



Impact of Human–Wildlife Conflict on Agriculture in Assam: Causes, Consequences and Sustainable Management Strategies

Riju Laskar

Kampur College, Kampur, Nagaon, Assam, India.

*Corresponding Author Email: rijulaskar.kmapur@gmail.com

Abstract: Human–wildlife conflict has emerged as an important environmental, agricultural and livelihood issue in Assam. The state contains extensive forests, protected areas, wildlife corridors, wetlands, tea landscapes, agricultural fields and densely inhabited rural areas. These landscapes increasingly overlap as agricultural expansion, infrastructure development, habitat fragmentation and settlement growth bring people and wildlife into closer contact. Among the different forms of human–wildlife conflict, crop raiding is particularly important for rural communities because it directly affects agricultural production and household income. Although elephants are one of the most prominent species involved, other wildlife, including wild boar, porcupines, deer and rhesus macaques, can also damage crops. Studies from different parts of Assam demonstrate that crop damage can affect subsistence crops, commercial crops, homestead gardens and livestock-related livelihoods. In the Manas landscape, for example, paddy was identified as the principal crop affected by elephant raiding, while research in Poba Reserved Forest documented damage to paddy, potato, sweet potato, mustard, pea, maize, chilli, sesame and other crops by different wildlife species. The agricultural consequences of human–wildlife conflict extend beyond the immediate value of damaged crops. Repeated crop raiding can increase labour requirements, reduce effective farm income, discourage agricultural investment, create psychological stress, alter cropping decisions and in severe situations encourage farmers to abandon cultivation. Recent research has also highlighted the growing importance of rhesus macaque conflict in Assam, including crop damage in Nagaon and agricultural losses associated with macaques in Lakhimpur. This paper examines the causes, patterns, agricultural impacts, socio-economic consequences and possible solutions to human–wildlife conflict in Assam. It argues that sustainable management requires a shift from reactive conflict control toward landscape-level coexistence based on habitat protection, corridor conservation, early-warning systems, community participation, appropriate crop planning, effective compensation and scientifically evaluated non-lethal mitigation measures.

Keywords: Human–wildlife conflict, Assam, agriculture, crop raiding, Asian elephant, farmers, livelihood, conservation, crop damage.

1. INTRODUCTION

Assam is one of India's most biologically diverse states and contains a wide range of wildlife habitats, including tropical forests, grasslands, wetlands, riverine landscapes and protected areas. The state's ecological richness supports important populations of Asian elephants, rhinoceroses, primates, wild boar, deer and numerous other species. At the same time, agriculture is a major component of rural livelihoods. Consequently, the boundaries between wildlife habitat and agricultural landscapes are often not sharply defined. Wildlife frequently moves through or around cultivated areas, particularly where forests have become fragmented or where traditional movement routes intersect with human settlements. Human–wildlife conflict occurs when interactions between people and wildlife produce negative consequences for either or both sides. In agricultural areas, one of the most visible forms of conflict is crop raiding. Animals enter agricultural fields and consume or trample crops, damage stored produce, destroy fencing and property, or sometimes injure people attempting to protect their fields. For farmers whose livelihoods depend heavily on agriculture, even relatively small crop losses can have significant consequences. Human–elephant conflict provides one of the clearest examples in Assam. Research around Manas National Park found that crop damage was the most common form of human–elephant conflict and that paddy was particularly vulnerable. In a broader study of Sonitpur and Goalpara, crop damage was again identified as the most common form of conflict, with a strong seasonal relationship between elephant movement and the agricultural calendar. The problem is not restricted to elephants. Rhesus macaques have also become a significant agricultural concern in parts of Assam. A 2024 study conducted in Nagaon and Kaliabar examined human–monkey conflict and reported impacts on people's daily lives and income, with crop and garden protection requiring substantial human effort. Recent research from Lakhimpur has similarly documented substantial agricultural damage associated with rhesus macaques, particularly to vegetables and paddy. Wild boar and porcupines also contribute to agricultural losses. Research in Poba Reserved Forest, Dhemaaji, documented crop losses associated with wildlife and reported damage to crops including taro, potato, sweet potato, paddy, mustard, pea, maize,

chilli and sesame. The study identified elephants as causing major losses through foraging and trampling, while wild boar and porcupines damaged crops through feeding and rooting activities.

