporting over 3, 000 elephants, which includes 225 isolated elephants in Idukki Sanctuary and Kothamangalam Forest Division.
- **Periyar-Agasthyamalai landscape** with Periyar, Ranni, and Srivilliputhur as the most important elephant habitats harbouring nearly 2, 000 elephants including 250 elephants isolated to the south of Shenkota pass in the Agasthyamalai hills.

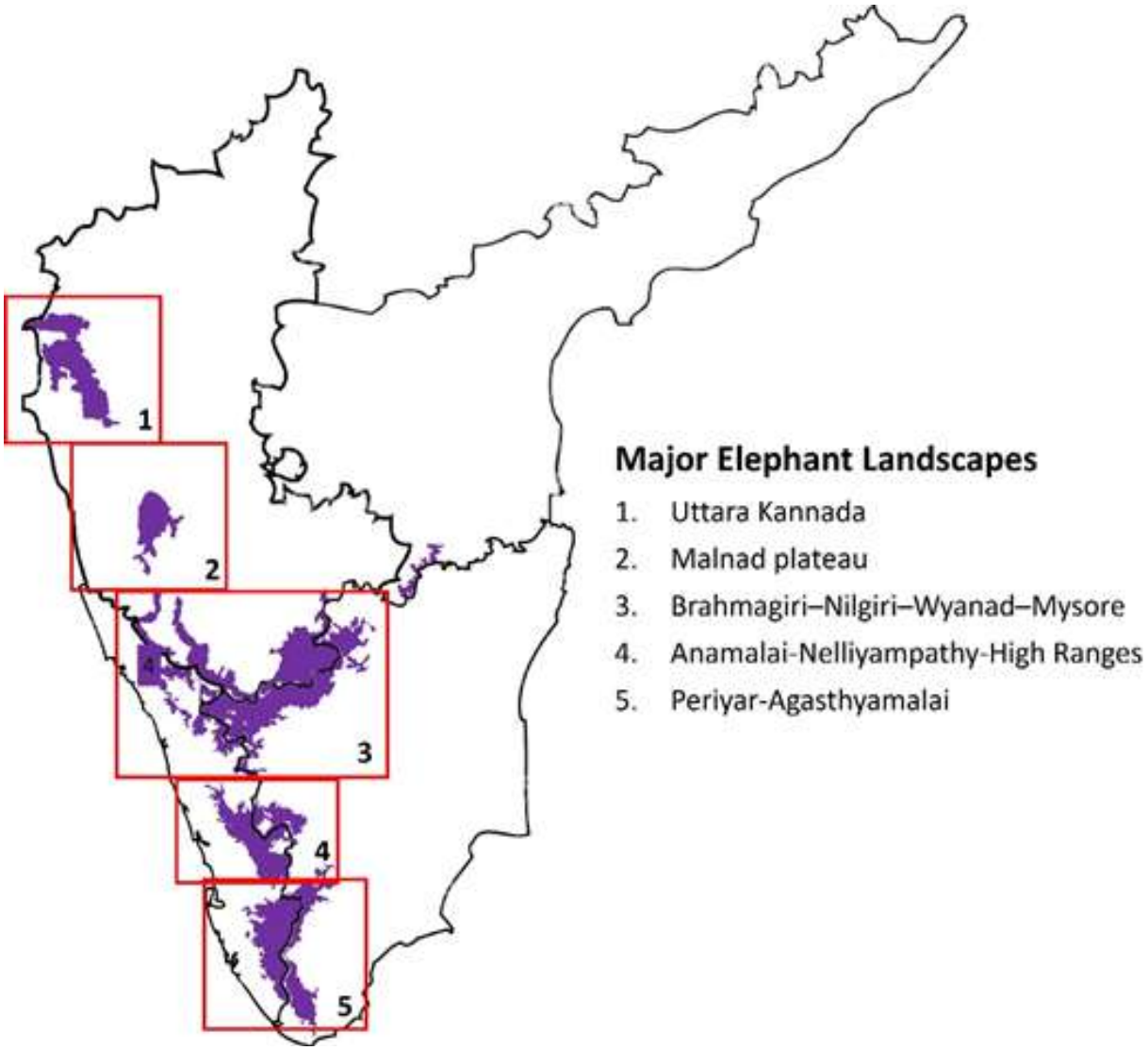


Fig-9: Map showing 5 Major Elephant landscapes in Southern Region

In Karnataka, elephants range from Bannerghatta-Hosur-Kolar and Ramnagar-Mandya-MM Hills- BR Hills to Bandipur-Nagarhole-Kodagu, with over 40% concentrated in Bandipur-Nagarhole, spilling into Kodagu's coffee estates and causing conflict. Movements extend across Kodagu, Hassan, Chikkamagalur, and from Bhadra-Shimoga towards Dandeli. Tamil Nadu's elephants inhabit areas like the Nilgiri Biosphere Reserve and Eastern Ghats, with Kerala's Anamalais landscape forming critical links with Karnataka and Tamil Nadu. Anamudi and Periyar elephant reserves also have their connectivity to adjoining forests of Tamil Nadu at different places. Andhra Pradesh sees recent elephant presence in Chittoor, Tirupati, and Annamayya districts. Seasonal migration defines their movement, but habitat fragmentation, agriculture, urbanisation, dams, and climate shifts disrupt traditional routes, underscoring the need for interstate cooperation and corridor management to sustain South India's elephant populations.

Elephant distribution in South Indian states is quite significant, with this region hosting a substantial portion of India's Asian elephant population (Fig-10). Karnataka stands out as a key state, harboring the country's largest population of Asian elephants, estimated to be around 6, 395 individuals, which accounts for roughly 25% of India's total elephant population. Kerala is home to around 1, 920 elephants with landscapes like Periyar National Park support significant populations. Tamil Nadu has a population estimation of around 2, 961 elephants. Lastly Andhra Pradesh has the smallest population of an estimated 142 elephants. They are primarily found in Chittoor, Tirupati, and Annamayya districts in south and Srikakulam, Parvathipuram and Manyam in north.

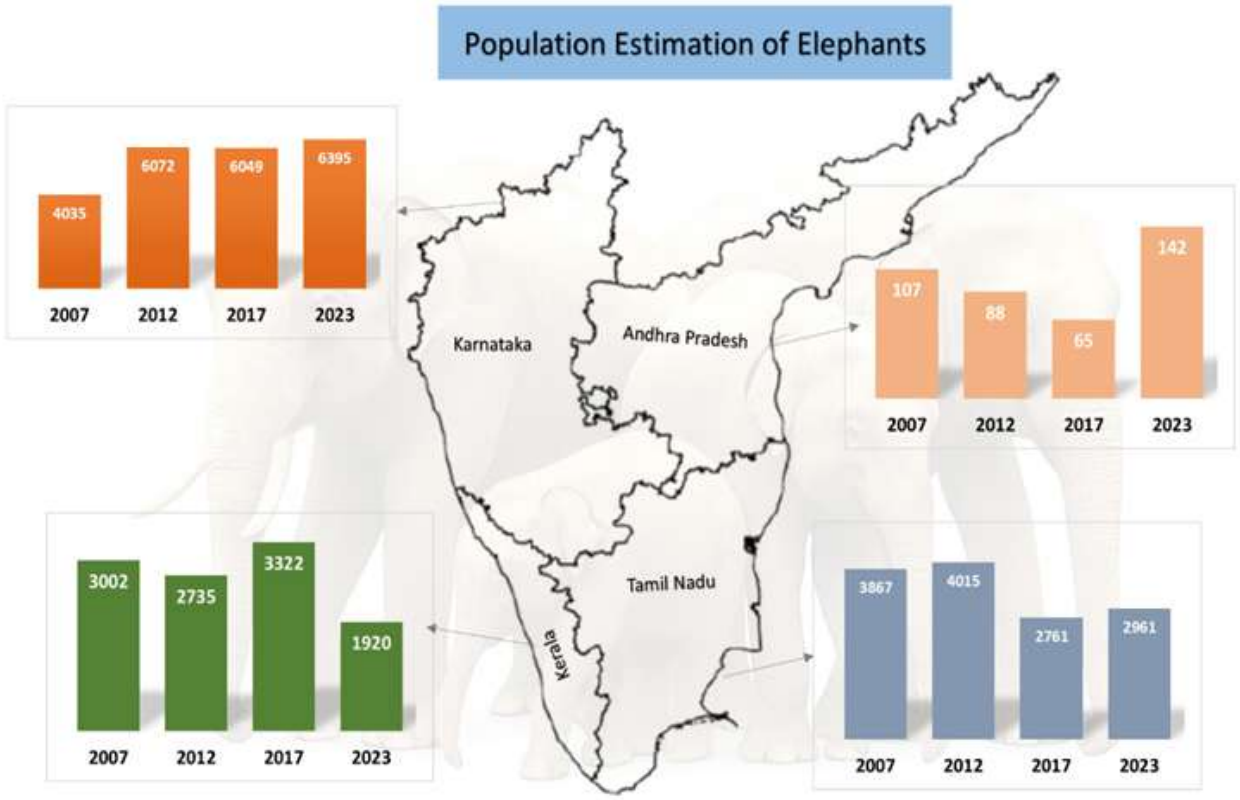


Fig-10: Graph showing Population Estimation of Elephants in Southern Region

The illustration above shows the estimated wild elephant population in South India across various years using two primary methodologies: Block Count Method and Dung Count Method. Both approaches have been integral to elephant population studies, providing insights into population dynamics over time.

2.2. HABITAT QUALITY AND UTILIZATION IN THE REGION

Human activities, unsustainable land use, wildfires, and climate change have degraded natural vegetation, reducing elephant habitats. Invasive species like Senna, Lantana, Ageratina and Eupatorium outcompete native plants, diminishing elephant forage. Increased human presence and disturbances further disrupt ecological balance, forcing elephants to seek food in agricultural fields, leading to crop-raiding and heightened human-elephant conflict. Furthermore, increased human presence and disturbances-- stemming from settlements, tourism, and infrastructure development-- have disrupted the delicate balance of these ecosystems. As a result of these cumulative pressures, elephants are increasingly compelled to seek alternative food sources beyond their traditional forested ranges. This shift in foraging behavior has led to heightened incidents of crop-raiding, with elephants venturing into agricultural fields in pursuit of palatable and energy-rich crops. Such behavior escalates human-elephant conflict, placing both elephants and local communities at risk. The consequences undermine conservation efforts and impact livelihoods alike, creating a challenging dynamic for coexistence.

Fig-11: Landscape dominated by Tea (Valparai), Coffee (Kodagu) & Mango orchard (Rayala)

In the landscapes dominated by tea-coffee plantations, elephants make use of forest patches and riparian strips during the daytime and move into plantations at night (Fig-11). Similarly, habitual crop-raiding elephants remain in patch forests or forest fringes surrounded by agricultural fields during the day and venture into crop fields at night. In states like Kerala and Karnataka, elephants have found a refuge in the coffee estates where there is ample shade and also supplemented with fruit bearing trees like Jackfruit and understory of grass. In Andhra Pradesh it was seen that elephants in the summer season are taking shelter in large mango orchards where there is good shade and the summer also coincides with mango fruits, to which they get attracted.

Fig-12: Elephant habitat quality with grass & bamboo regeneration (top) and Invasives (bottom)

Assessing habitat quality and utilization in Elephant Reserves 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 (Fig-12). An overview of the evaluation of habitat quality and utilization (Table-2), envisages:

Table-2: Evaluation of Habitat Quality and Utilization

Parameter	Requirement
Habitat Quality Assessment	• Conduct detailed vegetation surveys to assess the composition, structure, and diversity of plant species including identifying key forage species • Evaluate abundance/distribution, nutritional value of preferred food sources • Assess the abundance/distribution and status of invasives • Assess the availability and reliability of water sources • Evaluate the availability of suitable cover/ shade (dense forested areas)
Habitat Utilization Studies	• Conduct GPS based study for analysing the data to identify core areas of habitat utilization, migration routes, and seasonal movement • Monitor their presence to identify high-usage areas through camera-traps • Conduct dung surveys to understand their distribution and habitat use
Seasonal Variations	• Evaluate habitat quality changes (availability of water, food, and cover) with different seasons affecting movements and habitat preferences. • Study seasonal migration/ movement patterns

Behavioural Studies	• Analyse feeding behaviour including plant preferences & feeding intensity • Study areas of rest, socialization, and engagment in other behaviours
HEC Hotspots	• Identify and map locations of frequent HEC to understand limitations in habitat quality or availability
Corridor Utilization	• Assess the utilization of ecological corridors for understanding gene flow and maintaining population health
Health and Reproductive Success	• Monitor health to understand how habitat quality influences their well-being • Study reproductive success, including calf survival rates, which can indicate the availability of suitable habitats and resources for breeding females.

Assessing habitat quality and utilization in ER requires a holistic approach and by understanding how elephants interact with their habitat, we can implement measures to enhance habitat quality, reduce HEC, and ensure the long-term well-being of both elephants and ecosystems. Based on the assessment, we may develop and implement habitat management strategies incorporating habitat restoration, protection of critical habitats, and mitigating factors contributing to habitat degradation.

2.3. CURRENT STATUS, CAUSES AND EMANATING CHALLENGES OF HEC

2.3.1. Current Status of HEC

Human-elephant conflict (HEC) refers to the negative interaction between humans and elephant leading to the adverse impacts such as human injury and casualties, crop depredation, property and livestock damage, and retaliatory killings of elephants. The rising incidence of elephants straying into human-use areas is largely driven by severe habitat degradation, the lure of attractive crops grown in forest fringe villages, and the fragmentation and disconnection of habitats that force elephants into areas of human use. The current status of HEC in South India is a pressing conservation issue (Fig-13).

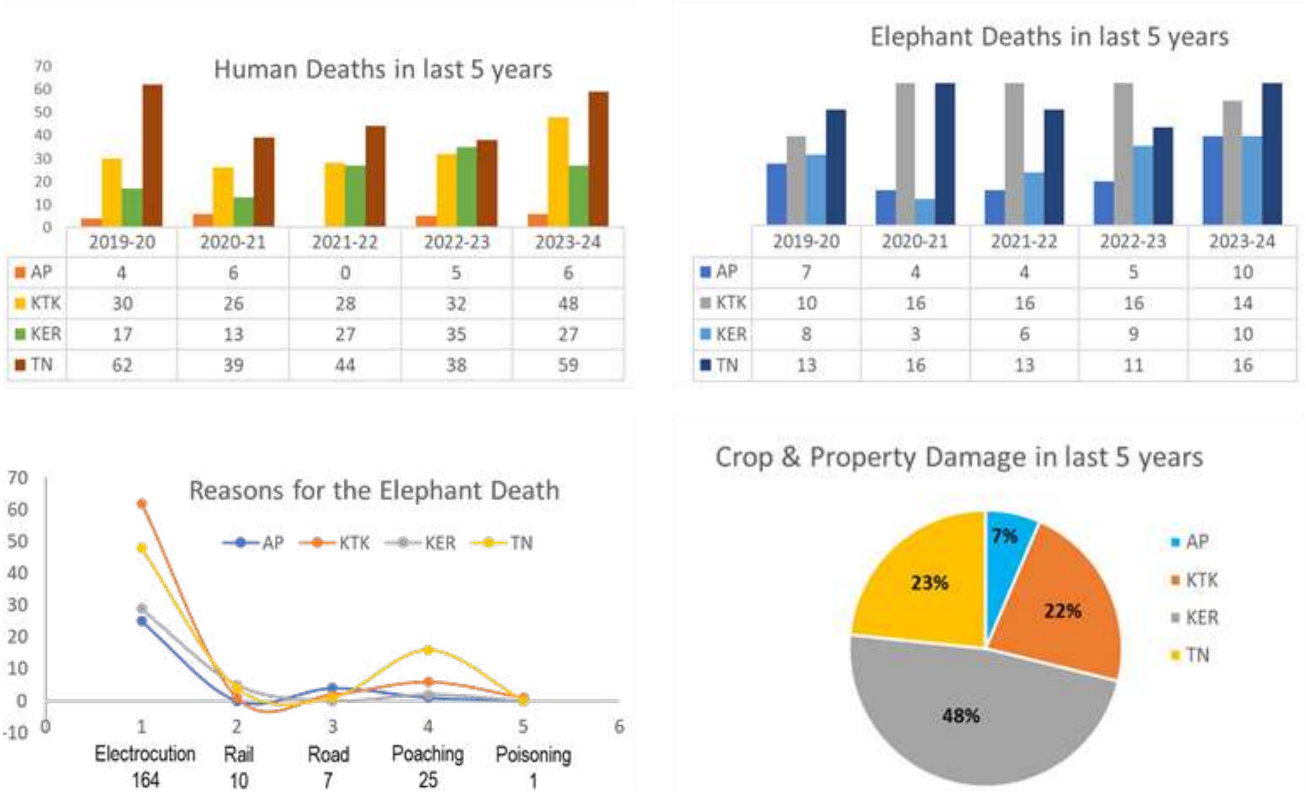


Fig-13: Graph and charts showing current status of HEC in the Region

From the above graph, it is evident that the nature and intensity of HEC vary from state to state, ranging from very low to high conflict. On an average, 109 human deaths happen annually in the region with maximum human deaths reported from Tamil Nadu and Karnataka and least from Andhra Pradesh. Also, the conflict cases in terms of reported human deaths appear to be on the rise in the last 4 years.

The elephant deaths due to anthropogenic causes in the region approximately around 40 elephants annually. States like Andhra Pradesh and Kerala recorded 5-6 elephant deaths per year while Karnataka and Tamil Nadu recorded 13-14 animals per year. When standardised by mortality rate per 100 elephants, the relative impact in Andhra Pradesh is considerably higher. Electrocution has emerged as a major cause of unnatural elephant deaths (80%). In most cases, these incidents are not intended to target elephants but arise from live wire fences erected to deter crop-raiding animals such as wild pigs. Elephants, however, often fall victim to these fences. The use of crude country-made bombs to kill crop-raiding animals, particularly wild pigs, poses another serious threat. Elephants frequently become unintended victims of these devices, leading to severe injuries or fatalities.

Crop and property damage incidents from elephants are reportedly high in Kerala, especially in Wayanad, Idukki, Palakkad, and forest fringe areas.

2.3.2. Causes of HEC

HEC in the South India is primarily driven by the following:

- *Habitat Fragmentation*: Human activities such as agriculture, settlements, & infrastructure development can lead to habitat fragmentation, increasing the likelihood of conflict.
- *Habitat Degradation*: Invasives, recurrent forest fire and over grazing cause habitat degradation and resource reduction in the habitat leading to conflict and crop raiding.
- *Corridor Disruptions*: Disruptions due to roads or other developments force elephants to navigate through human-dominated landscapes, leading to conflicts.
- *Water Source Conflicts*: Competition for water sources can result in conflicts, particularly during dry seasons when water is scarce.
- *Increase in Elephant Population*: The resources available for elephants have declined with increasing population leading to the crop-raiding behavior and conflict.
- *Cash Crop Cultivation:* Banana, paddy, coconut, arecanut, sugarcane, mango orchards attract elephants and may lead to conflict.
- *Proliferation of Power fences:* restricts natural movement; deflects conflict to other areas.

2.3.3. Emanating Challenges of HEC

The emanating challenges associated with the key factors related to HEC (Table-3) include:

Table-3: Emanating Challenges of HEC

Factors	Challenges
Habitat Loss and Fragmentation	Reduced and fragmented habitats force elephants to move through human-dominated landscapes, increasing likelihood of conflicts
Habitat Degradation	Large scale infestation of habitat with invasives and disturbance regimes requires close monitoring, maintenance and management
Crop Raiding	Crop losses result in economic hardships for farmers, leading to negative perceptions of elephants and conservation efforts
Water Scarcity	Ensuring access to water for both human and elephants while minimizing conflicts is a complex balancing act
Corridor Disruptions	Corridor disruptions can lead to increased conflicts as elephants navigate through areas not suitable for their movement
Inadequate Mitigation	The absence of adequate mitigation measures increases the likelihood of negative interactions between elephants and humans
Poaching and Retaliation	Retaliatory killings of elephants in response to conflicts perpetuate a cycle of violence and hinder conservation efforts
Depredation and Patrolling	Driving elephants, tracking in the night, elephant breaking ration shop/ shed in search of food creating panic, is a challenge
Climate Change	Changing climate may force elephants to adapt bringing them close to human settlements
Limited Research and Data	Lack of comprehensive information hinders the development of targeted and evidence-based conservation strategies

2.4. ASSESSMENT OF THREATS INCLUDING SPATIAL-TEMPORAL RISK ASSESSMENT

The challenges highlighted are common to protected areas (PAs) country-wide, but their scale and solutions vary depending on the landscape and species in question. A primary driver of human-elephant conflict is habitat loss for elephants, which critically diminishes their key resource: food. This reduction in food availability- or its compromised quality and quantity- often compels elephants to venture into human settlements seeking sustenance. The issue is pronounced with elephants and numerous instances document elephants exiting PAs in search of fodder and water, underscoring how habitat constraints push them into conflict-prone areas.

The challenges facing elephant conservation and human-elephant coexistence are complex, spanning ecological, institutional, and infrastructural dimensions. These threats arise from a mix of natural and human-induced factors contributing to habitat degradation, escalating conflicts, and inefficiencies in management.

