भारतीय वन्यजीव संस्थान
Wildlife Institute of India

# HUMAN ELEPHANT CONFLICT IN THE STATE OF TAMIL NADU

## INDIA (2010 - 2025)

## TRENDS, CHALLENGES & INSIGHTS

**Final Project Report**
**TR-0041-2026**

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**Cover Photo:** ID 264732569 © Wirestock | Dreamstime.com

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**Citation:** Bilal Habib, Anukul Nath, Mukesh Chand, Anshuman Gogoi, Athira N. G., Kalpana Roy, Aju Mathew George, Vaibhav C. Mathur, Parag Nigam, Gobind Sagar Bhardwaj, Ramesh Kumar Pandey (2026): Human-elephant conflict in the State of Tamil Nadu, India (2010 - 2025): Trends, Challenges and Insights. Wildlife Institute of India & Project Elephant Division, Ministry of Environment, Forest and Climate Change, Government of India. Pp. 92. TR-0041-2026.

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## INDIA (2010 - 2025)

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Photo: Sangram Parida.

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# Acknowledgements

We express our sincere gratitude to the Project Elephant Division of the Ministry of Environment, Forest and Climate Change (MoEFCC) for their financial assistance and necessary approvals for this study. Our heartfelt thanks go to the Principal Chief Conservator of Forests (PCCF) and Chief Wildlife Warden, Government of Tamil Nadu, for granting the permits essential to our work. We are also indebted to the staff of the Tamil Nadu Forest Department for providing access to their official records, which were invaluable to our research.

Additionally, we appreciate the support from the staff of the Project Elephant Division at MoEFCC and the Elephant Cell at the Wildlife Institute of India. Lastly, we extend our thanks to the Director, Dean, and Registrar of the Wildlife Institute of India for their unwavering support throughout this research endeavour.

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Photo: A. Vinoth/WWF-India

# EXECUTIVE SUMMARY

Tamil Nadu supports important Asian elephant populations across the Western and Eastern Ghats. However, increasing overlap between elephant habitats, agricultural areas, plantations, settlements, roads, railways, and electrical infrastructure has intensified human–elephant conflict. This study examined elephant mortality and human casualties recorded across Tamil Nadu between **2010** and **2025** to identify temporal patterns, spatial hotspots, demographic trends, and the ecological and anthropogenic factors associated with mortality and conflict.

# The Landscape in Numbers

**3,136**
*Wild Elephants (SAIEE-2025)*

**16 YEARS**
*Study Duration (2010–2025)*

**28** Forest Divisions Covered

TOTAL AREA
*130,058 KM$^2$*

## *Priority Areas and Management Implications*

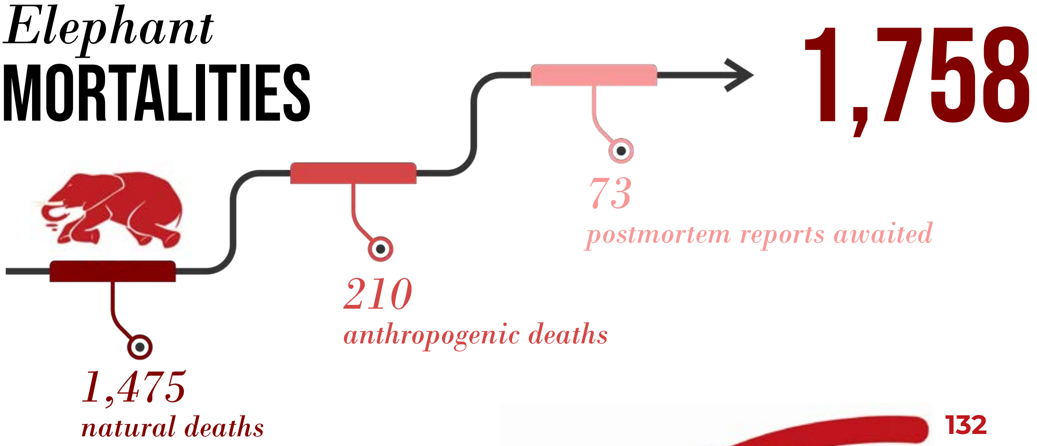
Elephant mortality and human casualties were concentrated in a limited number of landscapes, particularly Coimbatore, Sathyamangalam, Gudalur, Hosur, Anamalai, and Mudumalai. These areas should receive priority attention.

**The principals  recommended actions are:**

1. Deploy DAS-based alerts and improve elephant crossings along high-risk railway stretches.
2. Remove illegal electric fences and promote safe solar-powered fencing.
3. Protect elephant corridors and regulate development within movement routes.
4. Maintain barriers without blocking elephant corridors or safe exit routes.
5. Strengthen alert-to-action protocols and train rapid-response teams.
6. Enforce speed limits and install alerts at high-risk road crossings.
7. Use capture or translocation only as a last resort, with monitoring.
8. Ensure timely compensation and provide preventive support to affected households.

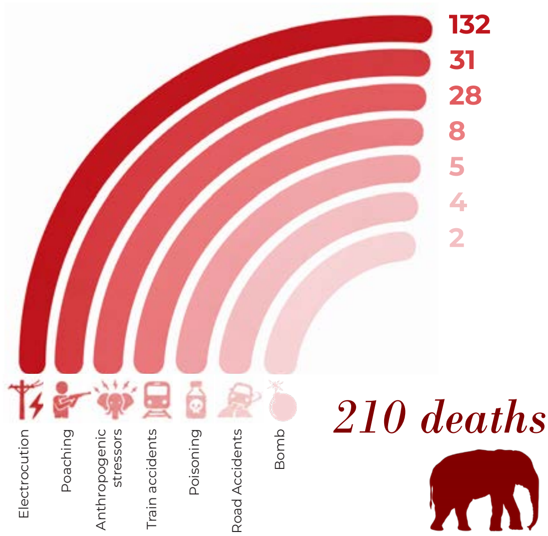
***Reducing conflict in Tamil Nadu requires coordinated action and targeted interventions in hotspot landscapes to improve human safety and reduce elephant deaths.***

*Elephant*
# MORTALITIES



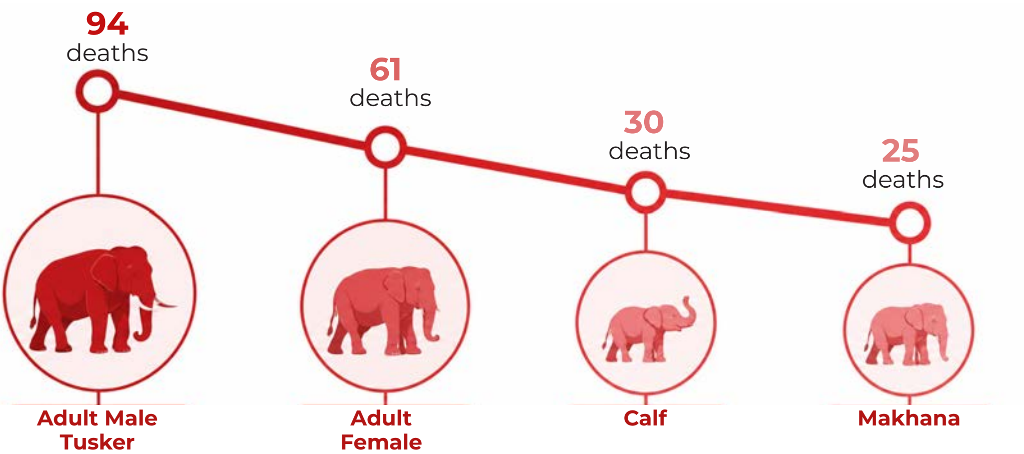

*Overall*
# DEATHS

Elephant mortality was highest in 2013, followed by 2024 and 2017. Seasonal mortality was highest during summer, followed by the monsoon, post-monsoon, and winter seasons.



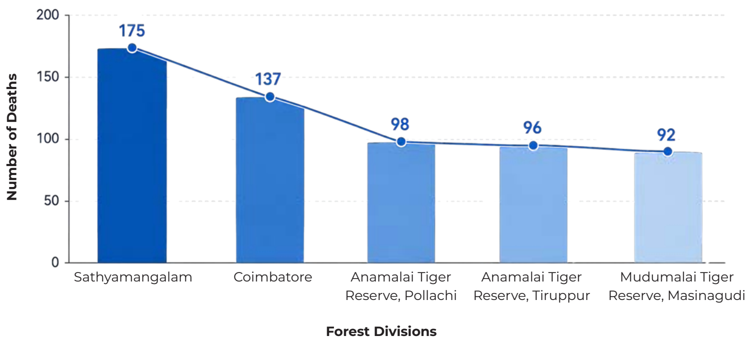

*Age-Class*
# DEMOGRAPHY

Adult males recorded the highest anthropogenic mortality.



# *Spatial Distribution of*
# OVERALL ELEPHANT MORTALITY

**These divisions were also identified as major elephant-mortality hotspots.**




*Elephant mortality was higher near built-up areas and reserves, but lower in larger habitat patches. Two leading models received most of the Akaike support.*

**Key Factors Associated with Elephant Mortality**

The best-supported models showed that anthropogenic elephant mortality was associated with:

- Distance to built-up areas
- Distance to elephant reserves
- Largest Patch Index
- Edge Density or Patch Density

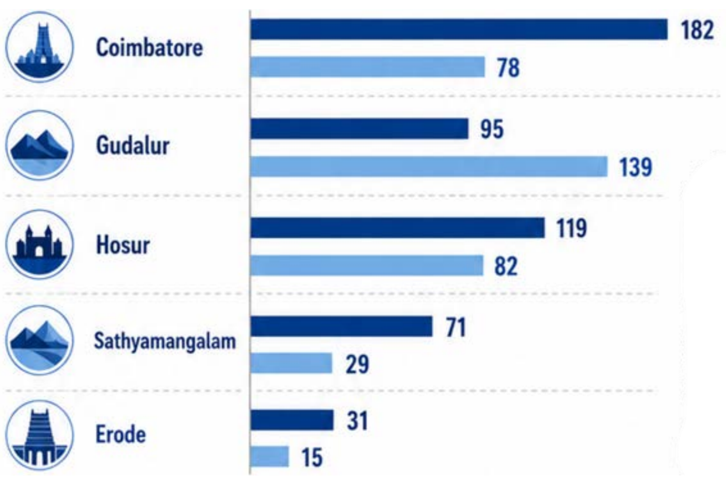
# *Human Fatalities*
# AND INJURIES

*720* *Human fatalities*

*484* *Human injuries*

Human fatalities peaked in 2019, when 61 deaths were recorded. Incidents occurred throughout the study period and across all seasons.

**The most affected divisions were:**




*Elephant mortality was higher near built-up areas and reserves, but lower in larger habitat patches. The two best-supported models received the highest Akaike support.*

*Largest Patch Index and Patch Density showed weak negative relationships with human-fatality occurrence.*

**Key Factors Associated with Human Casualties**

Human-fatality locations occurred closer to:

- Forest patches
- Built-up areas
- Roads
- Elephant reserve boundaries
- Tea estates

Human-fatality occurrence increased with increasing distance from:

- Croplands
- Railways
- Protected areas
- Mines

Photo: Anshuman Gogoi.

# INTRODUCTION

Human-elephant conflict (HEC) has emerged as a major conservation challenge in India, with far-reaching consequences for both wildlife conservation and human livelihoods (De Silva *et al.,* 2023; Roy *et al.,* 2025a, 2025b). Elephants, the world's largest megaherbivores, play a crucial role in shaping forest ecosystems through their foraging behaviour and extensive movement across landscapes (Prasad *et al.,* 2025). Historically, Asian elephants (Elephas maximus) moved across vast and contiguous forested regions, maintaining ecological connectivity and facilitating landscape-level processes (Sukumar, 2003). However, over the past few decades, these landscapes have undergone substantial transformation due to agricultural expansion, infrastructural development, and increasing human population pressures (Leimgruber *et al.,* 2003; Pandey *et al.,* 2024b).

As a result, elephant habitats have become fragmented and restricted, often surrounded by major infrastructures and human settlements. This has forced elephants to increasingly move through human-dominated areas in search of food, water, and safe passage. Such changes have led to a steady rise in human–elephant interactions, making conflict more frequent and widespread across the country (Gubbi, 2012; Pandey *et al.,* 2026a).

India holds over 60% of the world's wild Asian elephant population, the largest share among the 13 range countries (Williams *et al.,* 2020; Pandey *et al.,* 2024a; Qureshi *et al.,* 2025). Some elephant populations have remained stable or increased in recent decades (Haddad *et al.,* 2015; Pandey *et al.,* 2024a), but they remain increasingly vulnerable to conflict with people (Budd *et al.,* 2023). As elephants share space with approximately 1.46 billion people, traditional coexistence in India is being steadily undermined (Pandey *et al.,* 2022; De Silva *et al.,* 2023; Pandey *et al.,* 2024b; United Nations, 2024). Consequently, the impacts of HEC are substantial and persistent across India. These interactions result in the deaths of approximately 500 people and 100 elephants annually, while elephants also face mortality from electrocution, train collisions, poaching, and other anthropogenic pressures (Gulati *et al.,* 2021; MoEF&CC, 2010; Senthilkumar *et al.,* 2016; Das *et al.,* 2025; Pandey *et al.,* 2025a).

Previous research indicated that approximately 500,000 families are directly affected by crop damage in India annually, highlighting the severity of this conflict (MoEF&CC, 2010). Although HEC is often associated with crop loss, human injuries, and fatalities, its impacts extend beyond immediate physical damage (Anoop *et al.,* 2023). In many rural landscapes, repeated conflict leads to significant economic hardship, which in turn contributes to psychological stress and a gradual decline in tolerance towards wildlife (Shaffer *et al.,* 2019). Over time, such conditions can escalate conflict situations, and in several regions, repeated encounters have triggered retaliatory actions against elephants, contributing to non-natural elephant mortality (Gubbi *et al.,* 2014; Pandey *et al.,* 2026a).

In southern India, Tamil Nadu encompasses the biodiversity-rich landscapes of the Western and Eastern Ghats, which together support a large population of Asian elephants. Elephants are distributed across interconnected habitats, including Mudumalai, Annamalai, Sathyamangalam, Coimbatore, Gudalur, and the Hosur–Dharmapuri landscape (Vidya *et al.,* 2005; Baskaran *et al.,* 2007; Prasad *et al.,* 2025). These landscapes are highly heterogeneous, comprising a mosaic of protected areas, reserve forests, plantations, agricultural lands, and human settlements (Babu *et al.,* 2012). The close proximity of elephant habitats to agricultural and settled areas creates extensive spatial overlap between elephants and people, increasing both the intensity and spatial extent of human–elephant conflict in the state.

Over time, the structure of these landscapes has changed considerably. The expansion of monoculture plantations, including tea, coffee, eucalyptus, and wattle, together with the development of road and railway networks, irrigation systems, and the conversion of forest land for agriculture, has fragmented habitats and disrupted traditional elephant movement corridors (Baskaran, 2013; Daniels & Venkatesan, 2008; Menon *et al.,* 2017; PE-MoEFCC-WII, 2025; Roy and Sukumar, 2017). Consequently, elephants are increasingly moving through agricultural fields, plantations, and areas near human settlements in search of food, water, and safe passage. Such movements may become particularly frequent during the dry season, when natural resources are limited (Anoop *et al.,* 2023; Das *et al.,* 2025).

These forest–village interfaces create high-risk environments where ecological changes intersect with everyday human activities. Rural communities within elephant-ranging landscapes depend heavily on agriculture, livestock rearing, forest produce, and plantation labour. Cultivated crops such as paddy, sugarcane, banana, millet, and tapioca may also provide attractive forage for elephants, particularly during harvesting periods. Encounters may become more frequent during dry months, when elephants move towards irrigated agricultural fields, village tanks, and canal systems in search of food and water, as documented in regions such as Coimbatore and Mudumalai (Senthilkumar *et al.,* 2016; Ramkumar *et al.,* 2014). Many conflict incidents are also associated with routine livelihood activities, including crop guarding, fuelwood collection, and movement near forest edges, particularly during early morning and late evening hours (Shaffer *et al.,* 2019; Senthilkumar *et al.,* 2016). In response to repeated encounters, communities adopt various mitigation measures, including electric fencing, trenches, and active guarding. However, when these measures are poorly designed or inadequately maintained, they may fail to reduce conflict and, in some cases, contribute to elephant injuries and mortality, particularly through electrocution and entrapment (Prasad *et al.,* 2025; PE-MoEFCC-WII, 2025).

The most recent DNA-based Synchronous All India Population Estimation of Elephants (SAIEE) estimated India's elephant population at 22,514 individuals (18,255–26,645), providing the most robust national estimate to date (Qureshi *et al.,* 2025). State-wide elephant population estimates for Tamil Nadu increased from 3,737 in 2002 to 3,867 in 2007 and 4,015 in 2012, before declining to 2,761 in 2017. Subsequent synchronised population estimations recorded 2,961 elephants in 2023, while the latest synchronised and DNA-based assessments estimated 3,063 elephants in 2024 and 3,136 elephants in 2025, respectively (Tamil Nadu Forest Department, 2024; Qureshi *et al.,* 2025). These changes emphasise the importance of long-term monitoring to understand the factors influencing elephant populations in the State.

Previous studies across Tamil Nadu indicate that elephant mortality and human fatalities are influenced by a combination of ecological, landscape-level, and socio-economic factors. In regions such as Coimbatore and Annamalai, electrocution, disease, and accidental injuries have been identified as major causes of elephant mortality (Ramkumar *et al.,* 2014; Deivanayaki *et al.,* 2019). In contrast, fragmented landscapes such as Gudalur and Theni experience persistent conflict because of narrow forest patches and intensive agricultural interfaces (Jayaraman & Balasundaram, 2017; Baskaran *et al.,* 2006). These regional differences indicate that the causes and consequences of fatal encounters vary across the state according to landscape structure, human activities, and local resource availability.

Despite several landscape-specific studies, there remains a lack of a comprehensive, long-term assessment integrating patterns of elephant mortality and human fatalities across Tamil Nadu. Most existing studies are limited to specific regions or shorter time periods, restricting a broader understanding of temporal trends, spatial hotspots, and the combined influence of ecological and anthropogenic drivers. Given the dynamic nature of HEC, analysing long-term datasets is essential for identifying emerging patterns, understanding the role of land-use change, and evaluating the effectiveness of mitigation strategies (Fernando *et al.,* 2008; Leimgruber *et al.,* 2003).

To address these gaps, the present study analyses elephant mortality and human fatality records compiled from the Tamil Nadu Forest Department for the period 2010–2025. By integrating temporal trends, spatial distributions, elephant demographic characteristics, and landscape variables, the study seeks to identify high-risk areas and factors associated with human and elephant deaths. Specifically, the study examines:

1. How have the causes and spatial distribution of human fatalities and elephant mortality changed across Tamil Nadu between 2010 and 2025?

2. Are the age, sex, and other demographic characteristics of deceased elephants associated with specific causes of mortality, particularly anthropogenic causes?

3. Are changes in land use and land cover between 2010 and 2025 associated with the spatial and temporal patterns of human and elephant mortality?

Together, these analyses provide evidence to identify high-risk areas and inform targeted management strategies for reducing human and elephant deaths across Tamil Nadu.

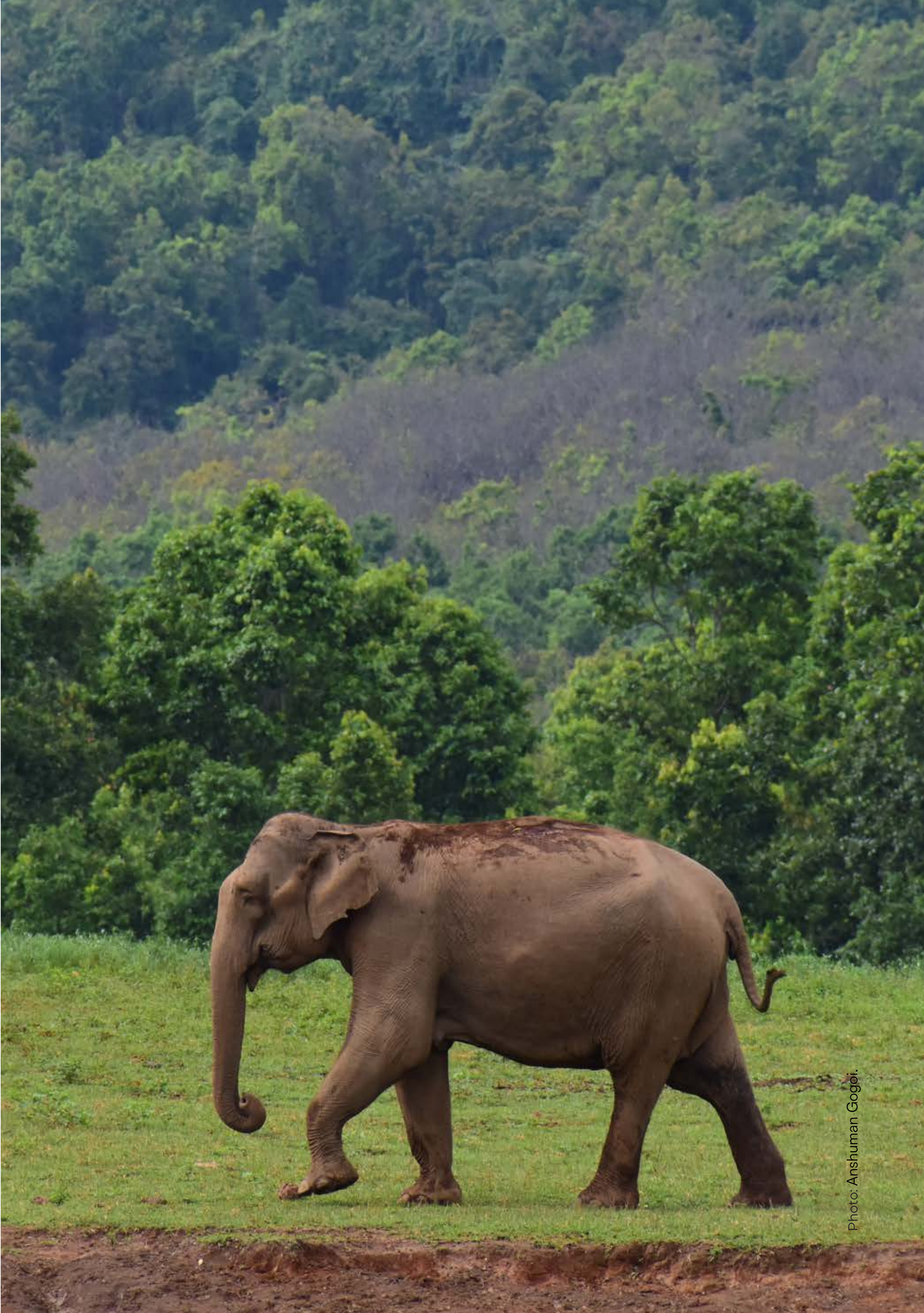


Photo: Anshuman Gogoi.

