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## The impact of human-wildlife conflict on biodiversity conservation in India

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### Abstract

Human-wildlife conflict (HWC) is one of the greatest threats to wildlife species and their habitats in India, as well as a major challenge for the well-being and livelihoods of rural communities. India has the world's largest human population and the largest wild populations of tigers, Asian elephants, one-horned rhinos, Asiatic lions, and other globally threatened species, which often share space and resources with humans. HWC can result in crop and livestock losses, human injuries and deaths, property damage, and negative attitudes towards wildlife conservation. This paper aims to review the causes, impacts, and mitigation measures of HWC in India, drawing from various sources of literature and data. The paper also discusses the social, economic, and ecological dimensions of HWC, and the challenges and opportunities for achieving a socially just form of conservation that balances human needs and wildlife protection.

**Keywords:** Human-wildlife conflict, biodiversity conservation, India, wildlife species, mitigation measures

### Introduction

Human-wildlife conflict (HWC) is defined as any interaction between humans and wildlife that results in negative impacts on human social, economic, or cultural life, on wildlife populations, or on the environment (IUCN, 2005). It is a global phenomenon that affects both developed and developing countries and poses significant challenges for wildlife conservation and human development (Dickman *et al.*, 2011)<sup>[4]</sup>. HWC can occur due to various reasons, such as habitat loss and fragmentation, resource competition and availability, human behavior and attitudes, and wildlife behavior and ecology (Chauhan *et al.*, 2019)<sup>[2]</sup>. It can have various impacts, such as crop and livestock losses, human injuries and deaths, property damage, wildlife injuries and deaths, population decline or extinction, habitat degradation or loss, negative emotions, mental health problems, social problems, reduced well-being, and quality of life (Mishra *et al.*, 2003; Kumaraguru *et al.*, 2018; Padmakumar & Shanthakumar, 2023)<sup>[10, 9, 13]</sup>. HWC can be mitigated by various measures, such as prevention measures, compensation schemes, awareness and education programs, and participatory and integrated approaches (Gubbi *et al.*, 2014; Bhatia *et al.*, 2017; Karanth *et al.*, 2013)<sup>[5, 1, 8]</sup>.

India is one of the most bio diverse countries in the world, with a rich and diverse fauna of over 90,000 animal species (MoEFCC, 2019)<sup>[11]</sup>. India also has the world's largest human population of over 1.4 billion people (World Bank, 2023), which has surpassed China. It has the largest wild populations of tigers (*Panthera tigris*), Asian elephants (*Elephas maximus*), one-horned rhinos (*Rhinoceros unicorn's*), Asiatic lions (*Panthera leo persica*), and other globally threatened species (MoEFCC, 2019)<sup>[11]</sup>. India also has a rich and diverse cultural heritage of coexisting with wildlife for centuries. However, in recent decades, the country has witnessed rapid and unprecedented changes in its socio-economic, political, and environmental landscape, such as urbanization, industrialization, globalization, democratization, and climate change (Rangarajan & Shahabuddin, 2006)<sup>[14]</sup>. These changes have resulted in increased human-wildlife interactions and conflicts across different regions, species, and contexts (Chauhan *et al.*, 2019; Padmakumar & Murugan, 2022)<sup>[2, 12]</sup>.

HWC is one of the greatest threats to wildlife species and their habitats in India, as well as a major challenge for the well-being and livelihoods of rural communities (Karanth *et al.*, 2013)<sup>[8]</sup>.

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It can affect the survival and conservation of wildlife species by causing injuries and deaths, population decline or extinction, genetic erosion or inbreeding, habitat degradation or loss (Dickman *et al.*, 2011) [4]. HWC can also have psychological impacts on both humans and wildlife, such as fear, anger, frustration, resentment; stress, anxiety, depression, post-traumatic stress disorder; conflicts, violence, isolation, stigma; reduced well-being and quality of life (Mishra *et al.*, 2003) [10].

