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Human-Elephant Conflict in India with Special Reference to Assam: Patterns, Consequences, and Mitigation Strategies

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ABSTRACT

Human–elephant conflict (HEC) has emerged as a significant conservation and socio-economic challenge, particularly in Assam, a major stronghold of the Asian elephant (*Elephas maximus*). The state supports approximately 5,719 elephants within highly fragmented habitats interspersed with human-dominated landscapes, resulting in frequent interactions. On average, around 70 human and 80 elephant deaths are reported annually in Assam due to conflict, with peak incidents occurring during the paddy harvesting season. This review synthesizes spatial and temporal patterns, drivers, impacts, and mitigation strategies of HEC in India, with special reference to Assam, using secondary data from published literature and government reports. The impacts of HEC are multidimensional, including ecological consequences such as elephant mortality and population disruption, as well as socio-economic challenges like crop loss, financial instability, and psychological stress among affected communities. Key drivers include habitat fragmentation, corridor disruption, and attraction to high-nutrient crops. Mitigation strategies have evolved toward integrated approaches involving early warning systems, solar fencing, community participation, use of trained elephants (Kumki), and habitat restoration. The study highlights the need for landscape-level planning, improved corridor connectivity, and coexistence-based strategies to ensure long-term conservation of elephants alongside human well-being.

Keywords Human–elephant conflict, *Elephas maximus*, Habitat fragmentation, Crop raiding, Mitigation strategies.

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INTRODUCTION

Human–elephant conflict (HEC) refers to negative interactions between humans and elephants that result in loss of human lives, crop damage, property destruction, and sometimes the death or injury of elephants. The conflict has emerged as a major conservation and management challenge across the range of the Asian

elephant (*Elephas maximus*). Rapid habitat loss, forest fragmentation, and increasing human pressure on natural landscapes have intensified interactions between elephants and human communities. The reduction of forest cover and disruption of traditional movement corridors limit elephants' access to natural forage, forcing them to enter agricultural fields and human settlements in search of food. These landscape changes have significantly altered elephant ranging behavior and increased the frequency and intensity of human–elephant encounters (Chartier *et al.* 2011, Latif and Palita 2023, Jamaluddin *et al.* 2024).

Occurrence and intensity of HEC are strongly influenced by landscape structure and seasonal patterns. Variations in crop cycles and habitat configuration shape the timing and intensity of conflict events, with crop-maturity stages often coinciding with increased elephant incursions into cultivated lands. Agricultural fields near forest boundaries provide highly nutritious crops such as paddy, maize, and sugarcane, making them attractive feeding sites for elephants. Consequently, forest–agriculture interface zones often become persistent conflict hotspots (Williams *et al.* 2001).

Anthropogenic landscape modifications have intensified human–elephant conflict, particularly in forest fringe regions where natural habitats meet agricultural lands. These interface zones provide easy access to cultivated crops, increasing elephant incursions and the likelihood of direct encounters with local communities (Pozo *et al.* 2017, Nad *et al.* 2022). This indicates that HEC is not an isolated ecological issue but a long-term outcome of land-use transformation and resource competition.

India supports nearly 60% of the global Asian elephant population. However, increasing anthropogenic pressures such as deforestation, agricultural expansion, infrastructure development, and habitat fragmentation have intensified conflict situations across elephant range states (Press Trust of India 2024a, Das *et al.* 2025). In northeastern India, the problem is particularly severe due to dense human populations and fragmented habitats, where elephants frequently move through human-dominated landscapes, causing crop damage, property destruction, and occasional casualties (Choudhury 2004). Conflict continues to intensify, with persistent conflict zones and increased incidents during crop maturation stages and monsoon periods in Assam Expanding settlements and agricultural activities increasingly overlap with elephant ranges and migratory corridors, further exacerbating conflict dynamics (Sukumar 2003, Goswami *et al.* 2015, Wilson *et al.* 2015). Addressing HEC requires balancing the conservation of this endangered megaherbivore with the protection of human lives and livelihoods. This can be achieved through integrated strategies such as ecological management, land-use planning, community participation, and institutional support (Rangarajan *et al.* 2010).

Understanding the ecological characteristics of elephants is essential for interpreting their behavior and interactions with humans, particularly in regions such as Assam where forest–human interfaces are extensive. Therefore, this review synthesizes existing knowledge on human–elephant conflict in India with special reference to Assam, focusing on patterns, drivers, impacts, and mitigation strategies to support sustainable coexistence.

Despite extensive research on HEC in India, there is a lack of consolidated reviews focusing specifically on Assam that integrate ecological, spatial, and socio-economic dimensions. This study aims to address this gap using available secondary data sources.

Distribution of Asian Elephants in India and Assam

The family Elephantidae was historically distributed across the continents of America, Europe, Asia, and Africa. However, at present, elephants are confined to certain regions of Asia and sub-Saharan Africa (Thouless *et al.* 2016, Calabrese *et al*. 2017). According to the IUCN Red List assessments, the extant Asian elephant (*Elephas maximus*) is classified as Endangered (Williams *et al.* 2020), the extant Asian elephant (*Elephas maximus*) is classified as Endangered, while the African savanna elephant (*Loxodonta africana*) and the African forest elephant (*Loxodonta cyclotis*) are categorized as Vulnerable.

The Asian elephant (*Elephas maximus*) is widely distributed across 13 countries in Asia, covering an estimated range of approximately 486,800 km² and holds significant ecological and cultural importance throughout its range. Earlier estimates suggested that the global population ranged from 41,410 to 52,345 individuals (Sukumar 2003, Sukumar 2006, IUCN Species SSC Asian Elephant Specialist Group 2010). Later assessments indicated that the global population increased to 48,323–51,680 individuals in the wild across all range countries (Menon and Tiwari 2019).