Critical Threats in the Elephant Landscape-

- *Biodiversity Loss*: Almost all the states face significant pressures from invasive species such as *Senna spectabilis, Lantana camara, and Mikania micrantha*, reducing native forage and altering ecosystems like marshy grasslands. This habitat degradation forces elephants into human-dominated areas seeking food and water.
- *Ecological Stressors*: Poorly maintained water sources in forests and spread of species like wattle in grasslands exacerbate habitat stress. Damage to riparian forest and grassland, drying of marshland, invasive species, mining, quarrying and effluent discharge impair the forest ecosystem & impact the landscape, which require ameliorative measures.
- *Linear Development Projects*: Presence of linear development projects (highways, railway lines, *etc.*) in the landscape fragment and disrupt the contiguity of habitats, amounting to ecological bisection of the extremely biodiversity-rich landscape.
- *Monoculture Plantations*: There are large number of commercial plantations of eucalyptus, teak and other species, in the higher reaches, responsible for accelerated soil erosion and degradation of vital watersheds including direct impacts on biodiversity and habitats.
- *Reservoirs & Hydel Projects:* The landscape has prime watersheds, catchments of rivers, and hill-valley terrain that offer potential sites for multipurpose reservoirs providing water for drinking and irrigation, and hydro-power. There is also extensive submergence in the reservoir area in the most productive riparian forests and wildlife-biodiversity habitats.
- *Tea & Coffee Plantations*: These occupy high potential biodiversity and wildlife habitats including corridors in the biodiversity rich forest area. The impact of labor habitations on nearby forests including firewood and livestock grazing is a critical issue.
- *Tourism and Pilgrimage*: The eco-tourism and pilgrimage potential of the landscape attract entrepreneurs to open resorts which may enhance disturbance and damage.
- *Tribal Settlements*: The tribal settlements and enclaves are expanding resulting in enhanced biotic pressure on the forested habitat.

Implications of Threats on HEC

- *Seasonal Patterns*: Conflict risk and habitat degradation intensify during dry seasons (when water scarcity peaks) and post-monsoon periods (when wildfire risk rises due to biomass accumulation). Lack of preventive fire management like controlled burns heightens ecosystem vulnerability.
- *Human-Elephant Conflict (HEC) Distribution*: HEC hotspots often lack physical barriers (fencing, early warning systems). Inadequate infrastructure maintenance and delayed responses by under-equipped field teams worsen conflict outcomes.
- *Information Dynamics*: Real-time misinformation via media during conflicts can amplify fear, hostility, and retaliatory actions against elephants.
- *Institutional Gaps*: Under-resourced veterinary units, absence of Primary Response Teams (PRTs), and lack of centralized data management hinder effective Forest Department responses. Limited interstate coordination and population monitoring impede transboundary conservation, especially for migratory elephant populations.

These threats exhibit spatial and temporal variability, tied to ecological factors (invasive spread, water availability), infrastructural deficits (communication tools, fencing), and institutional preparedness (trained teams, data systems).

An overview of how spatial-temporal risk assessment can be conducted (Table-4), envisages:

Table-4: Steps in Spatial-Temporal Risk Assessment

Parameter	Spatial Assessment	Temporal Assessment
Mapping	Distribution of populations, critical habitats, & threats	LULC change human activities & elephant movements
Identification of Threats	Areas with high HEC, poaching, regions facing habitat loss	Seasonal patterns in conflict and crop-raid incidences
Climate Change Impacts	Changes in vegetation, water availability, and temperature	Patterns of resource availability for elephants
Ecological Corridors	Identify areas which are intact, disrupted, or require restoration	How the use of corridors varies seasonally or annually
LULC Changes	Evaluate changes & identify areas with transformation	Study LULC changes over time and their implications
Anthropogenic Disturbances	Identify areas with high levels of human activities	Analyze daily, seasonal, and annual patterns
Human Population Density	Evaluate spatial distribution of human populations around ER	Changes in human population and its correlation with HEC
Tourism Impact	Assess impact of tourism on elephant behaviour & habitats	Study potential influence on elephant stress levels
Resource Availability	Evaluate distribution of key resources like water & forage	Seasonal changes in resource availability and its impact

Effective mitigation thus requires a robust spatial-temporal risk assessment integrating these elements to inform strategies addressing habitat restoration, conflict prevention, and coordinated management across landscapes (Fig-14).

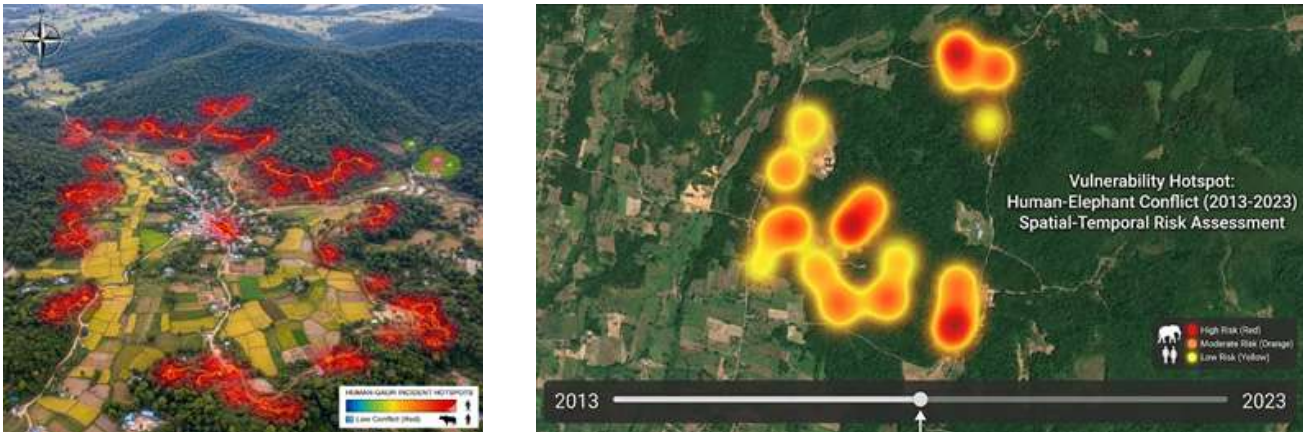


Fig-14: Mapping of vulnerability hotspots of HEC using spatial-temporal risk assessment

2.5. VISION, GOALS, OBJECTIVES AND STRATEGIES

2.5.1. Vision:

The vision is 'to reduce human-elephant conflict in southern India through strengthened mitigation systems, community centered development, and science-based, adaptive management'.

2.5.2. Goal:

The broad goal of this plan for elephant conservation in southern India centers on securing the long-term viability and welfare of wild elephant populations through sustainable, inclusive habitat management. This encompasses two interconnected specific goals:

- ***Enhancing Ecological Integrity***: Preserve and bolster the ecological and genetic health of elephant populations by improving habitat connectivity across forest divisions and administrative borders for long-term

survival. This is supported by integrated land-use planning, restoration of fragmented forests, and landscape-scale interventions.

- ***Mitigating Human-Elephant Conflict (HEC)***: Effectively reduce conflicts by minimizing crop damage, property loss, and threats to human life. Simultaneously, strengthen community resilience, protect rural livelihoods, foster harmonious coexistence, and promote conservation initiatives led by local communities.

This approach seeks a balance between ecological conservation and addressing human needs, aiming for mutually beneficial outcomes for elephants and local communities.

2.5.3. Objectives:

In South India's forested landscapes, where human-elephant interactions are increasingly common, a targeted and multifaceted approach is critical for ensuring the enduring conservation of elephants. The outlined objectives seek to steer conservation planning, conflict mitigation, and community engagement initiatives in a manner that is both holistic and sustainable.

1. ***Safeguard Elephant Habitats and Corridors***: Ensure protection, ecological restoration, and functional connectivity of vital forest areas and traditional elephant movement routes, maintaining landscape-level integrity crucial for their survival.
2. ***Mitigate Human-Elephant Conflict (HEC)***: Implement proactive, science-informed measures like early warning systems, thoughtful land-use planning, and locally tailored strategies to reduce risks for both humans and elephants.
3. ***Foster Collaboration and Community Engagement***: Strengthen local community involvement and multi-stakeholder coordination by empowering communities, integrating traditional knowledge, and promoting cooperation among forest departments, local governments, concerned Line Department agencies, NGOs, and other key stakeholders.
4. ***Leverage Research and Technology***: Enhance use of tools like telemetry, camera traps, GIS analysis, and data-driven insights to support evidence-based conservation and enable prompt responses to emerging challenges, bolstering elephant conservation efforts.
5. ***Command Control Centre***: Setup a fully functional Command Control Centre which facilitates all the above points and acts as a Centre for Monitoring, Research, Emergency Response and a point of first contact in case of HEC.

Logical Framework Analysis for Human-Elephant Conflict in Southern India (Fig-15), is as follows:

LOGICAL FRAMEWORK ANALYSIS FOR HEC	Objectively Verifiable Indicators (OVIs)	Means of Verifications (MoVs)	Assumptions
• **OBJECTIVES** 1. To restore existing habitats of elephants in traditional forest boundaries 2. To control fragmentation of habitats 3. To mainstream elephant conservation concerns into development of ER 4. To improve the effectivity of conflict management strategies 5. To strengthen science based management	1. Ecological status of habitats inside & outside elephant reserves 2. Level of conflict 3. Community sentiments towards elephant conservation programs	1. Results of long term ecological and social monitoring 2. Rapid field surveys	1. The programs keep live on the climate change issues 2. There are no new externalities affecting ecological and social dynamics of the landscapes
• **OUTPUTS** 1.1. State specific invasive species management plans 1.2 State specific and landscape specific Eco development plans 1.3 Habitat improvement plans for each Elephant Reserve (ER) 2.1 Mitigation of habitat loss inside and outside traditional boundaries of ER 2.2 Important elephant corridors acquired and managed 3.1 New social constituency for elephant conservation restored 3.2 Traditional communities become important part of conservation initiatives 4.1 Comprehensive capacity building program on conflict handling in place 4.2 Improved conflict mitigation mechanism 4.3 Improved mechanisms for redressal of conflicts 5.1 System of long term engagement between scientists & managers in place 5.2 Relevant long-term research and monitoring programs for HEC mitigation	1. Physical progress of different initiatives 2. Field effectivity of these initiatives	1. Office records 2. Community records 3. Records of developmental agencies 4. Records of scientific institutions 5. Community surveys	1. The policies remain stable and programs are long-term 2. The programs are dynamic and adaptive based on the results of long term monitoring 3. There is effective communication between different agencies involved in the program
• **ACTIVITY CLUSTERS** 1. Scientific plans of Fire management, invasive species management, Eco restoration of monoculture plantations, Soil and moisture conservation programs, Eco development programs for local communities, Mitigation plans for tourism & pilgrimage 2. Implement effective mitigations for existing and proposed linear infrastructure, promoting cropping patterns less prone to elephant damage adjoin elephant reserves, conservation friendly development programs in connectivity areas 3. Awareness and sensitization programs for communities, creation of local development funds from prominent public private partner initiatives, promote traditional indigenous communities and their knowledge system in ongoing elephant conservation programs 4. Capacity building programs for frontline staff, veterinarian & field scientist; incentives & rewards; mainstream traditional knowledge into strategies; prepare landscape level plans; create institutional mechanism for inter-sectoral & interstate coordination; create effective response teams (RRTs, PRTs & Kumki teams); involve communities in mitigation & redressal (Jan jagratha Samithis/local self-govts); efficient compensation systems 5. Put in place consortium of prominent scientists and managers, initiate system of regular meetings/workshops, system of regional and state level institutions for management oriented research, landscape level long-term monitoring plans and dynamic databases (state level and landscape level)	1. Physical progress of different activities	1. Records of forest departments 2. Records of eco development committees 3. Records of local self-governments 4. Records of scientific institutions involved	1. The funds for different activities are released regularly and are available in time for implementation 2. There are supportive policies and administrative frame work for implementations of these activities 3. Different stakeholders are willing to get involved in the program **Important Research Areas** 1. Climate change impacts on habitats and other aspects 2. Demographic studies on elephant population 3. Demographic changes of human populations and its impacts on habitats and other issues 4. Historical evolution of management strategies 5. Market impacts on elephant conservation 6. Specific programs for hottest hot spot impact landscapes 7. Public private models for elephant conservation
			Credits: Dr. Lakshmi Narayanan, Miss. Rashi Nautiyal and Miss. Feba, WII Dehradun; Miss. Aditi Bhardwaj, TISS Mumbai; and Miss Tanishtha Thakur, GEHU Dehradun

Fig-15: Logical Framework for HEC in Southern India

2.5.4. Strategies:

Based on the stated goals, and objectives, the following strategies can be derived to guide elephant conservation efforts:

1. ***Landscape-Level Habitat Management and Restoration***
   - Identify and restore degraded habitats and fragmented corridors critical to elephant movement.
   - Promote integrated land-use planning that aligns developmental activities with elephant conservation priorities including ESZ areas within elephant reserves.
   - Implement afforestation and ecological restoration using native species in key habitats and corridors.
   - Prevent further habitat fragmentation through zoning regulations and environmental safeguards.
   - Establish a robust habitat monitoring system to track changes and assess the health of the elephant habitats.

2. ***Corridor Protection and Connectivity Enhancement***
   - Secure traditional elephant corridors through various management activities and wherever possible legally recognize as PAs particularly, conservation reserves or community reserves as the case may be under the provisions Wild Life (Protection) Act, 1972 and declaration of ESZs around sanctuaries and National Parks with timely preparation of Zonal Master Plans. Further, efforts could be made for conservation easements where the farmers are incentivised for keeping their lands fallow for certain period. Strengthen protection of ecological corridors and implement measures to restore and reconnect fragmented habitats including maintaining viability of corridors.
   - Coordinate with inter-state agencies to maintain transboundary corridor integrity.
   - Use spatial mapping and ground-truthing to identify and prioritize strategic connectivity zones.

3. ***Human-Elephant Conflict Mitigation***
    - Deploy early warning systems and real-time monitoring tools (*e. g.* , thermal cameras, SMS alerts, mobile apps) in high-conflict zones.
    - Promote crop protection measures such as solar fencing, bio-fencing, and community vigilance networks.
    - Introduce crop-switching incentives to shift from elephant-attractive crops to alternative crops.
    - Deployment of Rapid Response Teams (RRTs) and Primary Response Teams (PRTs) at the Range/ section level for timely interventions.
    - Develop and regularly update emergency response protocols for immediate intervention during crises and involve local communities in response planning and preparedness.
    - Deploy early warning systems and real-time monitoring tools (*e. g.* , thermal cameras, bulk SMS alerts, mobile apps, and AI camera-based detection/alerting) in high-conflict zones.

4. ***Community-Based Conservation and Conflict Resolution***
    - Empower local communities through capacity building, training, and incentivized participation in conservation efforts.
    - Revive and strengthen local institutions such as Jan Jagratha Samithis (JJSs), Vana Samrakshana Samithi (VSS), Eco-Development Committees (EDCs), and Biodiversity Management Committees (BMCs) and 'Aane Mitra' volunteers/teams for early warning, community coordination, first response support, and reporting of elephant movement.
    - Develop and implement livelihood diversification programs that reduce dependency on forest resources.
    - Conduct regular outreach and awareness programs to foster positive attitudes towards elephant conservation.

5. ***Multi-Stakeholder Governance and Institutional Strengthening***
    - Create coordination platforms involving Forest Departments, Panchayati Raj Institutions, Government Agencies, NGOs, and research institutions.
    - Institutionalize inter-state and inter-agency coordination for collaborative management of elephant populations.
    - Collaborate with the adjoining States and establish mechanisms for sharing information, research findings, and best practices.

6. ***Science-Based Decision Making and Technological Integration***
    - Expand the use of telemetry, camera traps, drone surveys, and GIS for elephant tracking and habitat assessment.
    - Put in place a comprehensive monitoring programme to regularly update elephant population data, movement patterns, and conflict trends to guide adaptive management.
    - Promote applied research on elephant behavior, habitat use, and socio-ecological dimensions of conflict.
    - Build internal technical capacity in the Forest Department through training in data analysis, GIS, and remote sensing.

These strategies can collectively support the vision of ensuring long-term elephant conservation in South India while promoting coexistence and ecological sustainability.

03

DRIVERS & PRESSURES

3.1. ELEPHANT-HABITAT RELATIONSHIP (EHR) IN THE REGION

Elephant-Habitat Relationship (EHR) refers to the intricate and dynamic connection between elephants and their habitat and is essential for the survival and well-being of elephants. Factors that contribute to EHR include: habitat requirements; feeding patterns; migration and home range; human-elephant conflict; ecological role; and climate change impact *etc.*

The vegetation and structural features of the EHR are strongly shaped by rainfall and altitude and these ecological variations have bearing on the elephant distribution, as the long-ranging species depend on the availability of forage, water, and cover. Added to this are the effects of climate change, drying water sources and degraded forests, spread of invasives, which make it harder for elephants to survive and maintain genetic connectivity.

The vegetation and structural features in the Southern region represented by Western & Eastern Ghats are strongly shaped by rainfall regimes & altitudinal gradients, directly influencing elephant distribution, as these large-ranging animals depend on the availability of forage, water, and cover.

The degree of human presence and land use within these habitats varies considerably.

- In the Nilgiri-Sathyamangalam landscape of Tamil Nadu, elephants occupy large contiguous forests with well-defined boundaries but frequently raid adjacent agricultural lands producing maize, ragi, paddy, banana, sugarcane, and vegetables.
- In Coorg, Karnataka, elephants make extensive use of coffee plantations that blend into forest edges, often residing in them year-round.
- In the Coimbatore foothills, irregular forest boundaries along natural contours encourage elephants to use valley revenue lands as corridors, intensifying crop-raiding incidents.
- In fragmented regions such as Gudalur, Tamil Nadu, elephants move between forest patches embedded within tea and coffee plantations and human settlements, relying on streams and shaded plantations as cover.
- In Hassan, Karnataka, large extent of natural thickly wooded areas has been almost entirely replaced by coffee plantations, where elephants use coffee plantations during the day and raid paddy fields at night.
- Seasonal congregation near reservoirs and water bodies such as Bhavanisagar and Amaravathi (Tamil Nadu) or Kabini (Karnataka) further increases the frequency of interactions between elephants and people.
- The seasonal crop of Mango makes the elephants move towards the Northern ends of Rayala Elephant Reserve where there are extensive mango orchards.

Over the past decades, dispersal into new habitats has also been documented, such as the expansion of elephants from Hosur into Kuppam and the Koundinya Wildlife Sanctuary in Andhra Pradesh during the 1980s, or from the Anamalai Tiger Reserve into the adjoining Dindigul Forest Division. These movements highlight the dynamic nature of elephant distribution in response to ecological pressures and human disturbance.

Past management practices have significantly reshaped these habitats. Large-scale monoculture plantations of teak, eucalyptus, and wattle, in the past, altered natural vegetation and degraded habitat quality. Although many of these areas were later incorporated into Protected Areas, surrounding landscapes underwent rapid economic development, particularly irrigated agriculture and horticulture, as seen in Attapadi and Nilambur, Kerala. Such land-use changes have contributed to habitat loss, forcing elephants into human-dominated spaces. In addition, invasive alien species such as Senna, Lantana, Neltuma, and Chromolena have spread widely, reducing fodder availability despite management efforts.

Fig-16: Habitat Fragmentation due to Reservoir and Crop depredation by elephants

Elephants' use of habitats also varies by individual behavior. While most elephants forage continuously, certain adult males become habitual crop raiders, resting in forest edges during the day and entering farmlands at night, creating repeated conflict situations. The habitats where patta lands up to the foothills of mountains, the fencing is often done without leaving sufficient buffer space between mountain slopes and fences, which is necessary for movement of animals between valleys. Increased use of power fences in villages in and abutting forests deflects the conflict and the elephants have to take the riskier pathways such as roads and built-up areas. Such movements increase the likelihood of accidents and encounters.

In sum, the relationship between elephants and their habitats in South India is increasingly shaped by habitat fragmentation, invasive species, agricultural expansion, and human activity (Fig-16). Addressing these challenges requires landscape-scale planning, science-based management, and the integration of coexistence strategies. Protecting and restoring corridors, improving habitat quality, and ensuring that barriers do not compromise ecological connectivity is critical to sustaining elephant populations while minimizing conflict with human communities.

3.2. VARIOUS DISTURBANCE REGIMES IN THE EHR

Elephant habitats across the four southern states of Andhra Pradesh (AP), Karnataka (KA), Kerala (KL), and Tamil Nadu (TN) are increasingly exposed to multiple forms of disturbances. These regimes 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 human-elephant conflict. The extent and impact of these disturbance regimes may vary across the four states (Table-5).

3.2.1. Impact of Various Disturbance Regimes

Table-5: 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 behavior 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 lead to accidental elephant falls and fatalities • Solid waste dump sites affects elephant health

3.2.2. Addressing and Monitoring various Disturbance Regimes in the EHR

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

- *Addressing Disturbance Regimes*: through HEC mitigation; anti-poaching measures; 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 & GPS tracking; HEC reporting systems; ecological surveys; social surveys and community feedback; behavioural observations; monitoring.

Strategies for addressing & monitoring key disturbance regimes in the EHR include:

1. Spread of Invasives
Majority of invasives belong to Asteraceae/ Verbenaceae because of efficient adaptation for survival / distribution on land.

The spread of invasive alien species (IAS) in an elephant reserve can have significant negative impacts on the ecosystem, including competition for resources, alteration of habitats, and potential harm to native flora and fauna (Fig-17). 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-17: Common Invasive Alien Species in the Landscape- Neltuma, Lantana & Senna

Invasive species such as Wattle, Neltuma, and Subabul also exhibit aggressive growth tendencies, while shrubs like Chromolaena & Parthenium proliferate as problematic weeds.

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-18).

Lantana Control Operation (Innovative Strategy):
- Innovative management strategy envisages removal of Lantana by 'cut-rootstock method' on the basis of biological & ecological attributes (Fig-18). 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-18: 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.

BOX-1: 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 and local administration, civil society and academic institutions, industrial & businesses, and local communities including farmers, fishers, and forest dwellers, and general public*

BOX-2: INVASIVE SPECIES MANAGEMENT IN KERALA- SENNA AND LANTANA

- Field visits undertaken highlighted invasive alien plant species as 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 and 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.

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-19). 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.

