American Journal of Public Health Research, 2025, Vol. 13, No. 4, 170-176
Available online at http://pubs.sciepub.com/ajphr/13/4/4
Published by Science and Education Publishing
DOI:10.12691/ajphr-13-4-4

Climate Change and Veterinary Human Health from the Perspective of One Health

Utpal Das[1], Mahendra Pal[2,*], Ravindra Zende[3], Aishwarya Nair[3]

[1]Pet Cure, 58 A, Sastitala Street, Rishra, Hooghly, West Bengal, India
[2]Narayan Consultancy on Veterinary Public Health and Microbiology, Bharuch, Gujarat, India
[3]Department of Veterinary Public Health, Mumbai Veterinary College, Parel, Mumbai, India
*Corresponding author: palmahendra2@gmail.com

Received June 28, 2025; Revised July 30, 2025; Accepted August 06, 2025

Abstract Addressing climate change has emerged as a top priority on the global agenda, exerting profound and multifaceted impacts on both human and animal health. Anthropogenic climate change poses a significant threat to biodiversity by degrading ecosystems upon which all species on Earth depend for survival. In recent years, the rate of ecosystem degradation has accelerated, surpassing earlier projections. These adverse effects extend beyond human populations, impacting domestic animals, wildlife, and the broader environment. Since the early 2000s, the One Health approach has gained prominence, underscoring the necessity of collaboration across human, animal, and environmental health disciplines. Veterinary Public Health has played a pivotal role in advancing this interdisciplinary framework to address the complex interconnections between climate change and health. The rising number and intensity of climate events conditions, including floods, prolonged droughts, and heatwaves, have disrupted ecological equilibrium, facilitated the spread of infectious diseases, and forced the displacement of both humans and animals. This review uniquely examines ecosystem degradation driven by climate change and explores mitigation strategies through the integrated lens of Veterinary Public Health and the One Health approach. It underscores the critical need for a coordinated, transdisciplinary response to build climate-resilient health systems. The review highlights the importance of collaborative action at local, national, and global levels, aligning efforts with One Health principles. Enhancing early warning systems, developing climate-resilient health infrastructure, and fostering interdisciplinary education are essential for strengthening One Health initiatives in the context of a changing climate.

Keywords: *Climate change, Ecosystem degradation, Veterinary Public Health, One Health*

Cite This Article: Utpal Das, Mahendra Pal, Ravindra Zende, and Aishwarya Nair, "Climate Change and Veterinary Human Health from the Perspective of One Health." *American Journal of Public Health Research*, vol. 13, no. 4 (2025): 170-176. doi: 10.12691/ajphr-13-4-4.

1. Introduction

Human-induced climate change has been gradually progressing since the Industrial Revolution era, resulting in serious adverse consequences for human, animal, and environmental health. The drivers of climate change (CC) that are interrelated with the degradation of terrestrial, marine, and aquatic ecosystems, biodiversity loss, and the health, livelihoods, and wellbeing of humans and animals are all well documented [1,2]. Recent evaluations from the Intergovernmental Panel on Climate Change confirm that these changes are accelerating, disproportionately affecting vulnerable communities and ecosystems [3]. Hence, there is an urgent need for all the public health veterinarians to understand the drivers behind the changing environmental scenario. Veterinary Public Health (VPH) has provided leadership in the new field of One Health, aiming to identify sustainable and effective solutions to complex and interconnected human, animal, and environmental health problems [4]. This solution can help society to mitigate and adapt with the concerted efforts of health and environmental disciplines [5,6,7]. Moreover, recent work emphasizes the role of veterinarians in climate-sensitive disease surveillance, disaster preparedness, and antimicrobial stewardship [1,8]. It is critical that, in addition to the knowledge of public health veterinarians, they also have the expertise to detect, diagnose, and treat adverse conditions caused by climate change [6]. Additionally, the World Organization for Animal Health (WOAH) has highlighted the connections between climate change and the changing patterns of infectious diseases, as well as the impact on veterinary services [5]. Emerging interdisciplinary frameworks call for improved education and policy alignment across sectors to build climate-resilient veterinary health systems [9,10]. This review highlights alarming trends of climate change on human, animal and environmental health and is a call to initiate action at the earliest.

