

From Conflict to Coexistence Failure: Rethinking Human-Wildlife Relations in India

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ABSTRACT

Human-wildlife conflict in India is commonly framed as a series of isolated encounters involving species or locations, typically addressed through reactive mitigation measures and compensation schemes. This study revisits these interactions from a systemic perspective by examining whether persistent conflict outcomes reflect deeper conditions of coexistence failure. Rather than treating conflict as episodic incidents, the study analyses how structural transformations in landscapes, livelihoods, and governance arrangements shape recurring patterns of interaction between humans and wildlife. Using a Critical Interpretive Synthesis (CIS) approach, the research integrates evidence from interdisciplinary literature, national wildlife mortality records, compensation statistics, and policy documents to examine the drivers of human-wildlife conflict across India. The analysis focuses on five interrelated domains: land-use configuration and habitat fragmentation; expansion of linear infrastructure; livelihood dependence on agriculture and forest resources; climatic variability; and institutional governance frameworks. National evidence indicates that a substantial proportion of wildlife populations occur outside protected areas within agricultural and multi-use landscapes where routine livelihood activities intersect with wildlife movement. Human fatalities from wildlife encounters exceed several thousand annually, while infrastructure-related wildlife mortality - including elephant deaths from electrocution and train collisions - continues to rise. Compensation payments for crop damage and human fatalities have also increased significantly, reflecting the growing socio-economic burden borne by rural communities. The findings suggest that conflict persists not merely because of wildlife behaviour but because land-use planning, infrastructure development, and livelihood systems increasingly produce conditions in which human and wildlife activities overlap. Institutional responses remain fragmented and largely reactive, focusing on incident management rather than addressing structural drivers of risk. Conceptualising human-wildlife conflict as coexistence failure therefore provides a broader analytical framework for understanding persistent conflict outcomes and highlights the need for landscape-level planning, wildlife-sensitive infrastructure design, and coordinated governance approaches to support more stable forms of human-wildlife coexistence in India.

Key words: Human-wildlife conflict, Coexistence failure, Conservation governance, Structural drivers, Institutional mismatch, Climate change

INTRODUCTION

In reflecting on the long and often contested relationship between human societies and the natural world (Aisher and Damodaran 2016), the conservationist Baba Dioum once observed that we will conserve only what we love, we will love only what we understand, and we will understand only what we are taught (Barentine et al. 2023). This

insight remains deeply relevant to contemporary India, where scholarly and policy understanding of human-wildlife interactions has struggled to keep pace with rapid transformations in land use, rural livelihoods, and environmental governance systems (Ghosal et al. 2015, Khatri et al. 2024, Vinayak and Ramdas 2024). As economic development, infrastructure expansion, and climate variability reshape human-dominated environments, encounters

between people and wildlife are increasingly framed as human-wildlife conflict, revealing not only ecological tensions but also deeper institutional and social challenges (Abrahms et al. 2023, Cordero et al. 2018).

India's landscapes are characterised by a complex socio-ecological mosaic of forests, agricultural lands, grazing areas, and expanding peri-urban settlements that together support both human livelihoods and wildlife populations. Although protected areas constitute the core of the country's conservation strategy, a substantial proportion of wildlife populations occur outside these protected landscapes within multi-use environments that are simultaneously used for farming, grazing, and resource extraction (Bisui and Shit 2023, Fox et al. 1994). Recent estimates indicate that nearly 70-80% of India's wildlife occurs outside formally protected areas, often within agricultural and forest-fringe landscapes where interactions with human activities are frequent (Karanth and DeFries 2010). Many rural households depend directly on agriculture, livestock rearing, and forest-derived resources, creating routine spatial overlap between human activities and wildlife habitats (Amoako Johnson and Hutton 2014). This overlap is historically embedded within patterns of land use, tenure systems, and livelihood practices that have evolved over decades across rural India (Tripathi and Prasad 2010).

Over the past two decades, however, the scale and intensity of human-wildlife interactions have changed significantly. Rapid land-use transformations, expansion of linear infrastructure such as roads, railways, and power transmission networks, and increasing competition for land and water resources have altered ecological connectivity and wildlife movement patterns across many landscapes (Everard et al. 2017). India currently maintains over 68,000 km of railway lines and more than 6 million km of road networks, many of which intersect forest landscapes and wildlife movement corridors. These changes frequently bring wildlife into closer proximity with agricultural lands and settlements, increasing the probability of encounters that result in crop loss, livestock predation, property damage, injuries, and fatalities (Baduni et al. 2025, Gulati et al. 2021).

Recent national statistics highlight the magnitude

of this challenge. Government records indicate that more than 2,900 human deaths occur annually in India due to wildlife encounters, making human casualties the most visible cost of human-wildlife conflict. Asian elephants alone are responsible for approximately 450-500 human fatalities each year, reflecting the scale of conflict in landscapes where agriculture and elephant migration routes overlap (Kalra et al. 2026). Wildlife populations also experience significant mortality associated with these interactions. For example, elephants frequently die due to electrocution from power distribution lines, collisions with trains, or retaliatory actions linked to crop raiding (Sekar et al. 2026, Talukdar et al. 2024). Between 2009 and 2023, more than 1,000 elephant deaths in India were attributed to electrocution and railway accidents, highlighting infrastructure-related mortality as a major conservation concern.

Crop depredation and livestock losses occur far more frequently than fatal encounters and impose substantial economic costs on rural households, particularly smallholder farmers whose livelihoods depend on marginal agricultural production (Karanth et al. 2012, Guru and Das 2021). Studies from central and southern India suggest that annual crop losses from wildlife can reach 5-15% of household agricultural income, with particularly severe impacts on smallholder farmers living near forest boundaries (Ogra 2008).

The drivers of human-wildlife conflict are closely linked to broader environmental and socio-economic transformations occurring across Indian landscapes. Land-use change, agricultural intensification, and the expansion of infrastructure networks have altered habitat structure and landscape connectivity, influencing wildlife movement and foraging behaviour (Naha et al. 2020). At the same time, climate variability and environmental change are increasingly recognised as factors that may amplify human-wildlife interactions by altering resource availability and seasonal migration patterns (Aryal et al. 2014). These ecological changes interact with social drivers such as livelihood insecurity, dependence on forest resources, and limited access to alternative income sources, creating conditions in which both humans and wildlife compete for space and resources (Das and Mallick 2025, Nayak and Berkes 2014).

From a governance perspective, India has developed a comprehensive legal and institutional framework for wildlife conservation centred on statutory protection, protected area networks, and species-focused management programmes (Dutta 2025). The country currently maintains more than 900 protected areas covering approximately 5% of its geographical area, forming the backbone of national biodiversity conservation efforts. In response to increasing conflict incidents, government agencies have expanded compensation schemes, issued operational guidelines, and implemented mitigation measures, including barriers, early warning systems, and conflict response teams (Karanth et al. 2018, Mishra 2025). Despite these efforts, human-wildlife conflict continues to persist and expand across many regions of the country. This persistence suggests that current approaches often emphasise the management of individual incidents rather than addressing the broader socio-ecological conditions that generate recurring conflict outcomes (Johnson et al. 2018).

Much of the existing literature on human-wildlife conflict focuses on species, localised case studies, or the effectiveness of specific mitigation interventions (Barua 2014, Srivathsa et al. 2019). While these studies provide valuable insights into ecological processes and community responses, they often treat conflict as a series of isolated encounters rather than as an outcome of broader structural dynamics involving land-use change, infrastructure development, livelihood vulnerability, and institutional governance (Green et al. 2024). Consequently, there remains a need to examine human-wildlife conflict within an integrated socio-ecological framework that considers how these interacting drivers shape patterns of conflict across landscapes.

In this context, the present study examines human-wildlife conflict in India from a systemic perspective by analysing how structural factors such as land-use configuration, infrastructure expansion, livelihood vulnerability, and governance arrangements contribute to recurring conflict outcomes. By synthesising national-level evidence and interdisciplinary scholarship, the study aims to identify the key processes shaping human-wildlife interactions and highlight institutional and policy

gaps that influence conflict dynamics. Understanding these structural dimensions is essential for developing more integrated approaches to managing human-wildlife interactions and promoting sustainable coexistence in human-dominated landscapes.

Conceptualising human-wildlife conflict as coexistence failure

Human-wildlife conflict has conventionally been approached as a management problem centred on discrete incidents of harm (Barua et al. 2013), where analytical attention focuses on immediate triggers, loss assessment, and post-event administrative response (Ridwan et al. 2023). While this framing facilitates documentation and relief, it offers limited explanatory power for understanding why similar conflict outcomes recur across time and space. The persistence of conflict despite formal mitigation frameworks suggests that the problem lies not only in individual encounters but in the conceptual lens used to interpret them (Akhila et al. 2025).