India currently holds around 25,000–30,000 Asian elephants, distributed across approximately 163,000 km² of varied habitats. Their major populations are found in the states of Karnataka, Assam, Kerala, Tamil Nadu, and Odisha (Shaffer *et al.* 2019, Pandey *et al.* 2024b). The country also has 29 elephant reserves covering more than 65,000 km², highlighting its crucial role in global elephant conservation. The Asian elephant functions as a keystone species, influencing vegetation dynamics, seed dispersal, and habitat structure (Sukumar 2003, Rangarajan *et al.* 2010, Campos-Arceiz and Blake 2011, Baskaran *et al.* 2010). This ecological role further emphasizes the importance of conserving elephant populations despite increasing human–wildlife conflict.

Northeast India represents one of the most important elephant landscapes, supporting over 10,000 wild elephants, approximately 25% of the global population (Choudhury 1999). The region contains diverse habitats including wetlands, grasslands, tropical evergreen and deciduous forests, swamps, and subtropical and temperate forests that provide suitable environments for elephants (Choudhury 2004).

Among the northeastern states, Assam supports a significant population of elephants. The 2017 synchronized elephant census estimated 5,719 individuals distributed across about 15,050 km² of forest habitat in the state (Ministry of Environment, Forest and Climate Change 2017). Due to this substantial population, Assam is recognized as a critical stronghold for the conservation of Asian elephants in India.

Pattern of Human–Elephant Conflict

Human–elephant conflict (HEC) exhibits distinct spatial and temporal patterns across elephant range countries in Asia and Africa. Studies indicate that conflict most frequently occurs in landscapes where agricultural areas overlap with elephant habitats. Early research by Hoare (1999) demonstrated that HEC is strongly associated with land-use mosaics where croplands intersect with forested elephant habitats. Similarly, Perera (2009) reported that increasing human population, agricultural expansion, and fragmentation of elephant habitats intensify competition for space and resources, thereby increasing the likelihood of conflict.

Spatially, HEC is concentrated near forest edges, protected area boundaries, and traditional elephant corridors. Studies from Southeast Asia have shown that the expansion of plantations, road networks, and other infrastructure restrict elephant movement and force elephants into nearby agricultural landscapes (de Silva *et al.* 2023). In India, similar spatial patterns have been documented in areas such as Rajaji National Park and Bandipur National Park, where conflict hotspots occur along migratory routes and at the interface of forests and agricultural fields (Williams *et al.* 2001, GM and GV 2025). Long-term studies from Odisha and Jharkhand also reveal clustering of conflict incidents around forest fringes and corridor areas (Tripathy *et al.* 2021, Nad *et al.* 2022). These findings highlight the strong influence of landscape configuration on the spatial distribution of conflict.

Temporal patterns of HEC are often associated with seasonal changes and cropping cycles. Research from Sri Lanka suggests that crop-raiding incidents increase during crop maturation periods when elephants are attracted to high-nutrient agricultural crops (Ekanayaka *et al.* 2011, Sajla and Famees 2022). This seasonal synchronization between crop availability and elephant movement significantly increases conflict intensity.

In addition, male Asian elephants are the most frequent crop raiders, often occurring singly or in small groups, and exhibit risk-taking behavior to improve body condition prior to sexually active musth periods (Sukumar 1992, Hoare 1999). However, female elephants, when raiding in larger family groups, can also cause substantial economic damage to both

subsistence and commercial agriculture (Sitati and Walpole 2006, Hoare 1999).

In Northeast India, particularly in Assam, the pattern of HEC is closely linked to high elephant density, forest fragmentation, and the presence of human settlements along forest fringes. Studies by Choudhury (1999) documented frequent crop damage and human casualties in villages located near reserve forests and elephant movement corridors. Regions such as Karbi Anglong and West Karbi Anglong experience recurrent conflict incidents as elephants move through fragmented habitats and agricultural landscapes. These patterns suggest that the spatial distribution of settlements, agricultural activities, and disrupted elephant corridors strongly influence the occurrence and severity of human–elephant conflict in the region.

Causes and consequences of Human–elephant conflict (HEC)

Human–elephant conflict (HEC) arises primarily due to increasing overlap between human activities and elephant habitats. It is driven by a complex interaction of ecological and socio-economic factors rather than a single cause (Fig. 1). Rapid human population growth and expansion of agricultural land have resulted in the encroachment and fragmentation of forests, which historically served as elephant habitats. The intensity and frequency of conflict tend to increase significantly when habitat loss exceeds a critical threshold of approximately 30–40% (Chartier *et al.* 2011).

The loss and degradation of suitable habitats are another cause of HEC that reduce the availability of natural forage and restrict elephant movement, forcing elephants to enter human-dominated landscapes in search of food and resources. Such intrusions often lead to crop raiding, aggressive encounters, and in some cases, human or elephant mortality (Latif and Palita 2023, Sukumar 2003).

Habitat fragmentation and loss of connectivity between forest patches represent another critical factor contributing to HEC. When habitats become isolated, elephants are compelled to move through agricultural lands and settlements to access resources. The absence of functional wildlife corridors further disrupts traditional migratory routes and increases the likelihood of human–elephant encounters (Jamaluddin *et al.* 2024). Therefore, maintaining landscape connectivity is essential for reducing conflict intensity.

