International Journal for Multidisciplinary Research (IJFMR)
E-ISSN: 2582-2160 ● Website: www.ijfmr.com ● Email: editor@ijfmr.com

Mitigating Human Animal Conflict Through Resilient Urban Planning

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Abstract

Human-animal conflict (HAC) is a pressing issue exacerbated by urban expansion and habitat fragmentation. This research aims to explore strategies for mitigating HAC through resilient urban planning, focusing on creating harmonious coexistence between human settlements and wildlife. By examining case studies from various regions and employing innovative urban design techniques, this study proposes a multifaceted approach to address HAC. The first aspect of the study involves preventing animals from entering urban areas through the establishment of effective wildlife corridors, smart fencing, and the use of advanced technologies such as drones and satellite tracking. These measures ensure that wildlife can move safely between habitats without encroaching on human settlements. The second aspect addresses the management of situations where animals enter urban areas despite preventive measures. This includes the development of rapid response teams, the implementation of community education programs, and the use of non-lethal deterrents to safely guide animals back to their natural habitats. The third aspect focuses on facilitating the safe return of animals to their habitats. This involves designing urban spaces with natural buffers and green belts that direct animals away from densely populated areas and towards safe exit routes. Additionally, the use of augmented reality (AR) interfaces can aid in real-time monitoring and management of wildlife movements.

Keywords: HAC, AR

1. Introduction

As urban areas expand, the encroachment on natural habitats has intensified conflicts between humans and wildlife. This phenomenon is a global issue, affecting both rural and urban communities. The competition for resources such as food, water, and space often lead to negative interactions that can result in economic losses, property damage, and even loss of human life. For instance, wildlife may destroy crops, prey on livestock, or pose safety risks to people living near natural habitats. The escalation of these conflicts necessitates effective strategies to foster coexistence and protect both human livelihoods and wildlife populations. Human-wildlife conflict poses significant threats to biodiversity and conservation efforts. Many species are already endangered, and retaliatory killings in response to conflicts can further endanger these populations. By integrating wildlife considerations into urban planning, cities can create environments that support biodiversity while minimizing conflict. This approach not only aids in conservation efforts but also enhances the ecological integrity of urban areas, contributing to the overall health of ecosystems. Effective conflict mitigation requires the involvement of local communities in conservation efforts. Engaging communities in urban planning processes can lead to the development of solutions that are culturally and socially acceptable. Educational programs that inform residents about

wildlife behavior and promote coexistence strategies can also play a crucial role in reducing conflicts. By fostering a sense of stewardship and responsibility towards local wildlife, urban planners can create a more harmonious relationship between humans and animals.

2. Research Question

Can resilient urban planning effectively mitigate human animal conflict in wildlife interface areas?