Photo: Anil Sharma.

# STUDY AREA

Tamil Nadu is located in the southern part of India, bordered by Kerala to the west, Karnataka to the northwest, Andhra Pradesh to the north, and the Bay of Bengal along its eastern coastline. Geographically, the state extends roughly between latitudes 8°05'-13°35' N and longitudes 76°15'-80°20' E, covering an area of 130,058 km$^2$ (Routray *et al.,* 2025). The landscape comprises the high-elevation Western Ghats, the fragmented hill ranges of the Eastern Ghats, river basins, coastal plains, dry forest tracts, and intensively cultivated agricultural areas. Elevation ranges from near sea level along the Coromandel Coast to more than 2,600 m in the Nilgiris and Palani Hills. Tamil Nadu experiences a predominantly tropical climate, with rainfall influenced by both the southwest and northeast monsoons. Annual rainfall varies considerably across the state, ranging from approximately 700–1,200 mm in the eastern plains to 2,000–5,000 mm in the Nilgiris and Anamalai Hills (Sukumar, 1989; Jeganathan *et al.,* 2019).

The state contains a broad spectrum of vegetation types, ranging from tropical wet evergreen forests, semi-evergreen forests, moist deciduous forests, dry deciduous forests, thorn forests, and shola-grassland complexes to human-modified habitats such as tea, coffee, cardamom, eucalyptus, and wattle plantations. These habitats collectively support rich biodiversity and form important ecological linkages across the Western and Eastern Ghats (Vidya *et al.,* 2005). Evergreen forests are largely confined to the higher elevations of the Annamalai and Nilgiris regions and are characterized by dense canopy cover and species such as *Mesua*, *Palaquium*, and *Cullenia*. In contrast, the dry deciduous and thorn forests of eastern Tamil Nadu are dominated by species like *Tectona grandis*, *Terminalia*, *Albizia*, and *Acacia* (Daniels & Venkatesan, 2008).

Elephant distribution within Tamil Nadu is concentrated across the Nilgiris, Mudumalai, Sathyamangalam, Coimbatore, Gudalur, Anamalai, Hosur–Dharmapuri, and Theni landscapes. The northwestern part of the state, particularly the Nilgiris, Mudumalai, and Sathyamangalam regions, is connected with adjoining elephant habitats in Kerala and Karnataka. These regions contain a combination of evergreen, moist deciduous, dry deciduous, riverine, and grassland habitats that provide forage, water, shelter, and movement space for elephants (Vidya *et al.,* 2005; Baskaran, 2013).

The protected-area network within Tamil Nadu includes Mudumalai Tiger Reserve, Sathyamangalam Tiger Reserve, Anamalai Tiger Reserve, and Kalakkad–Mundanthurai Tiger Reserve, together with numerous wildlife sanctuaries and reserve forests. Elephant habitats also extend through reserve forests and other forest divisions outside these major protected areas. For example, the Hosur–Dharmapuri landscape consists of dry deciduous forests, hillocks, reserve forests, cultivated areas, and human settlements (Babu *et al.,* 2012; Daniels & Venkatesan, 2008).

Land cover varies substantially among the elephant-ranging regions of the state. Relatively large forest blocks occur within parts of Mudumalai, Sathyamangalam, and Anamalai, whereas areas such as Gudalur–O'Valley, Valparai, and Theni contain extensive tea, coffee, cardamom, eucalyptus, and wattle plantations. These plantation landscapes occur alongside remnant forests, agricultural areas, settlements, roads, and water bodies, creating a highly heterogeneous land-cover mosaic (Baskaran *et al.,* 2006; Jayaraman & Balasundaram, 2017).

Major rivers within and adjoining elephant landscapes include the Bhavani, Moyar, Cauvery, Chaliyar, and Amaravathi, together with their tributaries. These rivers, along with reservoirs, streams, village tanks, and irrigation canals, contribute to the spatial and seasonal distribution of water. Changes in water and vegetation availability between the monsoon and dry seasons influence the seasonal use of different habitat types by elephants (Sukumar, 1989; Jeganathan *et al.,* 2019). Seasonal variation in elephant distribution and habitat use has also been documented in regions such as Coimbatore and Mudumalai (Senthilkumar *et al.,* 2016; Ramkumar *et al.,* 2014).

The considerable variation in climate, topography, vegetation, protected-area coverage, water availability, land cover, and human land use across Tamil Nadu provides an appropriate geographical setting for examining spatial and temporal patterns of elephant mortality and human fatalities recorded between 2010 and 2025.


Photo: Sibasish Shahoo.

# METHODS

### *Collection of Elephant Mortality and Human Fatality Records*

Records of elephant mortality and human fatalities were compiled from 28 forest divisions across Tamil Nadu for the period 2010–2025. The elephant mortality dataset included deaths attributed to both natural and anthropogenic causes, whereas the human fatality dataset included deaths resulting from encounters with wild elephants. Information associated with each incident included the forest division, village or place of occurrence, date of incident, sex of the deceased person or elephant, and contextual remarks recorded by field staff. Additional information, including elephant age and cause of mortality, was included where available.

All records were obtained directly from the Tamil Nadu Forest Department. The entries were reviewed and cross-verified by the respective divisional authorities to improve their completeness and accuracy. Only officially documented and field-confirmed incidents were retained in the final dataset for temporal, spatial, demographic and landscape-level analyses.

Although the study initially aimed to compile records from 2000 to 2025, data from the earlier years were incomplete or unavailable across several forest divisions. Therefore, only complete and verifiable records covering the period 2010–2025 were retained for analysis. This restriction ensured greater consistency and comparability across the elephant mortality and human fatality datasets.

### *Categorization of Datasets*

Following verification, the elephant mortality and human casualty records were organised and standardised for analysis. The final database contained 1,758 elephant mortality records, 720 human fatality records and 484 human injury records from 2010 to 2025. As the present study focuses on elephant mortality and human fatalities, the injury records for the main spatial and statistical analyses.

Elephant mortality records were categorised into natural and human-induced causes following the classification system used by the Tamil Nadu Forest Department. The detailed categorisation of elephant mortality causes is presented in Table 1.1. For each elephant mortality incident, information was compiled on: (1) cause of death, (2) year and month of occurrence, (3) season of occurrence, (4) forest division, and (5) age, sex and other available demographic characteristics of the deceased elephant.

Natural deaths included mortality attributed to old age, disease, heart failure, malnutrition, neonatal mortality and intra-specific fighting. Accidental deaths included incidents associated with natural events or environmental conditions, such as drowning in rivers, lightning strikes, falls from cliffs or steep terrain, and entrapment in natural obstacles. Human-induced mortality included deaths associated with anthropogenic activities and infrastructure, as classified in the departmental records. Human-related records were categorised separately into human fatalities and human injuries caused by encounters with wild elephants.

The timing of each incident was classified by year, month and season. Seasonal categories included monsoon, post-monsoon, summer and winter, and the same month-based classification was applied consistently across all study years.

The demographic characteristics of deceased elephants were examined in relation to the recorded causes of mortality. Based on the categories available in the Tamil Nadu Forest Department records, elephants were grouped as adult females, adult tuskers, makhnas, calves and individuals of unknown demographic status. Makhnas represented adult males without visible tusks and were treated separately from adult tuskers (Arivazhagan and Sukumar, 2008).

The number and proportion of deaths within each demographic category were summarised separately for natural and anthropogenic mortality causes. Cross-tabulations were prepared to examine how natural deaths, illness, territorial fights, electrocution, poaching, anthropogenic stressors, train accidents, poisoning and road accidents were distributed among the demographic groups.

Pearson's chi-square tests were performed in R version 4.3.1 to determine whether the distribution of elephant deaths differed significantly among demographic categories. A separate chi-square test was used to examine whether elephants affected by anthropogenic mortality were distributed equally among adult females, adult tuskers, makhnas, calves and individuals of unknown demographic status. Records with missing or unconfirmed demographic information were retained as an unknown category in the descriptive summaries.

***Table 1.1:*** *Flowchart Illustrating the Categorization of Elephant Mortality Factors in Tamil Nadu.*

| Categories | Sub-Categories | Causes of Death |
|---|---|---|
| Natural | Natural deaths | Old age, stillbirth, neonatal mortality, malnutrition, dehydration, heat stress, heart failure |
| | Illness | Anthrax, acute fascioliasis, endoparasitism, and other diseases |
| | Territorial fights | Deaths caused by intraspecific fighting |
| Anthropogenic | Electrocution | Illegal electric fences, low-hanging power lines, and electrified infrastructure |
| | Poaching | Ivory removal, snares, traps, and other illegal killing |
| | Anthropogenic stressors | Entrapment in wells, open tanks, trenches, drains, and canals |
| | Train accidents | Collisions with trains |
| | Poisoning | Deliberate or retaliatory poisoning |
| | Road accidents | Collisions with vehicles |
| | Accidental | Treatment, Tranquilization, Translocation |
| Undetermined | Postmortem awaited | Final cause of death not yet confirmed |

## *Land Use and Land Cover change and factors influencing Elephant Mortality*

Land use and land cover analysis was conducted across Tamil Nadu for the period 2010–2025 to examine landscape transformations associated with the spatial and temporal patterns of elephant mortality and human fatalities. Satellite-based LULC maps were generated at five-year intervals for 2010, 2015, 2020 and 2025.

Google Earth Engine was used for image preprocessing, classification and multi-temporal comparison. ArcGIS Pro was used to clip the spatial datasets to the Tamil Nadu study boundary, compile the raster datasets, assess landscape fragmentation, calculate distances to settlements, plantations, water bodies and roads, and prepare the final maps.

Landsat imagery was classified using a Random Forest classifier from the "ee. Classifier.smileRandomForest" library (Bhungeni *et al.,* 2024), with six spectral bands: blue, green, red, near-infrared and two shortwave infrared bands. The spatial resolution was maintained at 30 m, and data were projected to UTM Zones 43N and 44N for Tamil Nadu.

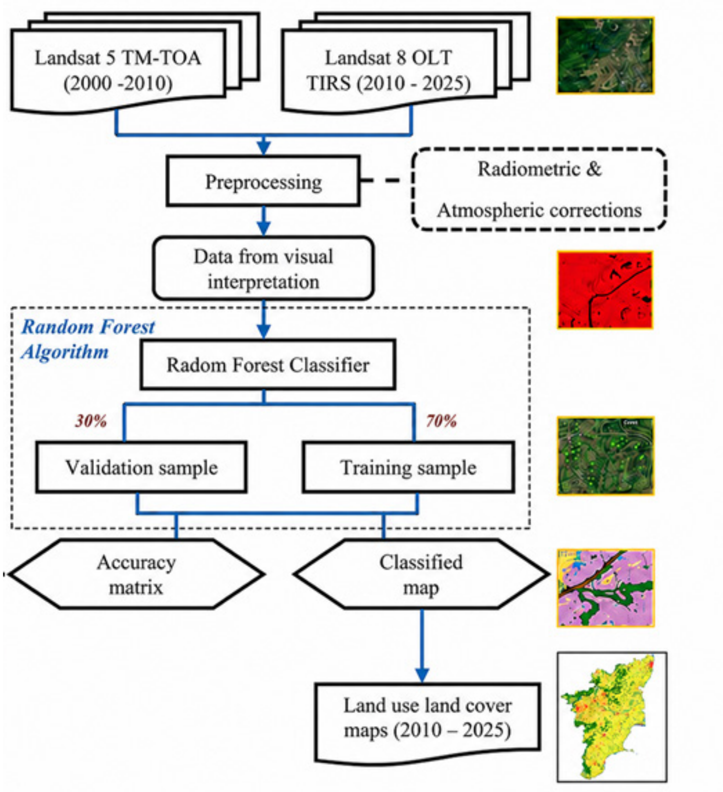



***Figure 1.1:*** *Land use and land change pattern methodology flowchart for the state Tamil Nadu. Six major LULC categories were mapped: (1) forest and grassland, (2) water bodies, (3) barren and open land, (4) agriculture, (5) human settlements, and (6) plantations, including tea, coffee, eucalyptus, wattle and cardamom.*

The classified maps for 2010, 2015, 2020 and 2025 were compared to quantify changes in habitat extent, landscape fragmentation and the expansion of human-modified land uses. Particular attention was given to changes in agriculture, settlements and plantations because these land-cover types were relevant to the spatial assessment of elephant mortality and human fatalities. The multi-temporal comparison presented in Figure 1.1 was used to examine the spatial correspondence between LULC transitions and recorded patterns of elephant mortality and human fatalities.

LULC layers for Tamil Nadu for 2010 and 2025 were used to calculate the fragmentation metrics Largest Patch Index (LPI) and Edge Density (ED). A 7 km × 7 km fishnet grid was overlaid on the fragmentation layers, and LPI and ED values were reclassified into five classes: Very Low, Low, Medium, High, and Very High. For LPI, higher classes indicate larger and more continuous forest patches, whereas lower classes indicate greater fragmentation. Conversely, higher ED classes represent greater forest fragmentation due to increased edge density, while lower classes indicate more compact and less fragmented forest landscapes. The proportion of each fragmentation class within every 7 km × 7 km grid was calculated and summarized as percentages to compare changes in forest fragmentation between 2010 and 2025 and to assess changes in forest landscape dynamics across Tamil Nadu.

### *Spatial Distribution of Elephant Mortality*

Elephant mortality incidents in Tamil Nadu were georeferenced using GPS coordinates and systematically mapped to examine their spatial distribution across the state. A heat map was generated using R version 4.3.1 to visualise spatial variation in elephant mortality intensity.

Kernel Density Estimation was applied to identify areas where elephant deaths were disproportionately concentrated (Poledník *et al.,* 2023). Administrative boundaries were overlaid to contextualise the identified mortality concentrations across forest divisions, ranges and village landscapes.

### *Landscape Fragmentation Analysis*

Landscape fragmentation in Tamil Nadu was assessed using FRAGSTATS version 4.2, with LULC data reclassified into two primary categories: forest and non-forest. Key landscape metrics, including Patch Density, Edge Density and Largest Patch Index, were computed to quantify forest structure across the three temporal intervals: 2010–2015, 2015–2020 and 2020–2025.

These metrics were used to examine the degree of habitat fragmentation, changes in forest-patch configuration and implications for habitat connectivity across Tamil Nadu's elephant ranges. Spatially explicit maps of Patch Density, Edge Density and Largest Patch Index were generated to visualise fragmentation gradients and assess their potential influence on elephant mortality patterns across forest divisions.

***Table 1.1:*** *Flowchart Illustrating the Categorization of Elephant Mortality Factors in Tamil Nadu.*

| Landscape Metric | Description | Formula (Copy-Ready) |
|---|---|---|
| Patch Density (PD) | Number of patches per unit area | PD = (N / A) × 10,000 × 100 |
| Edge Density (ED) | Total edge length per unit area | ED = (Σ $e_{ik}$ / A) × 10000 |
| Largest Patch Index (LPI) | Percentage of total landscape area comprised by the largest patch | LPI = (max($a_{ij}$) / A) × 100 |

Where: N = number of patches, A = total landscape area ($m^2$), $\Sigma\, e_{ik}$ = sum of all edge lengths, $\max(a_{ij})$ = area of the largest patch, i, j, k = patch/edge identifiers, Units: PD (patches/100 ha), ED (m/ha), LPI (%).

## *Predictors of Elephant Mortality*

A generalized linear model with a binomial distribution was implemented using R version 4.3.1 to identify environmental and anthropogenic factors influencing elephant mortality in Tamil Nadu. Spatial attributes of mortality events were integrated with GIS-based environmental layers representing key landscape variables across the state.

Mortality incidents were coded as 1, whereas randomly generated pseudo-absence points were coded as 0. The pseudo-absence points were generated across non-mortality landscape units to allow comparison between mortality locations and available background conditions.

The explanatory variables included distance to forests, croplands, built-up areas, major and minor roads, water sources, railways, protected areas, elephant reserves and plantation zones such as tea or coffee estates (Table 1.3). These predictors were selected based on their documented influence on elephant movement, habitat selection and conflict occurrence in the Western and Eastern Ghats landscapes. Variance Inflation Factors were calculated to assess multicollinearity among predictors. Highly correlated variables with VIF values greater than 3 were removed to ensure model stability. A set of competing models was generated and evaluated using the Akaike Information Criterion. Model ranking and selection followed Burnham and Anderson's (2002) information-theoretic approach, with models within $\Delta AIC \leq 2$ considered equally plausible. Where more than one model received substantial support, the final predictive model was obtained by averaging the top-ranked models.

Cross-validation techniques were used to evaluate predictive accuracy and reduce overfitting. Spatial predictions from the final model were used to map high-risk areas and identify landscape features associated with elephant mortality hotspots.

***Table 1.3:*** *Priori hypotheses for environmental and anthropogenic factors influencing elephant mortality and human–elephant conflict in Tamil Nadu.*

| Feature | Variable | Description and source | A priori hypotheses for elephant mortality | A priori hypotheses for Human casulities |
|---|---|---|---|---|
| Land cover | Distance from built-up areas (db) | Built-up areas were extracted from the classified land-cover data. Distance from each observation location was calculated using the Near Table tool in ArcGIS Pro 3.0.0. | Higher elephant mortality near settlements due to increased human–elephant interactions. | Higher proximity may reduce HEC due to increased human activity and habitat loss. |
| Land cover | Distance from cropland (dc) | Cropland was extracted from the classified land-cover data. Distance from each observation location was calculated using the Near Table tool in ArcGIS Pro 3.0.0. | Proximity to cropland increases mortality risk due to electrocution and retaliation. | Closer proximity increases HEC due to crop damage. |
| Land cover | Distance from forest (df) | Forest was extracted from the classified land-cover data. Distance from each observation location was calculated using the Near Table tool in ArcGIS Pro 3.0.0. | Mortality risk decreases with distance from forests, which provide essential resources. | Closer proximity increases HEC as elephants move into human settlements. |
| Land cover | Distance from waterbodies (dw) | Waterbodies were extracted from the classified land-cover data. Distance from each observation location was calculated using the Near Table tool in ArcGIS Pro 3.0.0. | Proximity to waterbodies lowers mortality risk by reducing movement into human areas. | Closer proximity increases HEC, especially in dry seasons. |

| | | | | |
|---|---|---|---|---|
| Land cover | Distance from tea gardens (dtea) | Tea gardens were extracted from the Roy *et al.* (2016) land-use and land-cover classification. Distance was calculated using the Near Table tool in ArcGIS Pro 3.0.0. | Mortality risk increases near tea gardens due to disrupted corridors and human encounters. | Closer proximity may increase HEC due to habitat loss, pesticides and human activity. |
| Anthropogenic | Distance from mines and quarries (dmn) | Mines and quarries were digitised using Google Earth Pro. Distance from each observation location was calculated using the Near Table tool in ArcGIS Pro 3.0.0. | Not included in the elephant mortality analysis. | Mining activities significantly influence the occurrence of HEC by disrupting elephant habitats; areas close to mines may show a higher likelihood of conflict. |
| Anthropogenic | Distance from roads (dr) | Road-network shapefiles were sourced from OpenStreetMap. Distance from each observation location was calculated using the Near Table tool in ArcGIS Pro 3.0.0. | Higher mortality risk due to vehicle collisions and habitat disturbance. | Closer proximity increases HEC due to habitat fragmentation and human activity. |
| Anthropogenic | Distance from railways (drail) | Railway-network shapefiles were sourced from OpenStreetMap. Distance from each observation location was calculated using the Near Table tool in ArcGIS Pro 3.0.0. | Close proximity increases mortality risk from train collisions and habitat fragmentation. | Not included in the HEC analysis. |
| Protected areas | Distance from protected areas (dpa) | Distance from each observation location to the nearest protected-area boundary was calculated using shapefiles provided by the Elephant Cell, Wildlife Institute of India, and the Near Table tool in ArcGIS Pro 3.0.0. | Lower mortality risk near protected areas due to reduced human pressure. | Lower mortality risk near protected areas due to reduced human pressure. |

| | | | | |
|---|---|---|---|---|
| Protected areas | Distance from elephant reserves (der) | Distance from each observation location to the nearest elephant-reserve boundary was calculated using the Near Table tool in ArcGIS Pro 3.0.0. | Lower mortality risk near reserves due to sufficient resources. | Lower mortality risk near elephant reserves due to resource availability. |
| Landscape metrics | Patch Density (pd) | Patch Density was calculated from the classified land-cover data using the Patch Analyst tool in ArcGIS. | Higher patch density increases fragmentation and human–elephant conflicts. | Higher patch density, indicating more fragmented landscapes, may lead to increased conflict due to disrupted habitats and movement corridors for elephants. |
| Landscape metrics | Edge Density (ed) | Edge Density was calculated from the classified land-cover data using the Patch Analyst tool in ArcGIS, focusing on boundaries between different land-cover classes. | Higher edge density increases mortality risk due to habitat fragmentation and human interaction. | Higher edge density may increase HEC by creating more interfaces between habitats and human settlements, where elephants are more likely to cross paths with humans. |
| Landscape metrics | Largest Patch Index (lpi) | Largest Patch Index was calculated from the classified land-cover data using the Patch Analyst tool in ArcGIS. It measures the relative size of the largest continuous land-cover patch. | Elephants near large habitat patches have lower mortality risk due to resource availability. | A larger Largest Patch Index may indicate a more stable habitat for elephants, potentially reducing HEC; however, fragmentation of the largest patches could lead to more conflicts. |

### *Categorizing Villages Based on Intensity of Elephant Mortalities*

Villages in Tamil Nadu were categorised into four mortality-intensity classes based on the total number of elephant mortality incidents recorded within or near their administrative boundaries. The categories included high-incident villages with more than 10 elephant mortalities, medium-incident villages with 5–10 mortalities, low-incident villages with 0–5 mortalities, and no-incident villages. This classification was used to investigate potential relationships between mortality intensity and key landscape variables, including forest cover, crop cover, built-up areas and plantation or mining areas.