Objectives of the study

- To examine the impact of human–wildlife conflict on agriculture in Assam.
- To identify the principal wildlife species involved in agricultural conflict
- To examine the economic and social consequences of crop damage.
- To examine the major causes of human–wildlife conflict, including habitat fragmentation, agricultural expansion, loss of wildlife corridors, availability of attractive crops, settlement expansion and changes in land use.

2. RESEARCH METHODOLOGY

This paper is based on secondary research and uses an analytical review of peer-reviewed research, institutional repositories and published studies dealing specifically with Assam. Wherever possible, Assam-specific empirical research has been prioritized rather than relying on general statements about human–wildlife conflict in India. The paper draws particularly upon research conducted in Manas National Park, Sonitpur, Goalpara, Dhemaji, Nagaon, Udalguri, Lakhimpur and other landscapes in Assam. These studies use different methodologies, including household surveys, forest department records, field observations, spatial analysis, crop-damage assessment and socio-economic surveys.

Concept of human–wildlife conflict: Human–wildlife conflict refers to situations in which interactions between wild animals and human beings result in negative consequences for people, wildlife, or both. Such conflict generally occurs when human activities and wildlife requirements overlap spatially. In rural areas, the problem becomes particularly visible when wild animals enter agricultural fields, consume crops, damage property, attack livestock, or create risks to human safety. From the perspective of conservation, conflict can also occur when human activities cause injury, displacement, or mortality of wildlife. Therefore, human–wildlife conflict should not be understood simply as animals entering human settlements; rather, it is a broader consequence of competition for space and resources between human communities and wildlife. In Assam, the problem is closely associated with the state's exceptional biological diversity and the large number of communities living close to forests, protected areas, wetlands, riverine areas and wildlife corridors. Agricultural land frequently occurs next to or within landscapes used by wildlife. This creates an interface where wild animals and people encounter one another regularly. Elephants are particularly important because they require large areas for movement and may travel through agricultural landscapes. However, conflict is not restricted to elephants. Rhesus macaques, wild boar, porcupines, deer and other species can also cause crop damage. Research in Poba Reserved Forest in Dhemaji, for example, documented human–wildlife conflict associated with agricultural expansion, forest use, livestock grazing, crop damage, and property damage and livestock loss. Human–wildlife conflict should therefore be examined as an ecological as well as a socio-economic phenomenon. The same landscape can provide important habitat for wildlife and simultaneously provide essential agricultural resources for local people. If the costs of wildlife conservation are concentrated among farming communities, negative attitudes towards wildlife may develop. Conversely, if wildlife populations are severely reduced to protect agriculture, important ecological functions and biodiversity can be lost. Sustainable management therefore requires a balance between conservation and livelihood security.

Human–Elephant Conflict in Assam: Human–elephant conflict is one of the most significant forms of human–wildlife conflict in Assam. The Asian elephant (*Elephas maximus*) requires extensive areas for feeding, breeding and movement. Historically, elephants could move across relatively continuous forest landscapes. Increasing agricultural expansion, settlement growth, infrastructure development and forest fragmentation have altered these landscapes. As a result, elephants increasingly encounter agricultural fields and villages while moving between remaining habitats patches. Research conducted in Assam has demonstrated a clear relationship between forest loss and human–elephant conflict. Wilson, Davies, Hazarika and Zimmermann examined human–elephant conflict in Sonitpur and Goalpara and found that landscapes had undergone substantial forest transformation, with remaining forest patches often small, disconnected and degraded. These patches and tea plantations could function as refuge areas for elephants moving through human-dominated landscapes. The problem is particularly serious because elephants can cause substantial damage in a short period. Unlike smaller crop-raiding animals, an elephant can consume and trample large quantities of crops while moving through a field. In addition, elephants may damage houses, grain stores, fences and other property. Thus, an elephant entering an agricultural area can create several forms of economic loss simultaneously. The Manas National Park study provides important evidence. Nath et al. studied human–elephant conflict in villages bordering Manas National Park and found that conflict was concentrated near the forest boundary and was particularly intense during July and August. Paddy, the major crop in the area, suffered the greatest damage from crop raiding. The researchers also found a positive relationship between crop maturity and frequency of elephant raids.