Key considerations and potential management strategies for addressing overgrazing by cattle in elephant reserves include:

- Implement controlled grazing regimes to prevent continuous and unrestricted access to sensitive areas and rotate grazing areas periodically to allow for vegetation recovery and to distribute grazing pressure more evenly.
- Establish strategic fencing to control the movement of cattle and prevent them from accessing vulnerable or recovering vegetation.
- Involve local communities in sustainable land-use practices and educate them to develop alternative livestock management practices that reduce negative impacts on the reserve.
- Enforce and strengthen regulations related to grazing within ER, including no-grazing zones and collaborate with JFM/EDC/VFC committees to ensure effective implementation.

Fig-19: Habitat degradation due to overgrazing in Nilgiri elephant reserve

3. Forest fire management and monitoring

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

- Conduct awareness campaigns to educate local communities and visitors about the risks of forest fires and maintain fire lines / firebreaks to create barriers that control the spread.
- Install elevated surveillance towers in strategic locations to enhance early detection capabilities and utilize remote sensing technology to detect wildfires in real-time.
- Develop Forest fire likelihood model in spatial domain using causative and anti-causative factors with habitat flammability as variables and plan mitigation strategy (Fig-20).
- Create and maintain mechanical firebreaks to prevent the spread of fires and conduct controlled burns before fire season to reduce fuel loads and minimize the risk of wildfires.
- Equip the reserve with firefighting tools, such as fire trucks, water tankers, and handheld firefighting equipment.
- Provide training programs for local communities on fire prevention and firefighting techniques and also establish community-based fire brigades to respond rapidly to fire.
- 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.
- Develop and implement early warning systems to alert authorities and communities about potential fire threats and utilize mobile alerts, and other communication channels for timely warnings. FSI issues fire alerts but ground-based detection is also essential.
- Support initiatives focused on understanding fire behavior and its ecological impact and explore innovative technologies for improved fire monitoring, detection, and management.

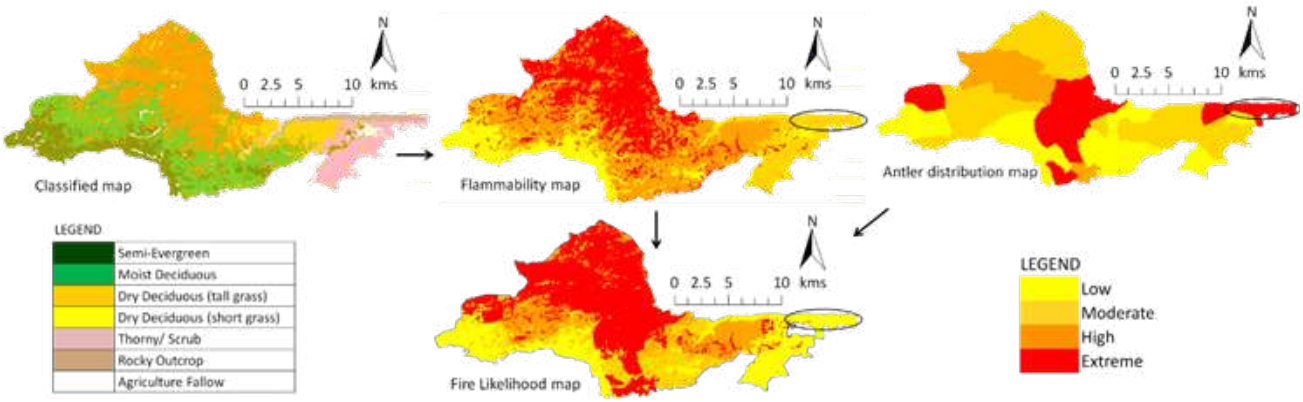


Fig-20: Developing Forest Fire Likelihood Model based on Causative & Anti-causative factors

4. Catchment capability and addressing water scarcity

Proper management of water resources is vital for the well-being of elephants and other wildlife. Considerations related to catchment capability, water scarcity, and wetlands in ER are:

- Assess the topography and hydrology of the catchment area to comprehend water flow patterns, seasonal variations, and the formation of water sources.
- Evaluate land use practices in the catchment area, such as agriculture and infrastructure development, to better understand their impact on water availability.
- Analyze climate data, including rainfall pattern, to assess availability of water throughout the year and consider the impact of climate change on precipitation & water availability.
- Recognize the potential for human-elephant conflict related to water scarcity, as elephants may venture into human settlements in search of water during pinch periods (Fig-21).
- Develop drought preparedness plans that include water management strategies and emergency interventions during extended dry periods.
- Map seasonal and permanent wetlands & water holes within the ER, and consider the ecological importance of wetlands for water storage, biodiversity & habitat maintenance.
- Envisage development of conjunctive basin management by judicious use of surface and ground water and ensure recharging as well as availability during the pinch period.

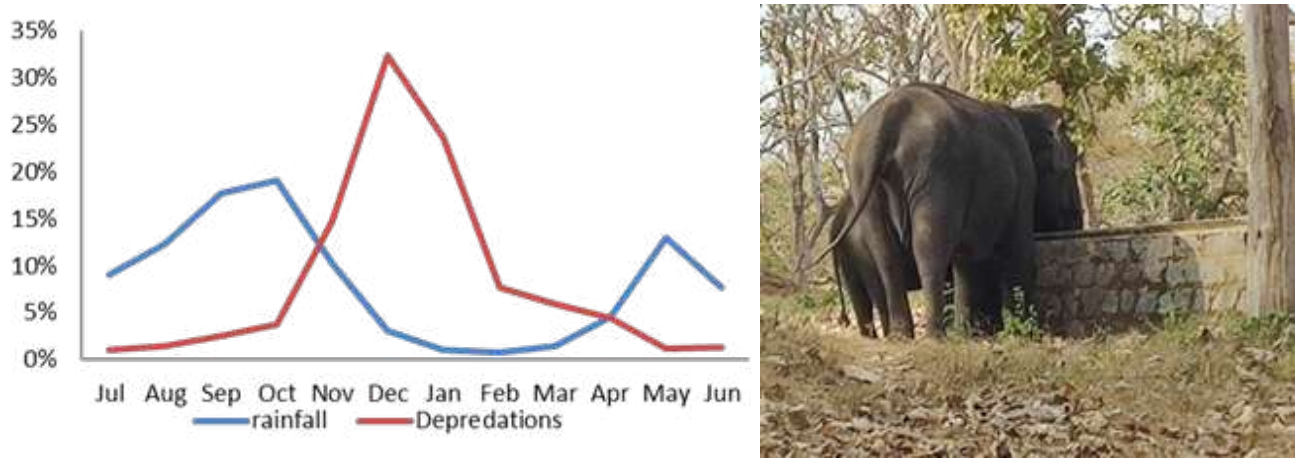


Fig-21: Relationship of crop depredation with rainfall-planning waterhole during pinch period

5. Habitat restoration and monitoring

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

The strategies for habitat restoration and monitoring in elephant reserves envisages:

- *Vegetation Management*: Implement measures to manage and control invasives that may threaten native vegetation and conduct habitat reforestation programs to restore areas affected by deforestation, or

other disturbances including agro-pastoral and silvicultural practices to improve availability of fodder species.

- *Soil Conservation*: Implement erosion control measures, such as the use of cover crops, contour ploughing, and check dams, to reduce soil erosion and use measures to enhance fertility and support plant growth in degraded areas.
- *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.
- *Habitat Connectivity*: Establish and maintain wildlife corridors to facilitate the movement of elephants between different habitats and envisage measures to reduce habitat fragmentation, such as the creation of canopy bridges or underpasses.
- *Bamboo and Grassland Management*: Plant bamboo, in areas where it has been depleted and implement initiatives to restore and manage grasslands, ensuring a diverse range of grass species for herbivores.
- *Remote Sensing and Spatial Mapping*: Use remote sensing to monitor changes in vegetation cover and distribution. Develop GIS-based systems to monitor changes in habitat conditions, land cover, and land use and integrate data from various sources, such as climate, topography, vegetation, to create comprehensive habitat maps (Fig-22).
- *Habitat Quality Assessment*: Assess the health of vegetation through field surveys to determine the quality of forage available for elephants and regularly monitor the quality of water sources to ensure that the requirements of wildlife are met.
- *Human-Wildlife Interaction Monitoring*: Monitor and document human-wildlife conflict incidents, especially those related to habitat use and resource competition along with the feedback from the local communities regarding wildlife interactions and habitat conditions.

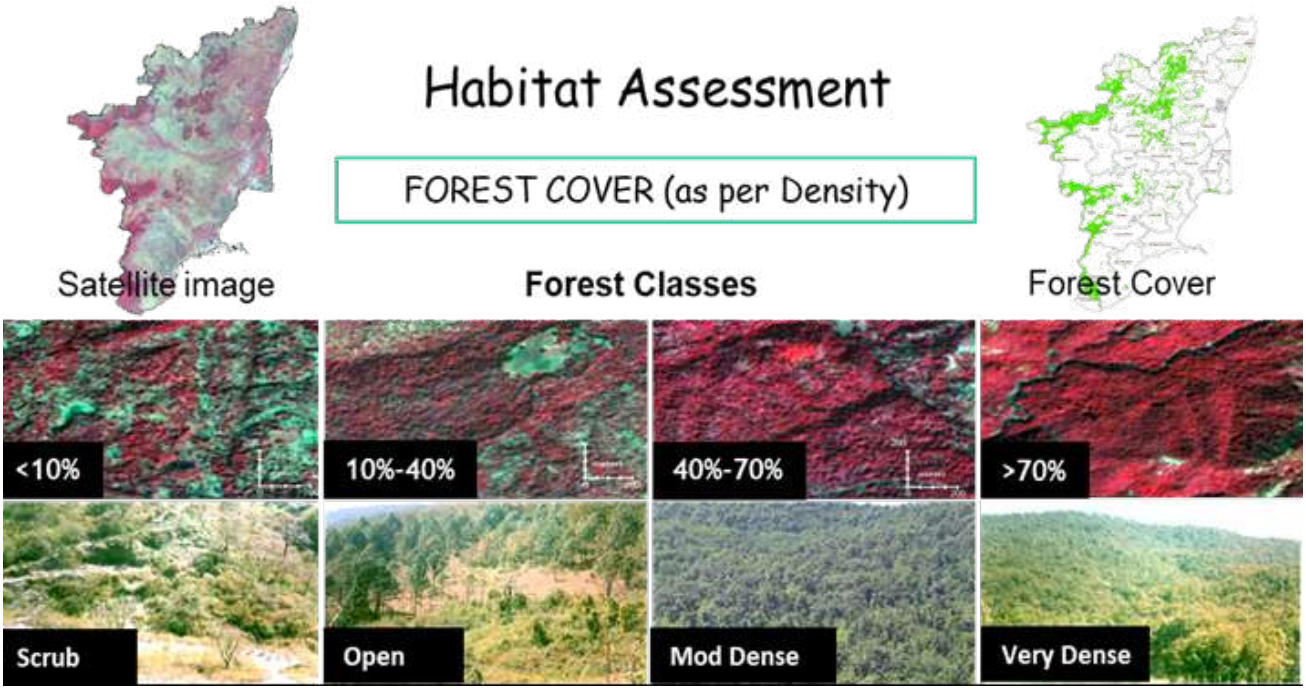


Fig-22: Habitat Assessment using remote sensing technology

6. NTFP Collection and Other Leases

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

For managing NTFP collection, and other leases in ER, following considerations are envisaged:

-
- Develop guidelines for the sustainable harvesting techniques of NTFPs and Community Forest Resources (CFR) management plan for managing the habitat including training; and support value addition to NTFPs to enhance their market value and assist local communities in developing market linkages, promoting sustainable livelihoods.

- Develop land use plans that consider the ecological needs of elephants in addition to the socio-economic needs of local communities and identify zones for different land uses, including agriculture, settlements, and conservation areas.
- Use EIAs to informed decision-making in proposed activities, such as mining or infrastructure development, to assess potential environmental impacts and implement mitigation measures wherever necessary (Fig-23).
- Establish a robust monitoring system for leased areas to track compliance with agreements and regulations and periodically assess the ecological health of leased areas and intercede if adverse impacts are observed.

Fig-23: Forest Mining Leased Areas at Kudremukh: Need for mitigation measures

7. Linear Development Projects

The elephant reserves have 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 railway, road and power transmission lines cause mortality due to road kills and electrocution.

Considerations for managing linear and other development projects in ER envisages:

- The Wildlife Institute of India has developed "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.

BOX-3: BANGALORE-CHENNAI EXPRESSWAY THROUGH RAYALA ELEPHANT RESERVE

- The proposed expressway cuts across three major points at which elephants have been known to cross in the recent past. This str*etc.*h is a critical elephant corridor which connects Koundinya Wildlife Sanctuary with Sri Venkateswara National Park. In the past few years more than fifteen locations of crossing have been identified in this str*etc.*h of 7. 1 km. Apart from being the only corridor this is a very narrow str*etc.*h of reserved forest. Hence it is critical to ensure that mitigation is provided to the extent possible.
- In the 72nd meeting of the Standing Committee of National Board for Wild Life (NBWL) in April, 2023, NBWL recommended for at least half of the str*etc.*h to be elevated and also for equivalent mitigation to be provided on the existing NH4, next to the expressway. This mitigation will be one on the largest underpass for elephants in India.

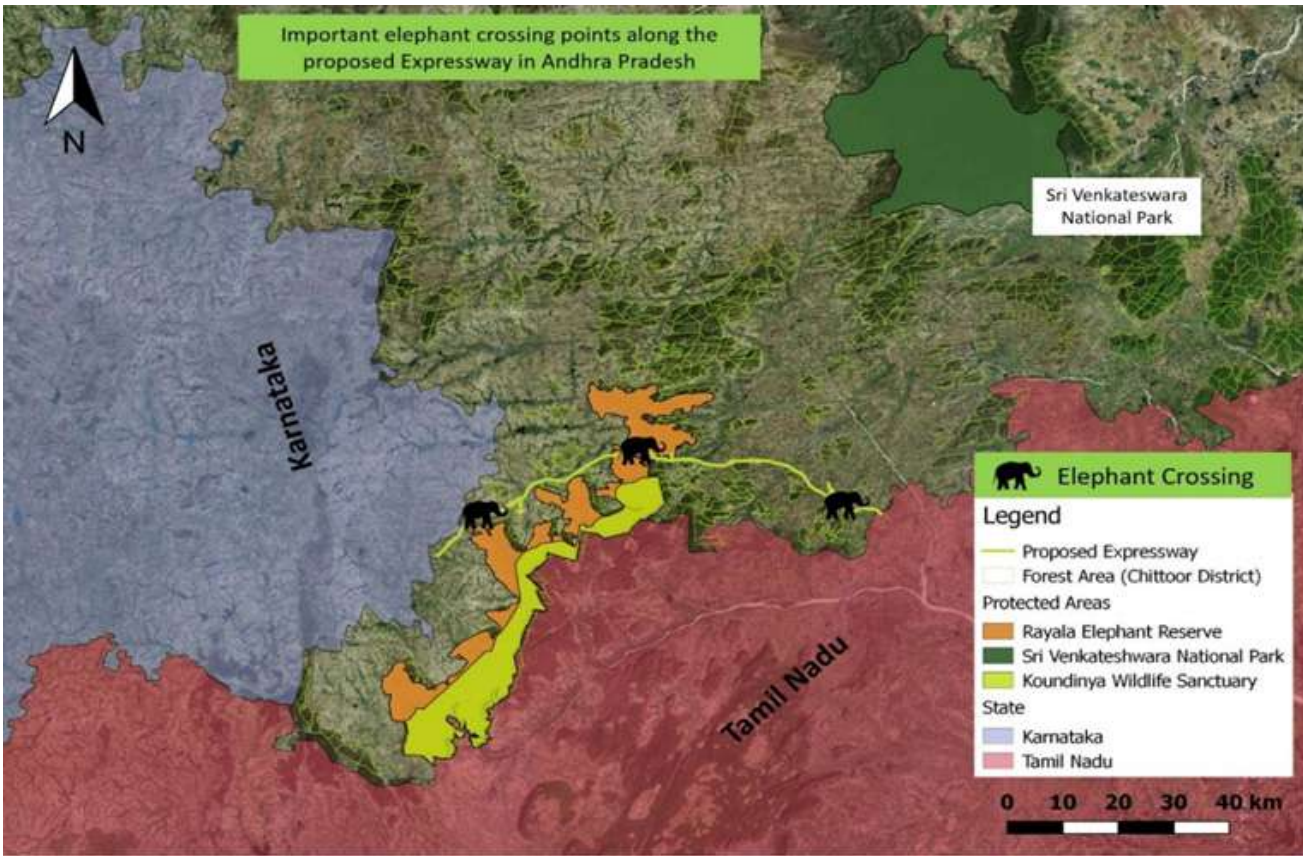


Fig-24: Map showing proposed Bengaluru- Chennai Expressway through ER in the Region

8. Other Development Projects and LULC Changes

Managing other development projects in ER requires a holistic approach that involves collaboration among govt agencies, local communities, conservation organizations, & developers.

-
- A separate prescription may be incorporated within the Tiger Conservation Plans for dealing with HEC. This prescription may hold good for protected areas other than tiger reserves where core elephant habitat could be the entire protected area and ESZ around the sanctuary or a National Park could act as a buffer to avoid any confusion among the field staff.
- Promote sustainable land use practices, especially in areas adjacent to elephant habitats and encourage agricultural and animal husbandry practices that minimize conflicts, such as raising non-palatable crops and controlled-rotational livestock grazing *etc.*
- Engage local communities in the planning and implementation of development projects and address community concerns by incorporating traditional knowledge in decision-making processes.
- Explore the possibility of establishing conservation easements within or adjacent to development zones and designate such areas, where certain development activities are restricted to protect critical wildlife habitats.
- Encourage the adoption of wildlife-friendly infrastructure design principles in development projects and incorporate wildlife crossings, green corridors, & habitat restoration features into project development plans (e. g tourism) impacting the elephant movement (Fig-25).
- Establish zoning regulations that consider the needs of both human and elephant and restrict certain types of development in areas with high elephant movement.
- Establish conflict resolution mechanisms to address HEC arising from development projects and provide compensation or alternative livelihood options for communities affected by wildlife-related issues.

Fig-25: Land-use between Black Thunder Park & Govt. Horticultural Farm at Kallar Corridor

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

3.3. CORRIDORS: DESCRIPTION AND PROTECTION

The structure and configuration of a corridor, that connects two larger habitats, facilitating safe movement of elephants between them and essentially serves as a movement pathway enabling access to foraging areas and ensuring genetic exchange across populations, can vary depending on the topography and the distance between the two connected habitats.

The description of elephant corridors within an elephant reserve may include:

- *Connectivity*: The corridors serve as links between the fragmented areas, allowing elephants to traverse the landscape without encountering significant barriers.
- *Natural Migration Routes*: These routes are influenced by factors such as availability of food, water, and seasonal changes.
- *Habitat Preservation*: Corridors contribute to the preservation of natural habitats by allowing elephants to access different areas for feeding, breeding, and social interactions.
- *Mapping and Planning*: This involves study of elephant movement patterns, behavior, and historical migration routes which could be used to plan and manage the landscape.
- *Corridor Conservation Measures*: This may include land-use planning, implementation of wildlife-friendly infrastructure, and community engagement to promote conservation.

Project Elephant division, MoEF&CC (2023) in its report titled 'Elephant Corridors of India' has identified 32 elephant corridors in the Southern Indian States (Fig-26).

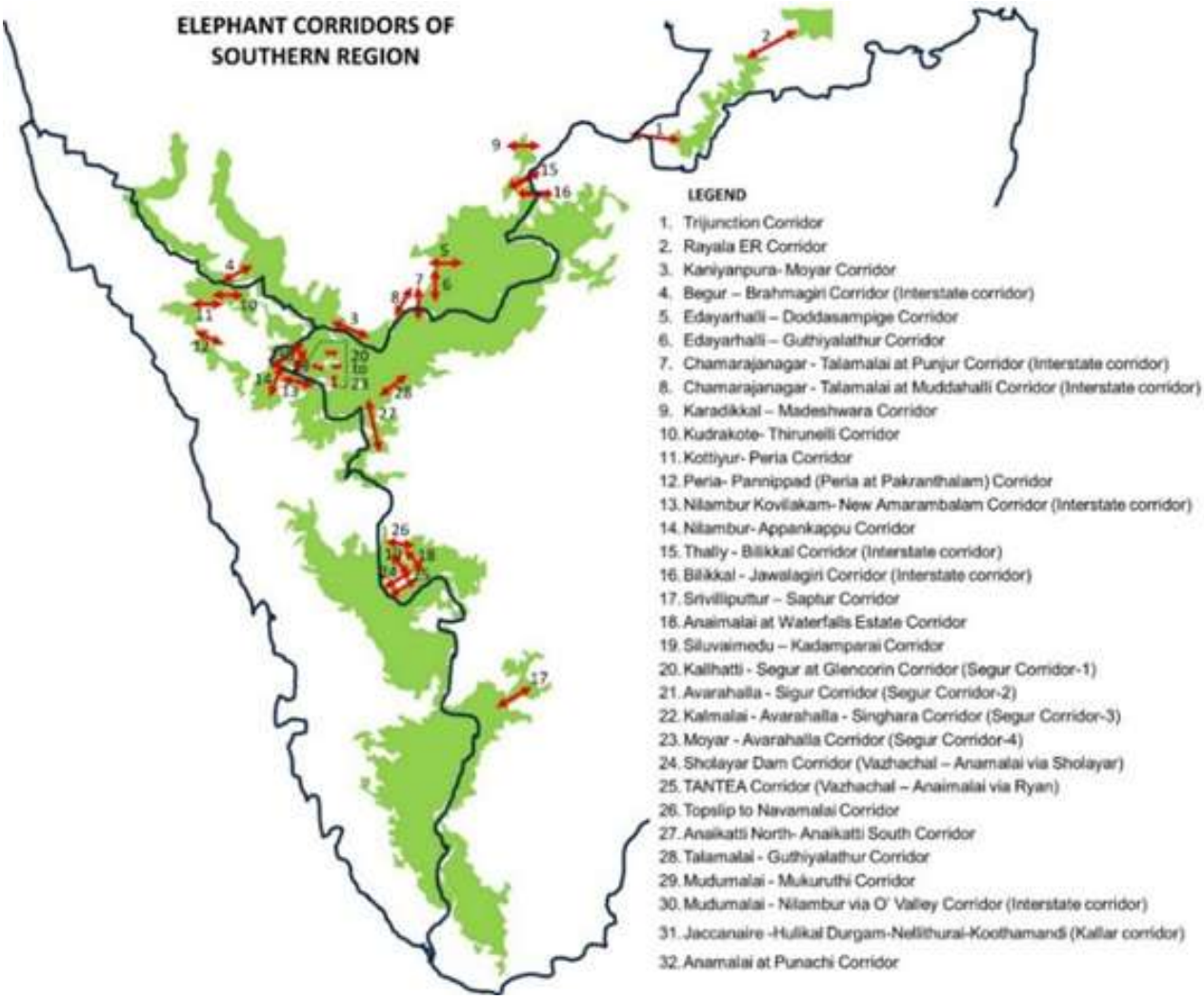


Fig-26: Map showing the 32 Elephant Corridors of Southern Region

- Major threats to these corridors include linear infrastructures such as highways, expressways, railways, canals and penstock pipelines, along with rapid land-use changes.
- Urban developments like farm houses, resorts, educational institutions, housing colonies, and other large-scale establishments within or near corridors further intensify the threats.
- These developments generate varied disturbances, including vehicular movements, artificial lighting, high-decibel noise, and solid waste accumulation which increases the risk of elephants venturing into human-modified regions, thereby escalating conflict.
- Solid waste in these sensitive zones not only degrades habitat quality but also attracts elephants, disrupting natural foraging behavior and leading to dangerous interactions.
- Keeping the genetic viability in view, there is need for restoration of historically known traditional elephant habitats *viz.* strengthening the connectivity between Mysore and Dandeli ERs in Karnataka and Mysore and Nilgiris ERs to Rayala ER in AP and beyond.