A Kruskal–Wallis rank-sum test was used to determine whether statistically significant differences occurred in the median values of landscape variables among the four village categories. This non-parametric method provided a robust comparison across multiple independent groups when normality assumptions were not satisfied. A Dunn test was subsequently conducted as a post-hoc analysis to identify specific pairs of village categories, such as high versus low and medium versus no-incident, that differed significantly in their landscape characteristics. Appropriate corrections for multiple comparisons were applied.

Village boundary data were obtained from ArcGIS Online using the Indian Administrative Layer 2024 shapefile. These boundaries were used to extract landscape metrics and link them with mortality-intensity categories for statistical analysis.

### *Land Use and Land Cover, Spatial Distribution of Human mortality and injuries, and Village level of HEC*

Between 2010 and 2025, Tamil Nadu recorded 1,204 human-elephant conflict incidents involving human casualties, resulting in 720 fatalities and 484 injuries. For descriptive comparisons, human fatality records were grouped into three reporting periods: 2010–2015, 2016–2020 and 2021–2025. The first reporting period covered six years, whereas the remaining periods each covered five years.

Human fatality records were categorised according to sex, year, season, forest division and whether the incident occurred inside or outside a protected area. Kernel Density Estimation was performed in ArcGIS Pro to visualise the spatial concentration of human fatalities across Tamil Nadu. The density surfaces were generated using an output cell size of 200 m. Forest-division and village boundaries were overlaid to contextualise the identified concentrations within the major elephant-ranging landscapes of the state. Village-level patterns were assessed by assigning each human fatality to the corresponding village administrative boundary. Villages were categorised according to the total number of recorded human fatalities during 2010–2025 as high-incident villages with more than 10 fatalities, medium-incident villages with 5–10 fatalities, low-incident villages with 0–5 fatalities, and no-incident villages with no recorded fatalities. The Indian Administrative Layer 2024 obtained from ArcGIS Online was used for this analysis.

The LULC maps prepared for 2010, 2015, 2020 and 2025 and the Patch Density, Edge Density and Largest Patch Index metrics described in Sections 1.3.3 and 1.3.5 were used to characterise landscape conditions associated with human fatality locations. A 7-km moving-window analysis was applied to generate continuous spatial surfaces of the fragmentation metrics and represent landscape structure surrounding human fatality locations. The moving-window distance was selected with reference to reported elephant movement patterns (Hassan *et al.,* 2023). The resulting surfaces were used to examine local and broader landscape conditions associated with the spatial distribution of human fatalities.

### *Factors Associated with Human Fatality Occurrence*

A binomial Generalized Linear Model was used to examine environmental and anthropogenic factors associated with the spatial occurrence of human death and injuries (partial and permanent) caused by wild elephants. Human casualty incidents (deaths and injuries) locations were coded as 1, whereas randomly generated background points were coded as 0.

The background points were generated within relevant elephant-ranging landscapes rather than across the entire state and were located at least 1 km from recorded fatality locations. These points represented available background landscape conditions and were not interpreted as confirmed locations where conflict did not occur.

Predictor variables included distance to forests, croplands, built-up areas, major and minor roads, waterways, railways, protected areas, elephant reserves, mines and plantation areas. Patch Density, Edge Density and Largest Patch Index were included to represent forest fragmentation and landscape configuration. The a priori hypotheses associated with these predictor variables are presented in Table 1.3.

Spatial variables were derived from the corresponding GIS and satellite-based datasets. The shortest distance between each fatality or background point and the nearest landscape feature was calculated using the Generate Near Table tool in ArcGIS Pro. Each fatality record was linked to the LULC and fragmentation layer representing the corresponding year or the nearest available LULC time point. Continuous predictor variables were standardised before model fitting. Multicollinearity among predictors was assessed, and variables showing unacceptable collinearity were excluded before constructing the candidate models. Generalized Linear Models were fitted in R, and candidate models were developed from predefined hypotheses concerning the environmental and anthropogenic factors associated with human fatality occurrence. Candidate models were ranked using the Akaike Information Criterion following the information-theoretic approach of Burnham and Anderson (2011). Models within $\Delta AIC \leq 2$ of the highest-ranked models were considered to have comparable support. Where more than one model received substantial support, model averaging was performed using the MuMIn package in R. Model convergence and parameter estimates were examined before interpretation.

Spatial cross-validation was used to assess predictive performance while reducing the influence of spatial dependence between nearby observations. Predictions from the supported model or model-averaged estimates were used to map relative spatial suitability for human fatality occurrence and identify landscape characteristics associated with recorded fatality locations.

# RESULTS

### *Forest Fragmentation Pattern*

The Temporal distribution of landscape fragmentation metrics revealed gradual changes in forest structure between 2010 and 2025. The largest patch index remained dominated by the very high class in both years, indicating that large forest patches continued to occupy a substantial proportion of the landscape. However, the proportion of the very high class declined slightly, while the very low, low, and medium classes increased, suggesting a gradual reduction in the dominance of large, contiguous forest patches. Similarly, the edge density analysis showed a decrease in the very low class and increases in the low, medium, and very high classes between 2010 and 2025. This pattern indicates


the formation of additional forest edges and increasing habitat fragmentation. Overall, the combined LPI and ED results suggest a gradual decline in forest connectivity and an increase in landscape fragmentation, which may influence elephant movement patterns and the spatial distribution of HEC in Tamil Nadu.

The fragmentation analysis showed that most forested areas were composed of relatively large and contiguous patches, whereas higher fragmentation was concentrated mainly along forest margins. Areas with high patch density and edge density, together with low largest patch index values, were characterised by smaller, more numerous forest patches and lower dominance of the largest forest patch. These fragmented areas were primarily associated with landscapes containing agriculture, settlements and transportation infrastructure.

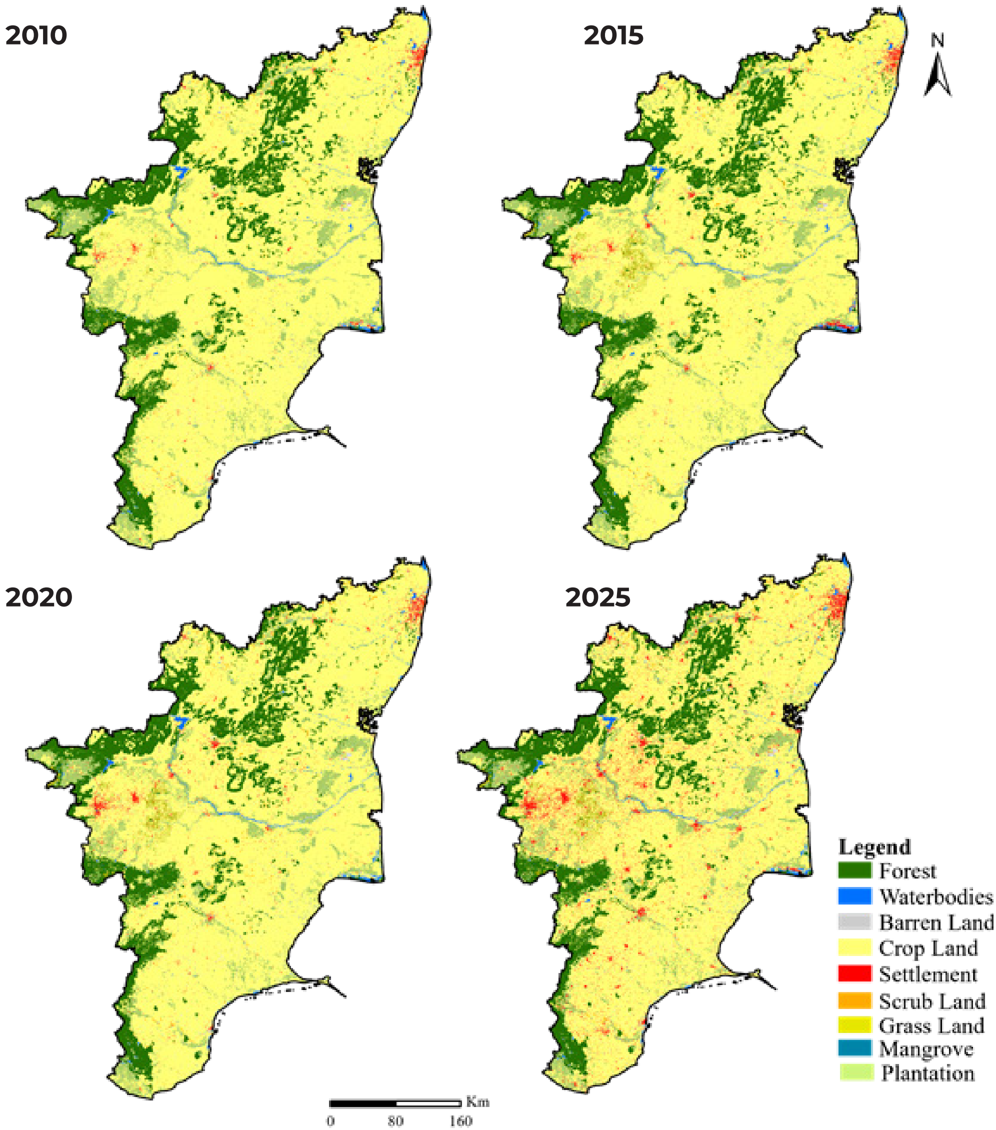



***Figure 1.2(a):*** *Land Use Land Cover (LULC) of Tamil Nadu from year 2010-2025.*

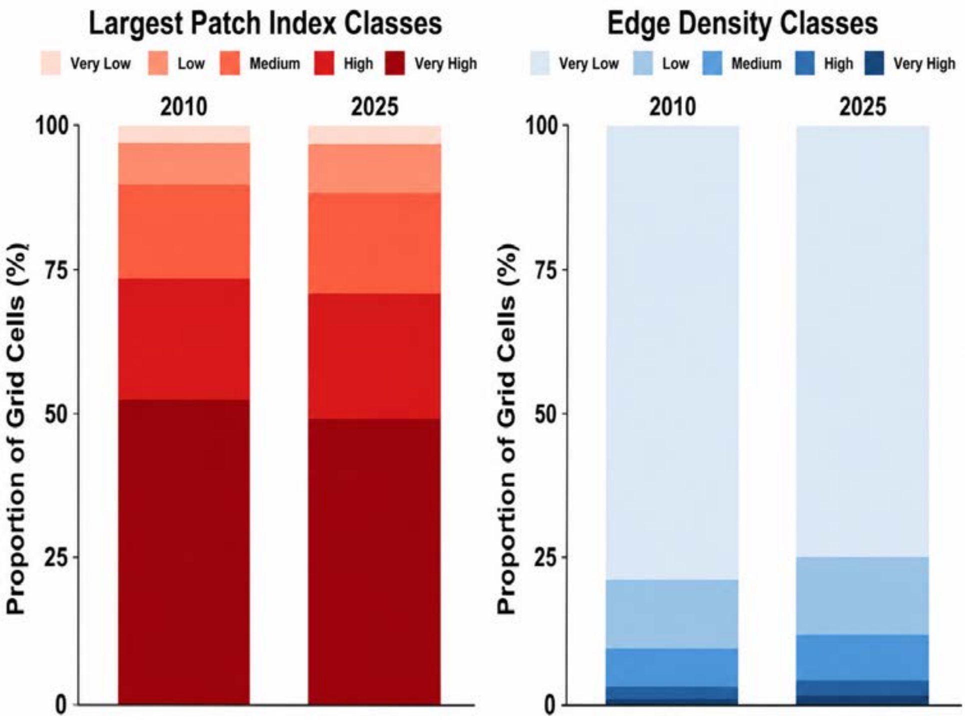



***Figure 1.2(b):*** *Proportion of grid cells 2010-2025.*

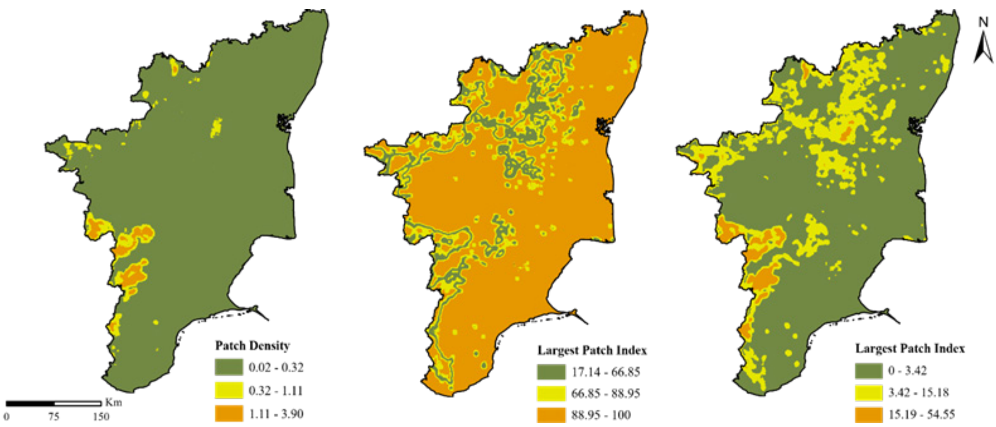



***Figure 1.3:*** *Spatial Distribution of Forest Patch Density, Largest Edge Density, and Patch Index in Tamil Nadu respectively.*

### *Temporal trends and spatial distribution of elephant mortality*

During the study period (2010–2025), a total of 1,758 elephant mortality cases were recorded in Tamil Nadu. Of these, 1,135 deaths were attributed to natural causes, followed by illness (335 cases) and territorial fights (5 cases). Anthropogenic causes included electrocution (132 deaths), poaching (31 deaths), bomb-related incidents (2 deaths), other anthropogenic stressors (28 deaths), train accidents (8 deaths), poisoning (4 deaths), and road accidents (5 deaths). In addition, 73 cases were recorded as post-mortem awaited (Fig. 1.4).

The highest number of elephant deaths was recorded in 2013 (150 deaths), followed by 2024 (137 deaths) and 2017 (136 deaths) (Fig. 1.4). Among anthropogenic causes, electrocution accounted for the highest number of deaths (132), followed by poaching (31), anthropogenic stressors (28), train accidents (8), road accidents (5), poisoning (4), and bomb-related incidents (2). The distribution of elephant deaths among anthropogenic causes differed significantly ($\chi^2 = 322.03$, df = 5, $p < 0.0001$) (Fig. 1.4).

Distribution of age group due to anthropogenic causes differed significantly ($\chi^2 = 129.24$, df = 4, $p < 0.0001$), with adult males (94) having the highest number of mortalities, followed by adult females (61), calves (30) and makhnas (25). Distribution of elephant fatalities across seasons revealed that the summer season had the highest number of elephant deaths (567; $\chi^2 = 119.29$, df = 3, $p < 0.0001$), followed by monsoon (537), post-monsoon (353) and winter (301) (Fig. 1.5).

Division-wise distribution showed that Sathyamangalam Division recorded the highest number of elephant mortalities (175 deaths), followed by Coimbatore (137), ATR, Pollachi (98), ATR, Tiruppur (96), and MTR, Masinagudi (92). Natural causes were the predominant mortality category in these divisions. Spatial analysis also identified these areas as important hotspots of elephant mortality in the state (Fig. 1.6; Fig. 1.6a).