The concept of coexistence provides an alternative analytical entry point by shifting attention from discrete events to the capacity of socio-ecological systems to sustain interaction between humans and wildlife without generating chronic or disproportionate harm within social-ecological systems scholarship, coexistence refers to the long-term ability of human societies and wildlife populations to share landscapes in ways that maintain ecological viability while minimising risks to human safety and livelihoods (Crespin and Simonetti 2019, Jolly et al. 2022). This capacity depends on identifiable conditions, i.e., land-use arrangements that account for wildlife movement, livelihood systems capable of absorbing wildlife-related losses, and governance institutions that anticipate interactions rather than respond only after damage occurs (Münster 2016). Where these conditions are absent, interaction becomes structurally risky rather than accidental, producing recurring conflict outcomes across landscapes.

Building on this perspective, coexistence failure is used here to describe situations in which governance, planning, and livelihood systems do not provide the conditions necessary for sustained human-wildlife interaction (Pooley et al. 2021).

Coexistence failure is observable through recurring patterns, e.g., repeated exposure of specific communities to risk, predictable wildlife mortality linked to unsafe infrastructure such as power lines or rail corridors, and institutional responses that address outcomes without reducing vulnerability. These patterns point to systemic shortcomings rather than isolated breakdowns in wildlife management (Read et al. 2019). Viewing human-wildlife conflict through the lens of coexistence failure clarifies responsibility and causality. In this perspective, harm is understood as the outcome of design choices embedded in land-use planning, infrastructure development, and institutional mandates, rather than as the result of wildlife behaviour alone (Thapa et al. 2024). For example, wildlife mortality resulting from train collisions or electrocution from poorly insulated power distribution networks reflects infrastructure planning decisions that fail to incorporate wildlife-safety considerations, rather than unpredictable wildlife actions (Fig. 1).

This framing also explains why dominant responses, such as compensation or reactive control, have limited preventive value, since they operate downstream of harm and leave structural drivers intact. Integrating human and wildlife outcomes within a single analytical frame allows conflict to be examined as a problem of system design and accountability rather than episodic misfortune (Woodroffe et al. 2005). Integrating human and wildlife outcomes within a single analytical frame allows conflict to be examined as a problem of system design, governance coordination, and spatial planning, rather than as episodic misfortune or behavioural anomalies of wildlife populations.

METHODOLOGY

Research design and analytical approach

This study employs a Critical Interpretive Synthesis (CIS) approach to examine the structural drivers of human-wildlife conflict in India and to conceptualise these interactions through the analytical lens of coexistence failure. Critical Interpretive Synthesis is a qualitative evidence-integration method designed to analyse heterogeneous literature and generate theoretical insights from interdisciplinary research. Unlike conventional systematic reviews, which

primarily aggregate findings, CIS adopts an interpretive approach that enables researchers to critically examine how knowledge is produced, framed, and interpreted across different research traditions. Rather than focusing on individual case studies or species-specific incidents, the study synthesises national-level evidence and interdisciplinary scholarship to understand how socio-ecological systems produce recurring patterns of human-wildlife conflict.

The analytical perspective adopted in this study draws on concepts from socio-ecological systems theory and political ecology, which emphasise the dynamic interactions between environmental processes, human livelihoods, and institutional governance structures. Within this framework, human-wildlife conflict is interpreted not merely as isolated encounters between humans and wildlife but as an outcome of structural arrangements involving land-use systems, infrastructure development, livelihood dependencies, and governance institutions. Accordingly, the study examines conflict patterns across five interrelated structural domains: (i) Landscape and land-use drivers, including agricultural expansion and habitat fragmentation; (ii) Infrastructure-related drivers, particularly the impacts of railways and power distribution networks on wildlife mortality and movement patterns; (iii) Livelihood and socio-economic drivers, including dependence on agriculture, livestock, and forest resources; (iv) Environmental drivers, including climate variability and ecological change; (v) Governance and institutional arrangements influencing conflict mitigation and management. By integrating these dimensions, the analysis aims to identify systemic patterns that contribute to recurring human-wildlife conflict outcomes across India.

Data sources

This study draws on multiple secondary data sources to examine the structural drivers of human-wildlife conflict in India, integrating evidence from ecological, socio-economic, and governance perspectives. The analysis is based on peer-reviewed scientific literature, government reports, policy documents, national wildlife mortality records, and socio-economic livelihood studies. Peer-reviewed journal articles and academic publications were

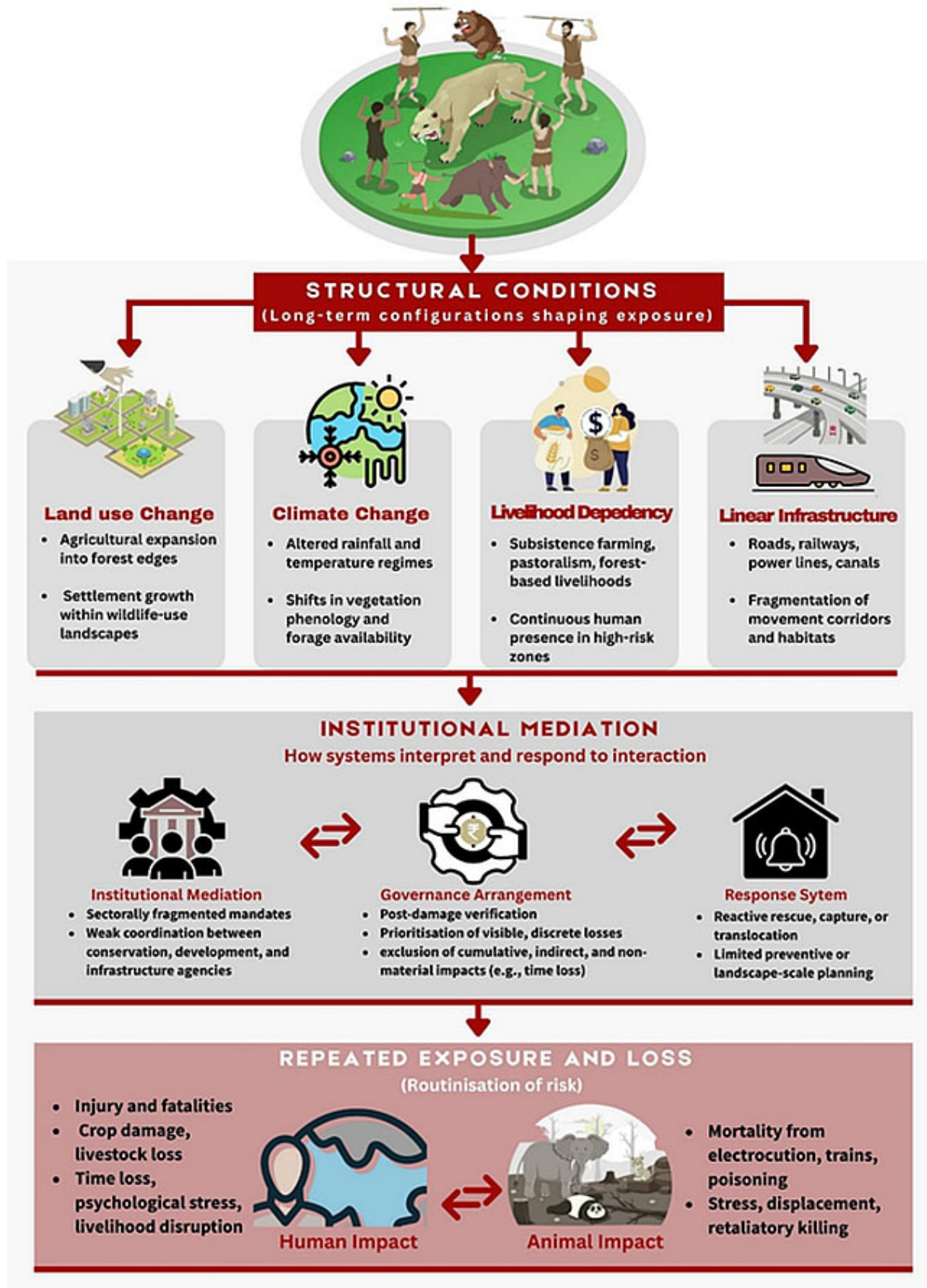


Figure 1. Conceptual representation of coexistence failure in human-dominated landscapes. Conflict becomes embedded in everyday life as risk is unevenly distributed across regions and social groups, institutional responses focus on managing consequences rather than underlying conditions, and human-wildlife relations stabilise into a state of chronic instability

reviewed to understand the ecological and institutional drivers of human-wildlife conflict, including land-use change, infrastructure development, and conservation governance. Government reports and policy documents issued by national and state agencies were examined to analyse regulatory frameworks and institutional responses to conflict mitigation and wildlife conservation. National wildlife mortality records, including documented cases of electrocution, railway collisions, and retaliatory killings, were analysed to identify patterns of infrastructure-related wildlife deaths and their spatial distribution (Choudhary 2024). In addition, socio-economic studies on rural livelihoods, agricultural systems, and forest dependence were reviewed to assess how livelihood practices influence community exposure to wildlife-related risks (Patel et al. 2015, Saxena et al. 2016).