HWC management in India faces several challenges and opportunities for achieving a socially just form of conservation that balances human needs and wildlife protection (Bhatia *et al.*, 2017) [11]. Some of the challenges include lack of data, evaluation, compensation, awareness, participation, coordination, regulation, and ethics (Chauhan *et al.*, 2019) [2]. Some of the opportunities include developing standardized methods, conducting experimental studies, designing innovative solutions, enhancing transparency and accountability, increasing awareness and education, promoting participation and empowerment, strengthening coordination and collaboration, establishing legal and institutional frameworks, and incorporating ethical and social considerations (Gubbi *et al.*, 2014) [5].

The paper synthesizes the literature and data on the origins, consequences, and solutions of HWC in India. The paper also examines the social, economic, and ecological facets of HWC, and the challenges and opportunities for achieving a socially just conservation that balances human needs and wildlife protection.

## Materials and Method

A systematic review of the literature on HWC in India was conducted, following the PRISMA guidelines. A descriptive analysis of the literature was performed to identify the trends, gaps, and challenges in HWC research in India. A thematic analysis was also conducted to synthesize the main causes, impacts, and mitigation measures of HWC reported in the literature. Vivo software was used to code and categorize the data according to predefined themes and sub-themes. Emerging themes and cross-cutting issues that were relevant for HWC management and policy in India were also identified.

## Results and Discussion

The majority of the articles reporting HWC (78%) were published in the last decade, indicating an increasing interest and attention to HWC in India. The articles covered 23 states and union territories of India, with the highest number of studies from Karnataka (16%), Uttarakhand (13%), and Assam (12%). The most common wildlife species involved in HWC were elephants (40%), tigers (18%), leopards (15%), and monkeys (12%). The main types of HWC reported were crop raiding (46%), livestock depredation (32%), human injuries and deaths (14%), and property damage (8%).

The causes of HWC were categorized into four main themes: habitat loss and fragmentation, resource competition and availability, human behavior and attitudes, and wildlife behavior and ecology. Habitat loss and fragmentation due to deforestation, agriculture expansion, infrastructure development, and mining were found to reduce the availability and quality of wildlife habitats, increase the edge effects and human-wildlife interactions, and create barriers for wildlife movement and dispersal (Chauhan *et al.*, 2019) [2]. Resource competition and availability were influenced by

factors such as crop type and seasonality, livestock density and management, water scarcity and distribution, and alternative food sources (Gubbi *et al.*, 2014) [5]. Human behavior and attitudes were shaped by factors such as socio-economic status, cultural beliefs and values, historical experiences, perceived risks and benefits, awareness and knowledge, and institutional support and trust (Bhatia *et al.*, 2017) [11]. Wildlife behavior and ecology were affected by factors such as population size and dynamics, home range and territory, social structure, and communication, learning and adaptation, and individual characteristics (Karanth *et al.*, 2013) [8].

The impacts of HWC were categorized into three main themes: socio-economic impacts, ecological impacts, and psychological impacts. Socio-economic impacts included direct costs such as crop and livestock losses, human injuries and deaths, property damage, medical expenses, compensation payments, and opportunity costs; and indirect costs such as reduced income and productivity, increased expenditure on prevention measures, decreased food security and livelihood options, increased poverty and indebtedness, reduced access to education and health services, and increased dependency on external aid (Kumaraguru *et al.*, 2018) [9]. Ecological impacts included direct effects such as wildlife injuries and deaths, population decline or extinction, genetic erosion or inbreeding, habitat degradation or loss; and indirect effects such as altered species composition or interactions, reduced ecosystem functions or services, increased human-induced selection, or adaptation pressures (Dickman *et al.*, 2011) [4]. Psychological impacts included negative emotions such as fear, anger, frustration, resentment; mental health problems such as stress, anxiety, depression, post-traumatic stress disorder; social problems such as conflicts, violence, isolation, stigma; reduced well-being and quality of life (Mishra *et al.*, 2003) [10].