Climate change has further exacerbated HEC by altering rainfall patterns and increasing the frequency of droughts. These changes reduce the availability of natural food and water resources, forcing elephants to move into human-dominated landscapes (Thant *et al.* 2021). In addition, shifts in vegetation composition and resource distribution may further intensify competition between humans and elephants (Bhatt *et al.* 2018).

Most human–elephant conflict incidents occur within forests and in the human-dominated fringe areas surrounding them. Human fatalities within forest areas are often the result of accidental encounters during activities such as firewood collection, livestock grazing, or the collection of other forest resources. In contrast, incidents in agricultural fields and set-

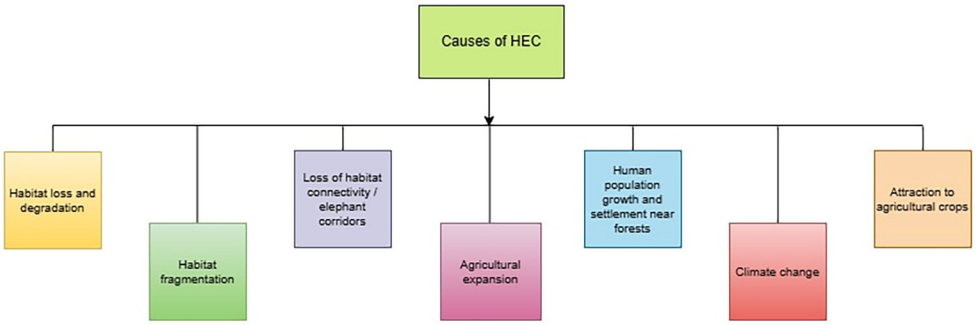

Fig. 1. Causes of Human Elephant Conflict (HEC).

Table 1. Annual human and elephant mortality due to Human–Elephant Conflict in selected countries.

Country	Estimated Human Deaths (per year)	Estimated Elephant Deaths (per year)	References
India	~571	~124	Ganesh (2019)
Sri Lanka	>70	~200	Santiapillai *et al.* (2010) Fernando & Pastorini (2011)
Kenya	~25	50–125	Shaffer *et al.* (2019)
Bangladesh	~37	~4	Islam *et al.* (2011)
Indonesia	~2	~9	Azmi & Gunaryadi (2011)

tlements are often linked to defensive or aggressive behavior by elephants, particularly when they are disturbed during crop-raiding events or when females are accompanied by calves (Sukumar 2003, Lenin and Sukumar 2011).

HEC has profound impacts on human lives and livelihoods. One of the most immediate consequences is the loss of crops and damage to property (Köpke *et al*. 2024). Elephants frequently raid agricultural fields, destroying or severely damaging crops, which results in considerable economic losses for farmers (Prins *et al.* 2022). In many cases, entire harvests may be lost, leaving rural households without adequate food supplies or sources of income. Furthermore, elephants may also damage houses, storage facilities, and other infrastructure, thereby creating additional financial burdens for affected communities (Zhang *et al.* 2024).

Human–elephant conflict also results in significant mortality of both humans and elephants across range countries. In India, approximately 571 human deaths and around 124 elephant deaths are reported annually due to conflict incidents (Ganesh 2019). Similarly, high mortality rates have been reported in other countries such as Sri Lanka, Kenya, Bangladesh, and Indonesia, indicating that HEC is a widespread global issue. (Table 1).

Table 2. Elephant deaths due to electrocution (2017–2022).

State	Number of elephant deaths	References
Odisha	71	Press Trust of India (2024a)
Assam	55	
Karnataka	52	
Tamil Nadu	49	
Chhattisgarh	32	
Jharkhand	30	
Kerala	29	

Table 3. Year-wise human fatalities due to Human–Elephant Conflict in India.

Year	Number of human deaths	Reference
2019	587	Press Trust of India (2024b)
2020	471	
2021	557	
2022	610	
2023	628	

In addition to overall mortality, specific causes of elephant deaths further highlight the severity of human–elephant conflict in India. Nearly 500,000 families are affected annually by crop raiding and associated damages, indicating the extensive socio-economic burden of HEC on rural communities (Ganesh 2019) (Table 2). Between 2017 and 2022, a total of 71 elephant deaths due to electrocution were reported from Odisha, followed by 55 in Assam, 52 in Karnataka, 49 in Tamil Nadu, 32 in Chhattisgarh, 30 in Jharkhand and 29 in Kerala (Table 2). Similarly, human fatalities resulting from human–elephant conflict have shown a consistently high trend in recent years. The year-wise data indicate approximately 587 deaths in 2019, 470 in 2020, 560 in 2021, 610 in 2022, and 630 in 2023 (Press Trust of India, 2024b) (Table 3).

Beyond mortality, human–elephant conflict also significantly affects the well-being of elephants. Repeated exposure to human disturbances and conflict situations can cause chronic physiological and psychological stress. Prolonged stress may lead to several health problems, including digestive disorders, reproductive complications, and weakened immune responses, ultimately reducing the overall survival and fitness of elephant populations (Franco *et al.* 2020).

The status of Human–elephant conflict (HEC) in Assam

Human–elephant conflict (HEC) involving the Asian

Elephant has emerged as a major conservation and socio-economic challenge in Assam. The state supports an estimated 5,719 elephants, representing one of the highest elephant populations in India, and the density of elephants is greater than that in many other regions of the country. However, rapid expansion of agriculture, fragmentation of forest habitats, and increasing human settlements around elephant habitats have intensified interactions between humans and elephants. In many areas, elephant habitats are highly fragmented or interspersed with human-dominated landscapes such as agricultural fields and settlements, which increases the likelihood of encounters between humans and elephants. As a result, incidents of human–elephant conflict have been increasing in the state over the past decades.