Analytical framework

The analysis was guided by a conceptual framework that interprets human-wildlife conflict as an outcome of coexistence failure within socio-ecological systems. Within this framework, conflict emerges when institutional arrangements, land-use configurations, and livelihood systems fail to provide conditions necessary for stable interaction between humans and wildlife. The analytical framework, therefore, focuses on identifying patterns across three interrelated dimensions:

Ecological dimension - Examines habitat fragmentation, wildlife movement patterns, and ecological pressures resulting from land-use change and climate variability.

Socio-economic dimension - Examines livelihood dependence on natural resources, vulnerability of rural households, and economic impacts of wildlife-related losses.

Governance dimension - Examines institutional arrangements, policy frameworks, and administrative mechanisms responsible for conflict mitigation and conservation management.

Data synthesis

The collected evidence was synthesised using an interpretive thematic analysis consistent with the principles of critical interpretive synthesis. Key themes related to the drivers of human-wildlife

conflict were identified through iterative reading and comparative interpretation of the reviewed studies. These themes were subsequently organised into a typology of structural drivers influencing coexistence failure in India, including (i) land-use configuration and habitat fragmentation, (ii) infrastructure development and associated wildlife mortality, particularly from railways and power distribution networks, (iii) livelihood vulnerability and dependence on agriculture, livestock, and forest resources, (iv) climate variability and ecological change influencing wildlife movement and resource availability, and (v) institutional fragmentation and governance gaps affecting conflict mitigation and management. This thematic synthesis forms the analytical basis for examining how interacting structural processes produce recurring human-wildlife conflict outcomes across socio-ecological landscapes in India.

Limitations of the study

The study relies primarily on secondary data sources and published literature, which may contain variations in data quality and reporting methods across regions. Wildlife mortality records and conflict statistics are also likely to underestimate the true scale of human-wildlife interactions because many incidents remain unreported. Despite these limitations, integrating multiple data sources provides valuable insights into broader structural patterns that shape human-wildlife conflict across India.

RESULTS AND DISCUSSION

National patterns of human-wildlife conflict

A defining feature of the Indian conservation context is the extensive spatial overlap between wildlife habitats and human-dominated land uses. Estimates suggest that 70-80% of wildlife populations in India occur outside formally protected areas, occupying agricultural fields, forest fringes, and peri-urban mosaics where cultivation, grazing, and forest resource extraction occur daily (Neelakantan et al. 2019). In such landscapes, wildlife movement routinely intersects with human livelihood activities, embedding risk into everyday land-use systems. Large mammals, such as elephants and large



Figure 2. Tiger mortality trends by cause, India (2012-2025)

carnivores, play a central role in these interactions because their ecological requirements involve movement across extensive territories that often extend beyond protected areas. National records indicate that elephants account for the largest share of wildlife-related human fatalities in India, with annual deaths often exceeding several hundred cases. Temporal trends also suggest an intensification of risk during the past decade. Reported elephant-related human deaths increased from approximately 423 fatalities in 2012-13 to nearly 629 fatalities in 2023-24, reflecting the growing frequency of encounters in landscapes where migratory routes intersect agricultural settlements (Fig. 2).

Patterns of wildlife mortality provide further insight into the systemic character of these interactions. Monitoring data for tigers show that annual mortality has increased alongside improved surveillance and population recovery across several landscapes. Recorded tiger deaths rose from 88 individuals in 2012 to more than 180 individuals in 2023, representing the highest mortality recorded during the monitoring period. The distribution of mortality by cause reveals the complex interaction between ecological and anthropogenic pressures shaping tiger populations. While natural causes remain significant, a substantial proportion of cases are associated with human activities such as

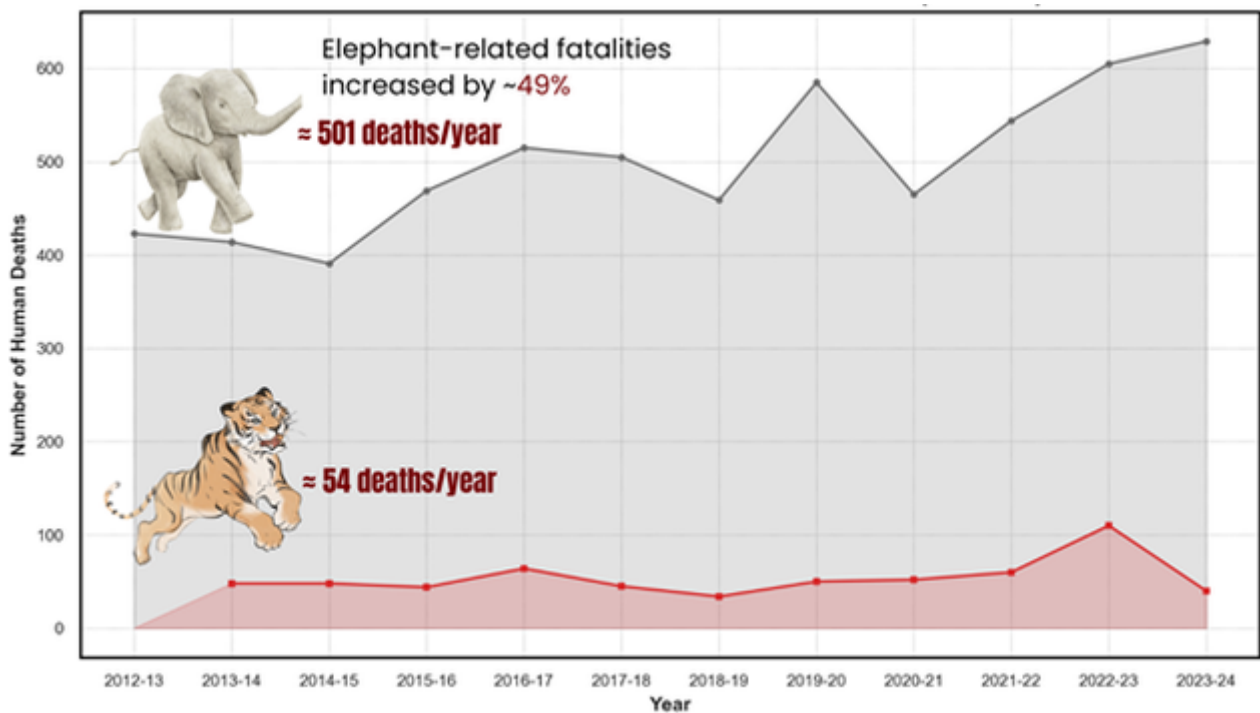


Figure 3. Trends in human deaths due to human-wildlife conflict in India (2012-2024)

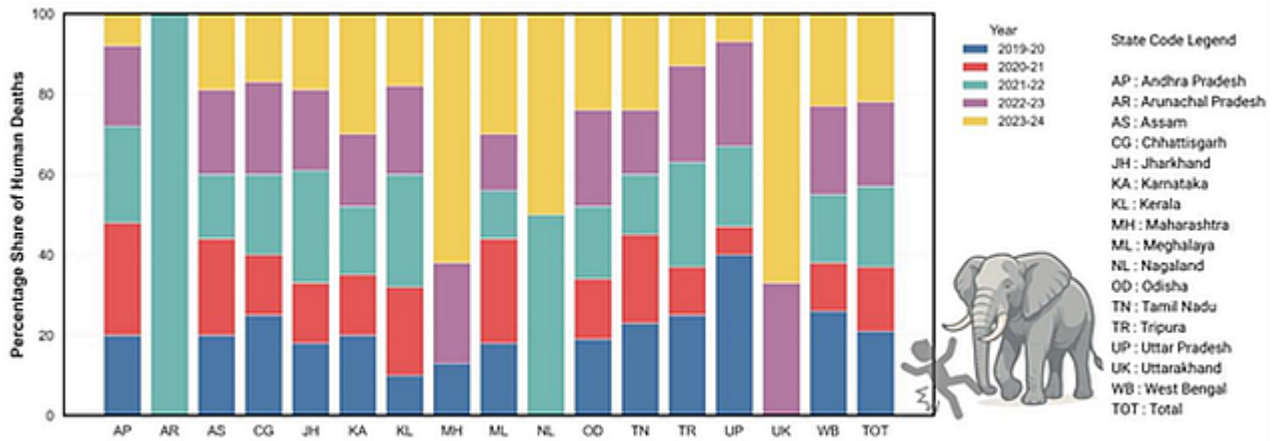


Figure 4. State-wise number of human deaths due to man elephant conflict (2019-20 to 2023-24)

poisoning, illegal hunting, and infrastructure-related incidents. The changing composition of mortality causes over time (Figs. 3, 4) highlights the growing number of cases classified under investigation alongside natural mortality. These records indicate that wildlife mortality cannot be explained solely by ecological factors, because anthropogenic pressures continue to influence mortality outcomes even within protected landscapes.

Anthropogenic pressures affecting wildlife populations are also evident in elephant mortality patterns. National records show that infrastructure and illegal activities account for a significant share of elephant deaths nationwide. Between 2008 and 2024, more than 200 poaching incidents were recorded nationally. Railway collisions between 2007 and 2024 accounted for more than 200 elephant deaths, particularly in eastern and north-eastern states where railway corridors intersect major elephant movement routes. In addition, 157 elephant deaths were attributed to electrocution between 2021 and 2023, reflecting risks associated with poorly insulated power distribution networks in wildlife-use landscapes. These patterns indicate that wildlife mortality is frequently driven by infrastructure and

human activities embedded in development processes rather than solely by ecological dynamics. A summary of the principal anthropogenic causes of elephant mortality is presented in Table 1.