2. Literature Review

2.1. Ecosystem Degradation

The human population is growing and is expected to reach 9 to 10 billion by 2050 [11]. To meet the energy demands for societal development and the nutritional needs of such a vast population, the world has still been largely dependent on fossil fuels. That dependence has unfortunately increased greenhouse gases like carbon dioxide, methane and nitrous oxide in the Earth's atmosphere. As of 2020, the Earth's average surface temperature has increased by 1.1°C, and by 2030, it is expected to surpass 1.5°C at current emission levels [12]. Prompt mitigation efforts are crucial, as failing to reach net-zero carbon emissions by 2030 could cause irreversible harm to vulnerable ecosystems. Oceans have warmed because of the absorption of higher carbon dioxide levels resulted in increase in the occurrence of extreme weather events, including tornadoes, hurricanes, thunderstorms, lightning, wildfires**,** severe droughts, flooding, and snowfall. These are all serious threats to human, animal, and environmental health that may exceed society's adaptive capacity. Climate change is believed to be a contributing factor to the increase in lightning and thunderstorms. Excessive heat and moisture are two basic ingredients for a thunderstorm. Deaths due to lightning are increasing and are more likely to occur in the afternoon. Rural populations (farmers, cattle grazers, jungle hunters) are found to be mostly victimized. Plantation of tall trees (e.g., coconut, palm tree) acts as a natural barrier to lightning. Recently, mobile-based early warning systems have been tested to monitor lightning activity and deliver GPS-based alerts to prevent fatalities [13].

Rivers have been dammed for hydroelectricity, water reservoirs for irrigation, and also to transport crops to ports or elsewhere through canals, for recreational purposes, and as a drinking water supply. These dams have also caused increased river water temperatures downstream**,** disrupting riverine habitats which are critical for the reproduction and survival of many wildlife species [14]. Elevated water temperatures and altered flows can also promote the spread of aquatic diseases, further threatening biodiversity. To supply food for the growing human and livestock population, large-scale deforestation is occurring. Forests shield humans from dangerous pathogens. Deforestation can have many adverse impacts, including habitat destruction for wildlife, which can exacerbate climate change. As tropical forests are destroyed, animals and birds that carry diseases come into closer contact with humans, giving pathogens prime opportunities to evolve and spill over to new hosts. Recent zoonotic disease emergence patterns confirm this association. Due to deforestation, bat colonies have declined in jungle habitats; they have mostly resettled in and around human habitations. Bats possess a robust immune system, and pathogens have minimal or no impact on them. Bats are recognized as natural reservoirs of several RNA viruses including Marburg Virus, Hendra Virus, Nipah Virus, Ebola Virus, MERS-CoV, SARS-CoV-2, SARS-CoV, and others [15]. Climate change influences the transmission patterns and geographic spread of vector-borne diseases, including zoonotic infections, by altering the replication dynamics and distribution of pathogens, vectors and animal hosts [16]. The key factors affecting the emerging and re-emerging zoonotic diseases are as shown in Figure 1.

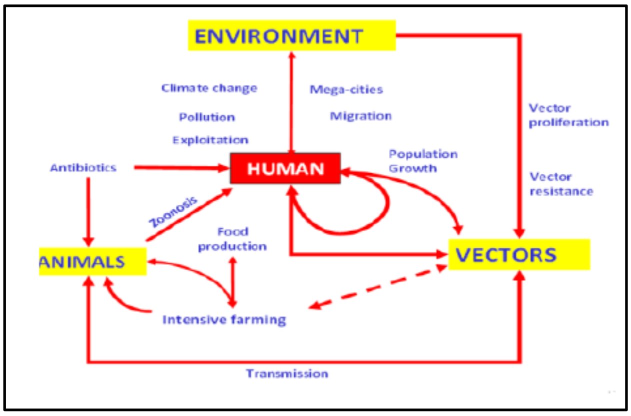

Figure 1. Interrelationship between humans, animals, vectors and environment within the One Health Framework [17]

There is also physical and chemical degradation of soil, making it gradually infertile (soil depletion). Rivers are increasingly polluted by chemical fertilizers, pesticides, industrial waste, heavy metals, plastic contaminants, and other pollutants [18]. Moreover, improper disposal of pharmaceuticals and waste from medical and veterinary sources worsens environmental contamination and promotes the spread of antimicrobial resistance [19]. Research indicates that inadequate waste management has contributed to increasing levels of antibiotic residues in aquatic environments, posing a threat to both ecosystem health and public safety [20]. All these factors accelerate the extinction of many marine and terrestrial species, endangering biodiversity and ecosystems that are vital to the health of humans, animals, and the environment [21].