A substantial number of conflict incidents and casualties have been recorded in Assam during the last two decades (Table 4). On average, approximately 70 humans and 80 elephants die annually in the state as a result of human–elephant conflict (Talukdar *et al.* 2024, Anonymous 2025a).

A large proportion of these incidents occur during the paddy harvesting season, when elephants move out of forest areas and raid agricultural fields in search of food, leading to increased confrontation with local communities.

Table 4. Overall Human–Elephant Conflict statistics in Assam (2000–2023).

Conflict Indicator	Number Recorded	References
Total human–elephant conflict incidents	1,806	Wildlife Institute of India (2025), Anonymous (2025a)
Human deaths	1,468	
Human injuries	337	
Elephant deaths	1,209	
Villages affected	527	

Fig. 2 indicates that elephant can die by various human-induced causes. Among them, electrocution is the leading cause of elephant mortality in Assam (Anonymous 2025a). The use of illegal electric fencing, poorly maintained power lines, and accidental contact with distribution lines contribute significantly to elephant deaths. Railway collisions and poisoning incidents also represent serious threats to elephant conservation in the region.

Human–elephant conflict is unevenly distributed across Assam. Certain forest divisions experience higher conflict intensity due to their proximity to elephant habitats, forest corridors, and agricultural landscapes (Anonymous 2025a). Table 5 represents major human–elephant conflict hotspots in Assam. where interactions between elephants and human

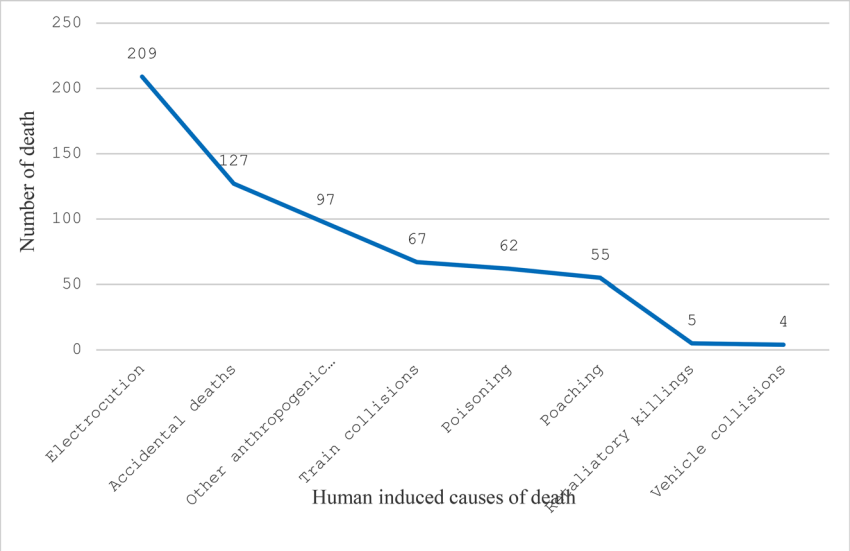

Fig. 2. Number of elephant death in Human–Elephant Conflict.

Table 5. Territorial Division-wise Human Casualties from HEC (2000-2023).

Forest Division	Human Deaths	Human Injuries	References
Sonitpur West	110	92	Anonymous (2025a)
Goalpara	175	—	
Udalguri	168	34	
Sonitpur East	156	21	
Golaghat	110	92	

communities are frequent due to overlapping land-use patterns.

Human–elephant conflict has affected a large number of villages located near forest boundaries and elephant migration corridors. Of the 527 conflict-affected villages, the majority were located in Goalpara division, reflecting intense human–elephant interactions in the region (Wildlife Institute of India 2025) (Fig. 3).

Mitigation strategies of Human–Elephant Conflict (HEC)

Mitigating Human–Elephant Conflict (HEC) requires a combination of ecological management, physical barriers, and community participation aimed at reducing interactions between humans and elephants. One of the most widely adopted mitigation measures is the installation of physical barriers, including electric fencing, solar-powered fencing, trenches, and stone walls to prevent elephants from entering agricultural fields and human settlements (Perera 2009, Sukumar 2003, Das *et al.* 2022). However, the effectiveness of these measures largely depends on proper installation, regular maintenance, and active involvement of local communities.

Another important strategy involves habitat management and the protection of elephant corridors. Habitat loss and fragmentation often force elephants to move through human-dominated landscapes in search of food and water. Protecting natural habitats and restoring migratory corridors allow elephants to move safely between forest patches, thereby reducing conflict with humans (Ramkumar *et al.* 2014, Menon *et al.* 2017, Pandey *et al.* 2024a).

Early warning systems and monitoring programs are also widely used to minimize human–elephant encounters. These systems include watchtowers, community patrol groups, and communication networks that inform villagers about elephant movements in advance, enabling them to protect crops and avoid dangerous interactions (Fernando *et al*. 2008; Cabral *et al.* 2022).