The 32 elephant corridors across the four southern states emphasize the importance of adaptive management in corridor conservation (Table-6). As elephant movement patterns change due to habitat modification and climate influences, management strategies must be flexible and responsive. The corridor-specific recommendations also stress the need for inter-state cooperation, especially for transboundary corridors where elephants move across administrative boundaries. Tourism regulation is highlighted as a recurring theme, given the rapid expansion of resorts and homestays adjacent to elephant habitats. The inclusion of engineering solutions, such as flyovers and underpasses, indicates the necessity of integrating wildlife concerns into infrastructure planning. Restoration of degraded habitats and removal of physical impediments are key actions proposed to improve habitat permeability.

Table-6: Bottlenecks and Conservation Actions in the Corridor

Bottleneck/ Linear Infrastructure	Conservation Action
• Roads: NH-4, 40, 42, 67, 209; SH-38 • Rail: Bengaluru-Chennai Rail line • Hydel project, • HT Power Line • Electric fences • Quarry • Narrow width of corridor • Tea & Coffee estate, Labor line • Home-stays & Resorts, Private land • Revenue/ Govt land (SACON/ FCRI), Horticultural Farm • Temple, Ashram, School • Shooting range	• Long-term monitoring of movement • No quarry/ construction • Encroachment removal • Fence removal • Ecodevelopment measures • Land Acquisition (Private/ Revenue/ Janmam land), Estate acquisition • Overpass & Underpass on the roads • Vehicle movement/ speed regulations • Habitat Improvement works • LULC & Tourism regulation • Conservation Easement • Notification of corridors

The Table-7 highlights the varying extent of corridor distribution, with Tamil Nadu having the greater number of corridors including best practices adopted in different states.

Table-7: Extent of corridor distribution and best practices

Variable	AP	Karnataka	Kerala	Tamil Nadu
Number of corridors	2	7+2 (Inter-state corridors)	4+2 (Inter-state corridors)	15+5 (Inter-state corridors)
Best practices		• Land acquisition by NGOs and handed over to the Forest Dept. • Night traffic closure	• Land acquisition by NGOs and handed over to the Forest Dept. • Night traffic closure	• Segur plateau elephant corridor is the only notified corridor in the country. • Notified private lands in corridor as Private Forests • Providing paths and bridges over canal to facilitate elephant movement. • Constituted sub committees to consolidate the corridors.

Protecting corridors and migration routes in elephant reserves are crucial aspects of elephant conservation. Certain strategies that can be implemented include:

Corridor and Migration Path Protection:

- Conduct thorough surveys and research to identify existing elephant corridors/ migration paths and use GIS technology to map and monitor corridors and paths.
- Implement measures to conserve and restore natural habitats within corridors/ migration paths and work with communities to reduce human activities that encroach upon habitats.
- Establish buffer zones around the corridors to minimize conflict and implement land-use planning regulations to restrict activities that can disrupt the corridors and migration paths.
- Install effective fencing along critical sections of the corridor and migration path to prevent human encroachment and use eco-friendly and wildlife-friendly fencing methods.
- Involve local communities in corridor protection initiatives and create awareness about the importance of corridors for elephants and the overall ecosystem.
- Envisage measures for notification of the critical corridors through Government Notification for ensuring safe passage and genetic contiguity of the elephants (Fig-27).

BOX-4: SEGUR PLATEAU ELEPHANT CORRIDOR- FIRST NOTIFIED ELEPHANT CORRIDOR

- The *Segur Plateau Elephant Corridor* was legally recognized by the Tamil Nadu Govt in 2010 as an ecologically vital wildlife corridor which forms part of the NBR.
- It provides critical connectivity between the Western Ghats and Eastern Ghats, enabling free movement of elephants and other wildlife across a broad landscape that includes forests in Tamil Nadu, Kerala and Karnataka.
- It consists of several linked migration paths across the Segur plateau, including four principal routes that connect forest blocks such as Kalhatti, Singara, Masinagudi and Glencorin areas and spans roughly 3, 400+ hectares and stretc.hes about 23. 5 km with an approximate width of around 1. 5 km.
- These corridors help elephants move between protected areas of Mudumalai Tiger Reserve and adjoining forests of the Western-Eastern Ghats complex (including Wayanad, Bandipur, Nagarhole and Sathyamangalam).
- Recent judicial decisions in 2025 have strengthened protection, including bans on disruptive commercial activities and steps toward land protection & corridor restoration.

ABSTRACT

Wildlife – Formation of Elephant Corridor as per the direction of the High Court dated 3.12.2009 and 1.3.2010 in W.P. No.10098/2008 filed by Elephant Rajendran – Representations / objections filed by the petitioners against the formation of elephant corridor – Rejected – Confirmation for the safe and undisturbed passage of elephant Elephant Corridor as per the direction of High Court - Orders – Issued.

ENVIRONMENT AND FORESTS (FR.5) DEPARTMENT

G.O.(Ms.) No.125 Dated: 31.08.2010

Read:

1. High Court, Madras order dated 30.9.2008 in W.P. No.10098 of 2009.
2. High Court, Madras order dated 3.12.2009 in W.P. No.10098 of 2009 and 2762
3. Government letter No.2805./FR.5/2009-15, dated 4.1.2010.
4. High Court, Madras order dated 11.1.2010.
5. High Court, Madras order dated 1.3.2010 in W.P. No.10098 of 2008.
6. From the Principal Chief Conservator of Forests letter No.WL5/24778/08, dated 26.05.2010.

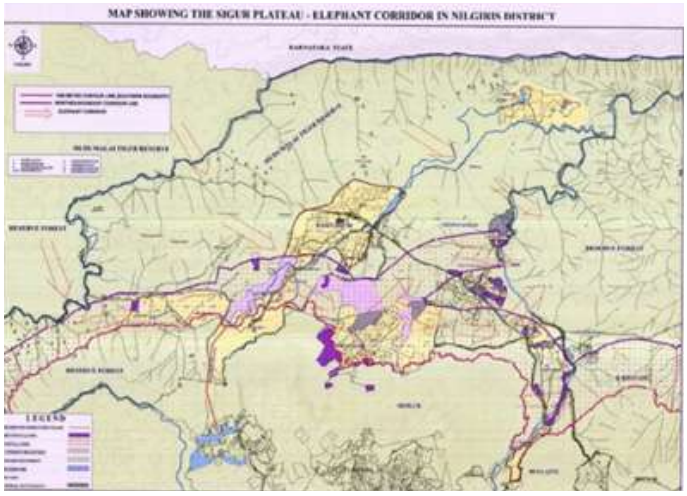


Fig-27: Government order of Segur Plateau Elephant corridor in Mudumalai Tiger Reserve

3.4. INVOLVEMENT OF STAKEHOLDERS, SECTORAL COORDINATION, AWARENESS & PARTNERSHIPS

Human-elephant conflict (HEC) and conservation challenges in South India demand coordinated, multi-stakeholder approaches. Although the issues of habitat fragmentation, crop depredation, and elephant mortality are common across states, each state has developed its own strategies and partnerships. Stakeholder involvement ranges from frontline communities to inter-departmental governance, while awareness and partnerships involve NGOs, research institutions, and civil society. The following table consolidates the approaches adopted by Kerala, Andhra Pradesh, Karnataka, and Tamil Nadu, highlighting their frameworks for stakeholder engagement, sectoral coordination, awareness creation, and partnership-building (Table-8).

Table-8: Involvement of stakeholders, sectoral coordination

State	Stakeholder Involvement	Cross-Sector Coordination	Awareness Initiatives	Partnerships
Kerala	Local communities (frontline in conflict zones), Panchayats, Kudumbashree units; Forest Department leads.	Forest, Agriculture, Irrigation, Revenue, Animal Husbandry, Police, Disaster Management.	School programs, farmer groups, Kudumbashree awareness, WhatsApp groups, media.	KFRI, WII, ATREE, NGOs, CSR initiatives, district-level conflict platforms.
Andhra Pradesh	Farmers, agricultural laborers, local communities; NGOs, researchers actively engaged.	Forest, District administration, Electricity, Railways, Police, NHAI, Revenue.	Kalajatha (street theatre in local dialect), NGO-led awareness, farmer training.	NGOs (wildlife & welfare), scientific researchers, Project Elephant initiatives.

Karnataka	Communities as partners: village elephant watch teams; residents engaged in coexistence strategies.	Forest, Energy, Revenue, RDPR, Police, Health, PWD, Agriculture, Animal Husbandry.	Aranya Samarasya (community dialogue), Chinnara Vana Darshana (children's prog).	Cross-departmental governance, joint training, NGOs, digital platforms (e-Parihara compensation).
Tamil Nadu	Village Forest Committees (VFC), Eco-Development Committees (EDC), tribal communities, farmers.	Forest, Revenue, Agriculture, PWD, Police, Tourism, EB, Railways, Highways.	Sensitization of loco pilots, farmer awareness, ecotourism promotion, social media outreach.	AIWC, NGOs, research institutions (GIS mapping), civil society, media, interstate coordination

Each state has developed its own distinctive strengths in managing human-elephant coexistence.

- Kerala emphasizes district-level multi-stakeholder platforms and local governance through institutions like Jana Jagrita Samithis (JJS) and Primary Response teams, invoking the instrument of disaster management (Fig-28); AP prioritizes grassroots awareness through cultural media and NGO involvement; Karnataka has pioneered an integrated governance model with strong community engagement; Tamil Nadu highlights interstate coordination, infrastructure adaptations, and the involvement of tribal communities.

Fig-28: Sensitization of Jana Jagritha Samithi and Field Training of RRTs in Kerala

BOX-5: HUMAN- ELEPHANT CONFLICT (HEC) MITIGATION STRATEGIES OF KERALA

- HEC in Kerala is now recognized as a socio-political challenge, not merely an ecological or managerial issue. In response, the State has adopted an integrated, multi-institutional mitigation framework that goes beyond conventional forest department interventions.
- At the operational level, RRTs comprising trained forest staff and veterinarians provide specialized & immediate responses to conflict incidents. To address delays in reaching remote locations, PRTs- largely drawn from local / tribal communities-function as first responders, managing crowds and stabilizing situations until technical teams arrive. JJSs at the village/ local level act as community-based monitoring and communication platforms, strengthening early warning & trust between local people and administration.
- A major policy innovation has been the declaration of human-wildlife conflict (HWC) as a '**State Disaster**', ensuring coordinated involvement of district administration, police, revenue, agriculture, and local self-governments. This has also enabled shared and time-bound compensation mechanisms, supported by an online claims' portal.
- The State has further adopted a mission-mode approach, dividing the problem into ten focused missions addressing power fencings, habitat quality, water availability, crop damage, and incorporation of indigenous knowledge. These measures are complemented by the strategic use of trained Kumki elephants and improved communication through digital and social media platforms.
- Overall, Kerala's approach reflects a shift towards a participatory, responsive, and governance-driven model for managing human-elephant conflict.

Together, these approaches reflect the diversity of strategies in addressing HEC in the region.

Further collaboration and sectoral coordination in the ERs may be accomplished by:

- Integrate indigenous knowledge about elephants into conservation strategies and collaborate with local communities to blend traditional practices with modern approaches.
- Engage with the private sector, especially businesses operating in or around the ER and encourage for corporate social responsibility initiatives, supporting elephant conservation.
- Collaborate with the tourism industry to promote sustainable tourism and educate tour operators, guides, and visitors about the significance of minimizing habitat disturbance.
- Facilitate collaboration among various government agencies, and jointly plan and execute conservation activities and use of digital communication apps may be employed.
- Establish cross-border/ inter-state collaborations (Fig-29) and share information/ best practices with neighboring jurisdictions; and also include Andhra Pradesh in the inter-state coordination committee charter along with Kerala, Karnataka and Tamil Nadu states.
- Establish mechanisms for information sharing among stakeholders and integrate data from various sources to enhance the overall understanding of the reserve.

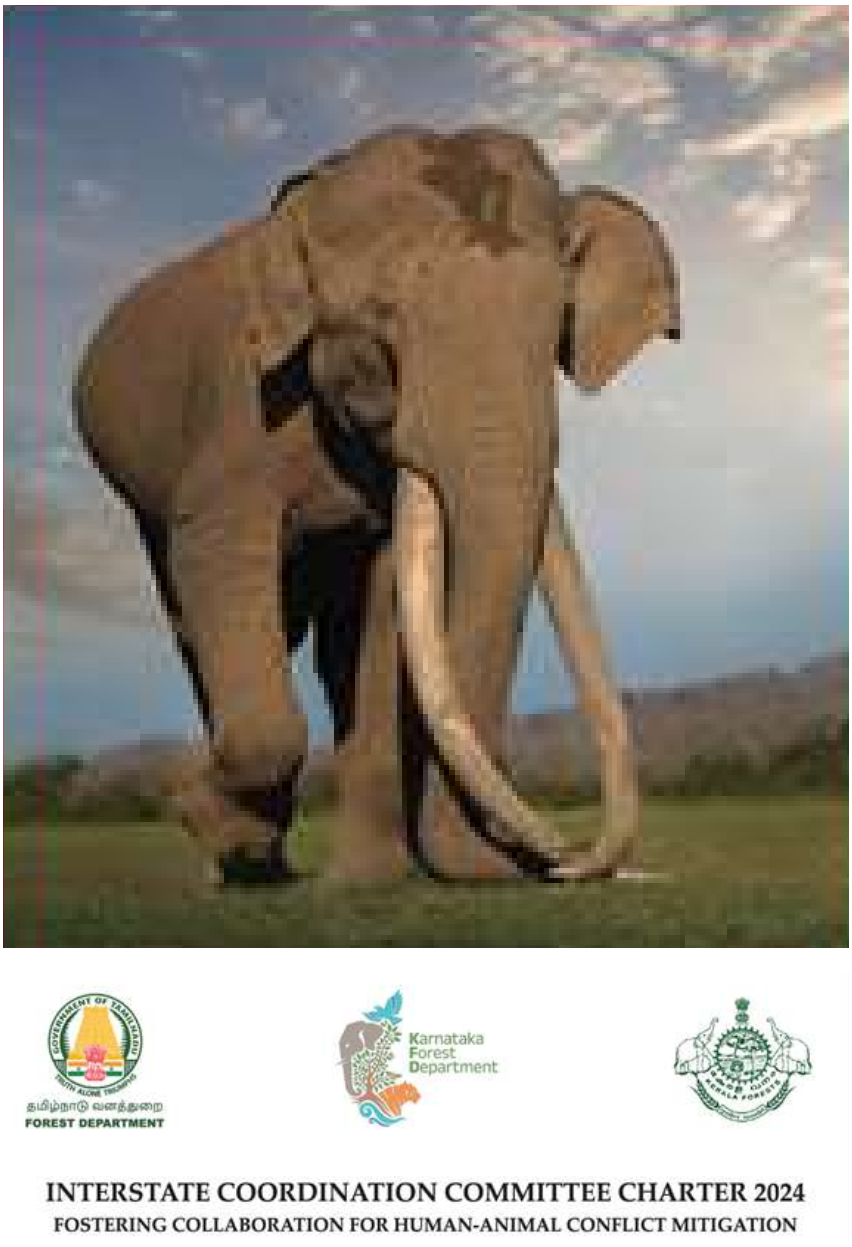


Fig-29: Inter-state Coordination Committee Charter, 2024 at Bandipur, Karnataka

04

HUMAN-ELEPHANT CONFLICT (HEC) & MITIGATION STRATEGY

4.1. APPROACHES AND METHODS 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, analyzing elephant movement corridors, and identifying crop raiding patterns. 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 behavior.

BOX-6: 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.	Analyze 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.

Given that three out of the four states have been dealing with HEC for decades, there is already a system in place with regard to monitoring, identifying hotspots and identifying HEC causing individuals. They are using traditional tracker-based monitoring and technologies like GPS collars, camera traps, drones and other devices to monitor, profile and understand the distribution and behavior of elephants. Andhra Pradesh is relatively new to not only HEC but also to the elephants, hence, there is need to better monitor elephants and in-turn address HEC. All the states have community level WhatsApp groups through which information is being shared as a mechanism for early warning.

Identifying conflict hotspots

Identifying conflict hotspots that could also provide a direction towards the drivers of conflict (Fig-30), is critical in providing site-specific solutions to mitigate HEC. Conflict hotspots can be mapped through geo-spatial assessments, by using both primary and secondary data including time-series data (Table-9). The hotspots can be identified and mapped as under:

- *Incident hotspot*: Frequency of occurrence of incidences over past specific years such as previous five or ten years, mapped over the target area. Data include number of incident of injury and death, attack/killing of domestic animals.
- *Vulnerability Hotspot*: Cumulative index by overlaying past incidents, vulnerability of local community and potential risk of the area.

The critical HEC hotspots in the southern region have been identified as under:

- Tamil Nadu: Valparai, Gudalur-Nilgiris, Sathy, Dharmapuri-Krishnagiri-Hosur belt.

- Karnataka: Kodagu and Hassan coffee estate landscapes, Bannerghatta edge, Mysuru-Chamarajanagar area.
- Kerala: Wayanad, Palakkad, Idukki.
- Tri-junctions: Tamil Nadu-Karnataka-Kerala borders

Fig-30: Elephant Congregation near Water body- a driver of conflict

Table-9: Steps in the Conflict Identification in the Southern States

Step	State			
	Kerala	Karnataka	Tamil Nadu	Andhra Pradesh
Collection of daily elephant movement and conflict data.	• Daily Elephant monitoring system in place. Using Division-level Emergency Operation Centers (DEOCs). These EOCs act as decentralized hubs for real-time data collection and preliminary coordination of field-level responses. • Through GPS Collaring of individuals.	• Through traditional monitoring using elephant trackers. • Dedicated teams to monitor the stray herds, individuals. • Through GPS Collaring of individuals. • Through Elephant Task Force	• Currently efforts are put to record the elephant movement, in 'tnfdyaanai. com'. • Artificial Intelligence based surveillance system in some areas. • Through GPS Collaring of individuals.	• Daily monitoring and reporting through the Elephant Task Force (ETF). • Monitoring through Mobile App 'GAJA PRAJA' will be executed in second half of 2025.
Identifying Conflict Hotspots.	Through historical data and analysis of elephant movement data. Classification into Static & Dynamic hotspots is done.	Identifying hotspots and presence through the e-Parihara.	Using secondary data like crop and property damage, human and elephant casualty data.	Through secondary data.

Analysis of data to understand movement and hotspots.	Advanced geo-spatial assessments & predictive modelling using GIS tools are employed to map these hotspots with spatial and temporal precision by the IT wing of KFD	Through data from e-parihara	Data from tnfdyaanai.com is being used for identification of hotspots.	Scientific analysis of data is yet to be undertaken.
Profiling individual elephants and identify problem elephants	Elephants causing repeated conflict are currently monitored in high conflict areas (Wayanad) using tracking techniques like spoor identification, camera traps, and geo-mapping. Information from local Tribal watchers, Primary Response Teams (PRTs) and Jan Jagrita Samithis (JJSs) are also used for this purpose.	Conflict elephants and area specific elephants are profiled. In HEC hotspots like Hassan all individuals are profiled.	Conflict elephants and area specific elephants are profiled.	Profiling individual elephants is yet to be taken up.