2.2. Why Climate Change is Veterinary Human Health Issue?

Existing veterinary education has primarily focused on protecting the health of food-producing animal populations to help meet the nutritional needs of both global human and animal populations. However, the global decline of certain insects, birds, and other animal pollinators, which are impacted by climate change (CC), is threatening global food production and food security [22]. Extreme heat due to global warming is causing higher rates of heat-related and cardiovascular morbidity and mortality in humans [3, 23] and animals that would not occur from other causes alone. Industrial emissions and air pollution from wildfires pose a significant risk factor for asthma, allergies, respiratory, and cardiovascular diseases in humans, and have detrimental impacts on animal health [24,25,26]. Many animals act as "sentinels," providing warning information to humans about zoonoses and pollution-related human illness [1,27]. The One Health approach is beneficial for identifying "shared risks" to humans and animals from environmental health hazards or zoonotic agents associated with bioterrorism. Increased ecological temperature expands the range of arthropod-borne diseases like malaria, dengue, Chikungunya, Hantavirus, Lyme disease and leishmaniasis [28]. In addition, hot climates trigger climate-sensitive disease outbreaks like cholera, diarrheal diseases, cryptosporidiosis, campylobacteriosis, and leptospirosis [29]. The increased rise of sea level with environmental degradation is often leading to civil conflict and the forced relocation of coastal human populations with their animals; thereby threatening their physical and mental health, livelihoods, and cultural well-being [30]. In such climate-related emergencies, public health veterinarians have worked with other health professionals to provide rescue, recovery, and relief to people and animals exposed to extreme temperatures, floods, droughts, wildfires, famine, etc., and unhealthy environmental conditions [31].

2.3. Added Value of One Health to Reduce Effect of Climate Change (CC)

The climate change is superposed by demographic, socio-economic, environmental, and landscape changes [32]. The One Health strategy emphasizes safeguarding the well-being of humans, animals, and the ecosystem against potential hazards. Integrated approaches through One Health save human and animal lives and reduce the overall costs incurred separately. For instance, the human health advantages from controlling brucellosis in Mongolia do not outweigh the expenses associated with large-scale livestock vaccination aimed at preventing the disease in humans. But, if all the benefits of animal vaccination against brucellosis are summed up, the societal benefits of livestock mass vaccination are three times higher than the intervention cost [33]. Another example is joint human and animal vaccination services for people living in remote, hilly areas, providing mobile herders or pastoralists with access to healthcare facilities for everyone, while saving financial resources by sharing the transport cost and cold chain [34]. The synergistic animal and human surveillance of West Nile Virus (WNV) in Italy shows savings of one million euros, as compared to separate sectoral disease surveillance [35]. Similar savings can be expected from food-borne zoonoses like salmonellosis, campylobacteriosis; integrated benefits were found in European countries like Belgium, Switzerland, and also in New Zealand [36]. Even when the laboratory infrastructure is common or shared, savings can also be achieved. The World Bank estimates a saving of 26% of the operation cost of the Canadian Science Centre in Winnipeg, hosting laboratories for both human and animal highly contagious infections under one roof. A 2022 study further confirms that intersectoral collaboration under the One Health framework in East Africa significantly reduced costs associated with zoonotic outbreak responses and improved surveillance efficiency [37].