Community participation is another crucial el-

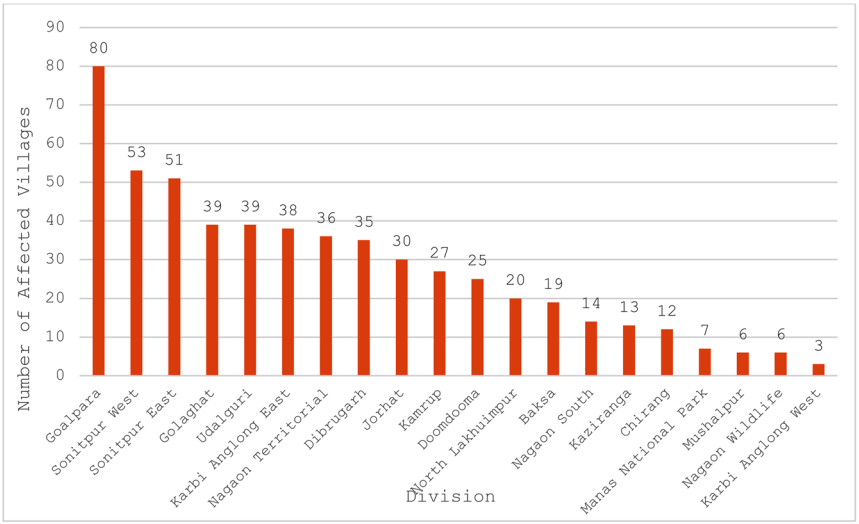

Fig. 3. Divisions with highest Number of HEC-affected villages .

ement in effective conflict mitigation. Local people often engage in night patrols, crop guarding, and maintenance of mitigation structures. In addition, compensation schemes for crop damage, property loss, and human casualties are implemented in several countries to reduce negative attitudes toward elephants and encourage coexistence (Enukwa 2017).

Another important strategy used in managing Human–Elephant Conflict is the deployment of Kumki elephants, which are specially trained captive Asian elephants used by forest departments to control and guide wild elephant herds. Kumki elephants are trained to assist forest personnel in driving wild elephants away from human settlements and agricultural fields and directing them back into forest areas. These elephants play a crucial role during rescue operations, capture missions, and conflict management situations because their training enables them to safely approach and influence the movement of wild elephants without causing harm. Kumki elephants are widely used in wildlife management operations in several parts of India, including Karnataka, Tamil Nadu, and Andhra Pradesh, where trained elephants have been deployed to divert wild elephant herds away from villages and crop fields to reduce damage and protect human lives. Overall, integrated approaches combining physical barriers, habitat conservation, and community participation are considered the most effective strategies for long-term management of human–elephant conflict (Anonymous 2025b).

Mitigation strategies of Human–Elephant Conflict in Assam

In Assam, Human–Elephant Conflict has emerged as a major conservation and socio-economic challenge due to rapid habitat degradation, agricultural expansion, and increasing human settlements near forest areas (Choudhury 2004). To address this problem, several mitigation measures have been implemented by the Assam Forest Department in collaboration with local communities.

Physical mitigation methods such as solar-powered electric fencing and trenching have been widely used in many conflict-prone areas to prevent elephants from entering villages and agricultural fields. In addition, villagers often use traditional deterrents such as firecrackers, drums, and night patrols to drive elephants away from crop fields (Choudhury 2004).

Community-based initiatives have also been introduced to improve coexistence between humans and elephants. One such initiative is the Hatibondhu Initiative, which was launched in 2018 to promote coexistence between humans and elephants. It focuses on creating designated feeding zones for elephants by planting elephant-preferred vegetation such as Napier grass, bamboo, and other fodder plants on large areas of barren or community land. In regions such as Nagaon and Karbi Anglong, the programme has helped reduce crop raiding and improve coexistence between local communities and elephants. This initiative has shown encouraging results in villages such as Hatikhali-Ronghang, where providing alternative food resources helps reduce crop-raiding incidents and promotes coexistence between local communities and elephants (Anonymous 2022, Anonymous 2025c).

In addition, the government provides compensation for crop damage, property loss, and human casualties caused by elephants. Such compensation programs are intended to reduce hostility toward elephants and support conservation initiatives. However, delays in compensation payments and lack of maintenance of mitigation structures often limit their effectiveness (Choudhury 2004).

Future Perspectives

Future management of human–elephant conflict (HEC) must shift from short-term, conventional approaches to integrated, sustainable, and evidence-based strategies. As conflict continues to escalate, site-specific solutions that consider both ecological and socio-economic factors are essential. Community-based conservation should be prioritized, as it promotes local participation, ownership, and coexistence. Strengthening awareness, livelihood support (such as beekeeping, cultivation of chili, ginger, and Indian palm, as well as eco-tourism activities), and ensuring benefit-sharing mechanisms (such as compensation for crop damage, sharing tourism revenue, and employment in conservation programs) can improve tolerance toward elephants and reduce conflict. At the same time, technological

tools such as early warning systems and tracking methods should be effectively maintained and integrated with traditional knowledge. A major focus should be on landscape-level planning, including habitat restoration, protection of wildlife corridors, and identification of conflict hotspots. This will help reduce habitat fragmentation and prevent the shifting of conflict from one region to another. Future research must adopt an interdisciplinary approach, combining ecological, geographical, and social science perspectives. Understanding human behavior, resource use, and local decision-making is critical for addressing the root causes of HEC. Finally, adaptive management based on continuous monitoring and scientific evidence is necessary. Although complete elimination of HEC may not be possible, reducing it to manageable levels while ensuring the safety of both humans and elephants is the ultimate goal for long-term coexistence.

CONCLUSION

Human–elephant conflict (HEC) in Assam represents a complex conservation and socio-economic challenge, arising primarily from habitat fragmentation, agricultural expansion, and increasing human settlements near forest areas. This review highlights that conflict incidents are concentrated in forest–agriculture interface zones and peak during crop-maturation periods, resulting in significant human and elephant mortality, economic losses, and psychological stress for affected communities. Mitigation strategies in Assam have evolved from conventional physical barriers to integrated approaches, including habitat restoration, early warning systems, community participation, and the use of trained elephants (kumki). However, long-term conflict management requires landscape-level planning, protection and restoration of wildlife corridors, evidence-based monitoring, and participatory conservation programs. While complete elimination of HEC may not be feasible, adopting sustainable coexistence strategies can reduce conflict intensity, safeguard human livelihoods, and ensure the long-term conservation of the Asian elephant (*Elephas maximus*) in Assam.