Seasonal patterns of mortality further illustrate the interaction between ecological behaviour and human livelihood activity. Monitoring records suggest that wildlife deaths are unevenly distributed across the year. Higher mortality is observed during winter and early summer months, when wildlife movement and agricultural activity overlap more intensely in forest-edge landscapes. During these periods, activities such as crop guarding, livestock grazing, and forest resource collection increase human presence in areas frequently used by wildlife. This overlap increases the probability of encounters and contributes to higher mortality. Mortality tends to decline during the monsoon season, when reduced agricultural activity and limited access to forest interiors reduce the likelihood of interactions. When considered together, the persistence of human fatalities, wildlife mortality, and infrastructure-related incidents across multiple regions demonstrates that human-wildlife conflict in India operates as a recurring socio-ecological process. These outcomes reflect structural

Table 1. Elephant mortality causes

Cause of mortality	Period	National total	Major affected states
Poaching	2008–2024	200+ incidents	Odisha, Assam, Karnataka, Kerala
Railway Collisions	2007–2024	200+ elephants	Assam, West Bengal, Odisha, Uttarakhand
Electrocution	2021–2023	157 elephants	Odisha, Karnataka, Tamil Nadu, Chhattisgarh

Source: MoEFCC, Project Elephant records

interactions occurring within landscapes where wildlife habitats, rural livelihoods, and expanding infrastructure networks increasingly intersect (Lin and Zaidi 2025).

Structural drivers of coexistence failure

Human-wildlife conflict in India is not solely the outcome of individual wildlife behaviour or isolated incidents; rather, it emerges from structural transformations in landscapes where ecological processes and human activities increasingly overlap. Changes in land use, infrastructure expansion, livelihood dependence on natural resources, and climatic variability collectively shape the conditions under which coexistence becomes difficult to sustain. These drivers alter spatial relationships between wildlife habitats and human settlements, increasing the frequency and intensity of encounters across rural landscapes (Table 2).

One of the most significant drivers of coexistence failure lies in the reconfiguration of land-use patterns across forest-agriculture interfaces. Agricultural expansions, conversion of common lands, and settlement growth have progressively reduced the ecological buffers that historically separated wildlife habitats from cultivated landscapes. National assessments indicate that more than 40% of India's forest landscapes are now fragmented or located within one kilometre of human infrastructure, substantially increasing the likelihood of encounters between wildlife and people in forest-edge villages

(Naha et al. 2019). These patterns are particularly visible in eastern and central India, where agricultural fields frequently extend directly up to reserve forest boundaries. As a consequence, wildlife movements increasingly intersect with areas of intensive human activity, transforming encounters into routine features of everyday rural landscapes rather than exceptional events.

The ecological pathways through which different wildlife taxa interact with human systems (Fig. 5) summarises the major wildlife groups involved in human-wildlife conflict and the dominant interaction pathways associated with each group. Large mammals such as elephants (*Elephas maximus*), tigers (*Panthera tigris*), leopards (*Panthera pardus*), and bears (*Melursus ursinus*) cause the most severe conflict outcomes because they can cause human fatalities and significant livestock losses. Herbivorous species, including wild boar (*Sus scrofa*), nilgai (*Boselaphus tragocamelus*), and several deer species, primarily contribute to conflict through crop depredation in agricultural landscapes. Other taxa, such as monkeys, birds, and crocodiles, are associated with more localised conflicts in peri-urban, agricultural, or riverine environments. Although these conflicts differ in severity and spatial distribution, they share a common structural foundation: the increasing overlap between wildlife habitats and human livelihood systems.

Infrastructure expansion represents another major structural driver of coexistence failure. Transport

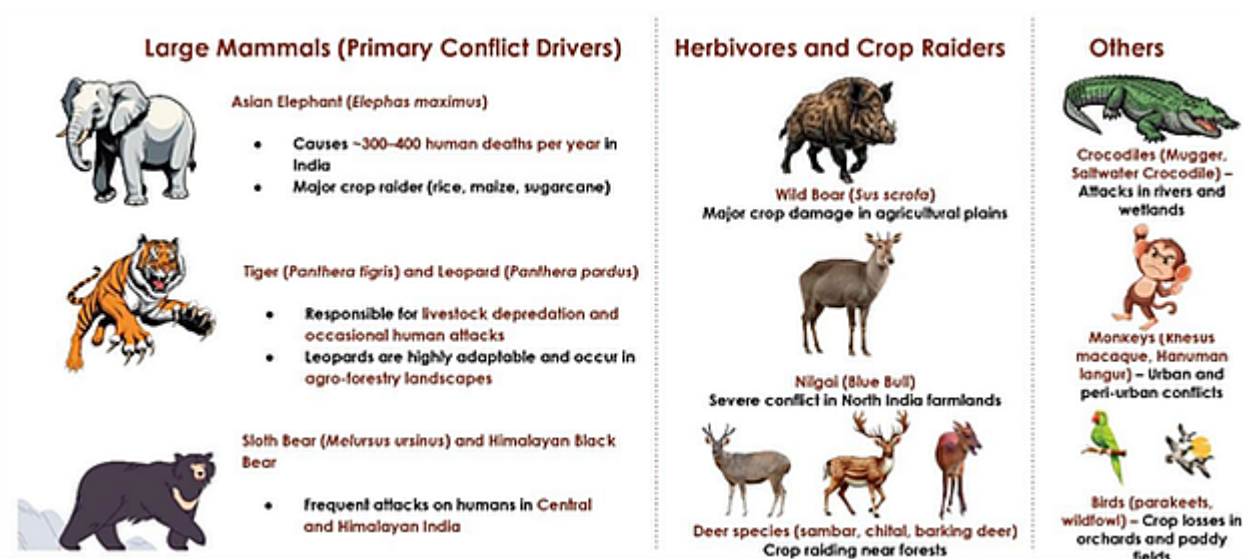


Figure 5. Major Wildlife Species Involved in HWC

Table 2. Structural drivers of human-wildlife conflict in India

Structural domain	Condition observed	Primary interaction pathway	Dominant outcome type
Land-use configuration	Forest-agriculture adjacency at village boundaries	Cultivated land directly abutting reserve forests and unclassified forest land	Crop loss; direct human exposure
Landscape connectivity	Fragmented habitats and disrupted corridors	Interruption of established wildlife movement routes by land conversion	Increased encounter probability
Transport infrastructure	Rail corridors intersecting wildlife-use areas	High-speed rail movement without fencing, underpasses, or speed regulation	Wildlife mortality
Energy infrastructure	Overhead power distribution lines in forested and rural landscapes	Electrocution due to uninsulated conductors and poor maintenance	Wildlife mortality
Agrarian systems	Predominance of smallholder and subsistence farming	Daily human presence in fields located near forests	Recurrent livelihood loss
Livestock systems	Open grazing near forest commons and revenue land	Spatial overlap between grazing livestock and large carnivores	Livestock depredation
Climate stress	Seasonal variability in rainfall and water availability	Temporal shifts in wildlife foraging and movement towards cultivated areas	Seasonal spikes in interaction
Institutional design	Sectoral planning silos across departments	Lack of cumulative risk assessment across land-use, infrastructure, and conservation	Persistent conflict outcomes
Development clearance process	Project-wise environmental clearance	Assessment limited to individual projects without landscape context	Long-term conflict persistence
Rural infrastructure planning	Expansion of roads, irrigation, and settlements	Increased accessibility and edge effects in wildlife-use landscapes	Increased frequency of encounters

corridors, electricity transmission lines, and other linear infrastructure often intersect established wildlife movement routes without adequate mitigation measures. Wildlife mortality associated with infrastructure provides particularly clear evidence of these structural shortcomings. National wildlife mortality records indicate that a substantial proportion of elephant deaths occur due to electrocution from power lines and collisions with trains, both of which are directly linked to infrastructure design and placement. Between 2009 and 2023, more than 1,000 elephants were reported to have died from electrocution and railway collisions across India, with many incidents concentrated in states such as Assam, West Bengal, Odisha, and Uttarakhand, where rail networks and power distribution lines intersect elephant corridors (Ghosh et al. 2025). These outcomes are therefore not random events but predictable consequences of infrastructure development that fails to incorporate wildlife movement ecology. Rail corridors operating at high speeds without fencing or underpasses create collision risks, while poorly insulated power lines in forested landscapes expose elephants and other wildlife to electrocution hazards.