Crop Damage Caused by Elephants: Crop damage is one of the most direct and economically important consequences of elephant conflict in Assam. Elephants damage crops through both feeding and trampling. They may enter an agricultural field, consume mature crops, break plants while moving through the field and trample areas that they do not necessarily consume. Consequently, the actual economic loss can be greater than the quantity of food consumed by the animals. Paddy is particularly important because rice is the principal staple crop for large sections of Assam's rural population. Damage to paddy can therefore have both commercial and subsistence consequences. The Manas study found that paddy suffered the most damage from elephant raiding and that crop maturity was positively associated with raiding frequency. The timing of crop damage is also important. Farmers invest labour and financial resources throughout the agricultural season before

receiving the final harvest. When wildlife destroys a mature crop shortly before harvest, farmers lose not only the expected market value but also the investments already made in seeds, land preparation, labour, fertiliser and other inputs. Research from Sonitpur and Goalpara further demonstrates the seasonal nature of crop damage. Wilson et al. recorded 1,561 human–elephant conflict incidents across the two study sites during their three-year dataset. Crop damage was the most frequently reported type of conflict and crop damage showed pronounced seasonal peaks. In 2007 and 2008, crop damage was particularly extensive from August to December. This demonstrates that crop damage cannot be treated as a random event. It is strongly influenced by agricultural calendars, crop availability, elephant movement patterns and landscape characteristics. Understanding these relationships can help authorities and farmers concentrate preventive measures during periods of greatest risk.

Impact on vegetable cultivation: Vegetable cultivation is an important source of nutrition and supplementary income for rural households. Vegetables are often cultivated in relatively small plots around homesteads or agricultural fields. Because these plots are frequently close to human settlements and forest edges, they may become accessible to wildlife. Rhesus macaques can damage a variety of vegetable and fruit crops. The problem is particularly significant when farmers depend on vegetable cultivation for regular cash income. Unlike paddy, which is harvested mainly at specific times of the year, vegetables can provide repeated income throughout a production season. Destruction of vegetable crops can therefore affect household cash flow. The Nagaon research on human–monkey conflict specifically examined crop damage and local mitigation practices, demonstrating that macaques have become a livelihood concern for rural communities. Vegetable damage also has a nutritional dimension. Household gardens often provide vegetables and fruits for family consumption. When these crops are destroyed, households may need to purchase equivalent food from markets. Thus, the impact of wildlife conflict is not limited to lost agricultural income; it can also affect household food availability and dietary diversity.

Human–Wildlife Conflict and Agricultural Land Use: Land-use change is one of the fundamental factors behind increasing human–wildlife conflict. Agricultural expansion often involves the conversion of forest or other natural habitats into cultivated land. When such conversion occurs near wildlife habitats or movement routes, the probability of interaction increases. Assam provides a clear example because many agricultural communities are located close to forests and protected areas. Agricultural land may also develop along riverine areas, forest boundaries and other landscapes used by wildlife. The research of Wilson et al. demonstrates the importance of land-use change. Their study found that large areas of the landscapes examined in Sonitpur and Goalpara had been converted to agriculture, while remaining forest patches were frequently small, disconnected and degraded. Agricultural expansion therefore has two consequences. First, it reduces the amount of natural habitat available to wildlife. Second, it increases the area of human activity within landscapes that wildlife may continue to use. This creates a situation in which humans and wildlife are not simply competing for separate spaces. Instead, they are increasingly sharing the same landscape.