Limitations of the study

This study is based primarily on secondary data obtained from government reports, published literature, and news-based information. Consequently, the findings are subject to the limitations inherent in these sources, including possible underreporting, reporting bias, and variation in data collection methods across different regions and time periods. The reliance on published reports may also exclude unpublished or local knowledge, potentially overlooking nuanced aspects of human–elephant conflict at the community level. Furthermore, temporal and spatial inconsistencies in data availability may affect the accuracy of conflict patterns and mitigation effectiveness. Despite these limitations, this review provides a comprehensive synthesis of existing knowledge and highlights key trends and strategies for human–elephant conflict management in Assam.

REFERENCES

Anonymous. (2022). Assam: 'Hatibondhu' initiative successfully reduces human-elephant conflict in Hatikhali-Ronghang village. The Sentinel. https://www.sentinelassam.com/north-east-india-news/assam-news/assam-hatibondhu-initiative-successfully-reduces-human-elephant-conflict-in-hatikhali-ronghang-village-624913

Anonymous. (2025a). Assam's human-elephant conflict claims over 2,600 lives in 23 years: Report. India Today NE. https://www.indiatodayne.in/assam/story/assams-human-elephant-conflict-claims-over-2600-lives-in-23-years-report-1242079-2025-07-09

Anonymous. (2025b). In a first, Kumki elephants divert wild jumbos back to forest in Ap. The Times of India. https://timesofindia.indiatimes.com/city/vijayawada/in-a-first-kumki-elephants-divert-wild-jumbos-back-to-forest-in-ap/articleshow/123101634.cms

Anonymous. (2025c). Pm hails 'Hati Bondhu' for drop in man-elephant conflict. The Times of India. https://timesofindia.indiatimes.com/city/guwahati/pm-hails-hati-bondhu-for-drop-in-man-elephant-conflict/articleshow/117378181.cms

Azmi, W., & Gunaryadi, D. (2011). Current status of Asian elephants in Indonesia. *Gajah,* 35, 55-61.

Baskaran, N., Balasubramanian, M., Swaminathan, S., & Desai, A. A. (2010). Feeding ecology of the Asian elephant Elephas maximus Linnaeus in the Nilgiri Biosphere Reserve, southern India. *Journal of the Bombay Natural History Society,* 107(1), 3-13.

Bhatt, J. R., Das, A., & Shanker, K. (2018). Biodiversity and climate change: an Indian perspective. New Delhi, India: Ministry of Environment, Forest and Climate Change, Government of India.

Cabral de Mel, S. J., Seneweera, S., de Mel, R. K., Dangolla, A., Weerakoon, D. K., Maraseni, T., & Allen, B. L. (2022). Current and future approaches to mitigate conflict between humans and Asian elephants: the potential use of aversive

geofencing devices. *Animals,* 12(21), 2965. https://doi.org/10.3390/ani12212965

Calabrese, A., Calabrese, J. M., Songer, M., Wegmann, M., Hedges, S., Rose, R., & Leimgruber, P. (2017). Conservation status of Asian elephants: the influence of habitat and governance. *Biodiversity and Conservation,* 26(9), 2067-2081. https://doi.org/10.1007/s10531-017-1345-5

Campos-Arceiz, A., & Blake, S. (2011). Megagardeners of the forest–the role of elephants in seed dispersal. *Acta Oecologica,* 37(6), 542-553. https://doi.org/10.1016/j.actao.2011.01.014

Chartier, L., Zimmermann, A., & Ladle, R. J. (2011). Habitat loss and human–elephant conflict in Assam, India: does a critical threshold exist?. *Oryx,* 45(4), 528-533. https://doi.org/10.1017/S0030605311000044

Choudhury, A. (1999). Status and conservation of the Asian elephant Elephas maximus in north-eastern India. *Mammal Review,* 29(3), 141-174. https://doi.org/10.1046/j.1365-2907.1999.00045.x

Choudhury, A. (2004). Human–elephant conflicts in Northeast India. *Human dimensions of wildlife,* 9(4), 261-270. https://doi.org/10.1080/10871200490505693

Das, A., Kumar, N., Panda, A., Uniyal, R., Sahu, R. K., Rout, S., & Kumar, S. (2025). Human-elephant conflicts in India. In Faunal Wealth of India, Volume 1 (pp.1-17). Ambika Prasad Research Foundation.

Das, G., Selvan, K., Lahkar, B., & Gopi, G. V. (2022). Effectiveness of physical barriers in mitigating human–elephant negative interactions in North-East India. *Frontiers in Conservation Science*, 3, 956568. https://doi.org/10.3389/fcosc.2022.956568

de Silva, S., Ruppert, K., Knox, J., Davis, E. O., Weerathunga, U. S., & Glikman, J. A. (2023). Experiences and emotional responses of farming communities living with A0n Elephants in Southern Sri Lanka. Trees, Forests and People, 14, 100441. https://doi.org/10.1016/j.tfp.2023.100441

Ekanayaka, S. K., Campos-Arceiz, A., Rupasinghe, M., Pastorini, .J., & Fernando, P. (2011). Patterns of crop raiding by Asian elephants in a human-dominated landscape in Southeastern Sri Lanka. *Gajah,* 34, 20-25. https://doi.org/10.5167/uzh-59040

Enukwa, E. H. (2017). Human-Elephant conflict mitigation methods: A review of effectiveness and sustainability. *Journal of Wildlife and Biodiversity,* 1(2), 69-78. https://doi.org/10.22120/jwb.2017.28260

Fernando, P., Kumar, M. A., Williams, A. C., Wikramanayake, E., Aziz, T., & Singh, S. M. (2008). Review of human-elephant conflict mitigation measures practiced in South Asia. Gland, Switzerland: WWF.