4.2. ESTABLISHING SYNERGISTIC MITIGATION STRATEGIES

There are three key elements in most conflict situations: the elephant, humans (settlement) and the attractant for the elephant (such as palatable crop). Sometimes removal of one of these elements in the conflict 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-31) *viz.*

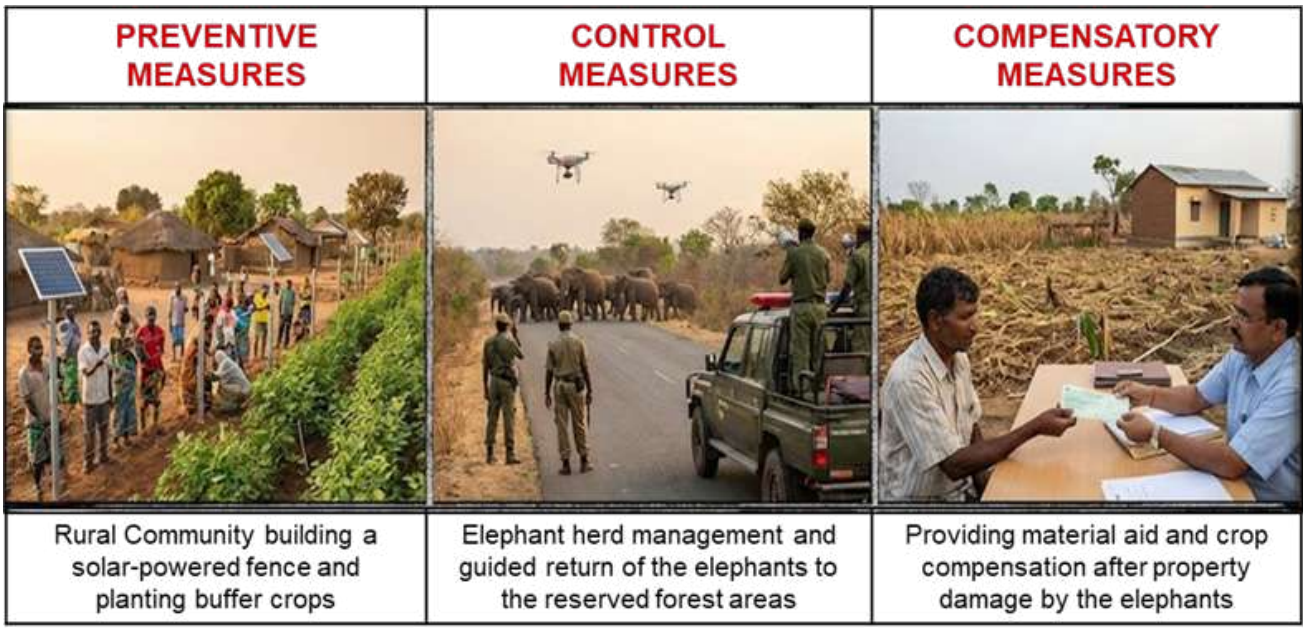


Fig-31: The three categories of controlling HEC

In each of the measures the states have used a combination of traditional, industrial and technological backed mitigation measures.

As regards short term measures, no single method is effective in all cases against all elephants. Elephants are known to exhibit remarkable intelligence in finding out the limitations of various methods and adapt themselves accordingly. Therefore, constant improvisation of various methods is required keeping the psychology and physical capabilities of the elephant in mind.

Another important aspect proposed under this approach is the zoning of the landscape based on conflict intensity and land-use characteristics, with the aim of facilitating site-specific interventions. As part of the strategy, an attempt is made to delineate three conflict-management zones.

- The *Elephant Conservation Zone*, located within core forest areas with focus on habitat restoration, fodder enrichment, water augmentation, and regulating human activities.
- The *Human-Elephant Co-existence Zone*, situated at the forest-human settlement interface, prioritizes EWS, physical barriers, RRT, and active involvement of communities.
- The *Human-Elephant Management Zone*, covering human-dominated areas, addresses chronic conflict through translocation or rehabilitation of problem elephants.

Formulation of a mitigation strategy for HEC varies according to the landscape and the land use pattern. 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 more in the Co-existence and Management Zone, whereas Preventive measures are more in the Conservation Zone.

4.2.1. Preventive/Protective Measures:

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-7: STEPS ENVISAGED IN PREVENTIVE/ PROTECTION MEASURES:

Step 1.	A detailed land-use classification and vegetation mapping to be done.
Step 2.	Overlaying the land use classification with elephant movement data to help to identify bottlenecks and vulnerable areas to HEC.
Step 3.	Apart from vegetation mapping, the spread of invasive species to be mapped.
Step 4.	Form a landscape level Restoration Plan.
Step 5.	Design Mitigation Plan/Management Plan to reduce the impact/effect of bottlenecks.

4.2.2. Control Measures:

Control measures aim at controlling conflict through physical structures, translocation (Fig-31) and other technological interventions to keep elephants away from human habitations.

BOX-8: STEPS ENVISAGED IN CONTROL MEASURES:

Step 1.	Based on analysis of conflict Identification (4.1. above) identify conflict hotspots.
Step 2.	Identification of key areas of entry of elephants and regular conflict.
Step 3.	Predicting animal movement once the entry is stopped *i. e.* once the entry from this area is stopped potential movement of the animals is to be studied.
Step 4.	Choosing apt barrier or combination of them based on factors like substrate, terrain and funds availability.
Step 5.	Procurement and installation of the barrier.
Step 6.	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.*, taking sectional-parts of the beat for documenting.
Step 7.	Monitoring the elephant movement after installation of the barrier to see how the elephant movement has changed.
Step 8.	Community involvement in its maintenance is to be encouraged, under a MoU with forest department

4.2.3. Compensatory Measures:

Compensatory Measures, more of a post-conflict measure, is a critical aspect of mitigating HEC, aiming to alleviate economic losses suffered by communities due to elephant-related damage, such as crop depredation or property destruction. Key elements include fair assessment of damages, transparent processes, and timely disbursement of compensation.

The key to ensuring timely dissemination of compensation involves:

- *Streamlined assessment procedures*: Simplifying damage verification processes
- *Efficient Govt mechanisms*: Dedicated channels for prompt compensation release
- *Community engagement*: Enhancing awareness & participation in reporting process
- *Technology integration*: Digital platforms for reporting claims and tracking status
- *Collaboration*: Coordination amongst agencies, NGOs community in implementation

Each of the states have their own mechanism through which this is done and the rates of compensation are also different for each of the states. Ex-gratia compensation shall be disbursed through Direct Benefit Transfer (DBT) within defined timelines. A standardised, simplified claims workflow shall be adopted using mobile/app-based geo-tagged photo/video evidence with minimal documentation requirements, integrated with existing digital governance platforms to ensure transparency, timeliness, and reduced transaction burden.

The position in various States could be summarized as under:

- All the states seem to be focusing more on control measures and large investments have been made particularly in the state of Karnataka.
- All the states seem to have a good mechanism for distribution of compensation.
- All the states have devised an online based mechanism to file, issue and follow-up on the compensation/ ex-gratia for damage done by elephants whether its eParihar in Karnataka or Gaja Praja in Andhra Pradesh.
- There seems to be limited focus on the Preventive measures by most of the states. Though few states are working towards addressing the invasive (Senna, Lantana) and also towards habitat connectivity, there still exists a great scope to be done.

4.2. 4 Approach to mitigation strategy for HEC:

This requires integrating 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.

Early warning and rapid response (EWRR) system at conflict hotspots: EWRR 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 Teams (Range RRT) and village level Primary Response Teams (Community PRT).

EWRR system for addressing HEC in the Southern region specifically includes -

- modern technological tools such as trip alarm system, drones, thermal imaging, camera traps, radio collars *etc.* to receive early warning; and
- public announcements, bulk SMS, WhatsApp group, local radio and tv channels, and LED display messages to disseminate the information.
- In Andhra Pradesh the current practice involves sending SMSs alerts to all Grama Sachivalaya staff members and sarpanches in the Mandal Police department, District administrators.

Site-specific barriers and other exclusionary measures: The principal types of barriers used against elephant in the region (Fig-32) include:

- Elephant Proof Trench (EPT)
- Solar powered electric fences/ hanging fences
- Rubble walls
- Other types-railway girders / tracks, steel channels / ropes / bars *etc.*

Fig-32: Types of Physical Barriers-Traditional EPT; Modern Fences- Railway Girder (KAR); Hanging Power Fence (All States); Steel Rope Fence (TN); AI-Smart Fence (KER)

It is observed that Karnataka has taken major stride in the development of the barriers followed by Tamil Nadu and Kerala. Initially, the focus of all the States was on the construction of EPT and erection of Solar fence but considering the maintenance and effectiveness, focus has shifted on new barriers like rail barricades (Karnataka & Kerala) and steel rope (Tamil Nadu) & hanging solar fences (all States) (Table-10 & 11).

Different strategies have been envisaged to install barriers in the region as under:

- Strategy (a) Barriers around forest areas to keep elephants inside forest
- Strategy (b) Barriers across the landscape between two states / districts
- Strategy (c) Barriers around settlement to be protected such as village/ enclave

As regards the effectiveness of the barriers, strategy (a) is not advisable around small forest blocks because such forests cannot provide all the space and food requirements and confines the elephant population. Strategy (b) 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 (c) 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.

Other measures being experimented in the region include innovative repellent techniques like honey-bee boxes, use of drones besides deterrents like trip/ sensor-based alarm system.

Site specific mitigation methods may also be implemented based on the research and considering the appropriateness and effectiveness; and the existing barriers may be maintained with public support and also explore the possibilities for providing subsidies for maintenance of barriers.

Anti-depredation squads (ADS) & patrolling: Creating anti-depredation squads for driving elephants away from human settlements and protecting both elephants and people requires a coordinated effort. The squads are equipped with the vehicles, communication tools, and non-lethal deterrents such as bright lights/ torch, loud sounds/ siren.

Table-10: Mitigation Strategies with Protection Measures adopted in Southern Region

Mitigation Strategies: Preventive / Protective Measures				
Measure	**Kerala**	**Karnataka**	**Tamil Nadu**	**Andhra Pradesh**
Land use and vegetation mapping	• Land use and vegetation mapping has been done to a great extent, including mapping of invasive species. • Vayals are being mapped and restoration being undertaken.	• Identifying, mapping and restoration of Hadlu's is being undertaken. • Habitat restoration post invasive removal undertaken in PAs	• Landuse and elephant distribution mapping has already been done. • Restoration work is being undertaken in PAs and ER divisions	• Few measures like providing water sources for elephants through solar bore wells has been taken up. • No landscape level mapping done so far
Elephant corridor identification and recognition	• Five elephant corridors have been identified out of which one is an interstate corridor with Tamil Nadu.	• Seven elephant corridors have been identified out of which two are interstate corridors with TN and Kerala.	• Eighteen elephant corridors have been identified out of which three are interstate corridors with Karnataka and Kerala.	• Two elephant corridors are identified within the state.
Invasive species management	• All the States are in the forefront of identifying and removing invasive species. • Some of the key species are Senna spectabilis, Lantana, Chromolaena and Mikania. • Scientific based management required for removal of invasives with a joint interstate initiative to address at the landscape level. • A community lead initiative could also be tried.			
Use of technology	• Connectivity Conservation: Focuses on maintaining landscape connectivity, allowing elephants to migrate seasonally and access vital areas. • All the states are familiar in using GIS tools and vegetation mapping to initiate the first steps for Invasive species management and analyse and formulate movement data to come up with functional corridors.			

Table-11: Mitigation Strategies with Control Measures adopted in Southern Region

Mitigation Strategies: Control Measures				
Measure	**Kerala**	**Karnataka**	**Tamil Nadu**	**Andhra Pradesh**
Physical Barriers	Kerala has a network of almost 1472 km of different barriers, primarily comprising of Solar Fencing (traditional & hanging) which accounts for almost 93% of the entire barriers being used, followed by EPT of around 81. 65 Km. **Effectiveness:** Solar fencing is quite effective in HEC. But it requires regular maintenance, right from batteries, repairs to lines and poles to vegetation clearance.	Karnataka has an extensive network of EPT (2286. 62 km), Solar Fencing (3, 426. 84 km) and in the recent past have taken up Railway barricade (312. 92 km). Some stretc.hes have multiple barriers. **Effectiveness:** Despite requiring a significant upfront investment, railway barricade is considered viable, economically in the long term (low maintenance cost & its effectiveness)	Tamil Nadu has 1310 km of EPT, 510 km of Solar Fence, 30 km of Hanging fence, 40 km of Steel Rope fence & 2 km of Stone wall. Steel Rope is primarily in Hosur-Dharmapuri and Virtual Fence in Valparai landscape, **Effectiveness:** Steel rope fencing has proven to be effective with ongoing design refinement. Virtual Fencing has sound & light-based deterrents (over time may act more as an EWS than a barrier.	Andhra Pradesh has EPT (735 Km) primarily around Koundinya Wildlife Sanctuary, that was undertaken almost two decades ago. Apart from that, small stretc.hes are barricaded with Solar fencing. **Effectiveness:** Many roads, villages inside the forest area and lack of maintenance or damage of the EPT's has rendered them ineffective in many stretc.hes.

Early Warning System (EWS)	Early warning system is presently functional in Munnar Region. Elephant monitoring squads pass the sighting information to the Control Room which in-turn is passed on to the registered users via SMS.	The SMS systems, sirens and electronic display boards broadcast early warnings to communities. The AANE ELLI control room serves as central coordination point processing data & dispatching alerts to vulnerable village.	Tamil Nadu is using multiple strategies. Radio collaring of wild elephants for real time monitoring, Artificial Intelligence based Elephant Alert system is being used along Railway track, Trip wire alarm system and SMS based early warning system in Valparai.	Presently through various Range level WhatsApp groups, information is disseminated to the locals. But the newly launched Gaja Praja app has a mechanism to send in a notification of elephant movement on the app.
Use of Technology in Control Measure	• Use of GIS, remote sensing and GPS satellite collars to monitor elephants & mapping habitats. • Camera traps, Drones for monitoring • KFD has introduced Android Application-Human-Wildlife Conflict (HWC) to collect real time data • HAWK to document and analyze wildlife mortality	• Currently has 23 radio collared elephants that are being monitored on real time basis • Thermal drones, AI-cameras, laser fences are used to monitor hotspot • HEJJE integrated dashboard provides movement information to forest officials. • Display boards and SMS system as early warning. • E-Parihara for processing and ex-gratia sanction	• AI-based Smart Alert system on Coimbatore-Palakkad Rail Track. • Regular drone use during day & thermal drones at night. • Smart virtual fencing and GSM based Tower lights used as an EWS • TNFD has Thadam Portal and tnfdyaanai. com for centralized HEC data management. • HAC-Kathon' 25 program was conducted for innovative solutions to tackle HEC	• Mobile Application "Gaja Praja" for early warning and disposal of compensation/ex gratia payments. • AI based thermal drones for detecting and monitoring movement of elephants

***Power Fencing within Elephant Reserve*:**
The Guidelines for Human-Elephant Conflict Mitigation (2023) issued by the MoEF&CC focuses on a harmonious coexistence approach and a suite of tools (early warning systems, landscape planning, compensation mechanisms) to reduce conflict.

The state-level and district-level action plans incorporate fencing as one among multiple mitigation tools, emphasizing safety, ecological integrity, and non-lethal design.

Considering majority of the elephant deaths due to electrocution, States like Tamil Nadu and Karnataka have envisaged following measures to mitigate the conflict as a preventive action.

- 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. These Rules could be adopted in other States.
- Also, Govt. of Karnataka have issued orders dated 16/09/2016 and 27/03/2025, providing subsidy for individuals and to community for solar fencing of various designs and that of technical specifications, to these stakeholders, living in forest fringe villages for protection of their crops, grown in their farm lands, from wildlife. Orders specify the procedures for implementation of scheme and providing subsidy to beneficiaries.

It is recommended that all physical barrier interventions (including EPTs, solar fences, rail barricades, and related structures) should include a dedicated Life-Cycle Maintenance Budget covering routine upkeep, rapid repairs, and periodic replacement. Custodianship shall be assigned at Division/Range level with clearly defined responsibilities. Standardised maintenance SLAs, incident reporting protocols, and third-party technical audits should be mandatory to ensure functionality and safety.

4.2.5. Managing Local Overpopulation and Dispersing Populations

The ER landscape has been witnessing an increase in the population of elephants over the last few decades and this local overpopulation or overabundance may or may not be regarded as a major conservation or management

challenge in the absence of any carrying capacity studies specifying unique density of elephants that can serve to qualify as threshold of carrying capacity.

Local overpopulation of elephants can lead to various challenges, including habitat degradation, human-elephant conflict (Fig-33), and increased competition for resources.

Some options for managing local overpopulation of elephants include:

- Translocating the elephant population, to areas with lower elephant densities or suitable habitats and ensuring careful planning, monitoring, and ethical considerations to minimize stress in the translocated individuals.
- Improving and expanding existing habitats to accommodate the local elephant population and implementing habitat restoration programs to enhance food availability and quality.
- Installing robust fencing to protect agricultural areas and human settlements from elephant depredation and implementing deterrent methods (noise devices, flashing lights, or chili-infused barriers *etc.*) to prevent elephants from entering specific zones.

Besides, options for dispersing population of elephants envisages:

- Developing and implementing EWS to alert local communities about approaching elephant herds and using technology such as sensors, or drones to detect elephant movement.
- Constructing safe passages like underpasses/ overpasses along highways to prevent road accidents & ensuring infrastructure development considers elephant movement patterns.

Fig-33: Capture and Translocation of Chinnathambi Elephant

BOX-9: WILD ELEPHANT TRANSLOCATION CAUSING CROP RAIDING AND HUMAN CONFLICT

- *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).
- *Similar Case*: 'Arikomban' (Rice Tusker), which raided the Chinnakanal-Santhanpara region of Idukki district, Kerala, translocated to Periyar TR in May 2023, crossed into Tamil Nadu, entering parts of Cumbum-Theni-Megamalai landscape, causing fresh conflicts, translocated to Kalakad-Mundanthuurai TR continues to range in forested tracts of Tamil Nadu-Kerala border, under intensive monitoring. Management shifted from repeated capture to a strategy of-real-time tracking, EWS; and conflict avoidance.

4.3. INSTITUTIONAL CAPACITY DEVELOPMENT

Building an operational institutional framework is crucial for effective HEC management.

- In most States (Table-12), the field support operations are structured around following key institutional arrangements consisting of Rapid Response Teams (RRT), Elephant Task Force (ETF)' Anti-depredation Squad (ADS); Elephant Camps & Koonkie Elephants; Mahouts & Cavadies; Veterinary Officers and staff; Rescue Centres *etc.* along with infrastructure required for tackling Emergency Response situations (Fig-34).
- Targeted training programs equips forest officials, frontline staff, local communities, and stakeholders with essential skills and knowledge in conflict management, EWS *etc.* Regular capacity building programs in non-lethal conflict resolution, behavioral understanding on elephants, and use of technology may be institutionalized.

Table-12: Institutional Capacity Development in Southern Region

Institutional Capacity Development in Southern States				
	Kerala	**Karnataka**	**Tamil Nadu**	**AP**
RRT / ETF / ADS	RRT-2	RRT-33; ETF-7; ADS-95	RRT-5	RRT-2
Elephant Camps		9	3	2
Captive elephants	409	110	63	24
Mahouts/ Cavadies		73 mahouts 75 cavadis	33 mahouts 30 cavadis	4 mahouts 4 cavadies
Veterinary Officers	13	6	9	2
Wildlife Rescue Centers	5 (Muthanga, Dhoni Kodanad, Kottur, Konni)	3 (Kurgalli, Kolar, Bannerughatta)	-	-

Fig-34: Elephant Camps in Rayala (AP), Wayanad (Ker), Dubare (Kar) & Mudumalai (TN)

This multi-dimensional strategy empowers stakeholders, improves governance, and ensures sustainable conflict mitigation, ultimately promoting integrated planning for elephant habitat management and human development needs.

4.4. EMERGENCY RESPONSE SITUATION

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-35).

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.

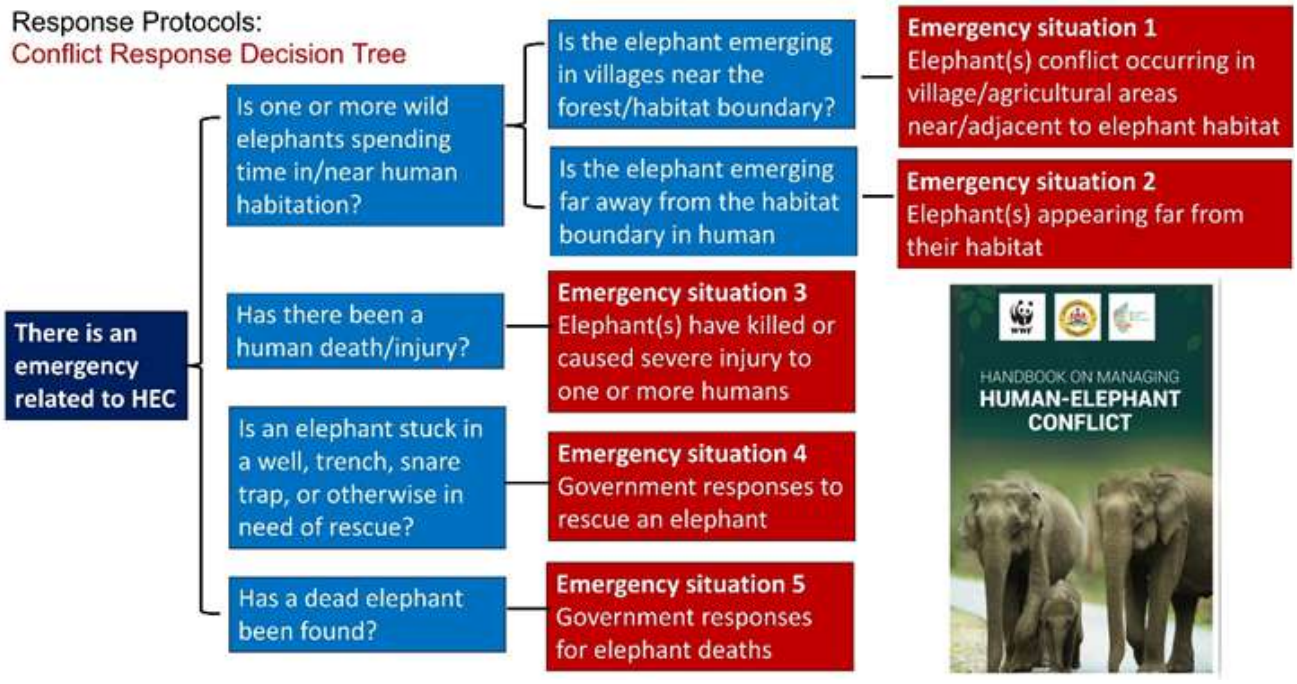


Fig-35: Flow Chart-Conflict Response Decision Tree (refer: Handbook on managing HEC)

Management of HEC in the Southern Region has evolved into a more proactive and regionally coordinated framework, driven by real-time response systems and inter-agency collaboration. A well-structured network has been established in all the states, with each of them following a different approach.