Livelihood systems further shape patterns of exposure to conflict. A large proportion of rural households located near forest landscapes depend on smallholder agriculture, livestock rearing, and forest resources for subsistence and income generation. These livelihood activities require daily engagement with landscapes that are also used by wildlife for movement and foraging. Farmers frequently cultivate crops such as rice, maize, and sugarcane in fields near forest boundaries, making them particularly vulnerable to crop depredation by elephants and other herbivores (Ghosh et al. 2024). Crop guarding during harvest seasons often requires farmers to remain in fields overnight, increasing the risk of direct encounters with wildlife. When losses occur, households with limited savings, insurance coverage, or diversified income sources experience disproportionate economic impacts. Although compensation schemes exist in several states to offset crop damage or human injury, these programmes typically address only direct losses. Indirect costs such as lost labour time, disrupted agricultural activities, and psychological stress are rarely

accounted for, allowing livelihood vulnerability to accumulate even when compensation payments are provided (Naik et al. 2024, Ogra and Badola 2008). Climatic variability interacts with these structural drivers, further intensifying human-wildlife interactions. Changes in rainfall patterns, increasing frequency of extreme weather events, and shifts in vegetation productivity influence both agricultural practices and wildlife movement patterns (Gupta et al. 2017). In several regions, altered cropping cycles and seasonal water availability have increased the temporal overlap between wildlife foraging behaviour and agricultural cultivation. At the same time, reduced availability of natural food resources within forests can encourage wildlife species to move into agricultural landscapes in search of alternative food sources (Nandrakumar and Harilal 2025). These climatic pressures do not necessarily create entirely new forms of interaction but rather amplify existing patterns of encounter, exposing the absence of anticipatory planning and adaptive governance mechanisms to manage emerging risks. Table 2 summarises the principal structural domains through which these drivers operate, highlighting how landscape configuration, infrastructure placement, agrarian systems, and institutional planning processes collectively shape the persistence of human-wildlife conflict across India.

Socio-economic exposure and livelihood vulnerability

Human-wildlife conflict in India is unevenly distributed across landscapes and social groups, with the greatest exposure among rural communities whose livelihoods depend directly on agriculture, livestock rearing, and forest resources. In many conflict-prone regions, villages are located along forest boundaries or within traditional wildlife corridors, leading to high spatial overlap between agricultural activity and wildlife movement (Greeshma et al. 2016). Farmers frequently cultivate crops such as rice, maize, sugarcane, and bananas in fields near reserve forests and wildlife habitats. These crops are highly attractive to herbivores and elephants, particularly during harvest seasons, which increase the likelihood of crop depredation and direct encounters with wildlife. As a result, farmers often engage in night-time crop guarding to protect fields

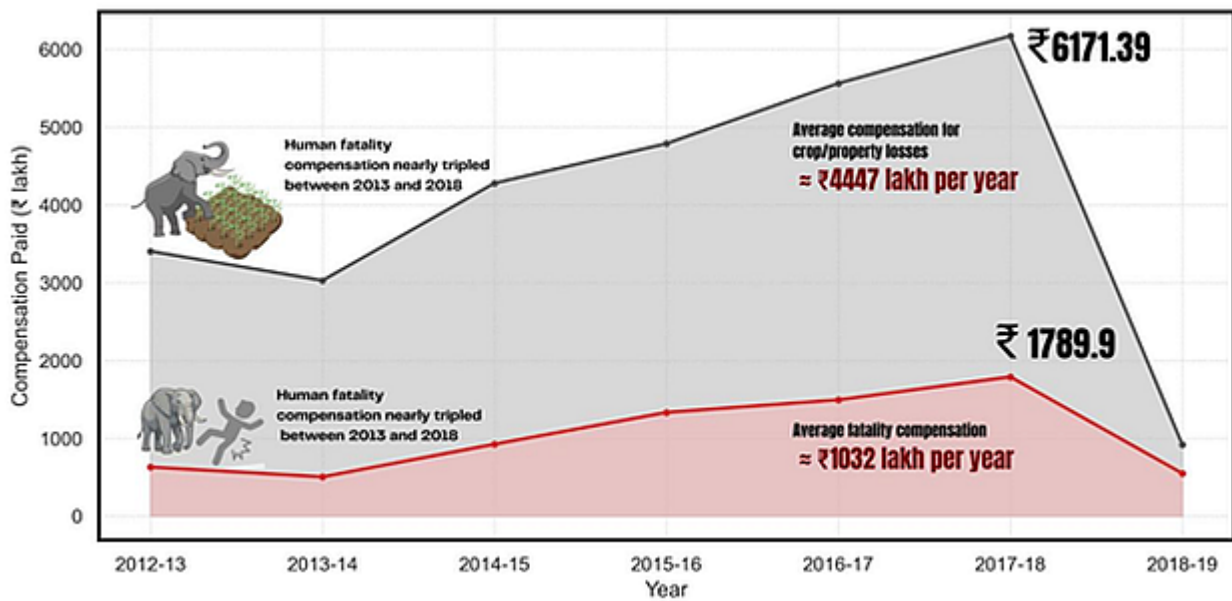


Figure 6. Total compensation paid in India for elephant conflict damages (2012-2019)

from wildlife incursions. This practice significantly increases the risk of dangerous encounters with elephants and other large mammals. The economic consequences of these interactions are reflected in national compensation records associated with elephant conflict (Manral et al. 2016). Figure 6 illustrates the total compensation paid in India for crop damage, property loss, and human fatalities resulting from elephant encounters between 2012 and 2019, highlighting the substantial financial burden on rural households and state administrations in conflict-prone landscapes.

The economic consequences of such encounters are reflected in national compensation records maintained under the Project Elephant programme of the Ministry of Environment, Forest and Climate Change. Compensation payments for crop and property losses caused by elephants increased substantially during the study period. National compensation payments rose from approximately INR 3404.86 lakh in 2012-2013 to INR 6171.39 lakh in 2017-2018, indicating a significant escalation in the fiscal burden associated with elephant depredation (Table 3). Several states consistently reported high compensation expenditures, particularly Odisha, Karnataka, Tamil Nadu, and Chhattisgarh, where agricultural landscapes overlap extensively with elephant habitats. In several years, compensation payments in individual states exceeded

INR 1000 lakh, highlighting the scale of economic losses experienced by rural households located in forest-agriculture interface landscapes.

Human fatalities associated with wildlife encounters further illustrate the socio-economic risks faced by rural communities. National compensation payments for deaths caused by elephant attacks increased from INR 630.3 lakh in 2012-2013 to INR 1789.9 lakh in 2017-2018, reflecting a substantial rise in the human costs associated with conflict. Under current national guidelines, compensation payments for loss of life caused by wildlife typically range between INR 5 lakh and INR 10 lakh per fatality, depending on state policies and available funding. The state-wise distribution of these payments indicates that fatal encounters are particularly concentrated in states such as Odisha, Assam, Jharkhand, and Karnataka, where dense rural populations coexist with large elephant populations (Table 4). These compensation payments, therefore, provide a measurable indicator of the increasing socio-economic burden associated with wildlife conflict.

Beyond direct financial losses, human-wildlife conflict generates broader livelihood vulnerabilities that are rarely captured in compensation statistics. Crop guarding and conflict mitigation activities require substantial labour inputs from rural households, often involving overnight field

Table 3. State-wise compensation paid for crop and property losses caused by elephant depredation in India (INR lakh), 2012-2019

States	2012-2013	2013-2014	2014-2015	2015-2016	2016-2017	2017-2018	2018-2019
Andhra Pradesh	3.7	16.88	83.08	78.98	53.08	24.39	54.2
Arunachal Pradesh	0	35.26	39.99	20.9	NR	NR	NR
Assam	66.87	49.01	1.62	0	222	103.49	0
Chhattisgarh	226.72	345.83	269.63	963.26	1425.86	1279.47	NR
Jharkhand	120.19	275.61	501.57	485.95	428.92	412.01	NR
Karnataka	1308.83	993.81	1239.38	705.5	709.65	1370	NR
Kerala	308.54	124.82	264.59	281.05	305.82	395.46	177.66
Maharashtra	86.83	118.8	123.43	155.22	67.99	65.52	53.03
Meghalaya	60	71.49	14.95	110.52	36.63	47.45	NR
Nagaland	9	5.15	4.6	9.56	8.75	33.33	5.51
Odisha	800.52	983.21	979.7	1196.34	1240.22	1272.38	445.82
Tamil Nadu	1658	979	255.44	250.76	237.01	186.41	183.05
Tripura	0	0	0.91	0.91	0	0	NR
Uttar Pradesh	3.24	#	0	0	10.98	11.55	NR
Uttarakhand	0	#	25.5	51.34	10.71	NR	NR
West Bengal	410.42	9.46	475.54	477.78	806.11	969.93	NR
India	3404.86	3029.33	4279.93	4788.07	5563.73	6171.39	919.26

Source: Ministry of Environment, Forest and Climate Change (MoEFCC), Project Elephant records; Lok Sabha Unstarred Question No.1083. NR - Not reported, # - Data not available for the reporting year

Table 4. State-wise compensation paid for human fatalities caused by elephant attacks in India (INR lakh), 2012-2019