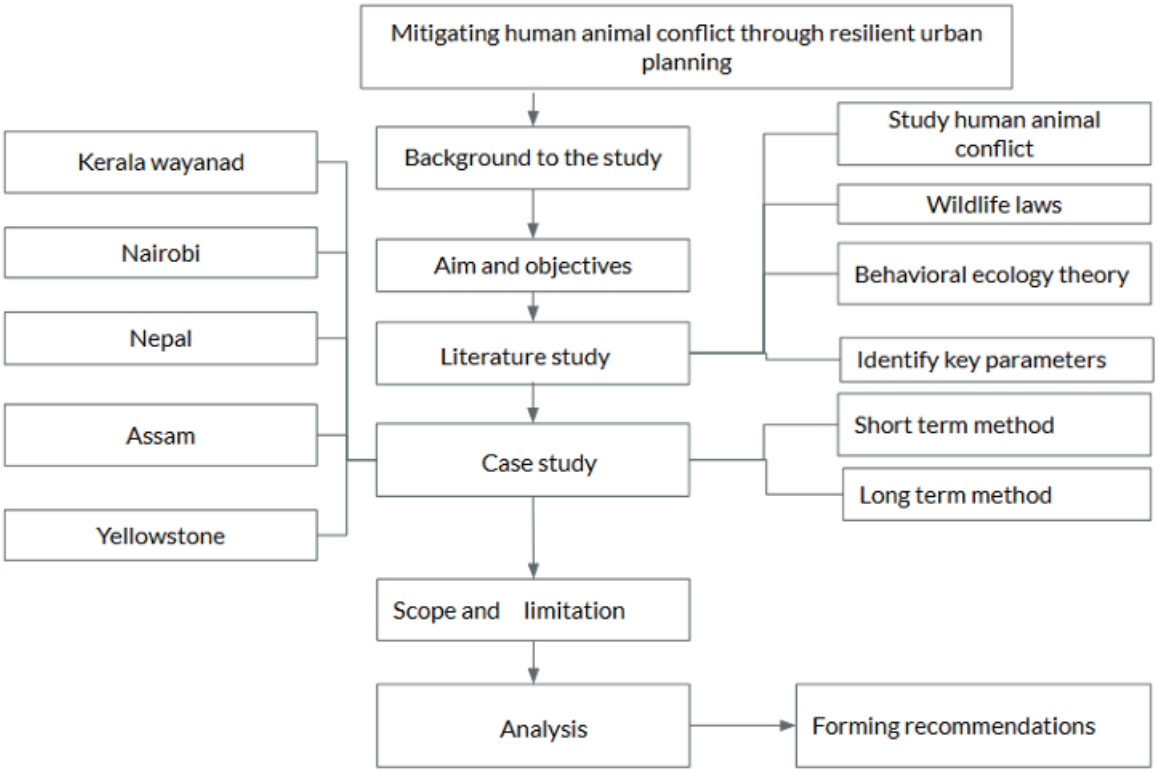
3. Aim

To evolve planning strategies and recommendations for wildlife interface areas that reduce human animal conflict.

4. Objectives

To study human wildlife interactions, wildlife laws, behavioural ecology theory.
To identify important parameters influencing human animal conflict.
To study the current state of human animal conflict in Kerala region.
To study and analyse case studies of human animal conflict from different regions and Successful Community Engagement and Adaptive Management Strategies.
Formulate mitigation recommendations for wildlife interface areas.

5. Methodology



6. Literature review

6.1 Human–wildlife interactions

Human wildlife interactions refer to any encounters between humans and wildlife. These interactions can range from neutral to negative, depending on the context and outcomes. The term is often used broadly to encompass all types of encounters, including those that are beneficial or neutral, as well as those that lead to conflict. Human-wildlife conflict (HWC), a subset of these interactions, specifically refers to negative interactions that result in undesirable consequences for both humans and wildlife. This includes situations where wildlife poses a threat to human safety, livelihoods, or property, leading to retaliation against the wildlife and disagreements among people about how to manage the situations.

Positive Interactions

Ecological Benefits Wildlife plays a crucial role in maintaining ecosystem balance, aiding in seed dispersal, pollination, and controlling prey populations. Herbivores such as elephants and deer help in maintaining vegetation diversity, while predators regulate prey populations, ensuring ecosystem stability.

Economic Opportunities

Wildlife-based tourism generates significant revenue for local communities and governments, providing jobs in eco-tourism, safaris, and conservation projects. Sustainable harvesting of forest resources, such as honey, medicinal plants, and non-timber products, benefits local economies while maintaining biodiversity.

Cultural and Religious Significance

Many communities revere certain animals, incorporating them into religious rituals, folklore, and traditions. Indigenous knowledge and conservation ethics often emerge from a deep-rooted respect for wildlife.

Negative Interactions (Human-Wildlife Conflict - HWC)

Crop Damage and Livelihood Losses

Crop raiding by elephants, wild boars, monkeys, and deer leads to significant agricultural losses. Farmers suffer financial strain as they struggle to protect their fields from repeated wildlife incursions.

Livestock Predation

Carnivores such as leopards, wolves, and tigers attack livestock, leading to economic losses for rural communities. Retaliatory killings by humans often threaten endangered predator species.

Human Casualties and Injuries

Large mammals like elephants, bears, and tigers sometimes attack people, resulting in injuries or fatalities. Fear of wildlife presence affects daily activities, restricting movement, especially in rural areas near forests.

Property Damage

Elephants, wild boars, and primates cause damage to houses, food storage facilities, and infrastructure. This leads to economic hardship for affected communities.

Road and Rail Accidents

Increasing human infrastructure in wildlife corridors results in frequent collisions between vehicles and animals, causing casualties on both sides.