- In **Kerala** to facilitate efficient conflict mitigation, District Forest Emergency Operation Centres (DFEOCs) have been established. These centres act as operational hubs for incident reporting, rapid deployment of field teams, coordination with local authorities, and public communication during conflict situations. To complement district-level efforts, a State Forest Emergency Operation Centre (SFEOC) has been set up at the state headquarters. This central unit provides strategic oversight, data integration, technical support, and resource mobilization to DFEOCs. It also facilitates coordination with other departments such as Revenue, Police, Health, and Disaster Management to ensure a unified and effective response to escalating conflict scenarios. This decentralized yet tightly integrated system with PRTs, RRTs, having links with the State Disaster Management Unit and Ten-Missions approach has significantly enhanced the State's capacity for quick, data-driven, and people-sensitive HEC management, ensuring the protection of both human lives and elephant populations.
- In **Karnataka**, Specialized Elephant Task Force (SETF) stands forefront in the mitigation strategy. The SETF has been established in 8 districts where human elephant conflicts are most prevalent, with separate staff. These ground units form the first line of response in conflict situation to manage potentially dangerous encounters. Besides, there are 33 RRTs as part of local forest divisions.
- Rapid Response Teams (RRT) are also functioning in the states of **Andhra Pradesh** and **Tamil Nadu** to tackle human elephant conflict issues whenever crisis situation arises. They are trained in various aspects of HEC, rescue, and crowd management.

In most States, the field support operations are structured around following key operational stages for synchronization of activities to meet the emergency as under:

- Monitoring and situational awareness
- Mitigation Hubs/Control Room/Helplines
- RRT/ PRT personnel, Vet-team, drug/ equipment & mobility/ communication
- Anti-depredation Squad (ADS) & Koonkie Elephants for Elephant Drives
- Intra and inter agency coordination & cooperation

To deal with the animals straying into human habitations, the RRT must be strengthened with necessary infrastructure facilities and capacity building and the crop raiders may be especially monitored.
A Grievance Redressal Cell may be established to address the complaints and grievances of people regarding wildlife damage issues and mob management may be done with the support of panchayat, police and revenue authorities during conflict situations.

Operating Procedures have been laid down to ensure that the capacities and capabilities of the various response teams (Community PRTs, RRTs) are developed through trainings and each response team is sensitized and equipped with appropriate and adequate response equipment and personal protective equipment.
Early Warning Systems (EWS) shall prioritise low-latency public alerting through a standardised operational chain: detection, validation, automated alert dissemination (SMS/IVRS/WhatsApp/ community systems), response mobilisation, and closure reporting. System design and deployment shall minimise delays between detection and community-level alerts.

Besides, post-emergency HEC situation involves a combination of relief measures and strategies including human safety, elephant welfare, psycho-social support, community meetings, public awareness campaigns, and coordination with govt agencies, NGOs and conservation groups.

4.4.1. Crowd and Media Management during HEC

Crowd management during HEC is critical to ensuring both human safety and animal welfare. When elephants enter human-dominated areas, large crowds often gather out of curiosity, fear, or misinformation, which can severely impede conflict response operations. Uncontrolled crowds increase the risk of human injury, provoke stress and aggression in elephants, and may lead to poor decision-making by response teams.

- Effective crowd management requires rapid zoning of the incident area, restriction of access to trained personnel, coordinated action between forest, police, and district administration, and calm communication in local languages. Use of public address systems, local leaders, and clear instructions helps prevent panic and ensures that mitigation actions- such as guiding elephants toward safe corridors- can be carried out safely and efficiently.

Media engagement during HEC plays a decisive role in shaping public perception and influencing crowd behavior on the ground. Sensational or inaccurate reporting can escalate fear, attract unnecessary crowds, and undermine trust in authorities, while responsible communication can facilitate cooperation and calm.

- A single, designated spokesperson may provide timely, factual updates that emphasize public safety, explain elephant behavior, and outline actions being taken. Proactive engagement with print, electronic, social media- including rapid correction of rumors- helps prevent misinformation & reduces pressure on field staff. By framing HEC incidents with empathy, scientific understanding, and transparency, media engagement becomes a vital tool in de-escalation & in reinforcing long-term coexistence between people & elephants.

4.4.2. Role of District Coordination Committee

The District Coordination Committee (DCC) plays a pivotal role in the effective management of HEC by providing an institutional platform for inter-departmental coordination, rapid decision-making, and accountability at the district level.

- Headed by the District Collector, the Committee brings together the Forest Department, Police, Revenue, Animal Husbandry (veterinary services), Panchayati Raj Institutions, Highways, Electricity Board, and other line departments to ensure a unified and timely response during conflict situations.

The DCC facilitates resource mobilization- such as deployment of trained response teams, vehicles, equipment, and veterinary support- while also overseeing crowd management, law-and-order issues, and emergency relief measures.

Beyond emergency response, the DCC has a crucial compensatory function in managing HEC. It ensures timely compensation for crop loss, property damage, or human injury. The Committee also guides community engagement, awareness programmes, and media communication to prevent panic and misinformation. By integrating conservation objectives with development planning and public safety, the DCC acts as the central governance mechanism for promoting coexistence between people and elephants within the district.

4.5. REDUCING THE IMPACT OF HEC ON PEOPLE AFFECTED

A major response to HEC has been compensation for losses (Table-13), but little evidence exists to support the claims that these schemes have an impact on people's attitude or the impact on the conservation of elephants. Therefore, the perceptions and attitudes of people who inhabit conflict prone areas are crucial to the management of HEC and offsetting economic losses plays a major role in building positive attitudes and tolerance toward elephants through timely payments and appropriate compensation (Fig-36).

Fig-36: Crop raiding incidences and assessment of crop damage

Certain States have adopted the norms prescribed for State Disaster Response Fund (SDRF) for compensation. Also, the possibilities of treating damage to crops by elephants as a natural calamity and claim compensation under PM Fasal Bima Yojana to be explored.

BOX-9: 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 Department, often limiting the scope and speed of response, especially in cases requiring coordination with other district-level agencies. By bringing HWC under the 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.
- Overall, the declaration of human-wildlife conflict as a State Disaster represents a progressive and systemic governance response, transforming conflict management from a sectoral responsibility into a coordinated state-wide action. Kerala's experience offers an important policy model that other states facing escalating human-wildlife conflict may consider adapting to their own contexts.

Table-13: Compensatory Measures adopted in various Southern States

Compensatory Measures				
Measure	**Kerala**	**Karnataka**	**Tamil Nadu**	**Andhra Pradesh**
Govt Order	GO(MS) No. 17/2018/F&WLD dated 05-04-2018	G. O. No FEE 114 FWL 2022 dt 15.1.2. 2022.	G. O. No. 33, Climate Change and Forestry (Vanam. 5) Department, dated 21.2. 2024	G. O. Ms. No 29 dated 22. 07. 2024, Environment, Forests, Science & Technology Department
Compensation/ Ex gratia				
Human Death	₹ 10, 00, 000	₹20, 00, 000 with a pension of ₹4, 000/ month for 5 years	₹ 10, 00, 000	₹ 10, 00, 000
Human Injury	Incapacitated permanently-₹2, 00, 000/- Other Injuries: maximum of ₹1, 00, 000.	Permanent Disability: ₹10, 00, 000 Partial Disability: ₹5, 00, 000	For major injury-₹ 59, 100	Grievous Injury-₹2, 00, 000/- along with medical Expenditure. Minor Injury-Actual cost or ₹ 20, 000/- whichever is lower.
Cattle Loss	100% of the loss assessed subject to a maximum of Rs 1, 00, 000/-	₹30, 000/- per animal	For Cattle kill-₹ 30, 000 (₹ 25, 000 for bullock & ₹ 3, 000 for goat/ sheep/ pig)	As per consultation with the Director, Animal Husbandry.
Crop Damage	Subject to a maximum of Rs 1, 00, 000/-	Minimum Rs 7500/- and a Maximum of Rs 1, 00, 000/-	₹ 25, 000/ acre ₹ 500/ coconut tree	Cash crops: Min. 10, 000 to Max. 12, 000/ acre. Horticulture crops: 12, 000 to Max. 50, 000/ acre.
Use of technology	E-Portal of Government of Kerala	e-Parihara Compensation System	-	Recently Launched Gaja Praja Android App.

4.6. REDUCING THE IMPACT OF HEC ON THE ANIMAL HEALTH

During human elephant conflict situation, care is to be taken to ensure that adverse impact of conflict on wild elephant's health is minimized. This is important during capturing/ radio collaring or even during elephant/s driving operations. Following measures are envisaged:

- Sensitization of the officers and staff to comply with various protocols and SOPs, already in place for capturing/ radio collaring, transportation, release.
- While handling the narcotics drugs or sedatives, only trained veterinarians/staff/ mahouts should be deployed.
- Health of captive elephant & staff engaged in capturing operation need special care.
- Due care should be taken towards health examination, transportation post capture, food and water during transportation, housing & sanitation and health screening of elephants.
- Care should be taken, while collecting the biological samples to avoid zoonotic/ anthroponosis or zoonosis.
- During the situation of crowd control, swift action is to be taken to ensure, elephant in conflict is not harmed.
- Personnel engaged in HEC management, including police men should have, basic training and good knowledge of elephant's ecology & behavior; hence, capacity building of officers/ staff/ vets from time to time is necessary.
- Elephants that have a record of high conflict are not released back when compared to the elephants not causing serious conflict; and release to be backed with radio-collaring and adequate monitoring.

Presently various aspects of HEC management, are being carried out carefully in the region; wherever needed states are coordinating with each other.

4.7. ECONOMICS AND APPROPRIATENESS OF HEC MITIGATION MEASURES

The economics of HEC mitigation measures involve analysing the costs and benefits of different strategies to reduce conflict and its impact on human and elephant population. These measures include various approaches, from compensation and insurance schemes to physical barriers and technological interventions. Additionally, the integration of community-based approaches, such as the deployment of trained "elephant watchers" and awareness programs, offers a more cost-effective alternative while fostering local participation. The suitability of these measures is influenced by factors such as the size of conflict-prone areas, local terrain, and the socio-economic conditions of communities living near elephant habitats. Moreover, government support and public-private partnerships can enhance the scalability and sustainability of these mitigation strategies, ensuring they are economically viable and adaptable to different regions.

4.7. 1 Cost-Benefit Analysis:

A key aspect of the economics of HEC mitigation is conducting cost-benefit analysis to evaluate the effectiveness and financial implications of different mitigation strategies. This involves assessing the costs of implementing and maintaining a particular measure (*e. g.* , building electric fences, establishing compensation programs) and comparing them to the benefits (*e. g.* , reduced crop damage, lower risk of human injury or death).

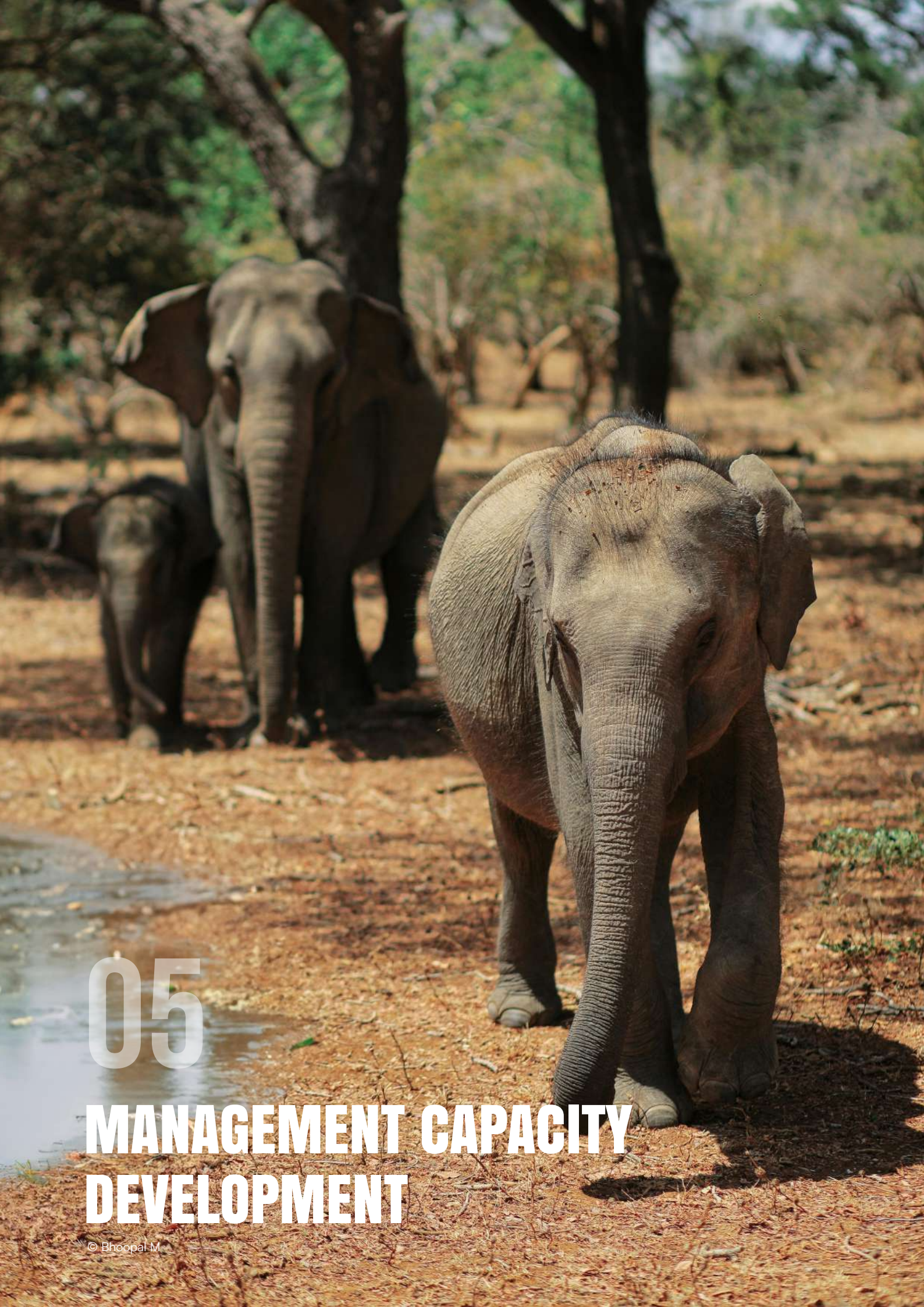
Many HEC mitigation programs involve compensation or insurance schemes to address the economic losses suffered by people who experience conflict with elephants. This can include compensation for crop damage, property damage, or even for human injury or death caused by elephants.

- There is a need to evaluate the relative merits of alternative approaches to HEC, ranging from ex gratia payments to measures that reduce conflict; in particular, efficacy of physical barriers, elephant capture, and behavior-based initiatives to influence the movement of elephants away from human settlements.
- The goal should be 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.

BOX-10: BANDIPUR TIGER RESERVE- ECONOMIC IMPACT OF RAILWAY BARRICADES

- The project costs are outlined with the average cost of constructing the Railway Barricade (RB) for 1 km being Rs 1, 70, 00, 000. Given the total length of the Bandipur TR boundary is 412. 54 km, the total cost for the RB is estimated at Rs 7, 01, 31, 80, 000. The break-even analysis shows that the entire population would reach break-even in 2. 03 years, while 50% of the population would take 4. 06 years, 25% would take 8. 12 years, and 10% would take 20. 29 years. For the farmer population alone, the break-even periods are longer, with the entire farmer population taking 9. 53 years, 50% taking 19. 07 years, 25% taking 38. 14 years, and 10% taking 95.3.4 years. At the current rate of HEC at 12. 65% of the total farming population, the break-even would be attained in less than 90 years.
- **Project Costs and Break-Even Analysis**: The cost of constructing the RB is substantial (Rs 7, 01, 31, 80, 000 for the length of 412. 54 km). The break-even analysis shows that the investment can be recouped within a reasonable time frame for entire population (2. 03 years) & for entire farmer population (9. 53 yrs).
- **Economic impact of RB on increase in income & break-even cost of barricading**

Total Population	2, 16, 370. 00
Total Farmer Population	46, 053. 00
Total Crop Claims	5, 827. 00
Average Income Before Barrier (INR)	74, 305. 00
Average Income After Barrier (INR)	90, 278. 00
Average CCR paid (INR)	8, 761. 58
Total CCR paid (INR)	5, 10, 53, 728. 60
No of people interviewed	72. 00
Average Increase in Income (INR)	15, 973. 00
Average Increase in Income for pop (INR)	3, 45, 60, 78, 010. 00
Average Increase in Income for 50% pop (INR)	1, 72, 80, 39, 005. 00
Average Increase in Income for 25% pop (INR)	86, 40, 19, 502. 50
Average Increase in Income for 10% pop (INR)	34, 56, 07, 801. 00



05

MANAGEMENT CAPACITY DEVELOPMENT

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5.1. APPLIED RESEARCH ACTIVITIES

Information and data is the most important asset when it comes to any management intervention or to analyze the pros and cons of any alteration to a natural ecosystem. Activating research activities in an Elephant Reserve involves careful planning, collaboration, and adherence to conservation principles.

- *Short-term research* can be particularly impactful when addressing urgent issues or specific challenges whereas *Long-term research* in conservation is essential for gaining a comprehensive understanding of ecosystems, species, and the impacts of conservation interventions over time.

States like Kerala, Karnataka and Tamil Nadu have been dealing with the elephant conservation since very long and have a robust system in place to monitor the elephants and quite a lot of research work has gone into population estimation, identifying hotspots and managing conflict through traditional methods and by using technology.
Considering HEC as one of the most critical issues in the landscape, there is a need for a more scientific approach to conflict management which would involve in-depth research to understand, analyze and predict elephant movement and behavior.

Engaging research institutions, organizations, NGOs, and individual scientists is crucial for garnering support, expertise, transparency and participation in HEC. Some examples of research institutions, NGOs and community-based organizations, in the region 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); Nature Conservation Foundation (NCF); World Wildlife Fund (WWF); Bombay Natural History Society (BNHS); Indian Institute of Science (IISc); Kerala Forest Research Institute (KFRI); Tropical Botanical Garden and Research Institute (TBGRI); Asian Elephant Specialist Group (AESG); Foundation for Ecological Research, Advocacy & Learning (FERAL); and Advanced Institute for Wildlife Conservation (AIWC).