Fernando, P., & Pastorini, J. (2011). Range-wide status of *Asian elephants. Gajah*, 35(2014), 15-20.

Franco dos Santos, D. J., Berger, V., Cristofari, R., Htut, W., Nyein U. K., Aung, H. H., & Lummaa, V. (2020). Seasonal variation of health in Asian elephants. *Conservation Physiology,* 8(1), coaa119. https://doi.org/10.1093/conphys/coaa119

GM, P., & GV, V. (2025). Studying Human-wildlife Conflict with the Geospatial Approach in Bandipur and Nagarhole National Parks. *Ecology, Environment & Conservation* (0971765X), 31. http://doi.org/10.53550/EEC.2025.v31i05s.005

Ganesh, S. (2019). Human elephant conflict kills 1713 people, 373 pachyderms in 3 years. The Hindu. https://www.thehindu.com/news/national/human-elephant-conflict-kills-1713-people-373-pachyderms-in-3-years/article26225515.ece

Goswami, V. R., Medhi, K., Nichols, J. D., & Oli, M. K. (2015). Mechanistic understanding of human–wildlife conflict through a novel application of dynamic occupancy models. *Conservation Biology,* 29(4), 1100-1110. https://doi.org/10.1111/cobi.12475

Hoare, R. E. (1999). Determinants of human–elephant conflict in a land-use mosaic. *Journal of applied ecology*, 36(5), 689-700. https://doi.org/10.1046/j.1365-2664.1999.00437.x

Islam, M. A., Mohsanin, S., Chowdhury, G. W., Chowdhury, S. U., Aziz, M. A., Uddin, M., & Azam, I. (2011). Current status of Asian elephants in Bangladesh. *Gajah,* 35, 21-24.

IUCN SSC Asian Elephant Specialist Group. (2010). Asian Elephant Status Report. https://iucn.org/our-union/commissions/group/iucn-ssc-asian-elephant-specialist-group

Jamaluddin, M. I. M., Abidin, K. Z., Nor, S. M., Shukor, A., Zainudddin, A. I., Illias, R., & Mansor, M. S. (2024). Asian elephants involved in conflicts exhibit similar habitat use but travel farther than non-conflict individuals. *Global Ecology and Conservation,* 55, e03228. https://doi.org/10.1016/j.gecco.2024.e03228

Köpke, S., Withanachchi, S. S., Chinthaka Perera, E. N., With anachchi, C. R., Gamage, D. U., Nissanka, T. S., & Thiel, A. (2024). Factors driving human–elephant conflict: statistical assessment of vulnerability and implications for wildlife conflict management in Sri Lanka. *Biodiversity and Conservation,* 33(11), 3075-3101. https://doi.org/10.1007/s10531-024-02903-z

Latif, A., & Palita, S. A. (2023). Human Elephant Conflict and Status of Habitat in Chaibasa Forest Division, West Singhbhum District, Jharkhand, India. *Pranikee-Journal of Zoological Society of Orissa,* 35, 1-22.

Lenin, J., & Sukumar, R. (2011). Action Plan for the mitigation of human-elephant conflict in India. Asian Nature Conservation Foundation, Report.

Menon, V., Tiwari, S. K., Ramkumar, K., Kyarong, S., Ganguly, U., & Raman Sukumar (Eds.). (2017). Right of Passag 25 e: Elephant Corridors of India (2nd ed.). Wildlife Trust of India, New Delhi.

Menon, V., & Tiwari, S. K. (2019). Population status of Asian elephants Elephas maximus and key threats. *International Zoo Yearbook,* 53(1), 17-30. https://doi.org/10.1111/izy.12247

Ministry of Environment, Forest and Climate Change. (2017). Synchronized elephant population estimation India 2017. Government of India. https://www.indiaspend.com/h-library/2017elephant-population-estimation-india-2017.pdf

Nad, C., Roy, R., & Roy, T. B. (2022). Human elephant conflict in changing land-use land-cover scenario in and adjoining region of Buxa tiger reserve, India. *Environmental Challenges,* 7, 100384. https://doi.org/10.1016/j.envc.2021.100384

Pandey, R. K., Lakshminarayanan, N., Mittal, D., Udhayaraj, A. D., & Selvan, K. M. (2024a). On the Pan-India assessment of elephant corridors: challenges, opportunities and future directions. *Indian forester,* 150(10), 909-915. 10.36808/if/2024/v150i10/170626

Pandey, R. K., Yadav, S. P., Selvan, K. M., Natarajan, L., & Nigam, P. (2024b). Elephant conservation in India: Striking a balance

between coexistence and conflicts. *Integrative Conservation,* 3(1), 1-11. https://doi.org/10.1002/inc3.38

Perera, B. M. A. O. (2009). The human-elephant conflict: A review of current status and mitigation methods. *Gajah,* 30(2009), 41-52.