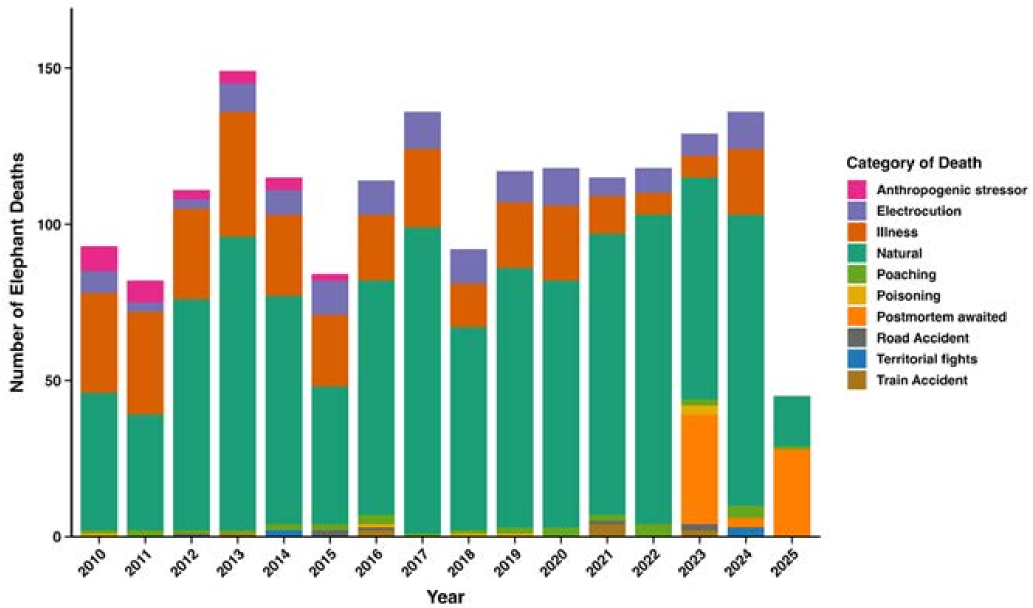



***Figure 1.4:*** *Temporal trends of elephant mortality in Tamil Nadu from 2010 to 2023*

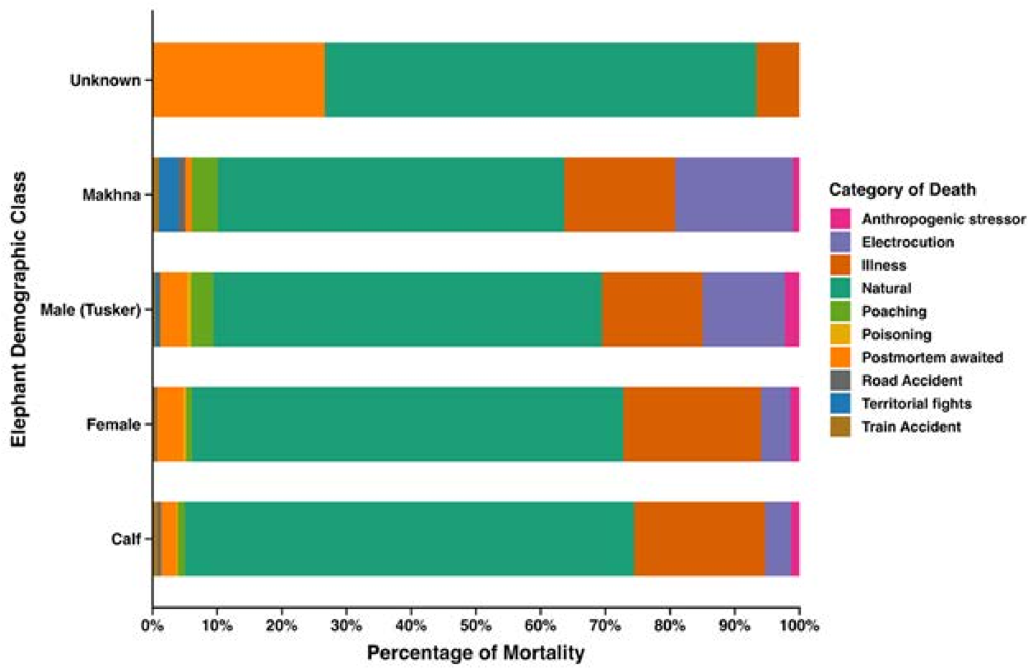



***Figure 1.5:*** *Causes of elephant mortality in relation to age class demography.*

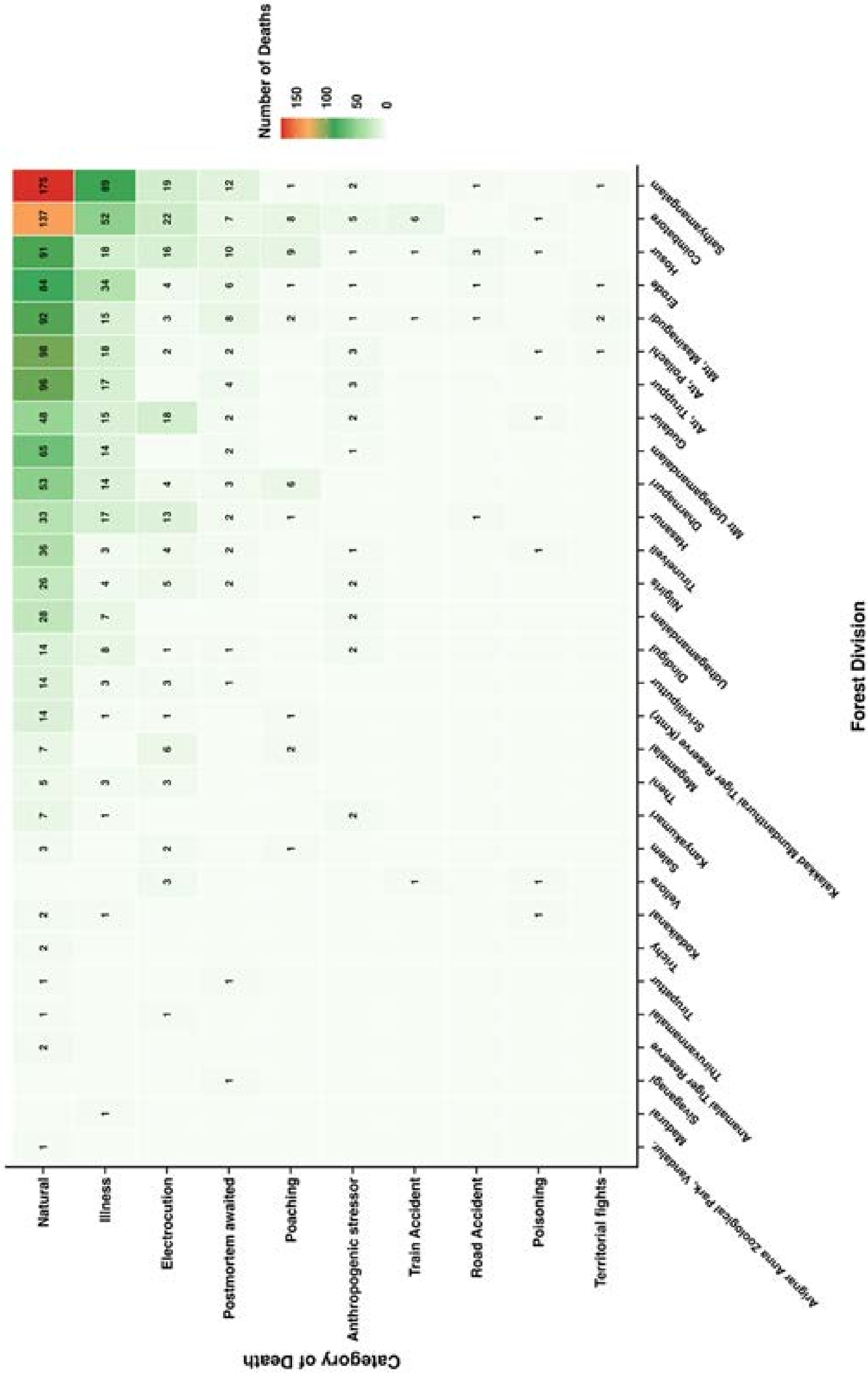



***Figure 1.6:*** *Heatmap showing distribution pattern of Elephant mortality in the different forest divisions of Tamil Nadu.*

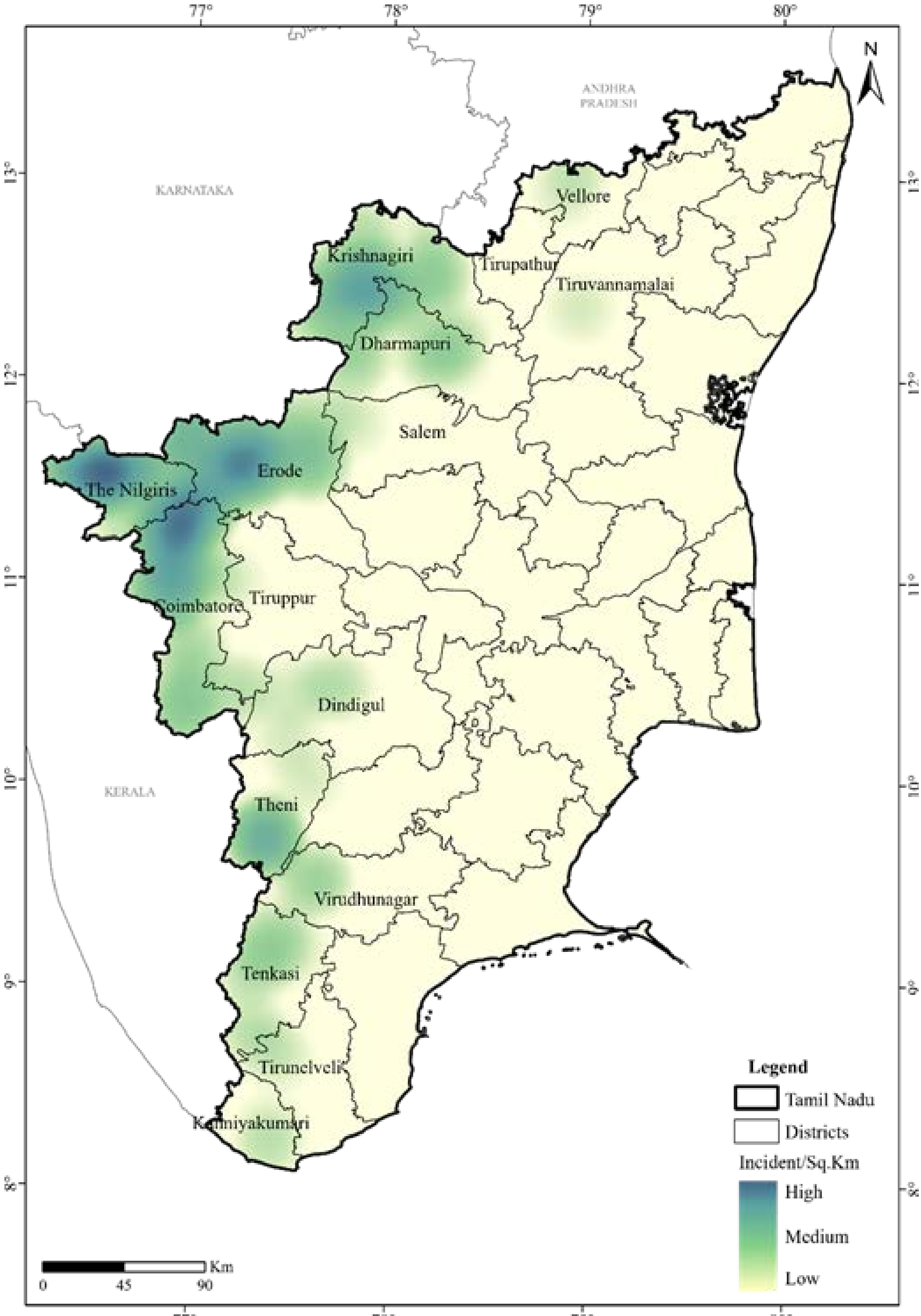



***Figure 1.6(a):*** *Asian Elephant mortality hotspot due to anthropogenic causes in Tamil Nadu (2010–2025).*

## *Natural Deaths of Elephants*

During the study period (2010–2025), 1,475 elephant deaths were attributed to natural-type causes, including natural deaths, illness, and territorial fights. Natural deaths accounted for the majority of these cases (1,135 deaths), followed by illness (335 deaths) and territorial fights (5 deaths).

Natural deaths were primarily recorded among adult females (515), followed by adult males (293), calves (264), makhnas (53), and individuals of unknown age (10). Illness-related deaths were also highest among adult females (164), followed by calves (77), adult males (76), makhnas (17), and individuals of unknown age (1). Territorial fights resulted in five deaths, including three makhnas and two adult males (Fig. 1.7).

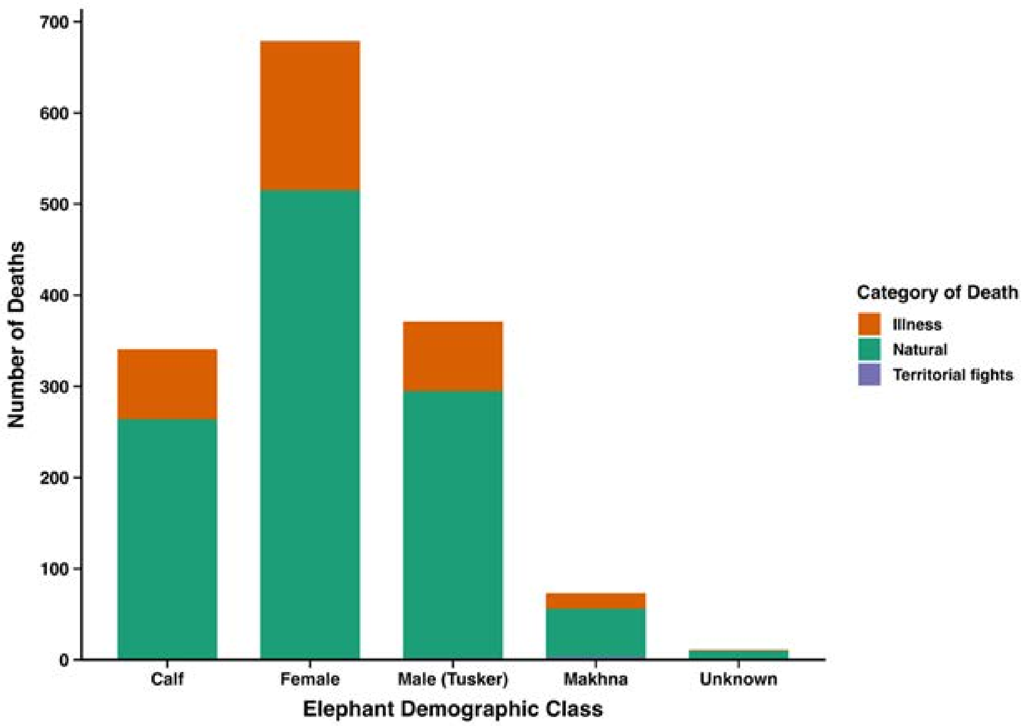



***Figure 1.7:*** *Natural reasons elephant death distribution in Tamil Nadu.*

## *Factor influencing elephant mortality and village characteristics*

A comprehensive examination of ecological and anthropogenic variables at the village level highlights distinct patterns across elephant-mortality intensity categories. High-mortality villages exhibit the highest median forest cover, while medium-mortality villages have the lowest median forest cover (Fig.

1.8a, Kruskal–Wallis: $\chi^2$ = 5.74, df = 2, p = 0.057). High-mortality villages show substantially lower crop cover percentages than low- and medium-mortality villages (Fig. 1.8b, $\chi^2$ = 9.53, df = 2, p = 0.009). Water percentage is highest in high-mortality villages, while medium-mortality villages show the lowest median water availability (Fig. 1.8c, $\chi^2$ = 0.75, df = 2, p = 0.686). Built-up cover is lowest in high-mortality villages, whereas low-mortality villages show the highest median built-up cover (Fig. 1.8d, $\chi^2$ = 7.74, df = 2, p = 0.021). Tea-estate cover is lowest in high-mortality villages and highest in medium-mortality villages (Fig. 1.8e, $\chi^2$ = 2.82, df = 2, p = 0.244). Railway density is lower in medium-mortality villages than in low-mortality villages; however, no observations were available for high-mortality villages, preventing a three-category comparison (Fig. 1.8f). Road density decreases across increasing mortality categories, with high-mortality villages showing the lowest median road density (Fig. 1.8g, $\chi^2$ = 7.72, df = 2, p = 0.021).

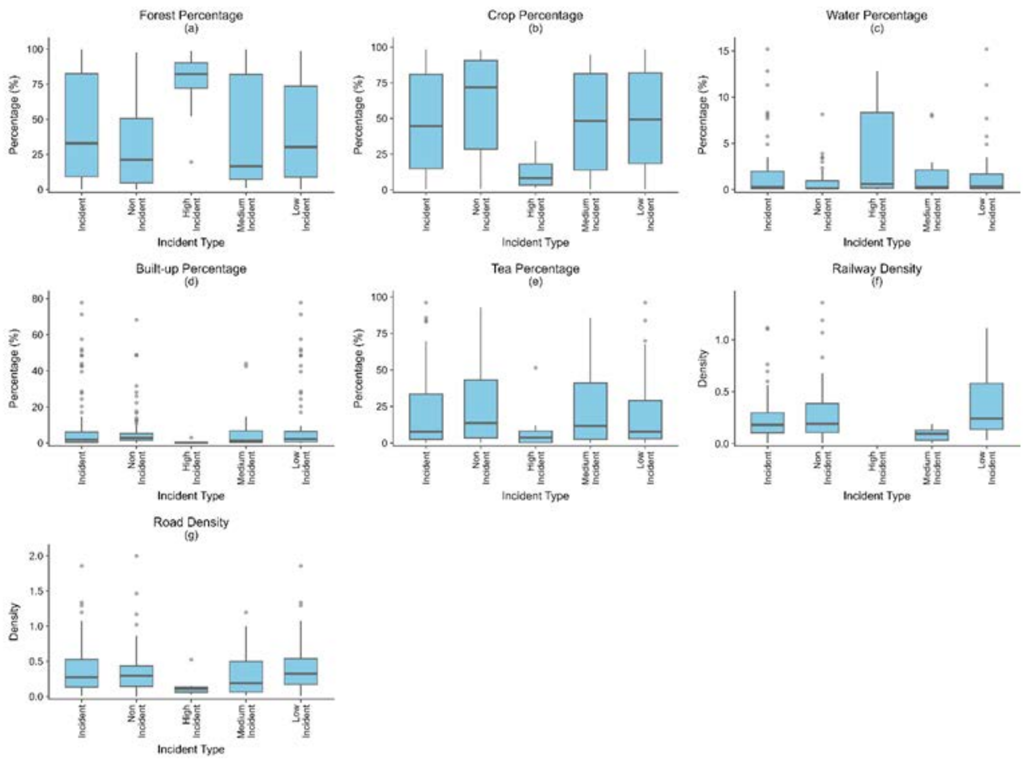



***Figure 1.8:*** *Box plot showing the built-up density, road density, railway density, crop percentage, forest percentage and mining percentage in non-incident, low-incident, medium-incident and high-incident villages in Tamil Nadu.*

## *Ecological and Anthropogenic Drivers of Elephant Mortality*

The probability of elephant mortality was significantly influenced by both ecological and anthropogenic landscape factors. Elephant deaths were more likely to occur closer to built-up areas ($p < 0.001$) and Elephant Reserves ($p < 0.001$). The best-supported model also included largest patch index and distance from forest; however, neither variable showed a statistically significant association with elephant mortality occurrence (largest patch index: $p = 0.131$; distance from forest: $p = 0.318$) (Tables 1.4 and 1.5; Fig. 1.10).

***Table 1.5:*** *Summary statistics loglikelihood (LogL), degrees of freedom (df), Akaike Information Criteria (AICc), relative support for hypothesis (Δ AICc), Akaike weights (Wi) of candidate regression model explaining elephant mortality in Tamil Nadu*

| Variable combination | K | AIC | AICc | Delta_AICc | AICc_ weight | log_ likelihood |
|---|---|---|---|---|---|---|
| db_z + der_z + lpi_z + df_z | 5 | 549.03 | 549.18 | 0.00 | 1.00 | -269.52 |
| dpa_z + der_z | 3 | 569.89 | 569.94 | 20.76 | 0.00 | -281.94 |
| dw_z + dpa_z + der_z | 4 | 571.29 | 571.39 | 22.21 | 0.00 | -281.65 |
| db_z + dc_z | 3 | 578.54 | 578.60 | 29.42 | 0.00 | -286.27 |
| df_z | 2 | 579.73 | 579.76 | 30.58 | 0.00 | -287.87 |
| db_z + dc_z + dr_z + dtea_z | 5 | 580.42 | 580.56 | 31.38 | 0.00 | -285.21 |
| df_z + dtea_z | 3 | 581.11 | 581.17 | 31.99 | 0.00 | -287.56 |
| df_z + dw_z | 3 | 581.13 | 581.18 | 32.00 | 0.00 | -287.56 |
| df_z + dr_z | 3 | 581.73 | 581.79 | 32.61 | 0.00 | -287.86 |
| Intercept only | 1 | 584.24 | 584.25 | 35.07 | 0.00 | -291.12 |
| pd_z | 2 | 584.61 | 584.64 | 35.46 | 0.00 | -290.30 |
| pd_z + dw_z + db_z + dc_z + dr_z + dpa_z + dtea_z | 8 | 585.21 | 585.56 | 36.38 | 0.00 | -284.61 |
| dw_z | 2 | 585.95 | 585.98 | 36.80 | 0.00 | -290.98 |
| dr_z | 2 | 586.02 | 586.05 | 36.87 | 0.00 | -291.01 |

***Table 1.6:*** *Parameter estimates effect (β) and probabilities of ecological and anthropogenic variables in determining mortality of Asian elephant due to various anthropogenic activity*

| Variable | Estimate | Std.error | Statistic | p.value | Significance |
|---|---|---|---|---|---|
| Intercept | -0.02686 | 0.103478 | -0.25957 | 0.795193 | |
| Distance from built-up area | -0.55476 | 0.133577 | -4.15309 | 0.0000328 | *** |
| Distance from Elephant Reserve | -0.48884 | 0.137573 | -3.5533 | 0.00038 | *** |
| Largest patch index | -0.18608 | 0.123164 | -1.51081 | 0.130836 | |
| Distance from forest | -0.14718 | 0.147528 | -0.99761 | 0.318468 | |

***Significance:*** ***p < 0.001; p < 0.01; p < 0.05; · p < 0.10.*

Photo: Anshuman Gogoi.

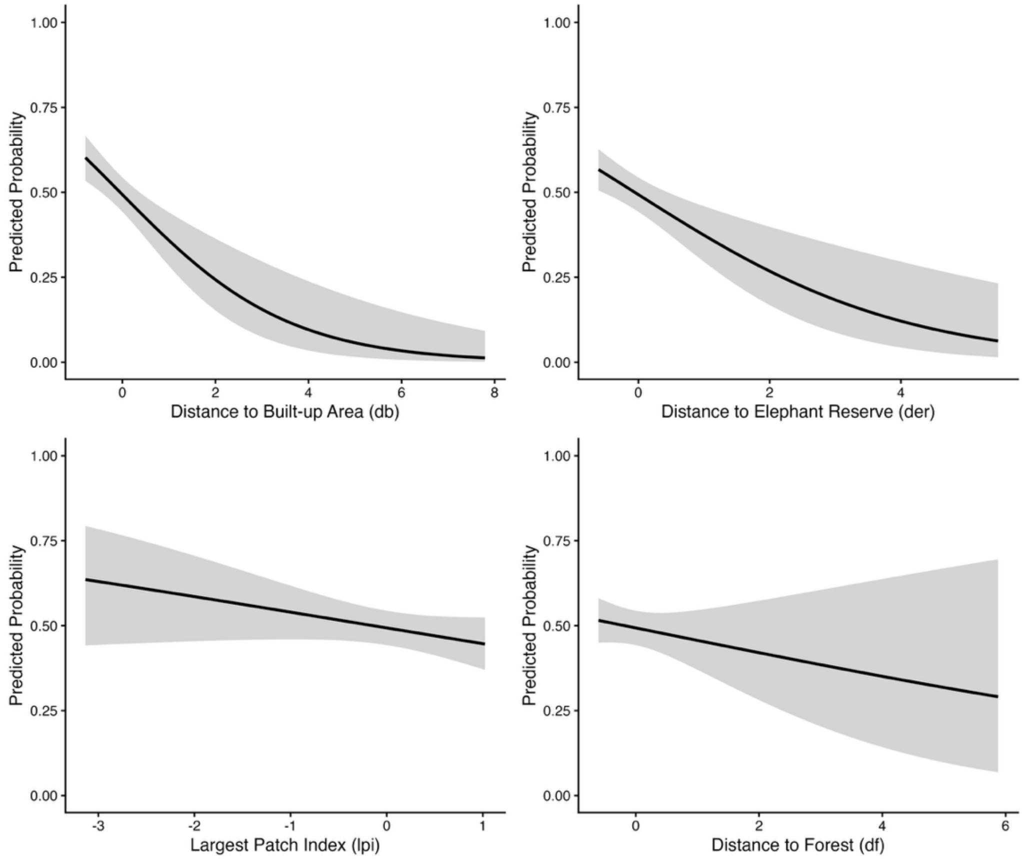



***Figure 1.8:*** *Graphs showing the probability of elephant mortality in relation to the different ecological and anthropogenic variables in Tamil Nadu.*

## *Temporal and Seasonal Pattern of Human Mortality and Injuries*

Between 2010 and 2025, Tamil Nadu recorded 1,204 incidents, resulting in 720 human fatalities and 484 injuries. Fatalities peaked in 2019 with 61 deaths, while injuries were reported throughout the study period with marked variation across years (Fig. 1.9). Coimbatore was the most affected division (182 deaths, 78 injuries), followed by Gudalur (95 deaths, 139 injuries), Hosur (119 deaths, 82 injuries), Sathyamangalam (71 deaths, 29 injuries) and Erode (31 deaths, 15 injuries) (Fig. 1.10). Other divisions such as Nilgiris, Pollachi, Dharmapuri, Hasanur and Dindigul also reported considerable numbers of incidents. Male victims accounted for the highest number of both fatalities and injuries compared to females. However, no significant association was observed between gender and incident type ($x^2$ = 3.66, df = 2, p = 0.1604, Fig. 1.11). Similarly, there was no significant association between gender and seasons ($x^2$ = 10.03, df = 6, p = 0.1234, Fig. 1.12). Season-wise distribution showed that incidents were recorded across all seasons, indicating that human-elephant conflict remained persistent throughout the year in Tamil Nadu.