The key aspects which could be considered for research in comprehensive understanding and management of HEC in the region, include:

- *Population Dynamics*: Study the population structure, including age distribution, is gender ratios, birth rates (helps in assessing the health and reproductive success) (Fig-36).
- *Migration/ Movement Patterns*: Understand the movement patterns and migration routes of elephants. (vital for effective conservation and management strategies).
- *Behavioral Ecology & Social Structure*: Investigate the social organization within elephant herds, including family dynamics, communication, and hierarchy (essential for developing strategies that respect natural behavior of elephants) (Fig-37).
- *Habitat Quality Assessment including Invasives*: Study the quality of habitat and the impact of invasives on the habitat (Fig-38).
- *Feeding Habits and Nutritional Studies*: Study the dietary preferences, foraging behaviour, and habitat utilization (critical for managing & preserving their habitats).
- *Habitat Use*: Study the elephants' habitat preferences (how changes in land use affect their movement and survival).
- *Human-Elephant Conflict*: Study the causes & patterns of HEC, including crop raiding and incidents of aggression (helps develop strategies to mitigate conflicts).
- *Health Monitoring & Disease Surveillance*: Conduct health assessments and monitor for diseases that may affect elephant populations (crucial for implementing interventions and preventing the spread of diseases).
- *Community-Based Conservation:* Research on community perceptions and attitudes towards elephants (can inform strategies that benefit both wildlife & local livelihoods)

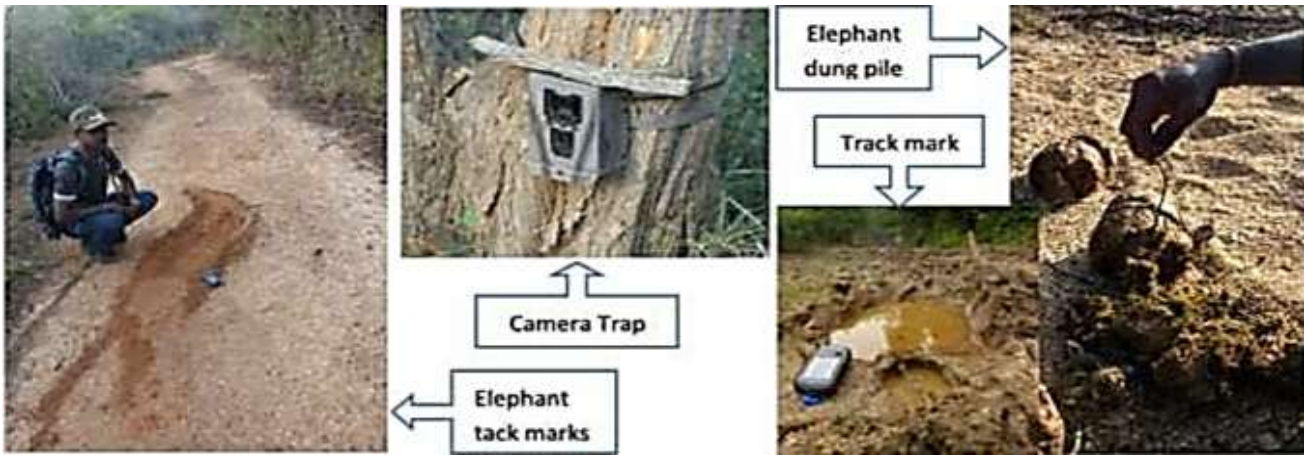


Fig-37: Field observations on Population dynamics & Behavioral ecology

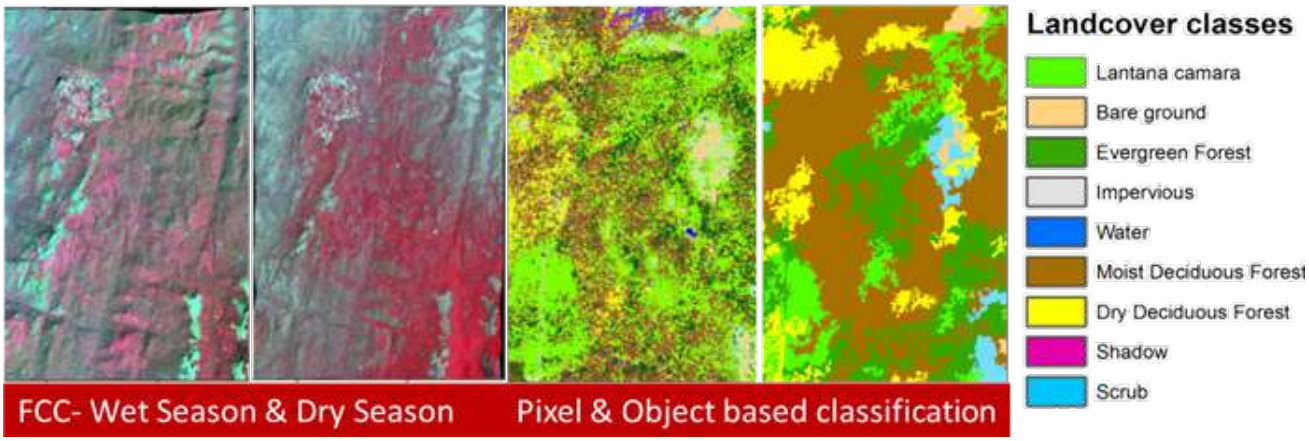


Fig-38: Habitat Quality Assessment by mapping of Lantana using Remote Sensing

5.2. CAPACITY DEVELOPMENT AND TRAINING

Capacity building and training programs are essential components of any HEC mitigation strategy. It is crucial to strengthen the skills and knowledge of forest staff, local communities, and stakeholders involved in HEC management. The Forest Department, in collaboration with conservation organizations, can offer specialized training for forest guards, local wildlife monitors, and community members on elephant behavior, conflict mitigation techniques, and emergency response protocols. These programs may focus on educating the public on how to coexist peacefully with elephants, emphasizing practices like securing crops, proper waste management, and alert systems to detect elephant movements. Training in non-lethal methods, such as the use of sound-based deterrents, and building community-led monitoring teams, may empower locals to actively contribute to conflict mitigation efforts.

Following measures have been envisaged for facilitating capacity development:

- *Field staff & response teams:* Regular trainings on critical operations such as rescue, capture and translocation in the form of mock-drills/ simulation trainings for the field staff including trainings of RRT, ADS, night patrolling teams, and railway track watchers on elephant behavior, stress signals, & human interaction.
- *Mahouts and assistants:* Regular trainings conducted for mahouts and daily wage workers/ anti-poaching watchers on elephant behavioural studies, guiding 'koonkie' elephants and conflict mitigation
- *Local population: Local NGOs,* People's representatives, volunteers, schools involved in the implementation of safety measures, aimed at preventing HEC including regular trainings during village meetings.

Establishing a Training cum Research & Command Control Centre: Given the movement of elephants and migration of elephants into neighbouring states, there is a need for a full-time Training cum Research & Command

Control Centre in each of the Elephant Reserves with proper staff and infrastructure.
Capacity Building for HEC: Effective mitigation of human-elephant conflict across different states requires continuous, multi-level, and multi-stakeholder capacity building. The region exhibits wide diversity in landscapes, institutional arrangements, conflict intensity, and skill levels among different cadres. At the same time, valuable experience, best practices, and traditional knowledge already exist within and across states.

The proposed training framework therefore adopts a tiered approach, comprising regional-level training, exchange workshops, state-level capacity building programs, local & community-based trainings, and periodic refresher programs. The structure of training programs, therefore, aims to

- standardize core competencies and operating procedures across states,
- strengthen state- and district-level institutional responses,
- empower frontline staff and communities for effective first response, and
- ensure continuous learning and skill upgradation.

Special emphasis is placed on RRTs/ PRTs, elephant mahouts, & veterinarians recognizing their critical operational roles in HEC mitigation. The framework also explicitly integrates the scientific community, traditional knowledge holders, allied govt departments, and elected representatives.

Given the dynamic nature of HEC, all trainings are envisaged not as one-time interventions but as part of an ongoing capacity development process, supported by regular refresher courses and interstate knowledge exchange (Table-14).

Table-14: List of broad training programs

Proposed Training Programs				
S. N	**Program**	**Level**	**Target Group**	**Frequency**
1	Regional Training Workshop on Human-Elephant Conflict Mitigation	Regional	Frontline forest staff	Once in 3-4 years
2	Regional Advanced Training for Rapid Response Teams (RRTs)	Regional	RRT & master trainers	Once in 3 years
3	Regional Training & Exposure Workshop for Elephant Mahavats	Regional	Mahouts	Once in 3 years
4	Regional Science-Management-Indigenous Knowledge Interface Workshop	Regional	Forest officers, scientists, local representative	Once in 3-4 years
5	Regional Knowledge Exchange and Best Practices Workshop	Regional	Stakeholder representative	Annual / Biennial
8	Training Programme for Frontline Forest Department Staff	State	FG/ FW/ Fr	Once in 2 years
9	Capacity Building Programme for Rapid Response Teams	State	State- division-level RRTs	Once in 2 years
10	State-level Training Programme for Elephant Mahouts	State	Mahouts	Once in 2 years
11	Veterinary Capacity Building Programme	State	Veterinarians	Once in 2 years
12	Training Programme for District level departments	State	Rev. Agr, Pol, PRI, local body	Once in 2 years
13	Training of Primary Response Teams	Local	Community-based PRT	Once in 2 years
14	Community-level Sensitisation for PRTs	Local	Local communities	As required
15	Indigenous Knowledge Integration Workshops	Local	Indigenous communities	Once in 2 years
16	Sensitisation Programmes for Elected Representatives	Local	PRI. Political leaders	As required
17	Refresher Training for Frontline Forest Staff	Refresher	Frontline forest staff	Once an year

18	Refresher Training for Rapid Response Teams	Refresher	RRT members	Once an year
19	Refresher and Advanced Training for Elephant Mahouts	Refresher	Mahouts	Once an year
20	Refresher Training for Wildlife and Forest Veterinarians	Refresher	Veterinarians	Once an year

5.3. USE OF INNOVATIVE TECHNIQUES/ TECHNOLOGIES

The use of innovative techniques and technologies in an elephant reserve is crucial for enhancing conservation efforts, improving monitoring capabilities, and mitigating human-elephant conflict. Several innovative approaches and technologies that can be applied in an elephant reserve, include:

- *Geographic Information System (GIS) and Remote Sensing*: can be used for mapping and monitoring habitat changes, vegetation, land-use patterns, and migration corridors.
- *Camera Traps and Sensor Networks*: are deployed to monitor elephant movement, behaviour, and population dynamics.
- *Unmanned Aerial Vehicles (UAVs) or Drones*: offers a cost-effective and efficient way to cover large areas, collect high-resolution imagery, and enhance surveillance (Fig-39).
- *Collar & Tracking Technology*: GPS and satellite collars are used to track the movements of elephants, especially in areas with high HEC and provides real-time data.
- *Acoustic Monitoring*: Acoustic sensors or listening devices are deployed to monitor elephant vocalizations and detect their presence in specific areas.
- *HEC Mitigation Technologies*: such as smart fences, sensor-based alarms, AI-based Early Warning System and deterrent systems are utilized to reduce HEC and enhances the effectiveness of mitigation (Fig-40).
- *Community-Based Mobile Apps*: enable communities to report elephant sightings, incidents, or potential conflict situations, and it facilitates real-time communication.
- *Environmental DNA (eDNA) Analysis*: is used to detect the presence of elephants through DNA traces in soil, water, or vegetation samples.


Fig-39: Drone based Monitoring in the high Conflict Zone

BOX-11: AI-POWERED EWS (MADUKKARAI, COIMBATORE RAILWAY MITIGATION)

The Tamil Nadu Forest Dept, in collaboration with the Indian Railways, vide G. O (MS) No 303 Environment, Climate Change and Forest (FR. 5) Department date 20. 11. 2019 installed this innovative system in February 2024, at a cost of approximately ₹7. 2 crore.

- *Technology*: The system uses 12 high-mass towers equipped with 24 high-resolution thermal and 4K cameras that monitor a 7. 05-kilometre stretc.h of the railway lines.
- *Detection and Alerts*: Artificial intelligence (AI) algorithms continuously analyze live video feeds for elephant movement near the tracks. When an animal is detected within a certain range (*e. g.* , 50-60 meters), the system instantly sends real-time audio and visual alerts to a central control room, forest officials, nearest station masters, and locomotive pilots via their mobile phones or control panels.
- *Response*: Upon receiving an alert, train drivers are instructed to reduce speed or stop the train, allowing forest department rapid response teams to guide the elephants away or ensure their safe passage.
- *Effectiveness*: Since its implementation, the system has facilitated over 6, 592 safe elephant crossings with zero deaths in the last two years and prevented numerous potential accidents, helping to maintain the ecological corridor.

Fig-40: AI-based Early Warning System (EWS) at Madukkarai, Coimbatore

5.4. ORGANIZATION AND INSTITUTIONAL FRAMEWORK

An effective organizational and institutional framework is necessary for the coordinated and sustainable management of HEC. This framework may involve a multi-stakeholder approach, bringing together the Forest Department, local authorities, wildlife conservation organizations, and local communities.

A dedicated HEC management unit within the Forest Department may be tasked with implementing and overseeing mitigation strategies, conducting research, and monitoring conflict trends (Fig-41). Village-level wildlife protection committees may be integrated into this framework to ensure community participation and support. Coordination with law enforcement agencies, agriculture departments, and local government bodies would be crucial for implementing cross-sectoral solutions (Fig-42), such as compensation schemes for farmers and infrastructure development like elephant corridors or barriers. Strengthening the institutional capacity and fostering collaboration between various entities would ensure that HEC mitigation efforts are comprehensive, sustainable, and adaptable to changing circumstances.

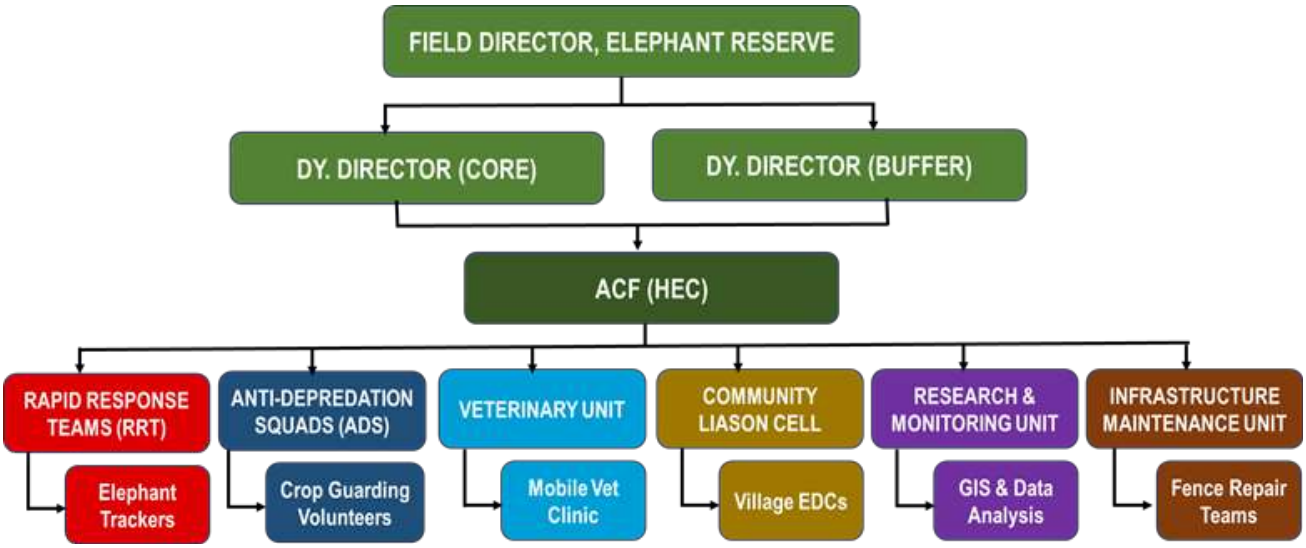


Fig-41: Organogram for HEC Mitigation in Elephant Reserve

All the states in the region are working towards a dedicated Rapid Response Team, Elephant Task Force to manage HEC. States like Karnataka and Kerala in terms of Human-resource are well equipped with Karnataka having a combined strength of around 800 people in ETF, RRT and ADC. Whereas Kerala has 28 RRT's to deal with conflict, followed by Tamil Nadu which at present has 5 RRT's. Andhra Pradesh has only recently set up an Elephant Task Force.

There is a need for a more robust inter-state coordination and sharing of information to manage conflict at the landscape scale and also to ensure reduction of HEC in the long run by connecting habitats/forest through functional corridors.

The inter-state coordination mechanism for managing HEC involves several key elements across Kerala, Karnataka, Andhra Pradesh, and Tamil Nadu, as under:

- *Interstate Coordination Committee*: May be formed among the four states to address human-wildlife conflict in border areas.
- *Nodal Officers:* Each state may appoint a nodal officer to facilitate joint action planning.
- *Meetings and Reviews:* Ministry and department-level meetings may be conducted to analyze factors contributing to wildlife straying into human habitations.
- *Data and Intelligence Sharing:* States may develop standardized formats for sharing data on animals in conflict including hotspots.
- *Capacity Building:* Training programs may be implemented for field staff from participating departments.
- *Standard Operating Procedures (SOPs):* A common landscape-level SOP may be developed for managing animals in conflict.

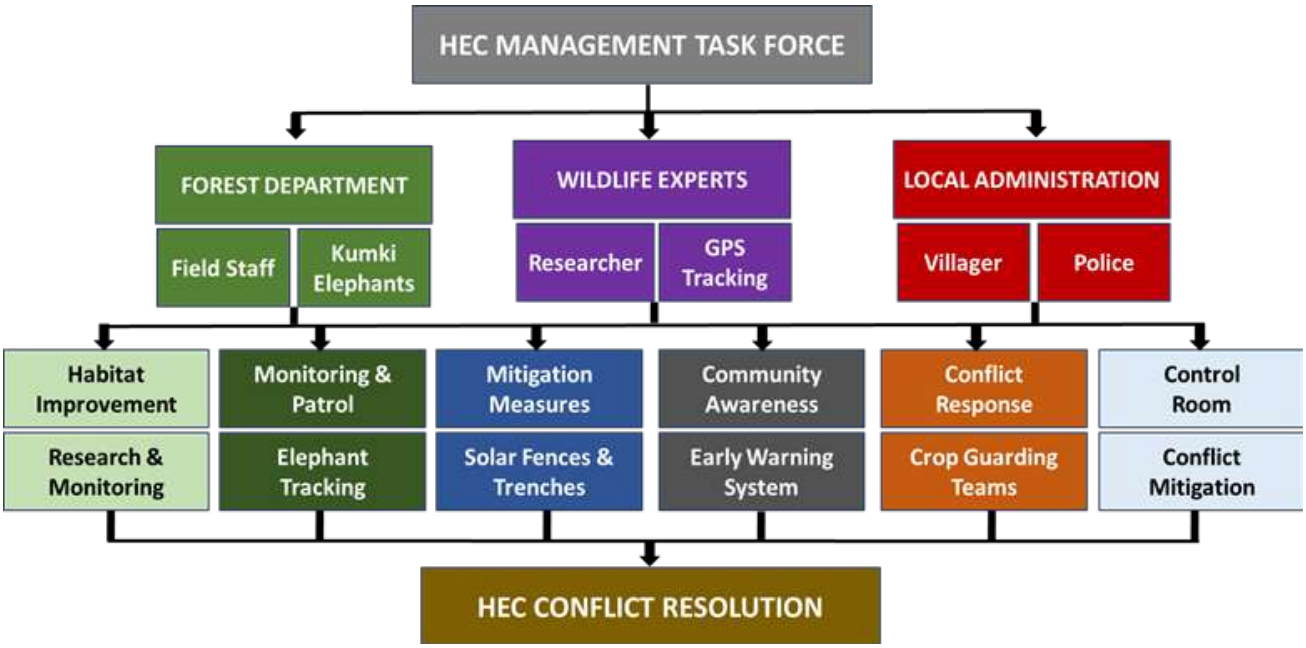


Fig-42: HEC Conflict Resolution in an Elephant Reserve

This collaborative approach aims to enhance coordination, data-driven decision-making, and effective response to HEC across state borders.

06

REGIONAL ASSESSMENT & PROPOSED ACTIVITIES

6.1. ASSESSMENT OF THE SOUTHERN REGIONAL LANDSCAPE

- Southern regional landscape holds 53. 7% of country elephant's population as per the recent 2021-25 DNA based (genetic mark-recapture) SAIEE report of WII Dehradun. The landscape encompasses large fed-connected forest tracts of the Western Ghats, Eastern Ghats foothills, and adjoining forest ranges. Major elephant habitats include:
  - Nilgiri-Bandipur-Nagarhole landscape (Western Ghats)
  - Wayanad and Periyar regions (Kerala)
  - Eastern Ghat fragments extending through Tamil Nadu, Karnataka to Andhra Pradesh
  - Koundinya WLS area in Andhra Pradesh as an important but smaller ER.

- Spatial hotspots across States include-

Region	Primary Issues
Wayanad (Kerala) & Gudalur (TN)	Frequent crop raids, human injuries
Nilgiri-Bandipur Landscape (TN-Kar)	Cross-state movements increasing conflicts
Palakkad, Idukki (Kerala)	Conflict near forest fringes
Kodagu & Chamarajanagar (Karnataka)	Crop loss, retaliatory incidents
Saklespur-Belur (Karnataka)	Landuse changes (tourism, hydel, highways)
Hosur & Krishnagiri (TN)	Recent herd influx damaging crops
Valparai plateau (TN)	High conflict in the estates
Chittoor & Koundinya (AP)	Emerging conflict in Elephant reserve zones

- Nilgiris- Eastern ghat range is a mega-habitat of more than 12000 sq. km, comprising of PAs and RFs of all the four states. With the addition of areas of Bhadra TR in Mysore ER and occasionally observed movements of elephants towards Dandeli ER in the northern part of western ghats, this landscape is the largest genetically linked habitat in the country.

- Principal Drivers of Conflict in the Region include -
  - Habitat Fragmentation & Loss through expansion of agriculture, plantations, and settlements; forcing elephants through human-use landscapes and corridors.
  - Disrupted Traditional Migration Corridors like those in the Sigur plateau and across the Palghat gap, which are stressed by infrastructure, reducing safe movement paths.
  - Crop & Livestock Attractants: paves way for the elephants to raid high-nutrient crops (*e. g.* , ragi, sorghum) and thus creates frequent conflict spots.
  - Environmental & Seasonal Factors like seasonal changes, rainfall variability, and dry season water scarcity push elephants closer to villages.
  - Physical deterrents like trenches, power & solar fences, intended to reduce conflict, have caused unintended elephant injuries/ deaths and can heighten conflict intensity.

- HEC in the four states is driven mainly by habitat loss/ fragmentation, agricultural/ horticultural crop expansion into elephant ranges, seasonal movement for forage/ water (occasionally climate-driven), tea-coffee plantations, and expanding human infrastructure (roads and buildings). Cross-border movements between states (and districts) demands for coordinated, landscape-level responses.

- Subject to availability of resources, providing the location specific barriers on the interface of forests and farmlands, attempts made for habitat restoration, timely payment of ex-gratia, mobilizing community support, use to technology in HEC mitigation, good veterinary care of captive elephants, improving connectivity *etc.* are efforts being made to address various issues in the conservation and coexistence-management zones.

- Important challenge is to manage HEC in the forest fringes/ commercial plantation crops, mainly coffee and tea. Cropping pattern and implementation of PMFBY, corridor restoration, long-term habitat amelioration, need for an interstate HEC protocol, community-based deterrence with EWRS are other issues, which need attention.