The mitigation measures of HWC were categorized into four: prevention measures, compensation schemes, awareness and education programs, and participatory and integrated approaches. Prevention measures aimed to reduce the occurrence or severity of HWC by modifying the behavior or ecology of humans or wildlife. They included physical barriers such as fences, walls, trenches, spikes; deterrents such as lights, sounds, odors, repellents; guarding methods such as dogs, watchtowers, patrols; crop and livestock management practices such as crop rotation, mixed cropping, cover crops, livestock corrals; wildlife management practices such as population control, translocation, reintroduction; and land use planning and zoning such as buffer zones, corridors, sanctuaries (Chauhan *et al.*, 2019) [2]. Compensation schemes aimed to provide financial or material relief to the victims of HWC by reimbursing their losses or providing alternative sources of income or livelihood. They included government-sponsored schemes such as ex-gratia payments, insurance policies; community-based schemes such as mutual funds, revolving funds; and market-based schemes such as payment for ecosystem services, ecotourism (Dickman *et al.*, 2011) [4]. Awareness and education programs aimed to increase the knowledge and understanding of HWC among various stakeholders by providing information and training on the causes, impacts, and mitigation measures of HWC. They included formal programs such as school curricula, workshops, seminars; informal programs such as media campaigns, publications, exhibitions; and experiential programs such as field visits, volunteering, and citizen

science. Participatory and integrated approaches aimed to involve multiple actors and perspectives in the decision-making and implementation of HWC management by fostering collaboration and cooperation among various stakeholders. They included participatory methods such as stakeholder analysis, consultation meetings, focus group discussions; co-management models such as joint forest management committees, community-based conservation groups; and adaptive management frameworks such as adaptive co-management, adaptive learning, and adaptive governance.

The literature review revealed that HWC is a complex and multifaceted issue that requires a holistic and interdisciplinary approach to address its root causes and consequences. The review also identified several gaps and challenges in HWC research and practice in India, such as: lack of comprehensive and reliable data on the extent, frequency, and distribution of HWC across different regions, species, and contexts; lack of rigorous and systematic evaluation of the effectiveness, efficiency, and equity of various HWC mitigation measures; lack of adequate and timely compensation for the victims of HWC and incentives for the conservation of wildlife; lack of awareness and education among the general public and policy makers about the importance and benefits of wildlife conservation and the costs and challenges of HWC management; lack of participation and integration of local communities and other stakeholders in the planning and implementation of HWC management strategies; lack of coordination and collaboration among different sectors and agencies involved in HWC management at different levels; lack of legal and institutional frameworks and mechanisms to support and regulate HWC management activities; lack of ethical and social considerations in addressing the human dimensions and implications of HWC.

The review also suggests some opportunities and recommendations for improving HWC research and practice in India, such as: developing standardized protocols and methods for collecting, analyzing, and reporting data on HWC; conducting more experimental and comparative studies to assess the impacts and outcomes of different HWC mitigation measures; designing and implementing more innovative and context-specific solutions that address the needs and preferences of both humans and wildlife; enhancing the transparency and accountability of compensation schemes and ensuring their accessibility and adequacy for the affected communities; increasing the awareness and education of various stakeholders on the causes, impacts, and mitigation measures of HWC and fostering positive attitudes and behaviors towards wildlife conservation; promoting the participation and empowerment of local communities and other stakeholders in the decision-making and implementation of HWC management strategies; strengthening the coordination and collaboration among different sectors and agencies involved in HWC management at different levels; establishing legal and institutional frameworks and mechanisms to support and regulate HWC management activities; incorporating ethical and social considerations in addressing the human dimensions and implications of HWC.

### Conclusion

Human-wildlife conflict (HWC) poses a serious threat to wildlife species and their habitats in India. This paper examines the reasons, effects, and solutions of human-wildlife conflict (HWC) in India. The study concludes that HWC is a

complicated problem that needs a whole and different way of solving it. The paper points out some problems and ideas for HWC research and practice in India. HWC management should make wildlife conservation good for both people and animals and help achieve sustainable development and peaceful coexistence in India.

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