6.2 Human–wildlife conflict in India and Kerala

Human-animal conflict (HWC) is a significant issue in India, posing severe threats to human life, property, and wildlife. The increasing incidences of such conflicts highlight the urgent need for effective mitigation strategies. This section outlines the present relevance of HWC in India, with a specific focus on the state

of Kerala, supported by recent data. Human-Animal Conflict in India :Human-animal conflict has been a persistent problem in India, with both human and wildlife populations suffering significant losses. Between 2007 and 2011, human-animal conflicts resulted in 888 human fatalities, 7,391 injuries, and 14,144 livestock deaths. Additionally, around 80,900 crop destruction incidents by wild animals were reported during this period. Retaliatory measures against wildlife have also been a concern. During the same period, 203 incidents of electrocution and poisoning of animals were recorded, with 31 animals killed under official permission due to being considered dangerous. Financial compensation to victims of HWC amounted to 91.20 million rupees in ex-gratia payments. Recent trends indicate a rise in human-animal conflicts and associated human fatalities. For instance, during 2016-17, 2017-18, and 2018-19, elephants were responsible for 516, 501, and 494 human deaths, respectively. Tiger-related fatalities were also notable, with 62 deaths in 2016, 44 in 2017, and 29 in 2018. Elephants remain the leading cause of human deaths due to HWC in India. Human-Animal Conflict in Kerala: Kerala, a state with rich biodiversity and significant wildlife habitats, has experienced a troubling increase in human-animal conflicts. Over the past year, more than 100 people lost their lives due to wild animal attacks. According to the Union Ministry of Environment and Forests, between 2019 and 2024, approximately 486 people died from such incidents in Kerala.

The year-wise data for Kerala indicates a disturbing trend:

In 2023-24, there were 94 deaths.

The highest number of deaths occurred in 2021-22, with 114 fatalities, 35 of which were due to wild animal attacks.

6.3 Reason for Human Wildlife Conflict

Human-Wildlife Conflict (HWC) arises from a complex interplay of ecological and anthropogenic drivers that pressure landscapes where humans and wildlife coexist. Ecological drivers include seasonal changes, natural calamities, and the life cycles and movement patterns of wildlife. For example, the seasonal migration of animals can lead to increased interactions with human populations as animals search for food or breeding grounds. On the other hand, anthropogenic drivers significantly contribute to HWC. Habitat loss caused by expanding agricultural practices, urbanization, and infrastructure development reduces the areas available for wildlife, forcing animals into closer proximity to human settlements. Changes in land use and livestock management also play a critical role in heightening the likelihood of conflict. As humans encroach on wildlife habitats, the potential for HWC increases, particularly when human activities disturb animal behaviors and territorial ranges. The overarching trend is that as the land area shared by humans and wildlife expands—often due to diminishing habitats available for wildlife—the likelihood of conflict increases. Additionally, societal factors such as history, perceptions, attitudes, and cultural beliefs influence how HWC is experienced and understood, making it a multifaceted and often unpredictable issue. Each driver of HWC generates multiple pressures that can have various negative impacts on biodiversity and human welfare. For instance, deforestation for settlements or agriculture leads to habitat loss and fragmentation, compelling wildlife and humans to inhabit the same spaces. The degradation of natural habitats due to suburban expansion and livestock grazing exacerbates the problem, driving species to alter their territorial behaviors and movement patterns. As wildlife lose their natural habitats, they come into more frequent contact with humans, which can result in wildlife threatening or damaging human life and property. Such interactions can trigger significant social and economic repercussions for affected communities, further complicating the dynamics of HWC. To effectively understand and address HWC, it is essential to adopt a holistic perspective that encompasses all the drivers and their interactions. This

comprehensive understanding will facilitate the development of strategies that promote coexistence between humans and wildlife, ultimately reducing conflict and fostering sustainable solutions.

7. Mitigation measures

7.1 Short-term methods

Traditional methods are devised by local communities and these include prayer, noise (shouting, beating drums, burning bamboo, bursting fire crackers), light (fire at entry points to fields, powerful spotlights), and missiles (stones, spears). Platforms on trees (machan) or huts at ground level are used as look-outs.
Early Warning Barriers
Artificial Water Sources
EXPIRIMENTAL
Bio-Fence
Planting food trees in elephant habitat and corridors
Artificial Water Sources
Chemicals
Satellite Telemetry
Alternate Livelihoods : Providing alternate livelihoods such as bee keeping have been suggested. While these may not solve conflict they may provide resilience to the affected communities.
Geo-Fence : Known crop-eating elephants are collared with mobile phone SIM cards and a virtual "geofence" is set up. As soon as the elephant approaches the edge of this virtual fence, a text message is sent to a ranger who rushes to the spot to chase away the elephant.