Pozo, R. A., Coulson, T., McCulloch, G., Stronza, A. L., & Son ghurst, A. C. (2017). Determining baselines for human-elephant conflict: A matter of time. *PLoS One,* 12(6), e0178840. https://doi.org/10.1371/journal.pone.0178840

Press Trust of India. (2024a). India lost 528 elephants due to unnat ural causes in 5 years: Govt data. Business Standard. https://www.business-standard.com/india-news/india-lost-528-elephants-due-to-unnatural-causes-in-5-years-govt-data-124072900824_1.html

Press Trust of India. (2024b). Over 2,500 people died in 5 years in human-elephant conflicts: Govt data. Business Standard https://www.business-standard.com/india-news/over-2-500-people-died-in-5-years-in-human-elephant-conflicts-govt-data-124072600517_1.html

Prins, H. H., Liefting, Y., & de Jong, J. F. (2022). Marginal farmers carry the burden of damage caused by Asian elephants Elephas maximus in Bardiya National Park, Nepal. Oryx, 56(1), 73-81. https://doi.org/10.1017/S0030605319001431

Ramkumar, R., Ramakrishnan, B., Karthick, S., & Saravanamuthu, R. (2014). Human and elephant (*Elephas maximus*) deaths due to conflict in Coimbatore Forest Division, Tamil Nadu, India. Zoo's Print, 29(8), 12-19.

Rangarajan, M., Desai, A., Sukumar, R., Easa, P. S., Menon, V., Vincent, S., Ganguly, S., Talukdar, B., Singh, B., & Mudap pa, D. (2010). Gajah: Securing the future for elephants in India. Government of India. https://www.environmentandsociety.org/sites/default/files/key_docs/Gajah.pdf

Sajla, J. F., & Famees, M. F. (2022). Human-elephant conflict: challenges in agriculture Sector in Polonnaruwa district; A study based on literature review. *Sri Lanka Journal of Social ScSaiences and Humanities,* 2(1). https://doi.org/10.4038/sljssh.v2i1.58

Shaffer, L. J., Khadka, K. K., Van Den Hoek, J., & Naithani, K. J. (2019). Human-elephant conflict: A review of current man agement strategies and future directions. *Frontiers in Ecology and Evolution,* 6, 235. https://doi.org/10.3389/fevo.2018.00235

Santiapillai, C., Wijeyamohan, S., Bandara, G., Athurupana, R., Dissanayake, N., & Read, B. (2010). An assessment of the human-elephant conflict in Sri Lanka. http://drr.vau.ac.lk/handle/123456789/1738

Sitati, N. W., & Walpole, M. J. (2006). Assessing farm-based measures for mitigating human-elephant conflict in Transmara District, Kenya. *Oryx,* 40(3), 279-286.

Sukumar, R. (1992). The Asian elephant: Ecology and management. Cambridge University Press.

Sukumar, R. (2003). The Living Elephants: Evolutionary Ecology, Behavior, and Conservation. Oxford University Press, New York.

Sukumar, R. (2006). A brief review of the status, distribution and biology of wild Asian elephants *Elephas maximus. Inter national Zoo Yearbook,* 40(1), 1-8. https://doi.org/10.1111/j.1748-1090.2006.00001.x

Talukdar, N. R., Choudhury, P., & Ahmad, F. (2024). Human-elephant conflict hotspots in Assam: a rapid appraisal method. *Biodiversity and Conservation,* 33(6), 2231-2245. https://doi.org/10.1007/s10531-024-02858-1

Thant, Z. M., May, R., & Røskaft, E. (2021). Pattern and distribution of human-elephant conflicts in three conflict-prone landscapes in Myanmar. *Global Ecology and Conservation*, 25, e01411. https://doi.org/10.1016/j.gecco.2020.e01411

Tripathy, B. R., Liu, X., Songer, M., Kumar, L., Kaliraj, S., Chatterjee, N. D., & Mahanta, K. K. (2021). Descriptive spatial analysis of human-elephant conflict (HEC) distribution and mapping HEC hotspots in Keonjhar forest division, In dia. *Frontiers in Ecology and Evolution,* 9, 640624. https://doi.org/10.3389/fevo.2021.640624

Thouless, C., Dublin, H. T., Blanc, J., Skinner, D. P., Daniel, T. E., Taylor, R., & Bouché, P. (2016). African elephant status report 2016. *Occasional paper series of the IUCN Species Survival Commission*, 60, 309. https://conservation action.co.za/wp-content/uploads/2016/10/AfESG-African-Elephant-Status-Report-2016-Executive-Summary-only.pdf

Wildlife Institute of India. (2025). Elephant-human Conflict in the state of Assam, India (2000–2025): Trends, Chal lenges and Insights. Wildlife Institute of India. https://moef.gov.in/uploads/2025/07/Assam_Elephant_Human_Conflict_Reoport_March_2025_Final.pdf

Williams, A. C., Johnsingh, A. J., & Krausman, P. R. (2001). Elephant-human conflicts in Rajaji National Park, northwestern India. *Wildlife Society Bulletin,* 1097-1104.

Williams, C., Tiwari, S. K., Goswami, V. R., de Silva, S., Kumar, A., Baskaran, N., Yoganand, K. & Menon, V. (2020). Elephas maximus. The IUCN Red List of Threatened Species 2020: e.T7140A45818198. https://dx.doi.org/10.2305/IUCN.UK.2020-3.RLTS.T7140A45818198.en

Wilson, S., Davies, T. E., Hazarika, N., & Zimmermann, A. (2015). Understanding spatial and temporal patterns of human–elephant conflict in Assam, India. *Oryx,* 49(1), 140-149. https://doi.org/10.1017/S0030605313000513

Zhang, H., Guo, S., Ma, L., Su, K., Lobora, A., Hou, Y., & Wen, Y. (2024). Living with elephants: Analyzing commonalities and differences in human-elephant conflicts in China and Tanzania based on residents' perspectives. *Global Ecology and Conservation*, 53, e03034. https://doi.org/10.1016/j.gecco.2024.e03034