States	2012-2013	2013-2014	2014-2015	2015-2016	2016-2017	2017-2018	2018-2019
Andhra Pradesh	2.5	5	11	0	10	30	25
Arunachal Pradesh	0	1	1	1	NR	NR	NR
Assam	58	77.4	35	0	167.4	452.4	0
Chhattisgarh	42	*	75.46	178	288.25	292.25	NR
Jharkhand	91.17	109.3	107.5	184.9	110.18	223.95	NR
Karnataka	185	165	253.5	228	235	110	NR
Kerala	23.4	6.6	61	48.87	97.75	77.56	73.13
Maharashtra	0	0	15	8	0	0	NR
Meghalaya	3	4	7	30	12	0	NR
Nagaland	0	1	2	1	0	0	1
Odisha	147.93	122.4	137.9	203.21	251.33	259.8	294.45
Tamil Nadu	*	*	93	196.75	145.75	194.5	156
Tripura	0	0	0	2	NR	NR	NR
Uttar Pradesh	0	*	1	0	15	5	NR
Uttarakhand	14	*	18.5	23.03	9.3	NR	NR
West Bengal	63.3	12.9	105.41	228	152.34	144.44	NR
India	630.3	504.6	924.27	1332.76	1494.3	1789.9	549.58

Source: Ministry of Environment, Forest and Climate Change (MoEFCC), Project Elephant records; Lok Sabha Unstarred Question No.1083. NR - Not reported, * - Data not available for the reporting year

monitoring and collective guarding practices during harvest seasons. These activities reduce the time available for other productive work and may disrupt schooling for younger household members who participate in guarding. Women frequently assume additional responsibilities for domestic and agricultural labour when male household members engage in crop protection. Consequently, wildlife conflict becomes embedded in everyday livelihood strategies, generating cumulative economic and social pressures on households in forest-edge landscapes. Addressing these vulnerabilities, therefore, requires conflict mitigation approaches that integrate livelihood security with wildlife conservation, including improved early warning systems, rapid compensation mechanisms, and landscape-level planning that reduces direct interaction between wildlife movement routes and agricultural production systems.

Linear infrastructure, policy gaps, and international commitments: Challenges and opportunities for human-wildlife coexistence

India's environmental regulatory framework governing linear infrastructure reveals the disconnect between statutory clearance requirements and ecological risk in wildlife-dominated landscapes. Projects such as railway lines and power transmission projects are not covered under the Environment Impact Assessment (EIA) Notification, 2006, and therefore do not require prior Environmental Clearance (Anonymous 2006). Consequently, the requirement for wildlife clearance from the Standing Committee of the National Board for Wildlife (SC-NBWL) - which is typically invoked for EIA-applicable projects located within Eco-Sensitive Zones (ESZs) or within a 10-km radius of protected areas where ESZs are not formally notified - is not automatically triggered for these high-impact linear projects (Anonymous 1972, 2011). Unless such projects involve land diversion within legally notified protected areas or are specifically referred by statutory or judicial authorities, they may proceed without mandatory wildlife appraisal. While this legal position expedites the expansion of nationally significant infrastructure, it simultaneously creates regulatory blind spots in landscapes that function as wildlife movement zones, seasonal habitats, and

human-wildlife interaction frontiers. Railways and transmission corridors traversing ESZs and 10-km peripheral zones have been shown to fragment habitats, disrupt animal movement, increase wildlife mortality through collisions and electrocution, and intensify human-wildlife conflict by embedding permanent infrastructure within wildlife-use areas (Gubbi et al. 2012, Mathur et al. 2011). The absence of a compulsory wildlife clearance pathway for such projects underscores a systemic governance gap, wherein conflict mitigation, landscape connectivity, and coexistence-oriented design remain discretionary rather than legally embedded. In the context of escalating human-wildlife conflict across India, this regulatory lacuna reflects a need to align infrastructure governance with coexistence goals, thereby contributing to long-term conflict prevention and conservation outcomes beyond protected area boundaries.

At the international level, India's obligations under the Convention on Biological Diversity (CBD) and the Kunming-Montreal Global Biodiversity Framework (KMGBF) call for integrating biodiversity conservation, ecological connectivity, and conflict mitigation into sectoral planning, extending beyond formally protected areas (Anonymous 1992, 2022). KMGBF Target 4 specifically emphasizes reducing human-wildlife conflict and preventing biodiversity loss driven by conflict, providing a global policy benchmark for landscape-level interventions. The IUCN Species Survival Commission (SSC) provides guidance on conflict-sensitive planning for linear infrastructure and other high-impact projects (Anonymous 2016).

India's strategic response to the regulatory gaps in linear infrastructure governance is articulated through the National Human-Wildlife Conflict (HWC) Mitigation Strategy and Action Plan (2021-2026) (HWC-NAP) and the updated National Biodiversity Strategy and Action Plan (NBSAP) 2024-2030 (Anonymous 2021, 2024a). These frameworks transition from reactive conflict management to a "coexistence-based" model, specifically addressing the systemic "regulatory blind spots" by institutionalizing cross-sectoral cooperation between the forest department and development sectors such as railways and power (Anonymous 2021). By establishing State and

District-level Coordination Committees, the HWC-NAP provides a formal governance mechanism to embed conflict mitigation into the planning stages of high-impact projects, effectively localizing Target 4 of the Kunming-Montreal Global Biodiversity Framework (KMGBF), which mandates the management of human-wildlife interactions to minimize conflict (Anonymous 2022).

To fulfil international obligations under the Convention on Biological Diversity (CBD), the Indian government has adopted a “whole-of-government” approach, as detailed in its Seventh National Report (NR7) (Anonymous 2024b). This approach maps biodiversity safeguards across 33 central ministries, ensuring that linear infrastructure - even when exempt from mandatory prior Environmental Clearance under the EIA Notification 2006 - is increasingly subjected to technical “Eco-friendly Measures” (Anonymous 2020). These measures, including mandatory animal underpasses and bird flight diverters, are now integrated into the PARIVESH 2.0 single-window clearance system to ensure transparency (Anonymous 2024a). This alignment between domestic infrastructure growth and international biodiversity benchmarks (KMGBF Targets 4 and 12) reflects an emerging policy shift toward maintaining landscape connectivity and preventing conflict-driven biodiversity loss beyond protected area boundaries (Anonymous 2022, Gubbi et al. 2012). Table 5 summarizes how specific national policy instruments address the regulatory gaps and fulfil international commitments under the CBD and KMGBF.

Governance and institutional mismatch

Human-wildlife conflict governance in India is characterised by fragmented institutional mandates across multiple administrative domains (Nanda and Sahu 2024). Wildlife management, land administration, rural development, infrastructure planning, and disaster response operate through parallel systems with limited coordination. As a result, the risks associated with routine human-wildlife interaction are rarely addressed in an integrated manner. Wildlife agencies are primarily tasked with protection and incident response. In contrast, agencies responsible for agriculture, energy, transport, and rural development make decisions that

Table 5. Alignment of India’s domestic framework with global biodiversity targets - Towards coexistence-oriented infrastructure governance

Global/Policy benchmark	National implementation instrument	Primary mechanism for alignment	Addressing regulatory lacunae
KMGBF Target 4 (HWC Mitigation)	HWC-NAP (2021–2026)	Institutionalizes “Harmonious Coexistence” via State and District Coordination Committees	Mandates cross-sectoral collaboration with Railways and Power sectors to bridge the EIA exemption gap
CBD Article 6(b) (Mainstreaming)	NBSAP (2024-2030)	Adopts a “Whole-of-Government” approach mapping 33 Central Ministries	Ensures biodiversity safeguards are embedded in sectoral policies for infrastructure and agriculture
KMGBF Target 12 (Connectivity)	Eco-friendly measures (Anonymous 2020)	Technical mandates for underpasses, overpasses, and bird flight diverters	Enforces wildlife-friendly design at the planning stage for previously non-appraised linear projects
Transparency & Governance	PARIVESH 2.0 Portal	Single-window digital clearance for all environmental and wildlife appraisals	Provides a transparent, trackable mechanism for enforcing mitigation measures in “blind spot” landscapes

directly shape conflict risk but remain largely outside conflict governance frameworks (Sharma et al. 2021).

India currently maintains over 900 protected areas covering approximately 5% of its geographical area, forming the institutional core of wildlife governance. However, a large proportion of human–wildlife interactions occur outside these protected landscapes in agricultural and multi-use environments where governance responsibilities are distributed across multiple sectors. This institutional distribution complicates coordinated management of conflict risk across landscapes (Vishwapriya and Devaiah 2024). In many cases, infrastructure and land-use decisions intersect with wildlife habitats without systematic integration of wildlife risk assessments. For example, forest clearance (FC) and wildlife clearance procedures under the Forest (Conservation) Act and the Wildlife (Protection) Act are typically triggered only when projects involve the diversion of forest land or occur within legally notified protected areas. Projects such as railway expansion and electricity transmission lines are not automatically subject to the Environmental Impact Assessment (EIA) Notification, 2006. They therefore may not require prior environmental clearance unless they involve forest diversion or are located within notified eco-sensitive zones (Anonymous 2006, 2011). This regulatory arrangement can create governance gaps in landscapes that function as wildlife movement corridors. Compensation mechanisms form the central pillar of state response to human–wildlife conflict, yet their design reflects a narrow understanding of loss. Compensation procedures focus on quantifiable, immediate damages, such as crop loss, livestock deaths, or human injury, and are verified through administrative processes that are often time-consuming and unevenly implemented. Indirect and cumulative losses, including loss of labour time, disruption of education, psychological stress, and long-term livelihood insecurity, are not formally recognised (König et al. 2021). This selective recognition of loss creates a situation in which formal relief may be provided while structural vulnerability remains unchanged (Shrestha et al. 2026).