7.2 Long term methods

7.2.1 Land-Use Planning

Land-use planning is essential to accommodate the needs of both wildlife and human populations.
Several strategies can address the spatial basis of conflict:

1. Reduce the Conflict Interface: Restrict and consolidate human settlements and relocate agricultural activities within wildlife habitats to minimize interactions between humans and animals.
2. Enhance Agricultural Efficiency: Change the location of fields, cultivate less palatable or inedible crops, grow a diversity of crops, and alter cropping patterns to reduce the attractiveness of fields to wildlife.
3. Modify Animal Movements: Ensure safe passage for wildlife, protect critical water sources, re-draw habitat boundaries, and expand or create protected areas to allow for natural animal movements. Managing conflict successfully is crucial to conserving many unprotected populations. Other recommendations include identifying priority conservation areas and formulating land-use policies tailored to these regions. To minimize conflict, it is advised that irrigated agriculture and permanent human settlements not be permitted on the edges of protected areas. Creating clear and hard boundaries between wildlife habitats and human-use areas is essential. This restructuring can significantly reduce the potential for conflict. Should infrastructure development be unavoidable, the adverse impacts on wildlife should be minimized. This can include implementing wildlife-specific Environmental Impact Assessments and facilitating animal movement across existing obstacles such as roads and railways.

7.2.2 Buffer Zone

Without Clearing Vegetation: Allowing secondary vegetation around forests to mature into late successio-

nal forest can act as a natural buffer. Joint forest management can increase forest cover and generate income, though this might also provide shelter for wildlife during the day, leading to nighttime raids on neighbouring farms.

Cleared of Vegetation: Clearing secondary forest creates a visible boundary between wildlife habitats and agricultural areas, aiding in spotting approaching animals and reducing conflicts. Studies suggest that dense vegetation correlates with higher conflict events.

With Inedible Crops: Planting unpalatable crops, such as chili or citrus, along park boundaries can deter wildlife. However, extensive planting over hundreds of square kilometres is required for effectiveness, as animals may traverse smaller buffer zones to reach palatable crops. Additionally, farmers need incentives, like better revenue, to switch to inedible crops.

Relocation of Human Settlements and Agricultural Activities: Relocating human settlements and agricultural activities from wildlife ranges and corridors can reduce conflicts. This approach has been recommended by various authorities and implemented in some regions. However, relocation efforts face challenges such as local resistance, politicization, and potential habitat unsuitability post-relocation.

7.2.3 Protection of Corridors

Wildlife corridors are vital pathways that connect fragmented habitats, enabling the movement of animals between these areas. Protecting these corridors is crucial for the conservation of biodiversity and the mitigation of human-wildlife conflict (HWC). When animals can traverse between their habitats without obstruction, they are less likely to venture into agricultural lands or human settlements, where they might cause damage or encounter threats

8. Conclusion

The dissertation on "Mitigating Human-Animal Conflict Through Resilient Urban Planning" has explored comprehensive strategies to prevent animals from entering wildlife interface areas, manage encounters when they occur, and ensure the safe return of animals to their natural habitats. By analyzing various case studies and examining implemented measures and animal behaviors, this research provides valuable insights and practical recommendations. Effective urban planning must prioritize the integration of wildlife corridors and buffer zones to prevent animals from straying into human-dominated areas. Zoning strategies that clearly delineate wildlife habitats from human settlements are crucial. Infrastructure near wildlife habitats should incorporate design elements such as underpasses, overpasses, and fencing to facilitate safe animal movement and prevent road accidents. In instances where animals do enter human settlements, early warning systems and wildlife tracking technologies are essential for timely intervention. Establishing conflict resolution mechanisms, including rapid response teams and community engagement programs, can help manage these encounters effectively. Educational initiatives that inform communities about wildlife behavior and appropriate responses to animal encounters are critical in reducing panic and promoting coexistence. Ensuring the safe return of animals to their habitats involves coordinated efforts between wildlife authorities and local communities. Strategies such as the use of tranquilizers, relocation programs, and habitat restoration are vital. Providing adequate compensation for damages and supporting alternative livelihoods can also mitigate the economic impact on affected communities, fostering a supportive environment for wildlife conservation. The success of mitigation strategies is heavily dependent on community participation. Engaging local communities in planning and execution, leveraging their knowledge, and raising awareness about conservation efforts are fundamental for long-term sustainability. Compensation mechanisms must be timely, fair, and accessible to maintain local

support for these initiatives. Through resilient urban planning and community-driven approaches, it is possible to significantly reduce human-animal conflicts and promote harmonious coexistence. By integrating preventive measures, effective management strategies, and ensuring the safe return of wildlife, urban planners and policymakers can develop robust solutions that protect both human and animal populations. This dissertation's findings underscore the importance of a holistic approach to urban planning that prioritizes biodiversity conservation and the well-being of all ecosystem stakeholders.
Define abbreviations and acronyms the first time they are used in the text, even after they have been defined in the abstract.

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