Loss and Fragmentation of Wildlife Corridors: Wildlife corridors are areas that connect different habitat patches and enable animals to move between them. They are particularly important for elephants because elephants naturally travel over large distances in search of food, water, mates and suitable habitat. When corridors become blocked by settlements, agriculture, roads, railways or other infrastructure, wildlife may have fewer options for movement. Animals may then be forced to travel through agricultural fields or villages. Poba Reserved Forest is particularly important in this context. The study by Pegu, Tamuli and Teron described Poba as an important elephant corridor connecting the Daying Ering Wildlife Sanctuary in Arunachal Pradesh with Dibru-Saikhowa National Park through the wider landscape. The researchers also identified agricultural encroachment and human activity in forest areas as major sources of conflict. The protection of corridors is therefore not simply a wildlife-conservation activity. It can also be considered a strategy for protecting agriculture. If elephants can move safely between habitat patches without passing through cultivated areas, the probability of crop raiding may decline. Corridor conservation can therefore produce benefits for both wildlife and farmers.

Crop Calendars and Seasonal Conflict: Human–wildlife conflict is often strongly seasonal. Wildlife behaviour changes according to food availability, rainfall, temperature, breeding cycles and habitat conditions. Agricultural activities also change throughout the year. Conflict becomes particularly likely when the timing of wildlife movement coincides with the availability of attractive crops. In Assam, rice cultivation is especially important in this regard. Mature paddy fields can provide a concentrated food resource at a time when wildlife may be moving through agricultural landscapes. The Manas study found intense conflict during July and August and reported that crop maturity and frequency of elephant raiding were positively correlated. The Sonitpur and Goalpara study similarly demonstrated distinct seasonal patterns. Crop damage was particularly extensive during August–December in two of the study years. This seasonal pattern has major implications for management. Resources do not necessarily need to be distributed equally throughout the year. Instead, authorities and communities can intensify monitoring and crop protection during high-risk periods.

3. ECONOMIC IMPACT ON FARMERS

The economic consequences of human–wildlife conflict extend far beyond the immediate value of crops destroyed. The most obvious economic loss is the reduction in agricultural production. If a farmer expects a particular harvest but a portion of the crop is destroyed, the farmer loses the expected income from that portion. If the crop is intended for household consumption, the household may instead need to purchase food. There are also indirect costs. Farmers may spend money on fencing, lighting, crop protection equipment and other deterrents. They may also need to employ additional labour to guard fields. The Assam research provides evidence that the economic consequences can be substantial at the household level. An average

monetary loss calculated across a large region may appear relatively modest, but the same loss may represent a significant percentage of the annual agricultural income of a particular household.

Impact on Food Security: Agriculture in rural Assam is not only a source of monetary income; it is also a source of food. Paddy production is particularly important because rice is a major staple. When wildlife damages agricultural crops, households can experience a reduction in the amount of food available for their own consumption. This can force families to purchase food from markets, borrow money, reduce consumption or change their dietary patterns. The Poba Reserved Forest study explicitly associated crop raiding with food insecurity and economic losses among farmers. Food-security effects can be especially serious for households with limited savings. A household with alternative sources of income may be able to absorb a crop loss more easily, while a subsistence farmer may face immediate difficulty replacing lost food. Therefore, compensation for wildlife damage should not be viewed only as reimbursement for market value. In some cases, crop loss can have implications for household food security that exceed the simple monetary value of the damaged crop.

Impact on Agricultural Investment: Repeated wildlife damage can influence farmers' willingness to invest in agriculture. Agriculture requires investment before returns are received. Farmers purchase seeds, prepare land, apply fertilisers, hire labour, arrange irrigation and spend time managing crops. When wildlife repeatedly destroys crops, the expected return from these investments becomes uncertain. A farmer may consequently reduce the amount invested in agricultural inputs. For example, a farmer who repeatedly loses vegetables to macaques may decide that investing in improved seeds or additional cultivation is too risky. Similarly, farmers in elephant-prone areas may hesitate to expand cultivation if mature crops are frequently destroyed. This creates a potential negative cycle: Wildlife damage → reduced income → reduced agricultural investment → lower productivity → greater economic vulnerability.