A further mismatch arises from the scale at which governance operates. Wildlife movement and

ecological processes occur across landscapes, while administrative authority is organised along jurisdictional boundaries (Srivastava and Tyagi 2016). District administrations, forest divisions, and sectoral departments address conflict within their respective mandates, yet few mechanisms exist for managing cumulative risk across contiguous landscapes (Robbins et al. 2009). Environmental clearance procedures further reinforce this fragmentation. Development projects are typically assessed individually rather than evaluated for their cumulative effects on habitat connectivity and human-wildlife interaction patterns (Kashwan 2016, Robbins et al. 2007). As a result, infrastructure expansion and land-use change may progressively increase conflict risk without triggering corresponding adjustments in mitigation or planning strategies.

Institutional responses also exhibit a strong reactive bias (Table 6). Standard operating procedures, advisories, and response teams are activated after incidents occur, reinforcing a cycle of response rather than prevention. Preventive measures, such as land-use zoning, wildlife-safety infrastructure design standards, or livelihood risk reduction, receive comparatively limited institutional attention. This imbalance reflects a governance model oriented towards damage control rather than risk anticipation, even in areas where conflict outcomes are recurrent and predictable (Naha et al. 2021).

The uneven distribution of institutional capacity further exacerbates governance mismatch. Forest and wildlife departments in many regions operate with limited personnel and resources relative to the scale of landscapes under their jurisdiction. At the same time, local governments often lack formal authority or technical guidance to address conflict proactively (Tiwari and Totuka 2026). For example, several state forest departments manage thousands of square kilometres of forest landscapes with relatively small field staff strength, limiting their ability to monitor wildlife movement, implement preventive measures, or coordinate with other development agencies (Ogra 2009). At the same time, agencies whose decisions significantly influence conflict risk, such as transport and power utilities, are rarely held accountable for wildlife-related externalities. This asymmetry in

Table 6. Institutional roles and gaps in human-wildlife conflict governance in India

Institution / Actor	Formal mandate	Role in human-wildlife conflict governance	Observed institutional gap
Forest Department (State)	Wildlife protection under Wildlife (Protection) Act, 1972	Incident response, rescue operations, animal control, damage verification	Predominantly reactive mandate; limited authority over land-use, infrastructure, or livelihoods
Revenue Department	Assessment and disbursement of compensation	Verification of loss and compensation processing	Procedural delays; uneven valuation of losses; focus on direct damage only
District Administration	Coordination during emergencies and law-and-order situations	Crisis management during severe conflict events	Event-driven engagement; absence of preventive planning
Local Governments (Panchayats/Local Bodies)	Local development and service delivery	Informal mediation and reporting support	Limited technical capacity and statutory role in conflict prevention
Ministry of Environment, Forest and Climate Change	National wildlife policy and regulatory oversight	Issuance of advisories, guidelines, and SOPs	Weak enforcement and monitoring at implementation level
Railways	Transport infrastructure development and operation	Limited mitigation at wildlife crossing points	Wildlife risk treated as secondary to operational efficiency
Power Utilities (State Electricity Boards)	Electricity transmission and distribution	Infrastructure maintenance	Absence of mandatory wildlife-safety design standards
Ministry of Rural Development/Line Depts	Rural livelihoods and infrastructure	Development planning in conflict-prone landscapes	No integration of conflict risk into scheme design
EIA Authorities	Project clearance and compliance monitoring	Project-level environmental appraisal	Lack of cumulative and landscape-scale risk assessment
Insurance and Financial Institutions	Risk coverage and financial protection	Limited involvement in conflict risk mitigation	Wildlife-related losses largely excluded from coverage

responsibility and accountability reinforces the failure of coexistence by separating the production of risk from the obligation to mitigate it (Madden 2008). In such contexts, governance responses remain predominantly reactive, focusing on mitigation and compensation after conflict events rather than addressing the structural drivers that generate recurring conflict outcomes.

Lived dimensions of human-wildlife conflict

Human-wildlife conflict is embedded in the routines through which people engage with land, labour, and resources, rather than being confined to moments of visible damage or injury (Ghoshal 2021). In areas where wildlife presence is recurrent, everyday activities such as cultivation, grazing, collection of forest produce, and movement between settlements are organised around anticipatory risk.

Households modify cropping patterns, adjust work timing, restrict mobility during certain hours, or avoid particular spaces altogether in response to repeated wildlife encounters. These adaptations are not formally mandated but emerge through experience, local knowledge, and shared memory of past encounters (Vijayan and Pati 2002). Household surveys conducted in forest-edge villages surrounding Nagarahole and Bandipur National Parks in southern India documented that farmers routinely engage in night-time crop guarding during peak harvesting seasons to prevent crop raiding by elephants and wild boar (Lingaraju and Venkataramana 2014, Pawar and Mule 2025). Similar field-based research in Uttarakhand and Himachal Pradesh reports that farmers spend several hours each night guarding agricultural fields during periods of heightened wildlife activity (Bhatt et al. 2025, Uniyal et al. 2025).

Such conditions significantly shape labour organisation within households. Tasks associated with higher exposure to wildlife, including night-time field guarding, livestock monitoring, and forest-based resource collection, are distributed unevenly across age and gender. Women, children, and older household members often assume these roles due to availability or social expectations, despite facing heightened physical risk (Doubleday 2020). This redistribution of labour alters household time use and care responsibilities, yet remains largely

unrecognised in administrative assessments of loss or vulnerability.

Economic impacts of conflict extend beyond quantifiable damage to crops or livestock. Time diverted towards vigilance and repair reduces participation in wage labour, limits engagement with education, and constrains livelihood diversification. In contexts where agricultural margins are already thin, repeated low-level losses and disruptions accumulate into longer-term decisions, such as reduced investment in farming inputs or a gradual withdrawal from cultivation. These processes unfold incrementally, making their effects less visible than acute incidents but more consequential over time (Rao et al. 2002).

Psychological dimensions further shape lived experience. Recurrent exposure to risk generates persistent anxiety, particularly in households that have experienced prior harm or near encounters. The lack of predictability in the timing and location of wildlife movement leads to a state of continuous alertness, affecting sleep, social interaction, and perceptions of safety. Such effects are rarely articulated within formal reporting systems, yet they influence how households evaluate the viability of remaining in livelihoods or locations (Chowdhury et al. 2016).

Interactions with administrative institutions form another layer of everyday experience. Engagement with compensation procedures, verification processes, and field officials is often characterised by uncertainty regarding timelines, eligibility, and outcomes. Households adapt to this uncertainty by recalibrating their expectations of support and relying more heavily on informal coping mechanisms and social networks. These interactions shape how authority, responsibility, and legitimacy are perceived, influencing willingness to report incidents or cooperate with conservation agencies (Dash et al. 2025).

Everyday dimensions of human-wildlife conflict thus reveal how risk exposure is normalised within specific livelihoods and social positions. Adjustments made at the household level operate within constrained choice sets shaped by land tenure, income security, and institutional reach. Rather than appearing as discrete disruptions, conflict is woven into daily life through repeated negotiation,

accommodation, and restraint, producing patterns of endurance that remain largely invisible within incident-based governance frameworks (Maan and Chaudhry 2019).

Justice, equity, and the distribution of conservation costs

Human–wildlife conflict foregrounds questions of justice by revealing how the costs of conservation are unevenly distributed across social groups. While wildlife protection generates ecological benefits that extend beyond local landscapes, the risks and losses associated with coexistence are concentrated among communities living and working near wildlife habitats (Badola et al. 2021). Smallholder farmers, pastoralists, and forest-dependent households face repeated exposure to crop loss, livestock depredation, and physical risk, despite having limited influence over conservation priorities or land-use decisions that shape these conditions (Gopalan and Radhakrishna 2022).

Economic inequities are reinforced by how loss is defined and addressed institutionally. Compensation frameworks focus primarily on immediate and verifiable damage, such as crop destruction or human injury, privileging losses that can be readily quantified. Indirect and cumulative costs, including reduced labour availability, disruption of education, psychological stress, and gradual livelihood erosion, fall outside formal assessment mechanisms. As a result, households experiencing repeated low-intensity losses remain structurally vulnerable even when episodic compensation is provided (Sarma and Barpujari 2025).

Procedural dimensions further shape inequitable outcomes (Fig 7). Access to compensation and support depends on navigating administrative processes that require documentation, mobility, and familiarity with bureaucratic norms. Variations in verification practices and delays in disbursement create differential access to relief, disadvantaging households with limited literacy, social capital, or institutional reach. These procedural barriers influence perceptions of fairness and legitimacy, affecting how communities engage with conflict management institutions and conservation authorities (Batar 2026).