The extent and patterns of HEC in the southern states is summarized in the Table-15 as under:

Table-15: Extent and Pattern of HEC in Southern States

KERALA	KARNATAKA	TAMIL NAADU	ANDHRA PRADESH
• Conflict is widespread and intensifying across multiple districts *viz.* Wayanad, Idukki, Palakkad, Kannur, and Malappuram. • Hundreds of villages are designated conflict hotspots, with frequent crop raids, property damage, and human injuries/deaths. • The combination of dense human settlement adjacent to elephant ranges underpin conflict severity.	• Highest elephant population in India (~6, 000 elephants), concentrated in the Nilgiri-Bandipur-Nagarhole region, leads to significant conflict zones. • Large numbers of crop raids, livestock depredation, and occasional human deaths are recorded in multiple districts- Chamarajanagar & Kodagu. • Fragmentation and plantations have increased elephant movement through human-use areas.	• Conflict strongly linked to the Nilgiri landscape (*e. g.* , Coimbatore, Hosur, Sathyamangalam), where migrating herds move between Karnataka and Tamil Nadu. • Recent mass movements in Eastern Ghats have caused crop destruction and safety alerts in areas near Hosur and Krishnagiri. • Development projects (road/ rail/ dams/ estates) are adding to the HEC.	• Koundinya Wildlife Sanctuary hosts elephants that migrated into AP, creating new conflict zones in Chittoor and surrounding areas. • The influx of young lone bulls and all male herds are a cause of greater conflict in the region. • AP has seen human fatalities, extensive crop loss, and cattle depredation, prompting management responses such as elephant camps with Kumki elephants.

Thus, the Southern Regional landscape for human-elephant conflict is shaped by:
- High elephant densities and growing populations
- Fragmented habitats intersecting dense rural settlements
- Seasonal and ecological pressures pushing elephants outside core forests
- Increasing socio-economic costs for farmers and communities
-

An inclusive understanding and management of HEC in South India demands an integrated, science-based, and community-centred approach that surpasses administrative boundaries.

Key recommendations: include adopting a landscape-level plan; protecting critical corridors; physical barriers with community-centred measures; regulating and developing compensation mechanism; conducting monitoring & research; creating inter-departmental task force *etc.*

6.2. PROPOSED ACTIVITIES AND FINANCIAL IMPLICATIONS

Typically, the budget for dealing with the issue of Human-Elephant Conflict (HEC) of the southern region, includes the following broad components:

A. ***Habitat Improvement & Connectivity***: includes phasing out monocultures; eradication of invasives; development of grasslands; augmentation of water resources; and corridor acquisition, improvement & restoration (Rs 276. 86 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 587. 36 crores).

C. ***Infrastructure Development & Capacity Building***: includes establishment, and operation of control centre; procurement of all-terrain vehicles, drones, camera traps, drugs *etc.*; capacity building; veterinary care and elephant camps (Rs 118. 44 crores).

D. ***Community/stakeholder's involved Conflict Management, Awareness & Education***: includes formation of committees; awareness creation; workshops, seminars, meetings; intelligence networks; awareness materials (Rs 7. 08 crores).

E. ***Research, Monitoring & Inter State Coordination***: includes population estimation; understanding habitat fragmentation, corridors & bottlenecks; interstate coordination meetings; demographic structure; purchase of computers, GIS software (Rs 10. 26 crores).

A **total allocation** of Rs 990 crores has been proposed for the above 5 major components with each having 5 sub-components/ activities (***Annexure-1***) and with justification (***Annexure-2***).

Prioritization of Components & Sub-components:
Keeping in view the funds availability, all the activities (sub-components) have been prioritized into following 4 categories (represented by coloration) as under:

- Priority-I: (Red Color)-6 activities
- Priority-II: (Orange Color)-6 activities
- Priority-III: (Yellow Color)-6 activities
- Priority-IV: (Grey Color)-7 activities

ANNEXURE-1

REGIONAL ACTION PLAN for Comprehensive Understanding & Management of HEC in South India

FINANCIAL OUTLAY FOR 5 years (Rs. In LAKHS)

S. No	Particulars	1st year				2nd year			
A. HABITAT IMPROVEMENT & CONNECTIVITY		Andhra Pradesh	Karnataka	Kerala	Tamil Nadu	Andhra Pradesh	Karnataka	Kerala	Tamil Nadu
1	To restore monoculture plantations (Acacia, Mangium, Eucalyptus, *etc.*) into natural forests through phased ecological restoration approach	201.28	449.92	236.80	296.00	176.29	394.06	207.40	259.25
2	Eradication of Invasive Alien Species (Lantana, Senna, Eupatorium *etc.*)	397.29	888.06	467.40	584.25	482.29	1078.06	567.40	709.25
3	Fodder Availability through restoration of Hadlu's, development of grasslands	140.76	314.64	165.60	207.00	139.23	311.22	163.80	204.75
4	Augmentation of Water resources, solar borewell and other related activities	89.25	199.50	105.00	131.25	88.74	198.36	104.40	130.50
5	Special focus on investment for Corridor Acquisition, improvement & restoration	227.12	507.68	267.20	334.00	133.28	297.92	156.80	196.00
B. HEC MITIGATION MEASURES									
1	Erection & Maintenance of Physical Barriers (EPT, Rail Barricade, Steel rope Fencing, Solar Tentacle Fence)	1500.42	3353.88	1765.20	2206.50	1403.35	3136.90	1651.00	2063.75
2	Ex-gratia payment for loss of life, injury, damage to property, crop, *etc.*,	64.60	144.40	76.00	95.00	69.70	155.80	82.00	102.50
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.*	149.09	333.26	175.40	219.25	136.51	305.14	160.60	200.75
4	Early Warning System (Primarily technology driven systems like APP based monitoring, AI cameras, Virtual fencing, Bulk SMS and other such methods)	204.85	457.90	241.00	301.25	261.63	584.82	307.80	384.75
5	State/Area Specific Conflict Management, Supporting activities and other related activities	217.94	487.16	256.40	320.50	144.33	322.62	169.80	212.25
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	323.85	723.90	381.00	476.25	288.15	644.10	339.00	423.75

2	Procurement of All Terrain Vehicles for RRT, ETF and other teams	42.50	95.00	50.00	62.50	33.66	75.24	39.60	49.50
3	Procurement of Thermal Drones, Camera Traps, Tranquilizing kits, drugs, Radio Collars, Trackers, Satellite Phones and other related equipment.	69.70	155.80	82.00	102.50	43.01	96.14	50.60	63.25
4	Capacity building for Forest Department staff, Line Department personnel, Panchayat-level stakeholders, and exchange visits	22.44	50.16	26.40	33.00	22.61	50.54	26.60	33.25
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.	49.98	111.72	58.80	73.50	34.00	76.00	40.00	50.00
D. Community/stakeholder>s involved Conflict Management, Awareness and Education									
1	Formation of Community Level HEC management Committees like Jan Jagratha Samithis (JJSs), Vana Samrakshana Samithis (VSS) or other similar community driven initiatives.	3.06	6.84	3.60	4.50	1.87	4.18	2.20	2.75
2	Awareness Creation Activities for the Forest Fringe Villages affected by HEC	9.86	22.04	11.60	14.50	10.20	22.80	12.00	15.00
3	Holding of workshops, seminars, meetings of the stake holders	4.93	11.02	5.80	7.25	5.95	13.30	7.00	8.75
4	Division-Level Intelligence Networks, Informers	4.76	10.64	5.60	7.00	4.76	10.64	5.60	7.00
5	Awareness Materials, Mobile Application and Meetings	2.55	5.70	3.00	3.75	2.55	5.70	3.00	3.75
E. Research, Monitoring & Inter State Coordination									
1	Annual Population Estimation, Profiling of elephants and monitoring of elephant population	1.87	4.18	2.20	2.75	3.91	8.74	4.60	5.75
2	Detailed understanding of Habitat Fragmentation, Corridors and bottlenecks to elephant movement and Implication and strategies for HEC.	5.61	12.54	6.60	8.25	6.12	13.68	7.20	9.00
3	Annual Interstate Coordination Meetings at Ministerial-level, HoFF/ CWLW level, and regional-level meetings	2.89	6.46	3.40	4.25	2.89	6.46	3.40	4.25
4	Demographic Structure and Survival Trends of Wild Elephants and Implications for Long- term Conservation	3.23	7.22	3.80	4.75	3.40	7.60	4.00	5.00
5	Purchase of Work-stations, GIS software, colour printers, UPS, stationaries, internet charges, *etc.* , including AMC.	29.24	65.36	34.40	43.00	19.55	43.70	23.00	28.75
	Sub-total	**3769.07**	**8424.98**	**4434.20**	**5542.75**	**3517.98**	**7863.72**	**4138.80**	**5173.50**

S. No	Particulars	3rd year				4th year			
A. HABITAT IMPROVEMENT & CONNECTIVITY		Andhra Pradesh	Karnataka	Kerala	Tamil Nadu	Andhra Pradesh	Karnataka	Kerala	Tamil Nadu
1	To restore monoculture plantations (Acacia, Mangium, Eucalyptus, *etc.*) into natural forests through phased ecological restoration approach	180.37	403.18	212.20	265.25	186.32	416.48	219.20	274.00
2	Eradication of Invasive Alien Species (Lantana, Senna, Eupatorium *etc.*)	456.45	1020.30	537.00	671.25	357.85	799.90	421.00	526.25
3	Fodder Availability through restoration of Hadlu's, development of grasslands	137.19	306.66	161.40	201.75	135.83	303.62	159.80	199.75
4	Augmentation of Water resources, solar borewell and other related activities	89.59	200.26	105.40	131.75	83.98	187.72	98.80	123.50
5	Special focus on investment for Corridor Acquisition, improvement & restoration	133.28	297.92	156.80	196.00	138.21	308.94	162.60	203.25
B. HEC MITIGATION MEASURES									
1	Erection & Maintenance of Physical Barriers (EPT, Rail Barricade, Steel rope Fencing, Solar Tentacle Fence)	1417.63	3168.82	1667.80	2084.75	1354.90	3028.60	1594.00	1992.50
2	Ex-gratia payment for loss of life, injury, damage to property, crop, *etc.*,	76.50	171.00	90.00	112.50	85.00	190.00	100.00	125.00
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.*	139.91	312.74	164.60	205.75	138.72	310.08	163.20	204.00

4	Early Warning System (Primarily technology driven systems like APP based monitoring, AI cameras, Virtual fencing, Bulk SMS and other such methods)	236.30	528.20	278.00	347.50	303.11	677.54	356.60	445.75
5	State/Area Specific Conflict Management, Supporting activities and other related activities	153.51	343.14	180.60	225.75	152.83	341.62	179.80	224.75
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	238.17	532.38	280.20	350.25	256.02	572.28	301.20	376.50
2	Procurement of All Terrain Vehicles for RRT, ETF and other teams	4.42	9.88	5.20	6.50	5.95	13.30	7.00	8.75
3	Procurement of Thermal Drones, Camera Traps, Tranquilizing kits, drugs, Radio Collars, Trackers, Satellite Phones and other related equipment.	31.96	71.44	37.60	47.00	58.31	130.34	68.60	85.75
4	Capacity building for Forest Department staff, Line Department personnel, Panchayat-level stakeholders, and exchange visits	24.65	55.10	29.00	36.25	24.99	55.86	29.40	36.75
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.	32.64	72.96	38.40	48.00	30.26	67.64	35.60	44.50

D. Community/stakeholder's involved Conflict Management, Awareness and Education									
1	Formation of Community Level HEC management Committees like Jan Jagratha Samithis (JJSs), Vana Samrakshana Samithis (VSS) or other similar community driven initiatives.	2.72	6.08	3.20	4.00	2.72	6.08	3.20	4.00
2	Awareness Creation Activities for the Forest Fringe Villages affected by HEC	9.69	21.66	11.40	14.25	8.84	19.76	10.40	13.00
3	Holding of workshops, seminars, meetings of the stake holders	5.95	13.30	7.00	8.75	5.95	13.30	7.00	8.75
4	Division-Level Intelligence Networks, Informers	4.42	9.88	5.20	6.50	4.42	9.88	5.20	6.50
5	Awareness Materials, Mobile Application and Meetings	1.02	2.28	1.20	1.50	1.02	2.28	1.20	1.50
E. Research, Monitoring & Inter State Coordination									
1	Annual Population Estimation, Profiling of elephants and monitoring of elephant population	1.87	4.18	2.20	2.75	3.91	8.74	4.60	5.75
2	Detailed understanding of Habitat Fragmentation, Corridors and bottlenecks to elephant movement and Implication and strategies for HEC.	5.61	12.54	6.60	8.25	4.59	10.26	5.40	6.75
3	Annual Interstate Coordination Meetings at Ministerial-level, HoFF/ CWLW level, and regional-level meetings	2.89	6.46	3.40	4.25	3.06	6.84	3.60	4.50
4	Demographic Structure and Survival Trends of Wild Elephants and Implications for Long- term Conservation	2.89	6.46	3.40	4.25	2.89	6.46	3.40	4.25

5	Purchase of Work-stations, GIS software, colour printers, UPS, stationaries, internet charges, *etc.* , including AMC.	19.55	43.70	23.00	28.75	18.36	41.04	21.60	27.00
	Sub-total	**3409.18**	**7620.52**	**4010.80**	**5013.50**	**3368.04**	**7528.56**	**3962.40**	**4953.00**

S. No	Particulars	5th year				Total
A. HABITAT IMPROVEMENT & CONNECTIVITY		Andhra Pradesh	Karnataka	Kerala	Tamil Nadu	
1	To restore monoculture plantations (Acacia, Mangium, Eucalyptus, *etc.*) into natural forests through phased ecological restoration approach	184.11	411.54	216.60	270.75	**5461.00**
2	Eradication of Invasive Alien Species (Lantana, Senna, Eupatorium *etc.*)	111.69	249.66	131.40	164.25	**10621.00**
3	Fodder Availability through restoration of Hadlu's, development of grasslands	135.15	302.10	159.00	198.75	**4048.00**
4	Augmentation of Water resources, solar borewell and other related activities	96.56	215.84	113.60	142.00	**2636.00**
5	Special focus on investment for Corridor Acquisition, improvement & restoration	34.51	77.14	40.60	50.75	**3920.00**
B. HEC MITIGATION MEASURES						
1	Erection & Maintenance of Physical Barriers (EPT, Rail Barricade, Steel rope Fencing, Solar Tentacle Fence)	1326.34	2964.76	1560.40	1950.50	**41192.00**
2	Ex-gratia payment for loss of life, injury, damage to property, crop, *etc.*,	93.50	209.00	110.00	137.50	**2290.00**
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.*	142.97	319.58	168.20	210.25	**4160.00**
4	Early Warning System (Primarily technology driven systems like APP based monitoring, AI cameras, Virtual fencing, Bulk SMS and other such methods)	224.23	501.22	263.80	329.75	**7236.00**
5	State/Area Specific Conflict Management, Supporting activities and other related activities	154.53	345.42	181.80	227.25	**4842.00**
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	280.67	627.38	330.20	412.75	**8158.00**
2	Procurement of All Terrain Vehicles for RRT, ETF and other teams	7.82	17.48	9.20	11.50	**555.00**
3	Procurement of Thermal Drones, Camera Traps, Tranquilizing kits, drugs, Radio Collars, Trackers, Satellite Phones and other related equipment.	39.61	88.54	46.60	58.25	**1427.00**

4	Capacity building for Forest Department staff, Line Department personnel, Panchayat-level stakeholders, and exchange visits	17.85	39.90	21.00	26.25	**662.00**
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.	30.26	67.64	35.60	44.50	**1042.00**
	D. Community/stakeholder's involved Conflict Management, Awareness and Education					
1	Formation of Community Level HEC management Committees like Jan Jagratha Samithis (JJSs), Vana Samrakshana Samithis (VSS) or other similar community driven initiatives.	2.72	6.08	3.20	4.00	**77.00**
2	Awareness Creation Activities for the Forest Fringe Villages affected by HEC	8.84	19.76	10.40	13.00	**279.00**
3	Holding of workshops, seminars, meetings of the stake holders	5.95	13.30	7.00	8.75	**169.00**
4	Division-Level Intelligence Networks, Informers	4.42	9.88	5.20	6.50	**134.00**
5	Awareness Materials, Mobile Application and Meetings	1.02	2.28	1.20	1.50	**48.00**
	E. Research, Monitoring & Inter State Coordination					
1	Annual Population Estimation, Profiling of elephants and monitoring of elephant population	1.87	4.18	2.20	2.75	**79.00**
2	Detailed understanding of Habitat Fragmentation, Corridors and bottlenecks to elephant movement and Implication and strategies for HEC.	4.59	10.26	5.40	6.75	**156.00**
3	Annual Interstate Coordination Meetings at Ministerial-level, HoFF/ CWLW level, and regional-level meetings	3.06	6.84	3.60	4.50	**87.00**
4	Demographic Structure and Survival Trends of Wild Elephants and Implications for Long- term Conservation	2.89	6.46	3.40	4.25	**90.00**
5	Purchase of Work-stations, GIS software, colour printers, UPS, stationaries, internet charges, *etc.* , including AMC.	18.36	41.04	21.60	27.00	**618.00**
	Sub-total	**2933.52**	**6557.28**	**3451.20**	**4314.00**	**99987.00**

**** A composite conflict-risk index integrating elephant population size and conflict intensity (HEC per 100 elephants), adjusted by elephant distribution area, was used to comparatively rank the states. The factor values for the states were Andhra Pradesh (17%), Karnataka (38%), Kerala (20%), and Tamil Nadu (25%). The total financial outlay proposed is ₹99, 987. 00 lakhs, of which 50% (50, 000 lakhs) will be assisted by the Central Government. Of these 50, 000 lakhs, 48, 000 lakhs will be allocated to states and 2, 000 lakhs will be allocated to Elephant Cell , Wildlife Institute of India for Research, Monitoring and Evaluation.***

ANNEXURE-2

Regional Action Plan for Comprehensive Understanding & Management of HEC in South India		
S. 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, Mangium, 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 Hadlu's, development of grasslands	Restoring hadlus (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 state specific activities can be taken up to better manage human-elephant conflict.

C. Infrastructure Development & Capacity Building

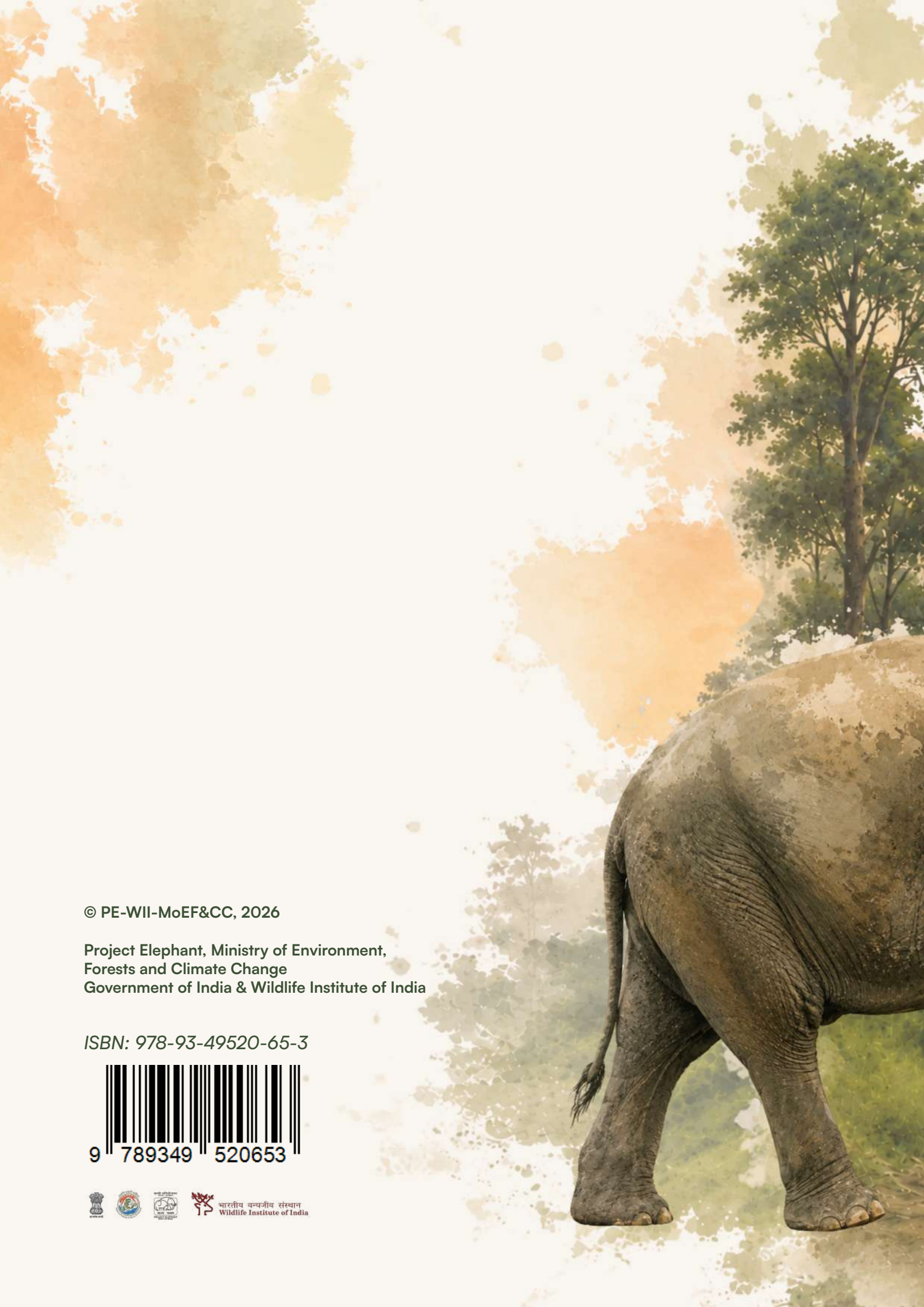
1	Establishment, Maintenance and Operation of Control Room, Tooling Room and other Facilities at Division level, State Level and Field Level in all elephant ranging divisions	Well-equipped tool rooms at Forest Range and Division levels are crucial for handling elephant-related emergencies and anti-poaching 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 Centre, Establishment of Soft Release centres, Training of Mahouts, Kavadi's and other staff.	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.

D. Community/stakeholder's involved Conflict Management, Awareness and Education

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 Implications for Long- term Conservation	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.
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.



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