



## Human-Wildlife Conflict: A Catalyst for Interspecies Disease Evolution

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### Introduction

Infectious diseases stemming from animals, particularly wildlife, have been a persistent challenge in human history. This transmission typically occurs through human contact with animals or their bodily fluids, known as the “animal-human interface.” While humans have shared their existence with domestic and wild animals for centuries, contemporary trends have significantly heightened this interface. Factors such as rapid population growth and endeavours to combat poverty have spurred intensified farming methods and unsustainable utilisation of natural resources. These activities have elevated our proximity to animals, thereby increasing the likelihood of disease transfer.

Human-wildlife conflict (HWC) is a constant problem that arises from the negative impacts of the interaction, such as loss of property, loss of lives on both ends, degradation of economic status, etc. Discord between the human population and wildlife is not a recent issue but has been a persistent event for an extensive duration, although lately, the severity and complexity of the conflict have evolved.

Many clustered issues lead to discrepancies between humans and natural diversity. Human-wildlife conflicts range from competing for resources to direct clashes. Fighting for essentials like food, water, or territory leads to resource-driven disputes. Livestock predation or crop destruction by wildlife further heightens these frictions. Urbanisation and development lead to encroachment into the wild biodiversity, which causes habitat loss and fragmen-

tation, forcing wildlife closer to human settlements and increasing conflicts over resources and space. The improper waste disposal and urban green spots additionally attract certain wildlife species, leading to encounters and conflicts in urban environments.

Globally, marine and terrestrial protected regions span merely 9.67%. Around 40% of African lion habitats and 70% of African and Asian elephant territories exist beyond these areas designated for protection [3] [6]. Limited protected areas restrict appropriate habitats for wildlife, pushing animals into human-inhabited areas to find resources, thus escalating conflicts. Within India, 35% of tiger territories extend outside the confines of protected areas [8]. This seriously threatens the local communities as these wild animals charge into the local nearby villages, causing loss of life and severe economic damage.

Moreover, habitat alterations due to climate change affect the availability of food and the migratory behaviours of wildlife, compelling them to seek new habitats and potentially elevating their interactions and conflicts with human populations. Wildlife species like wild boars and peacocks, characterised by prolific breeding habits, rapidly increase in numbers, intensifying the rivalry for resources and resulting in disputes over space, food, and territorial dominance. Agricultural or livestock-dependent rural communities experience setbacks as wildlife damages crops or preys on domestic animals, amplifying conflicts over resource utilisation.

One of the most concerning prospects of HWC is the transmission of emerging and re-emerging zoonotic diseases due to the increased human-animal interfaces. The proliferation of human-

animal interactions worldwide, coupled with the convergence of different animal species in densely populated human markets, gave rise to several viral diseases like SARS, avian influenza A/H7N9,

H5N1, MERS, Nipah virus, Ebola, Influenza A (H1N1) 09 pandemic, and the recent COVID-19 illness [1].

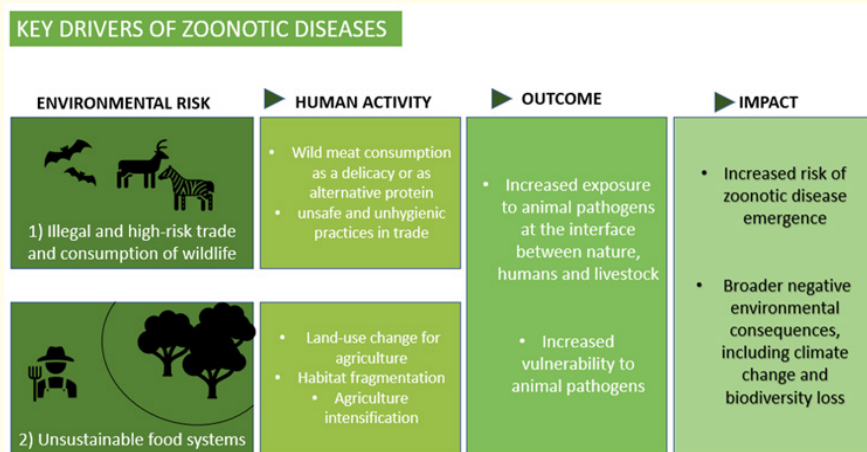


Figure a

### Emerging zoonotic diseases

Emerging infectious diseases (EIDs) encompass those that have recently surged in frequency, expanded their geographic scope, infiltrated new host populations, or are the outcome of newly evolved or identified pathogens. Some examples are monkeypox fever, West Nile virus, and H5N1 bird flu. The leading drivers behind EIDs among human populations arise from human-driven alterations in both physical and social environments. Human activities such as wild meat consumption, unhygienic trade practices, extensive land use for agriculture, intensification of agriculture and animal husbandry practices, etc., are essential drivers of increased wildlife interaction, which consequently lead to the spillover of zoonotic diseases. Rapid escalations in human and livestock populations heighten susceptibilities to newfound infections. Human interventions possess the capacity to modify the environmental dynamics that influence the proliferation of zoonotic diseases. For example, manipulating the population density of a principal animal host may induce a carrier organism, such as a mosquito, to demonstrate an escalated inclination towards human biting, thereby increasing the transmission of diseases within human populations [4,5]. Some of the recent zoonotic outbreaks have been mentioned as follows.