Questions of recognition extend beyond material and procedural concerns. Communities with long-standing relationships to forests and commons are often framed within policy discourse as sources of conflict or beneficiaries of relief, rather than as stakeholders with legitimate claims to safety, livelihood security, and participation in decision-making. Such framings obscure the social and historical dimensions of risk exposure and limit the incorporation of local knowledge into planning processes. Justice-related dynamics thus intersect with structural and governance conditions to shape how coexistence is experienced and sustained across different social positions (Daimari and Singh 2025, Stevens et al. 2025).

Bridging the policy-practice gap in linear infrastructure

The alignment of India’s National Human-Wildlife Conflict (HWC) Mitigation Strategy and Action Plan (2021-2026) with Target 4 of the Kunming-Montreal Global Biodiversity Framework (KMGBF) marks a paradigm shift toward a “coexistence-based” model (Anonymous 2021, 2022). By integrating technical “Eco-friendly Measures” into the PARIVESH 2.0 portal, the government has created a formal pathway to embed biodiversity safeguards, such as underpasses and bird flight diverters, into the lifecycle of nationally significant projects (Anonymous 2020, 2024a). This “whole-of-government” approach, reflected in the NBSAP 2024-2030, seeks to address systemic regulatory gaps where high-impact linear projects previously operated with minimal wildlife appraisal (Anonymous 2024b).

Despite these initiatives, significant regulatory and implementation gaps persist, undermining the efficacy of these frameworks. Wildlife-sensitive mitigation - such as overpasses, underpasses, fencing, or realignment - is inconsistently applied across states, often restricted to projects involving significant forest land diversion while bypassing those on revenue or private land. Furthermore, post-construction monitoring to assess the functional success of these structures is often absent, leaving a data gap regarding their actual impact on animal movement and mortality (Gubbi et al. 2012, Anonymous 2016). Crucially, ecological

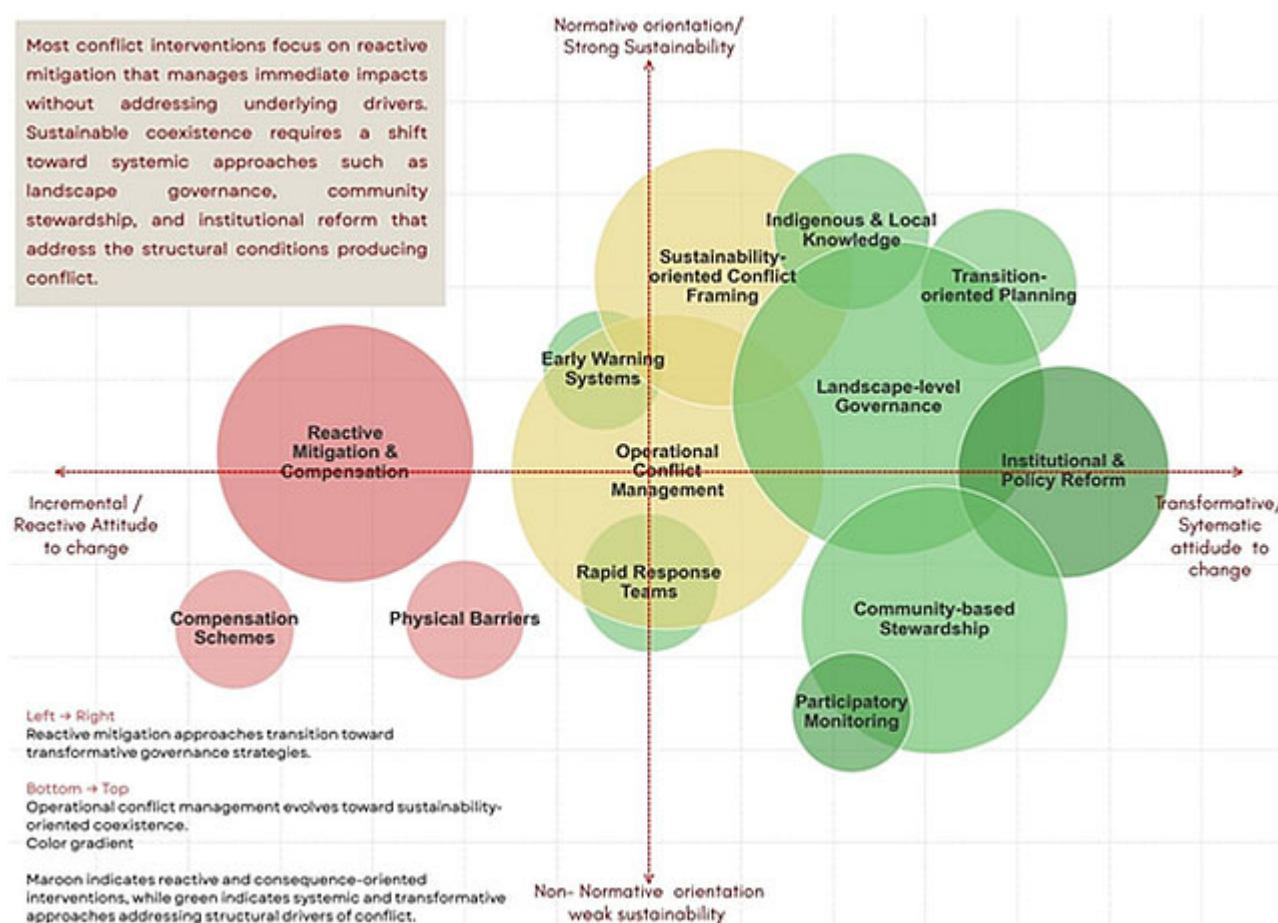


Figure 7. Typology of human-wildlife conflict interventions across change and sustainability dimensions

considerations for non-EIA-listed projects - such as power transmission and certain railway expansions - within the 10-km peripheral zone of Protected Areas remain largely discretionary. Without institutionalizing mandatory appraisal for all linear infrastructure traversing known wildlife-use areas, these landscapes remain vulnerable to fragmentation, potentially offsetting the conservation gains envisioned under the KMGPF.

To fulfil the “harmony with nature” vision by 2050, the way forward is to move beyond discretionary guidelines toward legally embedded safeguards. Strengthening the State-level Coordination Committees (established under the HWC-NAP) to oversee the entire project lifecycle - from pre-feasibility routing to long-term monitoring - is critical. Additionally, institutionalizing Integrated Landscape Management Plans (ILMPs) would ensure that connectivity remains a non-negotiable parameter in infrastructure planning. By ensuring that mitigation measures are scientifically designed,

consistently implemented, and rigorously monitored, India can align its infrastructure growth with the global mandate for landscape-level conflict prevention and biodiversity resilience.

CONCLUSIONS

Human-wildlife conflict in India persists not because interactions between people and wildlife are inherently unmanageable, but because coexistence has largely been assumed rather than institutionally designed. The recurrence of conflict outcomes across diverse landscapes indicates that prevailing approaches have focused on managing symptoms rather than addressing the conditions under which interaction becomes harmful. Viewing conflict through the lens of coexistence failure shifts attention from episodic events to the broader socio-ecological arrangements that shape exposure, risk, and response. This reframing highlights how conflict is produced through ordinary processes of land-use change,

infrastructure development, livelihood dependence, and administrative decision-making. These processes are neither accidental nor isolated; they reflect development and conservation trajectories that have evolved independently, often without mechanisms for reconciliation at the landscape scale. As a result, risk is systematically externalised onto particular spaces and social groups, while institutional responses remain fragmented and reactive. Understanding conflict as a failure of coexistence also underscores the importance of equity and accountability in conservation practice. The uneven distribution of risk, the selective recognition of loss, and the procedural barriers embedded in governance systems reveal that coexistence is not experienced uniformly. For many households, living with wildlife involves ongoing negotiation and adjustment in the absence of adequate institutional support, raising questions about whose safety, labour, and livelihoods are considered acceptable trade-offs for conservation outcomes.

India's shift toward a coexistence-oriented framework under the National HWC-NAP (2021-2026) and NBSAP (2024-2030) successfully aligns domestic policy with KMGBF Target 4. However, the persistent reliance on discretionary appraisals for EIA-exempt linear projects remains a systemic vulnerability. To bridge the gap between policy intent and ecological outcomes, India must transition from advisory guidelines to institutionalized, mandatory safeguards that encompass the entire project lifecycle, from pre-feasibility routing to post-construction monitoring. Strengthening these landscape-level protections is essential to ensure that national infrastructure expansion does not compromise the long-term ecological connectivity required for conflict prevention and biodiversity resilience. Reframing human-wildlife conflict in this way opens space for more integrated thinking about human-wildlife relations in human-dominated landscapes. It invites attention to how land-use planning, infrastructure design, livelihood security, and institutional coordination shape the conditions of coexistence over time. Rather than treating conflict as an exceptional disruption, this perspective situates it within everyday governance and development practices, where the possibilities for more stable and just forms of coexistence ultimately lie.

Authors' contributions: All authors contributed equally.

Conflict of interest: Authors declare no conflict of interest.

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Received: 3rd March 2026

Accepted: 14th April 2026