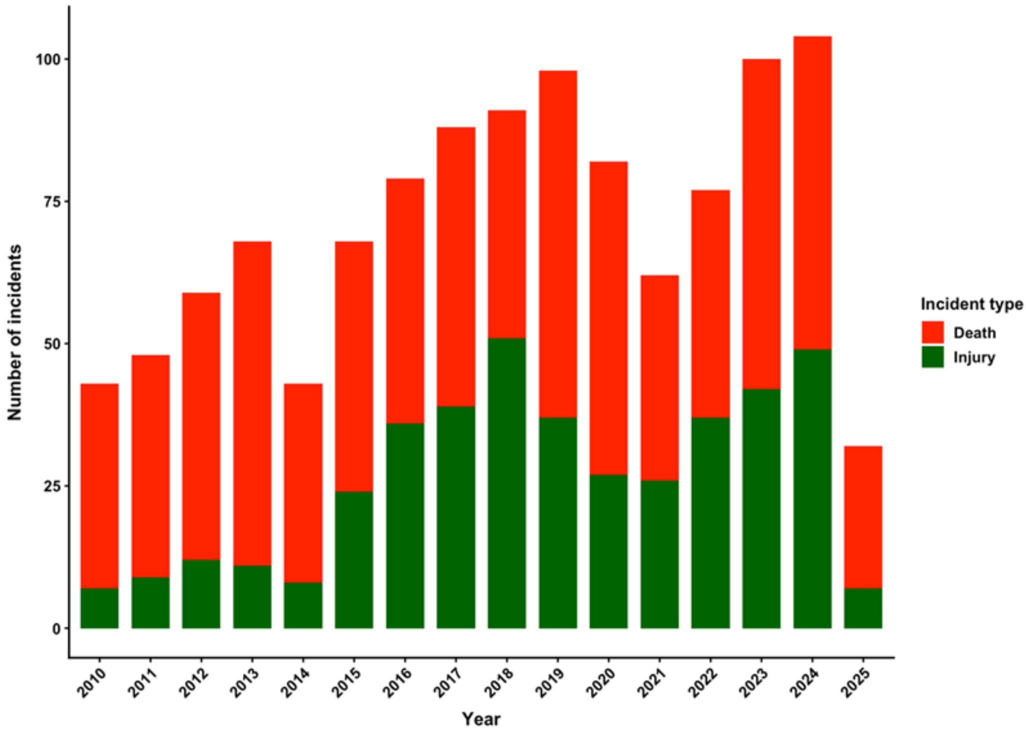



***Figure 1.9:*** *Trends in human deaths/Injuries due to human elephant conflict.*

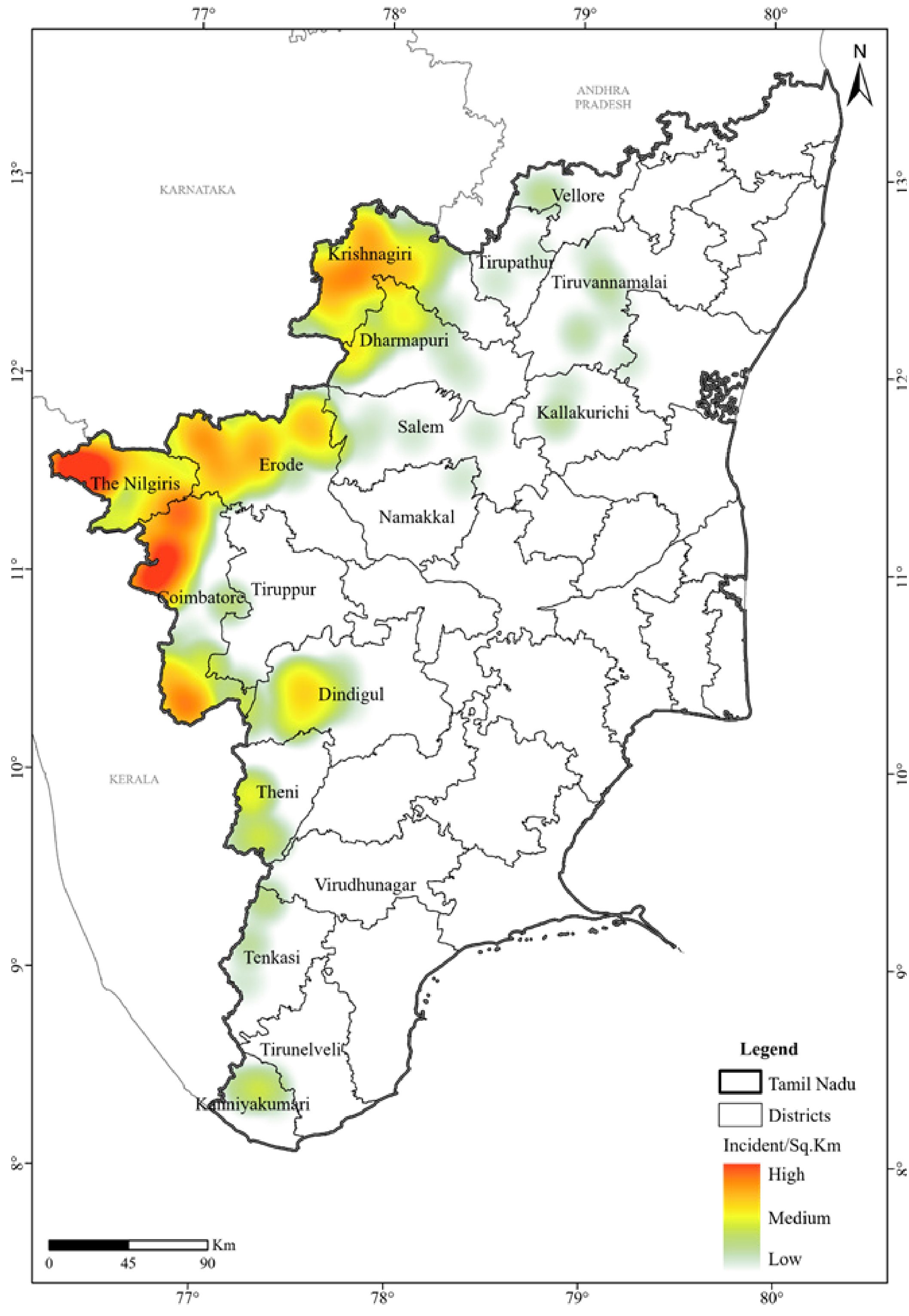



***Figure 1.9.1:*** *Kernel Density map visualizing the intensity and distribution, highlighting areas with higher HEC occurences in Tamil Nadu (2010-2025).*

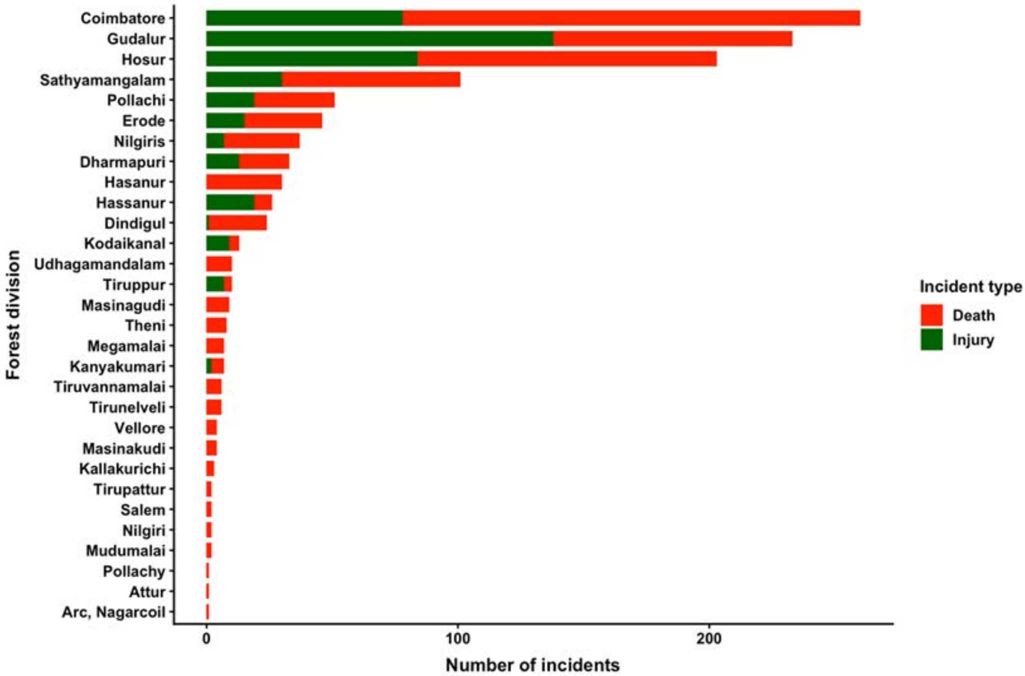



***Figure 1.10:*** *Division Vise distribution of human elephant incidents in Tamil Nadu.*

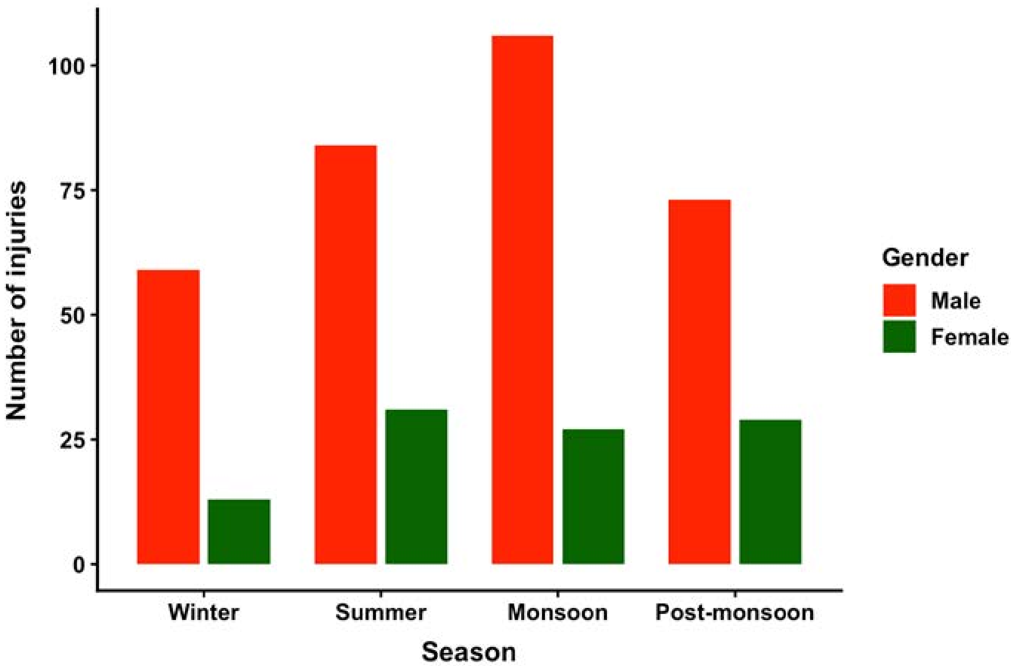



***Figure 1.11:*** *Seasonal variation in human injuries (male & female).*

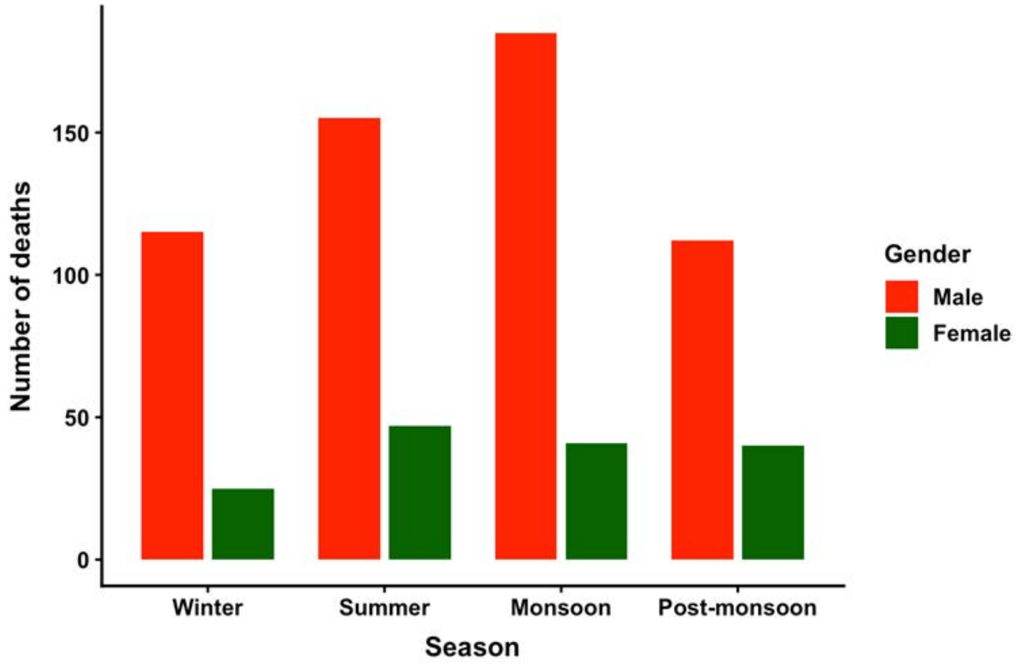



***Figure 1.12:*** *Seasonal variation in human fatalities (male & female).*

## *Village-Level Analysis of Ecological and Anthropogenic Variables of Human mortality and Injuries*

A comprehensive examination of ecological and anthropogenic variables at the village level highlights distinct patterns across human-fatality intensity categories. Forest cover percentages are higher in high-fatality villages, while low- and medium-fatality villages show lower median forest cover (Fig. 1.8a, Kruskal–Wallis: $\chi^2 = 2.24$, df = 2, $p = 0.326$). High-fatality villages exhibit substantially lower crop cover percentages than low- and medium-fatality villages (Fig. 1.8b, $\chi^2 = 10.15$, df = 2, $p = 0.006$). High-fatality villages show the lowest median water sources, whereas medium-fatality villages show the highest median water availability (Fig. 1.8c, $\chi^2 = 1.16$, df = 2, $p = 0.561$). Built-up cover is lower in high-fatality villages than in low- and medium-fatality villages (Fig. 1.8d, $\chi^2 = 8.02$, df = 2, $p = 0.018$). Tea-estate cover is lowest in high-fatality villages, while low- and medium-fatality villages show similar median values (Fig. 1.8e, $\chi^2 = 0.54$, df = 2, $p = 0.762$). Railway density is lowest in medium-fatality villages and highest in high-fatality villages, although the differences among categories are limited (Fig. 1.8f, $\chi^2 = 0.81$, df = 2, $p = 0.669$). Road density declines across increasing fatality categories, with high-fatality villages showing the lowest median road density (Fig. 1.8g, $\chi^2 = 7.94$, df = 2, $p = 0.019$).

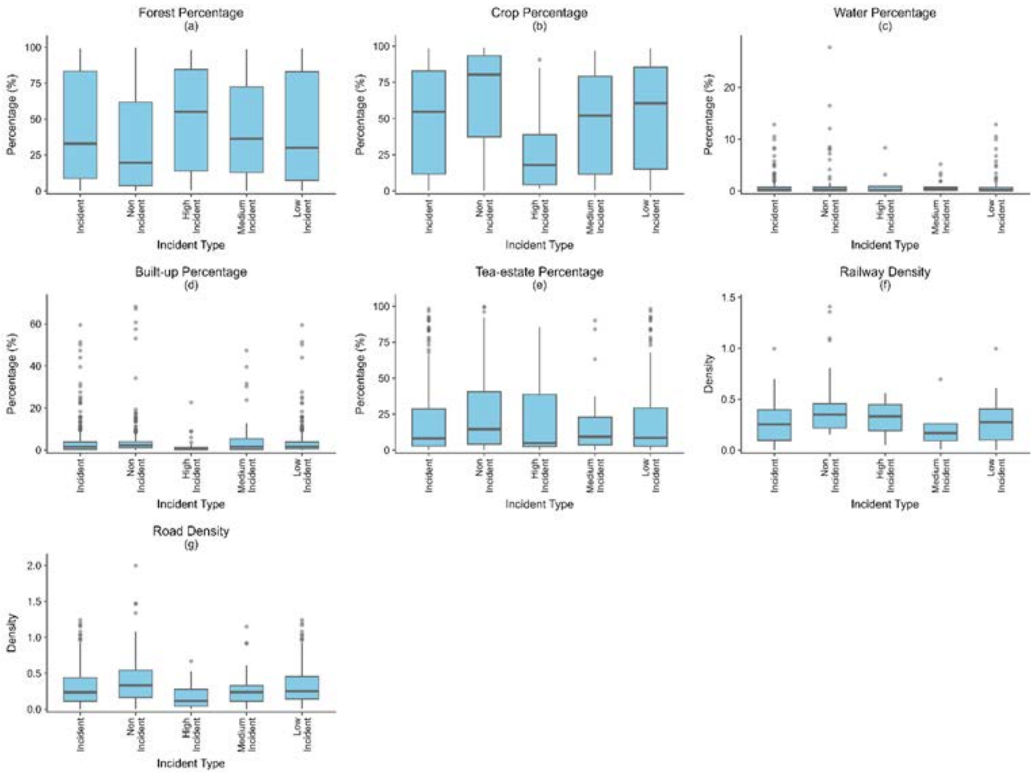



***Figure 1.12:*** *Comparison of ecological and anthropogenic variables across different incident types and non-incidence villages of Tamil Nadu.*

## *Key Predictors of HEC*

Human-fatality records were associated with both anthropogenic and landscape variables. The best-supported candidate model received support among all candidate models (AICc weight = 1.00) and included distance from roads, Elephant Reserves, tea plantations, built-up areas, largest patch index, and edge density (Tables 1.4 and 1.5).

The probability of a human-death record decreased with increasing distance from roads ($\beta = -0.186$, $p = 0.042$), Elephant Reserves ($\beta = -0.779$, $p < 0.001$), tea plantations ($\beta = -0.318$, $p < 0.001$), and built-up areas ($\beta = -0.417$, $p < 0.001$). These negative relationships indicate that human-fatality records were more likely to occur closer to roads, Elephant Reserves, tea plantations, and built-up areas.

Human-fatality probability also declined with increasing largest patch index ($\beta = -0.276$, $p < 0.001$) and edge density ($\beta = -0.117$, $p = 0.018$). These results suggest that landscape configuration also influenced the spatial distribution of human fatalities, although the strongest associations were observed for proximity to anthropogenic features and Elephant Reserves (Tables 1.4 and 1.5).