Impact on Crop Choice: Human–wildlife conflict can influence what farmers choose to cultivate. Farmers are generally expected to select crops according to soil conditions, climate, market prices, labour availability and household requirements. In conflict-prone areas, however, wildlife vulnerability becomes another factor. If a particular crop is repeatedly destroyed, farmers may replace it with another crop that appears less attractive to wildlife. This may be a rational short-term adaptation, but it can also create economic limitations. The crop that is less attractive to wildlife may not necessarily be the most profitable crop. Therefore, crop diversification programmes should be based on local research rather than generic recommendations. The ideal approach is to identify combinations of crops that provide reasonable income and food value while reducing the likelihood of severe wildlife damage.

Impact on Agricultural Labour: Human–wildlife conflict can significantly increase the amount of labour required to protect agricultural production. Farmers may have to guard fields during the night, particularly in areas where elephants are active after sunset. Family members may take turns watching fields and responding when animals approach. This means that the period when farmers would normally be resting can become a period of agricultural risk. The same issue appears in macaque conflict. The Nagaon study investigated local mitigation measures and documented the use of crop guarding as a response to monkey damage. Consequently, the cost of conflict should include the value of human time spent protecting crops. This is a hidden economic cost that may not appear in conventional estimates of crop damage.

Human Casualties and Agricultural Conflict: The most serious consequence of human–wildlife conflict is the loss of human life. People may be injured when they encounter wildlife while travelling, collecting forest products, grazing livestock, cultivating fields or attempting to drive animals away from crops. Agricultural conflict can therefore create a dangerous situation because farmers are often required to enter or guard fields precisely when wildlife is most active. The Assam research demonstrates that human–elephant conflict is not simply an economic issue. The Sonitpur and Goalpara study recorded human–elephant conflict incidents and identified crop damage and property damage as the most common forms, although there were too few records of human or elephant injuries and fatalities in that particular dataset to identify meaningful spatial or temporal patterns. The Poba study, covering a much longer period, documented cases involving casualties to both humans and wildlife. This creates an important policy dilemma. Farmers need to protect their crops, but some methods of protecting crops can themselves place people at risk. Consequently, conflict mitigation must prioritise human safety above the protection of individual crops or property.

Human–Wildlife Conflict and Poverty: The impact of wildlife conflict is closely related to household economic status. A farmer with diversified income sources may be able to absorb agricultural losses. A household that depends almost entirely on agricultural production may be much more vulnerable. This means that the same amount of crop damage can have very different consequences for different households. The Poba research found that crop and property damage resulted in economic losses and food insecurity among farmers, illustrating how wildlife conflict can interact with livelihood vulnerability. This suggests that conflict mitigation should be linked with rural-development programmes. Livelihood diversification can reduce dependence on a single agricultural harvest and therefore increase the ability of households to withstand wildlife-related losses.

Limitations of Traditional Crop Guarding: The first limitation is the requirement for continuous human labour. Farmers may have to remain awake during the night for several hours, particularly during periods of high elephant activity. This can cause fatigue and reduce the amount of time available for other agricultural and household activities. The second limitation is safety. Elephants are large and potentially dangerous animals. Attempting to chase an elephant away from a field can result in direct confrontation. Farmers may therefore be exposed to serious risks while trying to protect crops. The third limitation is that guarding does not address the underlying causes of conflict. If forest habitat is fragmented or wildlife corridors are blocked, elephants may continue entering agricultural landscapes even if farmers successfully drive them away from

individual fields. The Sonitpur and Goalpara study found that most conflict incidents occurred during the evening and early night, demonstrating why guarding can become a major burden for communities. Similarly, the Nagaon research on human–monkey conflict examined local mitigation measures and demonstrated that communities actively use local methods to reduce crop damage. Therefore, traditional crop guarding should not be abandoned, but it should be integrated with broader measures such as early-warning systems, habitat protection, corridor conservation, appropriate crop planning, improved fencing, compensation and community-based monitoring.