#### Nipah virus disease, Malaysia

Deforestation caused human encroachment into bat habitats, elevating the proximity between fruit bats, their original hosts, and pigs. As the natural reservoir, fruit bats transmitted the Nipah virus to pigs. Upon contact with infected pigs, the virus jumped species, causing a severe respiratory illness in humans. The disease caused the first outbreak in Malaysia in 1998, severely damaging the economy and lives of the pig farmers, and was only controlled after culling all the infected animals.

#### H5N1- Avian influenza, India

Human intrusion into the habitats of wild avian species and the practice of raising poultry in close proximity to water bodies visited by migratory birds has led to the interspecies jumping of the virus, threatening human lives and livelihoods. Wild birds carrying the H5N1 virus can transmit it to domestic poultry. Subsequently, humans in close contact with infected birds can contract the virus.

#### Ebola virus disease, central Africa

The Ebola virus, another lethal zoonotic pathogen, has drawn extensive focus from the international public health community.

Human encroachment into forests and increased hunting activity brought humans into close contact with wildlife, particularly bats, the presumed natural reservoirs of Ebola. Transmission of Ebola from bats to humans through handling or consuming bushmeat leads to outbreaks of severe haemorrhagic fever. There have been multiple outbreaks of this viral disease, which dreadfully affected the social and economic statuses of the affected community.

### Hendra virus disease, Australia

Human intrusion into flying fox habitats led to increased proximity between horses and these bat species. The Hendra virus is transmitted from bats to horses, resulting in severe respiratory illness. Subsequently, humans contracted the virus from infected horses, causing sporadic infections and fatalities. These occurrences underscore the dangers associated with human-wildlife interactions, emphasising the potential risks of disease transmission.

### COVID-19

Although there is no strong evidence, it has been speculated that COVID-19 has also occurred due to unwanted interactions between humans and wild bats. Bats are recognised as a natural source as they carry diverse types of coronaviruses, including variants resembling SARS-CoV and MERS-CoV [1].

### Challenges in managing disease outbreaks

Historical and present instances of these diseases have consistently posed significant challenges to public health authorities due to

- Limited awareness and understanding among communities about outbreaks, epidemics, or pandemics.
- Resource limitations, especially in low- and middle-income nations, create barriers to effective response.
- Insufficient surveillance and monitoring mechanisms in place.
- Absence of an integrated one-health strategy that spans multiple disciplines to mitigate emerging disease risks.
- Underlying deficiencies in bureaucratic and public management capabilities.

### Mitigating the conflict

It is, therefore, necessary to fully comprehend the negative impacts caused by the HWC. The loss of this conflict is far too significant on both ends, hence demanding urgent action from the government and higher authorities to alleviate the situation effectively. A growing challenge of human-wildlife conflict is propelled by development pressures and population expansion, leading to habitat loss and blurred boundaries between people and wildlife sharing living spaces. Official data disclosed over 500 elephant and 2,361 human casualties in human-elephant conflicts from 2014-15 to 2018-19 [2]. In India, despite an increasingly intertwined relationship between humans and animals resulting in human-wildlife conflict (HWC) and the threat of zoonotic diseases, animal and human health interventions are executed separately by wildlife, veterinary, and public health sectors. This division impedes the practical application of an integrated One Health approach. Various measures have been initiated, encompassing advisories, empowerment of local governance, insurance provisions, fodder augmentation, proactive committees, and prompt relief strategies for victims. State-specific endeavours in Uttar Pradesh, Uttarakhand, and Odisha focus on disaster categorisation, bio-fencing, legal validations, and innovative techniques like seed ball casting to address human-wildlife conflicts [10]. Creating boundaries between humans and wildlife will set back the zoonotic spillovers. Some effective methods include

- **Fencing and Barriers:** Constructing physical barriers like fences or walls can limit direct contact between humans and wildlife, reducing the potential for disease transmission.
- **Land-Use Planning:** Designating specific zones for human settlements and wildlife habitats can minimise overlap, decreasing the chances of close interactions [9].
- **Buffer Zones:** Creating buffer zones or green belts between human and wildlife areas can be transitional, reducing direct contact and potential disease transmission.
- **Education and Awareness:** Educating communities about the risks of interacting closely with wildlife and promoting safe practices can also help prevent zoonotic spillover.
- **Wildlife Corridors:** Establishing corridors that allow wildlife to move freely while avoiding human settlements can help maintain their natural movement patterns without direct contact with human populations.

It is important to empathise with and comprehend the needs, behaviours and challenges humans and wildlife face. This will facilitate a more balanced perspective in conflict resolution and promote harmonious coexistence [7].

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