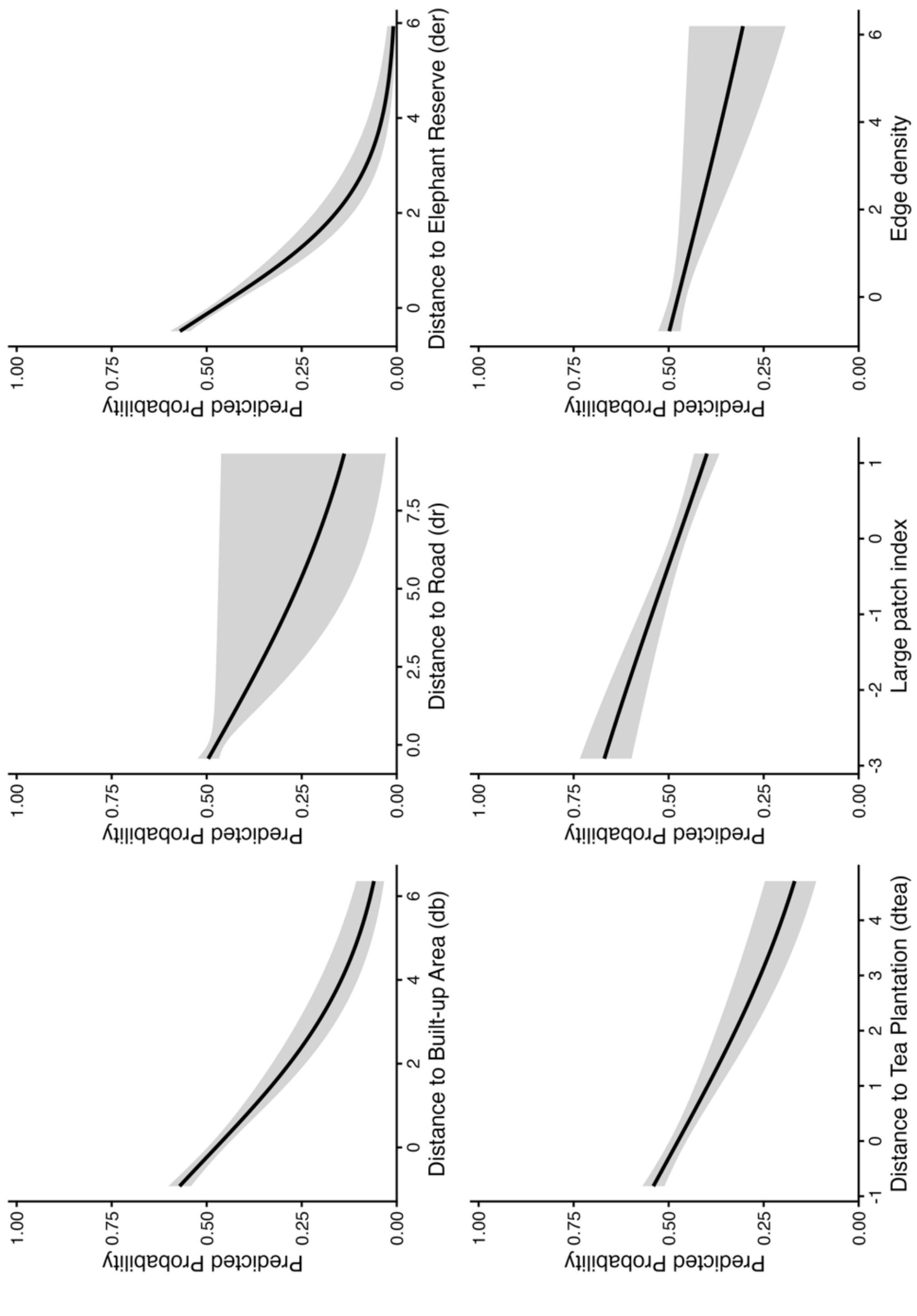



***Figure 1.13:*** *Evaluation of Key Factors Affecting Human-Elephant Conflict (Human Fatalities and Injuries) in Tamil Nadu.*

***Table 1.7:*** *Summary statistics loglikelihood (LogL), degrees of freedom (df), Akaike Information Criteria (AICc), relative support for hypothesis (Δ AICc), Akaike weights (Wi) of candidate regression model explaining HEC in Tamil Nadu.*

| Predictor combination | LogL | df | AICc | Δ AICc | Wi | ΔAICc |
|---|---|---|---|---|---|---|
| dr_z + der_z + dtea_z + lpi_z + ed_z + db_z | -1536.54 | 7 | 3087.118 | 0 | 1 | 0 |
| dr_z + der_z + dtea_z + lpi_z | -1583.29 | 5 | 3176.61 | 89.492 | 0 | 103 |
| dc_z + dr_z + der_z + dtea_z | -1597.01 | 5 | 3204.036 | 116.919 | 0 | 203 |
| df_z + dw_z + der_z | -1623.62 | 4 | 3255.264 | 168.146 | 0 | 224 |
| der_z | -1636.1 | 2 | 3276.197 | 189.079 | 0 | 248 |
| dc_z + dr_z + dtea_z | -1638.31 | 4 | 3284.626 | 197.508 | 0 | 284 |
| df_z + dc_z + dtea_z | -1646.94 | 4 | 3301.895 | 214.777 | 0 | 318 |
| dr_z | -1687.98 | 2 | 3379.961 | 292.843 | 0 | 344 |
| dw_z + db_z | -1693.73 | 3 | 3393.464 | 306.346 | 0 | 362 |
| db_z + dc_z | -1695.16 | 3 | 3396.323 | 309.205 | 0 | 376 |
| df_z + dw_z | -1703.85 | 3 | 3413.717 | 326.6 | 0 | 413 |
| df_z | -1712.27 | 2 | 3428.54 | 341.422 | 0 | 429 |
| dpa_z | -1721.63 | 2 | 3447.273 | 360.155 | 0 | 431 |
| dw_z | -1730.79 | 2 | 3465.592 | 378.474 | 0 | |
| Intercept only | -1739.8 | 1 | 3481.6 | 394.483 | 0 | |
| pd_z | -1739.73 | 2 | 3483.458 | 396.34 | 0 | |

***Table 1.8:*** *Parameter estimates effect (β), standard errors (S.E), and probabilities of ecological and anthropogenic variables in determining the human elephant conflict in Tamil Nadu.*

| Predictor | Effect (β) | Z-value | Probability (p-value) | Significance |
|---|---|---|---|---|
| Intercept | -0.099 | -2.151 | 0.0315 | * |
| Distance from road | -0.186 | -2.036 | 0.0418 | * |
| Distance from Elephant Reserve | -0.779 | -8.881 | < 0.001 | *** |
| Distance from tea plantation | -0.318 | -6.332 | < 0.001 | *** |
| Largest patch index | -0.276 | -5.434 | < 0.001 | *** |
| Edge density | -0.117 | -2.36 | 0.0183 | * |
| Distance from built-up area | -0.417 | -8.584 | < 0.001 | *** |

***Significance:*** ***p < 0.001; p < 0.01; p < 0.05; · p < 0.10.*

Photo: Saket Badola.


Photo: Anshuman Gogoi.

# DISCUSSION

## SPATIAL AND TEMPORAL PATTERNS OF ELEPHANT MORTALITY AND HUMAN CASUALTIES

Tamil Nadu has experienced persistent human–elephant conflict, with consequences for both elephant conservation and human safety. Our study recorded 1,758 elephant deaths and 1,204 human casualty incidents between 2010 and 2025, including 720 fatalities and 484 injuries. Elephant mortality was highest in Sathyamangalam, Coimbatore, Anamalai and Mudumalai divisions, while human casualties were concentrated in Coimbatore, Gudalur, Hosur and Sathyamangalam. This spatial overlap indicates that both outcomes were concentrated within major elephant landscapes where forests, plantations, cultivation, settlements and infrastructure occur in close proximity. Tamil Nadu's elephant populations move through interconnected habitats across the Western and Eastern Ghats (Vidya *et al.*, 2005; Baskaran *et al.*, 2007; Prasad *et al.*, 2025), and fragmentation of these landscapes has increased elephant use of human-dominated areas (Leimgruber *et al.*, 2003; Baskaran, 2013; Menon *et al.*, 2017). Our findings therefore show that human and elephant deaths are linked outcomes of the same shared-landscape problem. Elephant mortality was highest during summer, whereas human fatalities and injuries occurred throughout the year. Greater elephant mortality during summer may reflect seasonal constraints on forage and water that increase movement towards irrigated fields, village tanks and other human-modified resources, as previously reported from Coimbatore and Mudumalai (Senthilkumar *et al.*, 2016; Ramkumar *et al.*, 2014). However, human casualties were not confined to the dry season. Elephants use forest edges, plantations and agricultural mosaics across seasons, while people regularly undertake crop guarding, forest-resource collection and movement near elephant habitats (Anoop *et al.*, 2023; Shaffer *et al.*, 2019). Mitigation must therefore continue throughout the year, with additional attention during periods of resource scarcity and intensive crop protection.

## ANTHROPOGENIC ELEPHANT MORTALITY AND DEMOGRAPHIC VULNERABILITY

Our study identified electrocution as the dominant anthropogenic cause of elephant death, far exceeding poaching, entrapment, train collisions, poisoning and road accidents. Similar concerns have been reported across India, where electric fencing, unsafe power lines and other infrastructure contribute substantially to unnatural elephant mortality (MoEF&CC, 2010; Gulati *et al.,* 2021; Das *et al.,* 2025; Pandey *et al.,* 2025c). Studies from Coimbatore and Anamalai also identified electrocution and accidental injuries among important mortality causes (Ramkumar *et al.,* 2014; Deivanayaki *et al.,* 2019). The predominance of electrocution indicates that mitigation structures can become lethal when electric fences are illegal or poorly maintained (Prasad *et al.,* 2025; PE-MoEFCC-WII, 2025).

Adult males had the highest anthropogenic mortality, whereas adult females accounted for the greatest number of natural-type deaths. The high exposure of adult males to anthropogenic causes may reflect their wider movements and more frequent use of agricultural and settled landscapes. The report literature shows that elephant movement through farms, plantations and settlement edges increases contact with people and infrastructure (Baskaran *et al.,* 2006; Gubbi, 2012; Anoop *et al.,* 2023; Pandey *et al.,* 2025b). Human casualties were also numerically higher among men, although gender was not significantly associated with incident type or season. The observed male predominance therefore indicates greater recorded exposure, not that gender alone determines casualty risk. Routine activities near forest edges, including crop guarding and resource collection, can expose people to elephants at times and locations where visibility and response options are limited (Senthilkumar *et al.,* 2016; Shaffer *et al.,* 2019).

## SHARED LANDSCAPE DRIVERS

Our models showed that elephant mortality and human fatalities were associated with both landscape structure and proximity to human-modified features. Elephant deaths were more likely to occur closer to built-up areas and Elephant Reserves. The elephant-mortality model also included Largest Patch Index and distance from forest, but neither variable showed a statistically significant association. Human-fatality records were more likely to occur closer to built-up areas, roads, Elephant Reserves and tea plantations. These findings identify areas where elephant habitats, infrastructure, plantations and human settlements occur close together as important risk zones. Elephant Reserves do not themselves create conflict; rather, areas around them may contain farms, plantations, roads and settlements used by both elephants and people.

Similar overlap has been documented in Gudalur, Theni, Coimbatore and other fragmented Tamil Nadu landscapes (Baskaran *et al.,* 2006; Jayaraman & Balasundaram, 2017; Ramkumar *et al.,* 2014).

Largest Patch Index and Edge Density were significantly negatively associated with human-fatality occurrence, indicating that human-death records were more likely in landscapes with lower values of these variables. In contrast, Largest Patch Index was not significantly associated with elephant mortality. These findings suggest that landscape configuration may influence the spatial occurrence of human fatalities, while elephant mortality was more strongly associated with proximity to built-up areas and Elephant Reserves. However, these relationships should be interpreted cautiously because the GLMs identify spatial associations rather than demonstrating that any individual landscape feature directly caused mortality.

Our findings support targeted action in Coimbatore, Sathyamangalam, Gudalur, Hosur, Anamalai and Mudumalai rather than uniform intervention across Tamil Nadu. Priority measures should include auditing power lines and electric fences, removing illegal connections, securing wells, tanks, drains and canals, and strengthening monitoring where roads and railways cross elephant movement routes. Corridor protection and coordinated management across divisions are also necessary because elephants move beyond protected-area boundaries (Menon *et al.,* 2017; PE-MoEFCC-WII, 2025; Pandey *et al.,* 2025c; Pandey *et al.,* 2026b). Community-based warning, safer crop guarding and timely communication can reduce direct encounters, but these measures must be adapted to local conditions (Anoop *et al.,* 2023; Pandey *et al.,* 2026a). Treating elephant mortality and human fatalities as linked outcomes can focus prevention on interfaces where action is most likely to protect both people and elephants.

## CONCLUSION

Between 2010 and 2025, Tamil Nadu recorded substantial elephant mortality and human casualties arising from human–elephant interactions. Natural causes accounted for most elephant deaths, while electrocution was the leading anthropogenic cause. Adult males were particularly vulnerable to human-induced mortality. Human fatalities and injuries occurred throughout the year and were concentrated in a limited number of forest divisions, particularly Coimbatore, Gudalur, Hosur and Sathyamangalam. These areas require greater attention because they support important elephant populations while also containing settlements, plantations, roads and other infrastructure.

Our study showed that elephant mortality and human casualties were associated with the interfaces between elephant habitats and human-used landscapes. Mortality locations were linked with proximity to built-up areas and elephant reserve boundaries, while human casualty locations were associated with forests, roads, built-up areas, tea estates and elephant reserves. Landscape structure also influenced elephant mortality, indicating that habitat continuity and safe movement pathways remain important for reducing encounters.

Management should prioritise the identified hotspot divisions rather than applying the same intervention across the entire state. Immediate measures should include inspection and insulation of power lines, removal of illegal electric fences, securing open wells and canals, and increased monitoring along roads and railway lines passing through elephant movement areas. Protecting and restoring movement corridors can reduce the need for elephants to cross settlements and other high-risk locations.

Community participation is also essential. Early-warning systems, rapid communication with forest staff, safer crop-guarding practices and timely compensation can reduce human exposure and discourage retaliatory actions. Because incidents occurred throughout the year, monitoring and mitigation should remain continuous rather than seasonal. Long-term reduction of human–elephant conflict in Tamil Nadu will depend on coordinated action among forest divisions, infrastructure agencies and local communities. By focusing on electrocution prevention, hotspot monitoring and habitat connectivity, management can reduce avoidable deaths and support safer coexistence between people and elephants.

# Suggested Measures to minimize Human-Elephant Conflict in the State of Tamil Nadu

Human–elephant conflict (HEC) in Tamil Nadu remains a persistent conservation and socio-economic challenge because the state supports important elephant populations across connected landscapes. These include the Nilgiris–Mudumalai–Sathyamangalam complex, the Coimbatore landscape, including forest ranges adjoining Kerala, and several corridor-linked movement routes through which elephants regularly move between forests, plantations, agricultural mosaics, and settlements. Conflict is not uniformly distributed across Tamil Nadu. It is shaped by: (i) regular and seasonal elephant movement through recognised corridors; (ii) land-use pressures around corridor bottlenecks, including private land, plantations, high-traffic roads, power lines, and settlements; and (iii) high-risk linear infrastructure, such as railways and highways, that intersects elephant movement routes. Mitigation must therefore follow a site-specific and risk-based approach. This should combine proven field measures, including barriers, guarding, early-warning systems, rapid response, and compensation, with corridor protection and safe-passage interventions at key bottlenecks. Capture and translocation should be used only under clearly defined operating procedures and when adequately justified (Krishnan & Kumar, 2017; Prasad *et al.,* 2025).

Tamil Nadu has already adopted a broad conflict-management framework. Conventional measures include elephant-proof trenches (EPTs), solar-powered fences, stone walls, steel-wire rope fences, hanging solar fences, and the augmentation of water and fodder within forests through percolation ponds, check dams, waterholes, and troughs. These interventions aim to reduce factors that may encourage elephants to move into human-use areas. The state also deploys anti-depredation squads, conducts regular patrolling, and uses anti-poaching watchers. Conflict response has been strengthened through early-warning systems, radio-collaring for real-time monitoring, artificial intelligence (AI)-based elephant alert systems, trip-wire alarms, and georeferenced monitoring systems. Rapid-response teams drive elephants that have entered human-use areas back towards forests. In some cases, frequently straying elephants are captured using kumki elephants and tranquillisers under legal provisions and veterinary supervision. Compensation schemes and public-awareness programmes also form part of the state's response (Karnataka Evaluation Authority, 2022; Krishnan & Kumar, 2017; PE-MoEFCC-WII, 2025).

Building on these ongoing actions, the measures suggested below focus on preventing elephant deaths, reducing human fatalities and injuries, and addressing risks associated with corridors and railway lines. The aim is to strengthen existing interventions, address weaknesses in maintenance and design, improve governance at corridor bottlenecks, and prioritise action in areas identified as having the highest risk.

## RECOMMENDATIONS FOR MANAGING ELEPHANT MORTALITY IN TAMIL NADU

Elephant mortality risk in Tamil Nadu is closely linked to linear infrastructure (railways and highways), unsafe barriers and electrocution hazards around farms and settlements, and bottleneck pressures within corridors. While the causes can differ across landscapes, the prevention strategy should follow a clear principle: reduce lethal exposure (unsafe electrical infrastructure, trains, high-speed roads) and reduce the need for elephants to enter conflict-prone spaces by securing corridors, restoring habitat permeability, and providing safe passage (MoEF&CC, 2022; Panda *et al.*, 2020).

### *Railway Collisions: Site-Specific Prevention along Vulnerable Stretches in Tamil Nadu*

Railway-related elephant mortality in Tamil Nadu is concentrated along specific stretches where railway lines intersect established elephant movement routes. Vulnerable sections occur particularly within the Coimbatore, Nilgiris–Mettupalayam and Tirupattur landscapes, including the Ettimadai–Walayar, Madukkarai–Ettimadai, Kollar–Ooty, Patchur–Mallanuru and Vaniyambadi–Jolarpet railway stretches.

A joint assessment conducted by the Project Elephant Division, MoEF&CC, Wildlife Institute of India, and the Tamil Nadu Forest Department identified these vulnerable sections through field surveys and movement evidence, while also confirming that several railways stretch passing through densely settled areas do not experience elephant movement and therefore do not require mitigation interventions. Such screening is essential to ensure that mitigation efforts are targeted only at genuine risk zones and that resources are not deployed in areas with no elephant presence (MoEF&CC, 2022; Panda *et al.*, 2020; PE-MoEFCC-WII, 2025).

Based on this assessment, the following measures are recommended for reducing elephant–train collisions on vulnerable railway stretches in Tamil Nadu:

a. **Improvement and maintenance of safe crossing structures:** Existing underpasses, bridges, and upgrade crossing zones at identified elephant crossing points should be maintained and, where required, upgraded to facilitate rapid and unobstructed elephant movement across tracks.

b. **Implementation of DAS early-warning and detection systems:** On railway sections frequently crossed by elephants, DAS-based intrusion detection could use existing optical-fiber infrastructure to provide continuous monitoring without relying solely on visual detection. AI-enabled cameras remain useful for visual confirmation but require regular maintenance and can be affected by vegetation, weather, restricted fields of view and false or missed detections. Where suitable optical fiber is available, DAS could complement camera-based monitoring and reduce the number of trackside installations required. Its operational performance, maintenance needs and comparative cost-effectiveness should be assessed through site-specific trials before wider deployment.
c. **Vegetation and visibility management along tracks:** Regular clearance of vegetation along railway corridors should be undertaken to improve visibility for loco pilots and reduce the risk of sudden encounters.
d. **Institutional coordination and operational protocols:** Effective mitigation requires close coordination between the Forest Department and railway authorities, including shared monitoring, communication protocols, and sensitisation of train crews operating through elephant-prone sections.

These measures, when applied selectively to verified elephant movement zones and maintained through inter-departmental coordination, are expected to significantly reduce the risk of elephant mortality due to train collisions in Tamil Nadu without creating new barriers to elephant movement (PE-MoEFCC-WII, 2025).

### *Electrocution Risk: Enforcement of Safe Practices and Removal of Lethal Electrical Installations*

Electrocution remains a significant cause of elephant mortality in Tamil Nadu, particularly in agricultural landscapes and corridor bottlenecks where elephants encounter illegal or unsafe electrical installations. Although the State has adopted several mitigation measures, including solar-powered fencing, wire rope fencing, and technology-based monitoring systems, mortality risk increases when barriers are poorly designed, improperly maintained, or directly connected to high-voltage power sources. National guidelines and field evaluations emphasise that such unsafe practices pose serious risks to both elephants and local communities and must be addressed through enforcement as well as technical support (MoEF&CC, 2022; Panda *et al.,* 2020). The high anthropogenic mortality among males is particularly concerning, especially where mature bulls are affected. Older bulls can influence collective movement and social regulation, and reduced presence of older males has been associated with increased aggression in African elephant populations; its relevance to Asian elephants should therefore be interpreted cautiously (Kopf *et al.,* 2025).

The following measures are recommended to reduce electrocution-related elephant mortality in Tamil Nadu:

a. **Enforcement against illegal high-voltage connections:** Direct connection of farm fences to electricity distribution lines represents the most lethal risk and should be strictly prohibited. Enforcement actions should be accompanied by the provision of accessible and legally compliant alternatives, such as low-voltage or solar-powered fencing systems, and a clear mechanism for reporting unsafe installations (MoEF&CC, 2022).
b. **Joint inspection and monitoring in hotspot areas:** Seasonal inspection drives should be conducted in conflict-prone belts adjoining forest boundaries and elephant corridors, involving the Forest Department, electricity distribution companies or agencies, and local administration, to identify and remove hazardous installations (Trumpet, 2025).
c. **Promotion of elephant-safe fencing standards:** Village-level demonstrations and training programmes should be undertaken to promote standardised, elephant-safe fencing designs and regular maintenance practices. Poorly maintained fences frequently develop breaches or unsafe connections, increasing the likelihood of risky encounters rather than reducing conflict (Panda *et al.,* 2020).
d. **Strategic Installation of Electric Fencing:** Before installing electric fencing, the Forest Department should assess the proposed location to ensure that the barrier does not obstruct established elephant movement routes.

Implementing these measures consistently across high-risk landscapes will reduce lethal exposure to elephants while ensuring that crop-protection interventions remain safe, lawful, and effective.

### *Habitat-Based Prevention: Reducing Resource-Related Movement into Human-Use Areas*

Tamil Nadu has invested in habitat-site interventions such as in-forest water provisioning and fodder augmentation, including percolation ponds, check dams, waterholes, and troughs. These measures are intended to reduce dry-season resource scarcity that often drives elephants toward agricultural fields, settlements, and other human-use areas. Evidence from national guidelines and field experience indicates that such interventions can contribute to conflict reduction when they are strategically located and monitored, rather than applied uniformly or assumed to be effective by default (MoEF&CC, 2022; Panda *et al.,* 2020).

The following measures are recommended to strengthen habitat-side prevention of elephant movement into human-use areas in Tamil Nadu:

a. **Strategic placement of water and forage resources in large forest patches:** Water and forage augmentation should be prioritised within elephant movement landscapes and corridor-linked large forest patches connected to corridors and within protected areas. Targeted provisioning in these zones may reduce elephant movement into farmlands and settlements during periods of water and forage scarcity during periods of water and forage scarcity (Project Elephant, 2023).
b. **Monitoring and improvement of interventions:** The effectiveness of water and forage measures should be regularly assessed using elephant-movement records, conflict locations and early-warning data. Measures should be continued, modified or stopped depending on whether they reduce conflict.
c. **Corridor protection and land-use planning:** Local habitat improvements should be combined with the protection of elephant corridors and regulation of development within movement routes. Otherwise, these measures may shift conflict to another location rather than reduce it (Project Elephant, 2023).

Strengthening habitat-side prevention through strategic placement, monitoring, and integration with corridor management will help address the underlying drivers of elephant movement into human-dominated areas while maintaining landscape connectivity.

### *Capture, Translocation and Elephant-Driving Operations: Use Only under Defined Procedures and with Appropriate Monitoring*

Capture, restraint, and translocation of elephants are often requested during periods of acute conflict; however, these interventions should not be treated as routine or universal solutions. National operating procedures indicate that capture or translocation may be considered only after careful assessment of conflict severity, feasibility, and risk, and must be undertaken within a structured planning framework that prioritises human safety, animal welfare, and post-release outcomes (PE-MoEFCC-WII, 2024; MoEF&CC, 2022).