Sustainable Management Strategies

- **Strengthening crop-protection measures:** Farmers should use suitable fencing, solar-powered electric fencing where legally and environmentally appropriate, watchtowers, trenches, crop barriers, and other non-lethal methods to protect agricultural fields from wild animals.
- **Promoting community-based management:** Local communities, farmers, forest departments, and village institutions should work together to monitor wildlife movement, share early warnings, and respond quickly to conflict situations. Community participation can make conservation measures more effective and socially acceptable.
- **Crop diversification:** Farmers can reduce losses by cultivating less wildlife-attractive crops in areas that experience frequent conflict. Agroforestry and mixed-cropping systems can also improve farm resilience while providing additional sources of income.
- **Habitat protection and restoration:** Protecting forests, wetlands, wildlife corridors, and natural food and water sources can reduce the need for animals to enter agricultural areas. Restoration of degraded habitats is particularly important in regions where habitat fragmentation has increased conflict.
- **Protection of wildlife corridors:** Maintaining and restoring movement corridors, especially for elephants, can help animals move between habitats without passing through densely cultivated areas. Land-use planning should consider important wildlife routes before new roads, settlements, or other infrastructure are developed.
- **Awareness and education:** Farmers and local residents should be educated about safe responses to wildlife encounters, wildlife behavior, and legal provisions related to wildlife conservation. Schools and community organizations can also promote coexistence-based approaches.
- **Integrated government action:** The Forest, Agriculture, Rural Development, and Disaster Management departments should coordinate their efforts. Government programmers should focus not only on responding to conflict after damage occurs but also on preventing conflict through long-term planning and habitat management

4. CONCLUSION

Human–wildlife conflict has become an important challenge to agricultural development and rural livelihoods in Assam. Crop damage, livestock loss, destruction of property, and occasional human casualties can create serious economic and social problems for farming communities. At the same time, wildlife conflict is often a consequence of habitat loss, fragmentation, increasing human pressure, and changes in land use. Therefore, the solution should not be the elimination or displacement of wildlife. Assam needs a balanced coexistence approach that protects both agricultural livelihoods and biodiversity. Effective compensation, community participation, early-warning systems, improved crop-protection methods, habitat restoration, and protection of wildlife corridors can significantly reduce conflict. Long-term success will depend on cooperation among farmers, local communities, scientists, conservation organisations, and government agencies. Sustainable management can help Assam achieve a situation in which agricultural development and wildlife conservation support rather than undermine each other.

REFERENCES

- [1]. Hedges, S., Fisher, K., & Epana, M. (2013). Understanding spatial and temporal patterns of human–elephant conflict in Assam, India. *Oryx*, 49(1), 140–149. <https://doi.org/10.1017/S0030605313000513>
- [2]. Nath, N. K., Lahkar, B. P., Brahma, N., Dey, S., Das, J. P., Sarma, P. K., & Talukdar, B. K. (2009). An assessment of human–elephant conflict in Manas National Park, Assam, India. *Journal of Threatened Taxa*, 1(6), 309–316. <https://doi.org/10.11609/JoTT.o1821.309-16>
- [3]. Pegu, R., Tamuli, A. K., & Teron, R. (2014). Assessment of human-wildlife conflicts in Poba Reserved Forest, Dhemaji District, Assam (India). *Ambient Science*, 1(2), 36–46. <https://doi.org/10.21276/ambi.2014.01.2.ra01>
- [4]. Nath, N. K., Dutta, S. K., Das, J. P., & Lahkar, B. P. (2013). Human–elephant interaction in villages around Manas National Park, Assam, India. *Gajah*, 39, 12–18.
- [5]. 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>