The following measures are recommended to guide the use of capture and translocation in Tamil Nadu:

a. **Use only when other measures have failed:** Capture and translocation should be considered only when non-lethal deterrence, physical barriers, and rapid response measures have proven insufficient, or where there is an immediate and sustained risk to human life (PE-MoEFCC-WII, 2024).
b. **Post-release monitoring of elephant:** Translocated elephants should, as far as practicable, be radio-collared and systematically monitored following release. Post-release monitoring should combine telemetry data with

physical field observations, as the long-term effectiveness of translocation depends on movement patterns, social integration, and conflict recurrence rather than on relocation alone.

c. **Pre- and post-intervention monitoring of solitary male elephants:** Solitary male elephants identified as recurrent conflict individuals should, where feasible, be radio-collared and monitored before and after any management intervention. Monitoring should assess their movement patterns, habitat use, behaviour and recurrence of conflict to determine whether the intervention has reduced risk or merely shifted the problem to another location.

d. **Avoid repeatedly driving conflict elephants into neighbouring ranges or divisions:** The repeated drive of conflict elephants from one range or forest division into another should be avoided unless the underlying causes of conflict, such as habitat constraints, corridor bottlenecks and food attractants, are also addressed. Otherwise, the intervention may only shift the conflict to another area rather than resolve it.

Applying capture and translocation strictly within these guidelines will help ensure that the intervention remains targeted, ethically defensible, and complementary to broader conflict-mitigation strategies in Tamil Nadu.

### *Prevention of Poaching and Retaliatory Poisoning*

Poisoning-related elephant deaths were recorded in several forest divisions of Tamil Nadu. Such incidents may occur as retaliatory killings following crop damage, property loss or human casualties. In contrast, poaching is generally associated with the illegal killing of elephants for ivory and its trade through black markets. The following measures are recommended to reduce these threats:

a. **Strengthen compensation mechanisms:** Transparent, fair and timely compensation for crop damage, property loss, injuries and human deaths can encourage affected communities to report incidents rather than resort to retaliatory poisoning. Efficient compensation also helps build trust between local communities and wildlife authorities.

b. **Community-based conflict management:** Trained community response teams should be established in conflict-prone villages to assist in safely deterring elephants from agricultural fields and settlements. These teams should work in coordination with Forest Department rapid-response units.

c. **Community awareness about elephant poaching and poisoning:** Awareness programmes should explain the ecological and legal consequences of killing elephants, possessing or trading ivory, and using poison against wildlife. Communities should also be informed about safe and confidential procedures for reporting suspected poaching, ivory trade and poisoning incidents.

d. **Strengthen intelligence and enforcement:** Surveillance and intelligence networks should be strengthened in poaching-prone areas to identify illegal hunters, ivory traders and transport routes. Regular patrolling, inter-agency coordination and strict enforcement of wildlife laws are required to prevent poaching and illegal ivory trade.

### *Vehicular Collisions: Prevention along High-Risk Road Sections*

Vehicular collisions may occur where roads intersect elephant corridors, forest boundaries and established movement routes. The following measures are recommended:

a. **Identification of high-risk road sections:** Elephant-crossing zones should be identified using collision records, field surveys and elephant-movement data.
b. **Speed regulation in elephant-crossing zones:** Reduced speed limits should be enforced along vulnerable road sections, particularly at night and during periods of frequent elephant movement.
c. **Installation of warning and detection systems:** Reflective signboards, flashing lights and sensor- or camera-based systems should be installed to warn motorists when elephants are approaching or crossing roads.

## RECOMMENDATIONS FOR MANAGING HUMAN FATALITIES AND INJURIES IN TAMIL NADU

Reducing human deaths and injuries resulting from human–elephant conflict in Tamil Nadu requires a combination of preventive, preparedness-based, and response-oriented interventions. Evidence from southern India indicates that human casualties may occur during sudden encounters, limited situational awareness, inadequate preparedness, and repeated elephant entry into high-risk spaces such as agricultural fields and settlements. In addition, the economic impacts of crop loss and property damage can increase tolerance thresholds and contribute to retaliatory responses (Krishnan & Kumar, 2017; Prasad *et al.*, 2025).

Tamil Nadu has established a strong foundation for conflict response through the deployment of rapid response teams, anti-depredation squads, early-warning and artificial intelligence (AI)-based alert systems, trip-wire alarms, and geo-referenced monitoring. The key objective of the following recommendations is to strengthen these existing measures by improving consistency, local ownership, and alignment with elephant movement corridors, rather than introducing entirely new interventions.

### *Physical Barriers at Settlement–Agriculture Interfaces*

Tamil Nadu employs a range of physical barriers, including elephant-proof trenches, solar-powered electric fences, stone walls, wire rope fences, and hanging solar fences, to reduce elephant entry into settlements and farmlands. National guidelines and field evaluations indicate that the effectiveness of such barriers depends less on their type and more on their placement, maintenance, and integration with elephant movement patterns. Poorly maintained or inappropriately located barriers frequently result in breaches that displace elephants into neighbouring villages, thereby escalating conflict rather than reducing it (MoEF&CC, 2022; Panda *et al.,* 2020).

The following measures are recommended to strengthen the effectiveness of physical barriers in Tamil Nadu:

a. **Strategic placement of barriers around high-risk areas:** Barriers should be installed around villages, agricultural fields and other locations with a high risk of elephant entry. They should not be placed across elephant corridors or established movement routes connecting forested areas, as this may obstruct elephant movement and increase conflict elsewhere (Project Elephant, 2023).
b. **Clear maintenance responsibility, transparent funding and rapid repair:** Responsibility for barrier maintenance should be clearly assigned at the village or cluster level, with designated committees or response teams responsible for specific fence segments or trench sections. Adequate maintenance funds should be transparently allocated and regularly maintained in a community-managed account so that repairs can be undertaken without delay. Rapid repair is essential to prevent minor damage from developing into repeated elephant-entry points.
c. **Integration with safe exit routes:** Barriers should be designed to guide elephants away from settlements while preserving access to natural movement corridors and forested areas. Barriers that block available exit routes may increase elephant stress and the risk of dangerous encounters.

Strengthening physical barriers through behaviour-informed placement, accountable maintenance, and corridor-sensitive design will improve their effectiveness as a preventive tool for reducing human deaths and injuries in Tamil Nadu.

### *Early-Warning Systems and Rapid Response*

Tamil Nadu has made substantial progress in deploying early warning and response mechanisms, including AI-based elephant alert systems, trip-wire alarms, radio-collaring, geo-referenced monitoring, and rapid response teams. These measures represent a strong foundation for reducing human casualties. Evidence from national guidance and field evaluations indicates that the effectiveness of such systems depends on how efficiently alerts are translated into timely and coordinated action on the ground (MoEF&CC, 2022; PE-MoEFCC-WII, 2025).

The following measures are recommended to strengthen early warning and rapid response in Tamil Nadu:

a. **Clear alert-to-action protocols:** A standardised response chain should be established to define how alerts are received, who responds, what equipment is deployed, and when the district administration and other relevant agencies should be engaged. Clearly defined protocols reduce delays and confusion during active conflict situations (Trumpet, 2025).
b. **Routine integration of district administration:** Existing coordination mechanisms should be formalised into periodic risk-review processes in hotspot blocks, ensuring that conflict preparedness, response capacity, and resource gaps are regularly assessed (MoEF&CC, 2022).
c. **Standardised training and equipment for response teams:** Rapid response teams should receive consistent training in safe, non-provocative deterrence methods, crowd management, and safe-distance protocols, in addition to understanding elephant behaviour. Standardisation improves safety for both responders and local communities.

### *Community safety and behaviour change: reduce risky encounters and crowd escalation*

Human–elephant conflict incidents frequently escalate due to behavioural factors such as night-time movement, alcohol-related risk-taking, crowding during elephant sightings, and retaliatory actions following losses. National operating procedures explicitly recognise that unmanaged crowds can rapidly shift from curiosity to confrontation, increasing risks to both people and elephants (PE-MoEFCC-WII, 2024).

The following measures are recommended to reduce risky encounters and crowd escalation in Tamil Nadu:

a. **Targeted awareness in corridor-edge institutions:** Awareness programmes should prioritise schools and colleges located near elephant corridors and forest edges, in line with corridor management recommendations that emphasise early behavioural intervention in high-risk zones (Project Elephant, 2023).
b. **Crowd management protocols during conflict events:** Standard crowd-control procedures, including pre-identified cordon points, communication

through local leaders, and clear enforcement of “do not approach” zones, should be integrated into every rapid response operation (MoEF&CC, 2022).

c. **Promotion of safe livelihood practices:** Villages with recurrent elephant presence should be supported with advisories on night travel, use of safe routes, and group movement during high-risk periods to reduce the likelihood of sudden encounters (Krishnan & Kumar, 2017).

### *Compensation and Grievance Redressal: Ensuring Timely, Transparent, and Reporting-Linked Support*

Tamil Nadu provides compensation for human fatalities, injuries, crop damage, and property loss associated with human–elephant conflict. However, evidence from southern India indicates that compensation mechanisms are most effective when they are timely, transparent, and closely linked to reporting and prevention efforts (Prasad *et al.,* 2025).

The following measures are recommended to strengthen compensation systems in Tamil Nadu:

a. **Fast-track verification and disbursal:** Compensation processes in hotspot blocks should follow clearly defined timelines with transparent escalation mechanisms to reduce delays and uncertainty (MoEF&CC, 2022).
b. **Linking compensation with prevention support:** Households repeatedly affected by conflict should be prioritised for preventive interventions such as barrier strengthening, early warning enrolment, and basic safety infrastructure (Panda *et al.,* 2020).
c. **Building institutional trust:** Predictable and consistent compensation processes help build trust between communities and authorities, which is critical for encouraging reporting and discouraging retaliatory actions.

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# APPENDIX I

*Details of Villages which witnessed Elephant Mortality in the state of Tamil Nadu from (2010-2025)*

| S.No | Elephant Mortality Count | Village Name | Sub-district | District |
|---|---|---|---|---|
| 1 | 3 | Sirumugai (TP) | Mettupalayam | Coimbatore |
| 2 | 1 | Odanthurai | Mettupalayam | Coimbatore |
| 3 | 1 | Nellithurai | Mettupalayam | Coimbatore |
| 4 | 1 | Mettupalayam (M) | Mettupalayam | Coimbatore |
| 5 | 1 | Jadayampalayam | Mettupalayam | Coimbatore |
| 6 | 3 | Thekkampatti | Mettupalayam | Coimbatore |
| 7 | 1 | NellimalaiR.F. | Mettupalayam | Coimbatore |
| 8 | 1 | Kemmarampalayam | Mettupalayam | Coimbatore |
| 9 | 2 | Marudur | Mettupalayam | Coimbatore |
| 10 | 1 | Kalampalayam | Mettupalayam | Coimbatore |
| 11 | 1 | Gudalur (TP) | Coimbatore North | Coimbatore |
| 12 | 1 | Veerapandi | Coimbatore North | Coimbatore |
| 13 | 1 | Kalapatti (TP) | Coimbatore North | Coimbatore |
| 14 | 1 | Pannimadai | Coimbatore North | Coimbatore |
| 15 | 1 | Vellakinar (TP) | Coimbatore North | Coimbatore |
| 16 | 1 | Vilankurichi (CT) | Coimbatore North | Coimbatore |
| 17 | 1 | Goundampalayam (M) | Coimbatore North | Coimbatore |
| 18 | 2 | Dhaliyur (TP) | Perur | Coimbatore |
| 19 | 1 | Thenkarai (TP) | Perur | Coimbatore |
| 20 | 1 | Theethipalayam | Perur | Coimbatore |
| 21 | 4 | Madur Pethikuttai Forest | Mettupalayam | Coimbatore |
| 22 | 1 | Odanthurai R F | Mettupalayam | Coimbatore |
| 23 | 1 | Jaganarai Slopes R F | Mettupalayam | Coimbatore |
| 24 | 3 | Thadagam R F | Coimbatore North | Coimbatore |
| 25 | 1 | Gopanari R F | Mettupalayam | Coimbatore |
| 26 | 1 | Booluvampatti (BlockII) | Perur | Coimbatore |
| 27 | 1 | Madukkarai (TP) | Madukkari | Coimbatore |

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|---|---|---|---|---|
| 28 | 1 | Boluvampatti R F | Madukkari | Coimbatore |
| 29 | 2 | Pichanur | Madukkari | Coimbatore |
| 30 | 2 | Thalakkarai | Pollachi | Coimbatore |
| 31 | 4 | Valparai (M) | Valparai | Coimbatore |
| 32 | 1 | Angalakurichi | Anaimalai | Coimbatore |
| 33 | 1 | Kottur (TP) | Anaimalai | Coimbatore |
| 34 | 1 | Vadakkusrivilliputhur | Srivilliputhur | Virudhunagar |
| 35 | 2 | Srivilliputhur (M) | Srivilliputhur | Virudhunagar |
| 36 | 2 | Panjapalli | Palakkodu | Dharmapuri |
| 37 | 3 | Gendanahalli | Palakkodu | Dharmapuri |
| 38 | 2 | Settikarai | Dharmapuri | Dharmapuri |
| 39 | 1 | Kelavalli | Karimangalam | Dharmapuri |
| 40 | 1 | Jakkupatti | Karimangalam | Dharmapuri |
| 41 | 1 | Bosinaickenhalli | Pappireddipatti | Dharmapuri |
| 42 | 2 | Bevanurmalai R F | Pennagaram | Dharmapuri |
| 43 | 1 | Pennagaram R F | Pennagaram | Dharmapuri |
| 44 | 1 | Alathucombai | Sathyamangalam | Erode |
| 45 | 3 | Guthiyalathur | Sathyamangalam | Erode |
| 46 | 1 | Pungar | Sathyamangalam | Erode |
| 47 | 1 | Ikkarainegamam | Sathyamangalam | Erode |
| 48 | 1 | Pudupeerkadavu | Sathyamangalam | Erode |
| 49 | 1 | Pattavarthiayyampalayam | Sathyamangalam | Erode |
| 50 | 1 | Ennamangalam | Anthiyur | Erode |
| 51 | 2 | Bhavanisagar (TP) | Sathyamangalam | Erode |
| 52 | 1 | Chikkarasampalayam | Sathyamangalam | Erode |
| 53 | 2 | Pachampalayam | Anthiyur | Erode |
| 54 | 1 | Patlur | Anthiyur | Erode |
| 55 | 1 | Talamalai | Thalavadi | Erode |
| 56 | 1 | Byannapuram | Thalavadi | Erode |
| 57 | 1 | Madahalli | Thalavadi | Erode |
| 58 | 1 | Marur | Thalavadi | Erode |
| 59 | 2 | Mallankuli | Thalavadi | Erode |
| 60 | 3 | Kembainaickenpalayam (TP) | Sathyamangalam | Erode |
| 61 | 1 | Pullappanaickenpalayam | Gobichettipalayam | Erode |
| 62 | 1 | Virupakshi | Oddanchatram | Dindigul |
| 63 | 1 | Athicombai | Oddanchatram | Dindigul |

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|---|---|---|---|---|
| 64 | 1 | Palani (M) | Palani | Dindigul |
| 65 | 1 | Vellagavi | Kodaikanal | Dindigul |
| 66 | 1 | Ebbiri | Krishnagiri | Krishnagiri |
| 67 | 2 | Chenathur | Hosur | Krishnagiri |
| 68 | 2 | Kallukurikki | Krishnagiri | Krishnagiri |
| 69 | 1 | Nagamangalam | Denkanikottai | Krishnagiri |
| 70 | 1 | Udedurgam | Denkanikottai | Krishnagiri |
| 71 | 1 | Krishnagiri (M) | Krishnagiri | Krishnagiri |
| 72 | 1 | Denkanikottai (TP) | Denkanikottai | Krishnagiri |
| 73 | 1 | Thavarakarai | Denkanikottai | Krishnagiri |
| 74 | 1 | Noganoor | Denkanikottai | Krishnagiri |
| 75 | 2 | Rathnagiri | Denkanikottai | Krishnagiri |
| 76 | 1 | Santhanapalli | Denkanikottai | Krishnagiri |
| 77 | 1 | Malligarjunadurgam | Denkanikottai | Krishnagiri |
| 78 | 1 | Madakkal | Anchetty | Krishnagiri |
| 79 | 1 | Gundalapatti | Krishnagiri | Krishnagiri |
| 80 | 1 | Natrapalayam | Anchetty | Krishnagiri |
| 81 | 1 | Velakalahalli | Krishnagiri | Krishnagiri |
| 82 | 1 | Denkanikotta R F | Denkanikottai | Krishnagiri |
| 83 | 1 | Jowlagiri R F | Denkanikottai | Krishnagiri |
| 84 | 1 | Udubarani R F | Denkanikottai | Krishnagiri |
| 85 | 1 | Thaggatti R F | Anchetty | Krishnagiri |
| 86 | 1 | Kesthur R F | Anchetty | Krishnagiri |
| 87 | 3 | Gullatty R.F. | Denkanikottai | Krishnagiri |
| 88 | 1 | Kovilpatti | Andipatti | Theni |
| 89 | 2 | Megamalai | Andipatti | Theni |
| 90 | 4 | Erasakkanayackanur Hills | Uthamapalayam | Theni |
| 91 | 3 | Erasakkanayackanur | Uthamapalayam | Theni |
| 92 | 1 | Suruli RF | Uthamapalayam | Theni |
| 93 | 2 | Kadanad | Udhagamandalam | The Nilgiris |
| 94 | 9 | Masinagudi | Udhagamandalam | The Nilgiris |
| 95 | 1 | Hallimoyar | Kotagiri | The Nilgiris |
| 96 | 2 | Nelliyalam | Panthalur | The Nilgiris |
| 97 | 3 | Devarshola (TP) | Gudalur | The Nilgiris |
| 98 | 2 | Cherangode | Panthalur | The Nilgiris |
| 99 | 1 | Kukkal | Udhagamandalam | The Nilgiris |
| 100 | 9 | Gudalur (M) | Gudalur | The Nilgiris |

| | | | | |
|---|---|---|---|---|
| 101 | 1 | Sholur (TP) | Udhagamandalam | The Nilgiris |
| 102 | 1 | Nelliyalam (M) | Panthalur | The Nilgiris |
| 103 | 1 | Hullathi | Udhagamandalam | The Nilgiris |
| 104 | 1 | Naduvattam (TP) | Udhagamandalam | The Nilgiris |
| 105 | 1 | O' Valley (TP) | Gudalur | The Nilgiris |
| 106 | 1 | Kotagiri (TP) | Kotagiri | The Nilgiris |
| 107 | 1 | Coonoor (M) | Coonoor | The Nilgiris |
| 108 | 1 | Huligal (TP) | Coonoor | The Nilgiris |
| 109 | 1 | Bikketti (TP) | Kundah | The Nilgiris |
| 110 | 1 | Rayagiri (TP) | Sivagiri | Tenkasi |
| 111 | 2 | Puliankudi (M) | Sivagiri | Tenkasi |
| 112 | 1 | Sankarankoil (M) | Sankarankoil | Tenkasi |
| 113 | 2 | Kadayanallur (M) | Kadayanallur | Tenkasi |
| 114 | 1 | Vikramasingapuram (M) | Ambasamudram | Tirunelveli |
| 115 | 1 | Therku Kallidaikurichi | Ambasamudram | Tirunelveli |
| 116 | 1 | Papanasam R.F. | Tenkasi | Tenkasi |
| 117 | 1 | Chiramadam | Thovala | Kanniyakumari |
| 118 | 1 | Nagercoil (M) | Agastheeswaram | Kanniyakumari |
| 119 | 1 | Paruvai | Palladam | Tiruppur |
| 120 | 1 | Andigoundanur | Udumalaipettai | Tiruppur |
| 121 | 1 | Anamalai R.F. | Valparai | Coimbatore |
| 122 | 1 | Oravandavadi | Chengam | Tiruvannamalai |
| 123 | 1 | Dakshinapathapalayam | Gudiyatham | Vellore |
| 124 | 1 | Gudiyatham (M) | Gudiyatham | Vellore |
| 125 | 1 | Lakkampatti | Mettur | Salem |
| 126 | 1 | Mettur (M) | Mettur | Salem |
| 127 | 2 | Burgur (North R.F.) | Anthiyur | Erode |
| 128 | 4 | Talamalai Extn. (R.F.) | Thalavadi | Erode |
| 129 | 3 | Guthiyalathur Extension RF | Sathyamangalam | Erode |
| 130 | 4 | Talamalai R.F. | Thalavadi | Erode |
| 131 | 6 | Guthiyalathur (Addition) R.F. | Sathyamangalam | Erode |
| 132 | 2 | Burgur South R.F.. | Anthiyur | Erode |

# APPENDIX II

*Details of Villages which witnessed Human Mortality by Elephants in the state of Tamil Nadu from (2010-2025)*

| S.No. | Human Casualties Count | Village Name | Sub-district | District |
|---|---|---|---|---|
| 1 | 3 | Sirumugai | Mettupalayam | Coimbatore |
| 2 | 22 | Odanthurai | Mettupalayam | Coimbatore |
| 3 | 2 | Chickadasampalayam | Mettupalayam | Coimbatore |
| 4 | 7 | Hulical Drug R F | Mettupalayam | Coimbatore |
| 5 | 3 | Nellithurai | Mettupalayam | Coimbatore |
| 6 | 6 | Thekkampatti | Mettupalayam | Coimbatore |
| 7 | 2 | Nellimalair | Mettupalayam | Coimbatore |
| 8 | 12 | Karamadai | Mettupalayam | Coimbatore |
| 9 | 8 | Nellithurai And Sundapatti R F | Mettupalayam | Coimbatore |
| 10 | 1 | Melur Slope R F | Mettupalayam | Coimbatore |
| 11 | 3 | Marudur | Mettupalayam | Coimbatore |
| 12 | 1 | Bilichi | Coimbatore North | Coimbatore |
| 13 | 1 | Gudalur | Coimbatore North | Coimbatore |
| 14 | 3 | Tholampalayam | Mettupalayam | Coimbatore |
| 15 | 5 | Veerapandi | Coimbatore North | Coimbatore |
| 16 | 16 | Anaikatti North R F | Mettupalayam | Coimbatore |
| 17 | 4 | Kurudampalayam | Coimbatore North | Coimbatore |
| 18 | 11 | Chinnathadagam | Coimbatore North | Coimbatore |
| 19 | 16 | Nanjundapuram | Coimbatore North | Coimbatore |
| 20 | 9 | Veerapandi | Coimbatore North | Coimbatore |
| 21 | 1 | Somayampalayam | Coimbatore North | Coimbatore |
| 22 | 1 | Vadavalli | Perur | Coimbatore |
| 23 | 2 | Veerakeralam | Coimbatore North | Coimbatore |
| 24 | 3 | Thondamuthur | Perur | Coimbatore |
| 25 | 5 | Devarayapuram | Perur | Coimbatore |
| 26 | 1 | Dhaliyur | Perur | Coimbatore |
| 27 | 2 | Vellaimalaipattinam | Perur | Coimbatore |
| 28 | 1 | Narasipuram | Perur | Coimbatore |

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|---|---|---|---|---|
| 29 | 1 | Vedapatti | Perur | Coimbatore |
| 30 | 19 | Ikkaraibooluvampatti | Perur | Coimbatore |
| 31 | 1 | Thenkarai | Perur | Coimbatore |
| 32 | 1 | Thennammanallur | Perur | Coimbatore |
| 33 | 1 | Theethipalayam | Perur | Coimbatore |
| 34 | 2 | Madampatti | Perur | Coimbatore |
| 35 | 1 | Perur Chettipalayam | Perur | Coimbatore |
| 36 | 7 | Pooluvapatti | Perur | Coimbatore |
| 37 | 7 | Alanthurai | Perur | Coimbatore |
| 38 | 3 | Madur Pethikuttai Forest | Mettupalayam | Coimbatore |
| 39 | 1 | Odanthurai R F | Mettupalayam | Coimbatore |
| 40 | 2 | Kandiyur R F | Mettupalayam | Coimbatore |
| 41 | 1 | Nilgiri Eastern Slope R F | Mettupalayam | Coimbatore |
| 42 | 28 | Thadagam R F | Coimbatore North | Coimbatore |
| 43 | 1 | Gopanari R F | Mettupalayam | Coimbatore |
| 44 | 3 | Anaikatti North | Coimbatore North | Coimbatore |
| 45 | 1 | Anaikatti South | Coimbatore North | Coimbatore |
| 46 | 13 | Boluvampatti Block I | Perur | Coimbatore |
| 47 | 30 | Booluvampatti Blockii | Perur | Coimbatore |
| 48 | 2 | Madavarayapuram | Perur | Coimbatore |
| 49 | 1 | Z Muthur | Pollachi | Coimbatore |
| 50 | 1 | Marchinaickenpalayam | Anaimalai | Coimbatore |
| 51 | 1 | Periapodu | Anaimalai | Coimbatore |
| 52 | 83 | Valparai M | Valparai | Coimbatore |
| 53 | 2 | Kaliyapuram | Anaimalai | Coimbatore |
| 54 | 6 | Arthanaripalayam | Anaimalai | Coimbatore |
| 55 | 3 | Kumarapalayam | Sulur | Coimbatore |
| 56 | 1 | Ettimadai R F | Madukkari | Coimbatore |
| 57 | 12 | Boluvampatti Exten R F | Perur | Coimbatore |
| 58 | 1 | Solakarai R F | Madukkari | Coimbatore |
| 59 | 1 | Panjapalli | Palakkodu | Dharmapuri |
| 60 | 1 | Chinnagowndanahalli | Palakkodu | Dharmapuri |
| 61 | 1 | Periyanur | Palakkodu | Dharmapuri |
| 62 | 2 | Marandahalli | Palakkodu | Dharmapuri |
| 63 | 1 | Gendanahalli | Palakkodu | Dharmapuri |
| 64 | 1 | Gujjarahalli | Palakkodu | Dharmapuri |
| 65 | 1 | Chikkardanahalli | Palakkodu | Dharmapuri |
| 66 | 2 | Palakkodu | Palakkodu | Dharmapuri |

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| 67 | 3 | Erranahalli | Palakkodu | Dharmapuri |
| 68 | 2 | Karagodahalli | Palakkodu | Dharmapuri |
| 69 | 1 | Naganampatty | Karimangalam | Dharmapuri |
| 70 | 1 | Mukkulam | Karimangalam | Dharmapuri |
| 71 | 1 | Morappur R F | Pennagaram | Dharmapuri |
| 72 | 1 | Murukkampatti | Karimangalam | Dharmapuri |
| 73 | 1 | Ajjanahalli | Pennagaram | Dharmapuri |
| 74 | 3 | Pennagaram | Pennagaram | Dharmapuri |
| 75 | 1 | Papparapatti | Pennagaram | Dharmapuri |
| 76 | 1 | Panaikulam | Pennagaram | Dharmapuri |
| 77 | 1 | Bosinaickenhalli | Pappireddipatti | Dharmapuri |
| 78 | 1 | Mekalanayakanahalli | Pappireddipatti | Dharmapuri |
| 79 | 9 | Bevanurmalai R F | Pennagaram | Dharmapuri |
| 80 | 1 | Woddapatti R F | Pennagaram | Dharmapuri |
| 81 | 1 | Pennagaram R F | Pennagaram | Dharmapuri |
| 82 | 2 | Keserkuli R F | Pennagaram | Dharmapuri |
| 83 | 1 | Panahahalli | Thalavadi | Erode |
| 84 | 11 | Guthiyalathur | Sathyamangalam | Erode |
| 85 | 8 | Illippili | Anthiyur | Erode |
| 86 | 8 | Kothamangalam | Sathyamangalam | Erode |
| 87 | 1 | Sathyamangalam M | Sathyamangalam | Erode |
| 88 | 2 | Ennamangalam | Anthiyur | Erode |
| 89 | 1 | Gettavadi | Thalavadi | Erode |
| 90 | 4 | Dhoddampalayam | Sathyamangalam | Erode |
| 91 | 3 | Kurumbapalayam | Sathyamangalam | Erode |
| 92 | 1 | Athani Tp | Anthiyur | Erode |
| 93 | 3 | Rajan Nagar | Sathyamangalam | Erode |
| 94 | 1 | Chikkarasampalayam | Sathyamangalam | Erode |
| 95 | 2 | Talamalai | Thalavadi | Erode |
| 96 | 1 | Gundri | Sathyamangalam | Erode |
| 97 | 5 | Iggalore | Thalavadi | Erode |
| 98 | 1 | Vinnappalli | Sathyamangalam | Erode |
| 99 | 4 | Thiginarai | Thalavadi | Erode |
| 100 | 1 | Marur | Thalavadi | Erode |
| 101 | 3 | Thingalur | Sathyamangalam | Erode |
| 102 | 1 | Dhoddahajanur | Thalavadi | Erode |
| 103 | 2 | Mallankuli | Thalavadi | Erode |
| 104 | 1 | Arulavadi | Thalavadi | Erode |

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| 105 | 1 | Talavadi | Thalavadi | Erode |
| 106 | 3 | Kembainaickenpalayam Tp | Sathyamangalam | Erode |
| 107 | 2 | Burgur | Anthiyur | Erode |
| 108 | 5 | Periyakodiveri Tp | Gobichettipalayam | Erode |
| 109 | 3 | Pullappanaickenpalayam | Gobichettipalayam | Erode |
| 110 | 1 | Perumugai | Gobichettipalayam | Erode |
| 111 | 1 | Mudukkanthurai | Sathyamangalam | Erode |
| 112 | 1 | Mookkanur | Sankarapuram | Kallakurichi |
| 113 | 2 | Ullepalayam R F | Sathyamangalam | Erode |
| 114 | 1 | Barabetta R F | Sathyamangalam | Erode |
| 115 | 14 | Thamarakkarai R F | Anthiyur | Erode |
| 116 | 2 | Vadakkanandal Tp | Chinnasalem | Kallakurichi |
| 117 | 1 | Oddanchatram Tp | Oddanchatram | Dindigul |
| 118 | 7 | Ayakudi Tp | Palani | Dindigul |
| 119 | 1 | Vadagadu | Oddanchatram | Dindigul |
| 120 | 1 | Sindalavadampatti | Oddanchatram | Dindigul |
| 121 | 4 | Palani M | Palani | Dindigul |
| 122 | 2 | Dasaripatti | Oddanchatram | Dindigul |
| 123 | 2 | Balasamudram Tp | Palani | Dindigul |
| 124 | 8 | Vadagounchi | Kodaikanal | Dindigul |
| 125 | 2 | Periyur | Kodaikanal | Dindigul |
| 126 | 1 | Kilakkuchettipatti | Kodaikanal | Dindigul |
| 127 | 1 | Chattirapatti | Dindigulwest | Dindigul |
| 128 | 1 | Sivagiripatti | Palani | Dindigul |
| 129 | 6 | Vilpatti | Kodaikanal | Dindigul |
| 130 | 3 | Adukkam | Kodaikanal | Dindigul |
| 131 | 1 | Pachalur | Kodaikanal | Dindigul |
| 132 | 1 | Thandigudi | Kodaikanal | Dindigul |
| 133 | 1 | Kullur | Shoolagiri | Krishnagiri |
| 134 | 1 | Begepalli | Hosur | Krishnagiri |
| 135 | 7 | Avalapalli | Hosur | Krishnagiri |
| 136 | 1 | Konganepalli | Krishnagiri | Krishnagiri |
| 137 | 3 | Punugandoddi | Hosur | Krishnagiri |
| 138 | 6 | Moranapalli | Hosur | Krishnagiri |
| 139 | 3 | Chenathur | Hosur | Krishnagiri |
| 140 | 2 | Bukkasagaram | Shoolagiri | Krishnagiri |
| 141 | 1 | Thorapalli Agraharam | Hosur | Krishnagiri |
| 142 | 2 | Sanamavu R F | Hosur | Krishnagiri |

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| 143 | 4 | Kamandoddi | Shoolagiri | Krishnagiri |
| 144 | 3 | Kondappanayanapalli | Krishnagiri | Krishnagiri |
| 145 | 9 | Sanamavu | Shoolagiri | Krishnagiri |
| 146 | 2 | Guruvinayanapalli | Bargur | Krishnagiri |
| 147 | 2 | Thiyagarsanapalli | Shoolagiri | Krishnagiri |
| 148 | 2 | Kundumaranapalli | Denkanikottai | Krishnagiri |
| 149 | 2 | Thiyarandurgam | Shoolagiri | Krishnagiri |
| 150 | 1 | Mallasandiram | Shoolagiri | Krishnagiri |
| 151 | 1 | Madagondapalli | Denkanikottai | Krishnagiri |
| 152 | 1 | Balagondarayanadurgam | Shoolagiri | Krishnagiri |
| 153 | 2 | Kottamadagu | Denkanikottai | Krishnagiri |
| 154 | 1 | Melumalai | Shoolagiri | Krishnagiri |
| 155 | 3 | Kurubarapalli | Krishnagiri | Krishnagiri |
| 156 | 2 | Nagamangalam | Denkanikottai | Krishnagiri |
| 157 | 1 | Kundarapalli | Krishnagiri | Krishnagiri |
| 158 | 5 | Karukkanahalli | Denkanikottai | Krishnagiri |
| 159 | 1 | Marupalli | Denkanikottai | Krishnagiri |
| 160 | 1 | Nellamaru Agraharam | Denkanikottai | Krishnagiri |
| 161 | 4 | Suligunta | Denkanikottai | Krishnagiri |
| 162 | 8 | Pachapanatti | Denkanikottai | Krishnagiri |
| 163 | 2 | Bayanapalli | Krishnagiri | Krishnagiri |
| 164 | 5 | Arasakuppam | Denkanikottai | Krishnagiri |
| 165 | 2 | Maharajakadai R F | Krishnagiri | Krishnagiri |
| 166 | 5 | Thalli R F | Denkanikottai | Krishnagiri |
| 167 | 5 | Pillari Agraharam | Denkanikottai | Krishnagiri |
| 168 | 5 | Ulimangalam | Denkanikottai | Krishnagiri |
| 169 | 5 | Denkanikottai | Denkanikottai | Krishnagiri |
| 170 | 1 | Kottur | Denkanikottai | Krishnagiri |
| 171 | 1 | Agalakotta | Denkanikottai | Krishnagiri |
| 172 | 5 | Thavarakarai | Denkanikottai | Krishnagiri |
| 173 | 1 | Kattiganapalli | Krishnagiri | Krishnagiri |
| 174 | 2 | Rayakotta | Denkanikottai | Krishnagiri |
| 175 | 4 | Chikkapoovathi | Krishnagiri | Krishnagiri |
| 176 | 5 | Noganoor | Denkanikottai | Krishnagiri |
| 177 | 1 | Alapatti | Krishnagiri | Krishnagiri |
| 178 | 1 | Rathnagiri | Denkanikottai | Krishnagiri |
| 179 | 1 | Palayamkotta | Denkanikottai | Krishnagiri |
| 180 | 1 | Santhanapalli | Denkanikottai | Krishnagiri |

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| 181 | 1 | Periamuthu | Krishnagiri | Krishnagiri |
| 182 | 1 | Bellarapalli | Krishnagiri | Krishnagiri |
| 183 | 3 | Andevanapalli | Denkanikottai | Krishnagiri |
| 184 | 3 | Nendimangalam | Denkanikottai | Krishnagiri |
| 185 | 1 | Hanumanthapuram | Denkanikottai | Krishnagiri |
| 186 | 1 | Malligarjunadurgam | Denkanikottai | Krishnagiri |
| 187 | 15 | Madakkal | Anchetty | Krishnagiri |
| 188 | 2 | Salivaram | Denkanikottai | Krishnagiri |
| 189 | 1 | Thaggatti | Anchetty | Krishnagiri |
| 190 | 1 | Vilangamudi | Pochampalli | Krishnagiri |
| 191 | 1 | Manchukondapalli | Anchetty | Krishnagiri |
| 192 | 1 | Karkoodalpatti | Rasipuram | Namakkal |
| 193 | 15 | Denkanikotta R F | Denkanikottai | Krishnagiri |
| 194 | 10 | Jowlagiri R F | Denkanikottai | Krishnagiri |
| 195 | 5 | Ulibanda R F | Denkanikottai | Krishnagiri |
| 196 | 2 | Ayyur R F | Denkanikottai | Krishnagiri |
| 197 | 1 | Manchi R F | Denkanikottai | Krishnagiri |
| 198 | 2 | Udubarani R F | Denkanikottai | Krishnagiri |
| 199 | 2 | Anchetty R F | Anchetty | Krishnagiri |
| 200 | 1 | Urigam R F | Anchetty | Krishnagiri |
| 201 | 1 | Natrapalayam R F | Anchetty | Krishnagiri |
| 202 | 1 | Kesthur R F | Anchetty | Krishnagiri |
| 203 | 1 | Biligundulu R F | Anchetty | Krishnagiri |
| 204 | 4 | Oddapatty R F | Anchetty | Krishnagiri |
| 205 | 2 | Gullatty R F | Denkanikottai | Krishnagiri |
| 206 | 3 | Megamalai | Andipatti | Theni |
| 207 | 1 | Gudalur M | Uthamapalayam | Theni |
| 208 | 1 | Thevaram | Uthamapalayam | Theni |
| 209 | 1 | T Meenakshipuram | Uthamapalayam | Theni |
| 210 | 2 | Pannaipuram | Uthamapalayam | Theni |
| 211 | 5 | Sankarapuram | Uthamapalayam | Theni |
| 212 | 1 | Kambam M | Uthamapalayam | Theni |
| 213 | 1 | Uthamapalayam | Uthamapalayam | Theni |
| 214 | 2 | Vannathiparai R F | Uthamapalayam | Theni |
| 215 | 1 | Suruli R F | Uthamapalayam | Theni |
| 216 | 13 | Mudumalai | Gudalur | The Nilgiris |
| 217 | 1 | Nellakotta | Gudalur | The Nilgiris |
| 218 | 14 | Masinagudi | Udhagamandalam | The Nilgiris |

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| 219 | 6 | Munnanad | Panthalur | The Nilgiris |
| 220 | 1 | Erumad | Panthalur | The Nilgiris |
| 221 | 26 | Nelliyalam | Panthalur | The Nilgiris |
| 222 | 5 | Ebbanad | Udhagamandalam | The Nilgiris |
| 223 | 20 | Devarshola Tp | Gudalur | The Nilgiris |
| 224 | 40 | Cherangode | Panthalur | The Nilgiris |
| 225 | 1 | Srimadurai | Gudalur | The Nilgiris |
| 226 | 2 | Kukkal | Udhagamandalam | The Nilgiris |
| 227 | 28 | Gudalur M | Gudalur | The Nilgiris |
| 228 | 4 | Sholur Tp | Udhagamandalam | The Nilgiris |
| 229 | 54 | Nelliyalam M | Panthalur | The Nilgiris |
| 230 | 2 | Nedugula | Kotagiri | The Nilgiris |
| 231 | 4 | Naduvattam | Udhagamandalam | The Nilgiris |
| 232 | 51 | O Valley | Gudalur | The Nilgiris |
| 233 | 1 | Aracode | Kotagiri | The Nilgiris |
| 234 | 1 | Naduhatty | Kotagiri | The Nilgiris |
| 235 | 2 | Kadinamala | Kotagiri | The Nilgiris |
| 236 | 6 | Konakarai | Kotagiri | The Nilgiris |
| 237 | 6 | Thummanatti | Udhagamandalam | The Nilgiris |
| 238 | 2 | Kengarai | Kotagiri | The Nilgiris |
| 239 | 1 | Kotagiri | Kotagiri | The Nilgiris |
| 240 | 1 | Wellington Cb | Coonoor | The Nilgiris |
| 241 | 1 | Burliyar | Coonoor | The Nilgiris |
| 242 | 3 | Coonoor M | Coonoor | The Nilgiris |
| 243 | 1 | Adikaratti | Coonoor | The Nilgiris |
| 244 | 2 | Balacola | Kundah | The Nilgiris |
| 245 | 3 | Huligal | Coonoor | The Nilgiris |
| 246 | 8 | Mulligoor | Kundah | The Nilgiris |
| 247 | 2 | Kilkunda | Kundah | The Nilgiris |
| 248 | 2 | Kinnakkorai | Kundah | The Nilgiris |
| 249 | 2 | Sivagiri R F | Sivagiri | Tenkasi |
| 250 | 1 | Viswanathapperi | Sivagiri | Tenkasi |
| 251 | 1 | Courtalam | Tenkasi | Tenkasi |
| 252 | 2 | Vairavankulam R F | Kadayanallur | Tenkasi |
| 253 | 2 | Veerapuli R F | Thiruvattar | Kanniyakumari |
| 254 | 1 | Kadayal | Vilavancode | Kanniyakumari |
| 255 | 3 | Ponmanai | Thiruvattar | Kanniyakumari |
| 256 | 1 | Veerapuli R F | Thovala | Kanniyakumari |

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| 257 | 1 | Asambu R F | Thovala | Kanniyakumari |
| 258 | 1 | Anamalai R F | Valparai | Coimbatore |
| 259 | 1 | Kallapuram | Udumalaipettai | Tiruppur |
| 260 | 3 | Amaravathi R F | Valparai | Coimbatore |
| 261 | 3 | Manjampatti R F | Kodaikanal | Dindigul |
| 262 | 1 | Polur | Polur | Tiruvannamalai |
| 263 | 1 | Vasur | Polur | Tiruvannamalai |
| 264 | 1 | Mangalam | Tiruvannamalai | Tiruvannamalai |
| 265 | 1 | Sorathur | Kilpennathur | Tiruvannamalai |
| 266 | 1 | Sandavasal R F | Polur | Tiruvannamalai |
| 267 | 1 | Radhapuram R F | Thandrampet | Tiruvannamalai |
| 268 | 1 | Chinnakolapadi | Chengam | Tiruvannamalai |
| 269 | 1 | Pernampattu M | Pernambut | Vellore |
| 270 | 2 | Rajakuppam | Gudiyatham | Vellore |
| 271 | 1 | Palamalai | Mettur | Salem |
| 272 | 1 | Kuttapatti | Mettur | Salem |
| 273 | 1 | Kannamoochi | Mettur | Salem |
| 274 | 1 | Salem M Corp | Salem | Salem |
| 275 | 1 | Idupali | Edappadi | Salem |
| 276 | 1 | Tumbal R F | Attur | Salem |
| 277 | 1 | Tirupattur | Tirupathur | Tirupathur |
| 278 | 1 | Alangayam Tp | Vaniyambadi | Tirupathur |
| 279 | 14 | Burgur North R F | Anthiyur | Erode |
| 280 | 16 | Talamalai Extn R F | Thalavadi | Erode |
| 281 | 22 | Guthiyalathur Extension R F | Sathyamangalam | Erode |
| 282 | 42 | Talamalai R F | Thalavadi | Erode |
| 283 | 7 | Guthiyalathur Addition R F | Sathyamangalam | Erode |

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