Arctic regions are particularly vulnerable to zoonotic diseases, while mountains and drylands are also recognized as hotspots affected by climate change. In semi-arid and highland areas, villagers keep livestock for their livelihood and food security [38]. In many African countries (like Ethiopia, Mali), droughts kill significantly more livestock than humans, with disastrous consequences in milk-based dietary systems [39], increasing the risk of malnutrition. Heat stress affects livestock and agricultural produce by reducing yield and growth, leading to increased mortality [40]. Namibia faced acute food insecurity during April to June 2024 due to the impact of El Niño on the production of crops and livestock affecting an estimated 48% of the population (nearly 1.4 million) of the country. In southern Africa, El Niño is associated with drought, erratic rainfall, and high temperatures, resulting in water scarcity, limited food availability leading to poor pasture and water deficits that negatively impacted livestock production [41]. In view of the hunger crisis, the Namibian government announced a controversial plan to cull 723 wild animals including 83 elephants, 30 hippos, 100 eland, 60 buffaloes, 50 impalas, 100 wildebeests, and 300 zebras to feed the starving population, as well as to reduce the risk of human–wildlife conflict [42]. However, recent findings cautioned that such wildlife culling could unintentionally increase zoonotic disease risks and disrupt ecological balances [43]. To alleviate food shortages, such culling of wild animals could unwittingly increase the spread of zoonotic infections, and to mitigate those public health hazards, the One Health approach is essential.

Mongolia is facing rising impacts of climate change, which threaten communities and livestock. Dzuds are severe droughts followed by harsh winters that disrupt herders' livelihoods. These conditions often result in high livestock mortality due to malnutrition and exposure to extreme cold. This situation affects herders' livelihoods, often pushing them into cycles of poverty and socioeconomic hardship. Over the past decade, Mongolia has experienced six dzuds, including one in 2024 [44]. Following the drought in summer 2023 and subsequent heavy snowfall in 2024, grazing land in Mongolia was virtually non-existent. Consequently, about 5.2 million livestock died, and more than 300,000 nomadic herders faced hardships. One-third of Mongolians are nomads who rely on farming. This is a human health, animal health, and environmental health issue, and the UN is providing urgent humanitarian support to ensure access to critical services.

The three burning challenges are: managing carcasses of dead livestock to prevent the outbreak of infectious diseases; improving the health and welfare of herders to facilitate recovery and addressing the increased risk of flash floods in many areas. Implementing carcass disposal protocols and safe sanitation under One Health frameworks are necessary to avoid secondary disease outbreaks in pastoralist settings. Here, the integrated One Health Approach to safe Water, Sanitation, and Hygiene (WASH) is essential.

2.4. WASH (Water, Sanitation and Hygiene)

Safe water, environmental sanitation, and hygiene are the most integral parts of the One Health approach. Climate change leads to high rainfall, causing wash-off of human and animal excreta containing zoonotic pathogens from manure-fertilized fields or open defecation to surface and drinking water sources, which will potentially increase disease outbreaks**,** pollute the environment, and spread antimicrobial resistance. Natural calamities, such as hurricanes and floods, have been linked to the emergence of leptospirosis, which necessitates a closer examination of the animal reservoirs [45]. Climate change and diarrheal diseases are often interrelated [47]. There is also an increased occurrence of non-cholera vibriosis in humans [48]. Besides infectious diseases, there are high levels of mercury and persistent organic contaminants in terrestrial and aquatic ecosystems, which are concerning for human reproductive health [49]. Safe procedures of animal and human excrement recycling and composting, controlling animal movements, promoting hand washing, creating safe child spaces in households and domestic environmental hygiene are the major approaches to reduce infection risk. These trans disciplinary approaches are an integral part of One Health.

2.5. Climate Change and Wild-life

2.5.1. Loss of Habitat

Global warming, in terms of rising temperatures, affects food, flora, water and many other aspects. Climate change has altered the practice of farming and the use of land, resulting in increased competition for food resources among animals and humans. This often creates a conflict of resources. Ecosystems may become uninhabitable for certain animals are pushed to migrate beyond their natural habitats in search of food and suitable conditions, leading to disruptions and animal death. Rising ambient temperature is a hallmark of climate change. Heat exposure is a significant cause of stress, causing mortality for livestock, wildlife, pets, and sporting animals. During 2019-20, a large number of native mammals, birds, and reptiles were displaced, injured, or died in bushfires in Australia [50]. If habitat loss due to global warming or human encroachment (deforestation) and poaching continues, Africa's elephant could be extinct in the next 40 years [51]. Billions of Wildlife animals (Koalas, Kangaroos etc.) were already displaced from their usual habitat in Australia. Only through the One Health approach, we can safeguard human health and promote harmony.

2.5.2. Human-wildlife Conflict (HWC)

This conflict arises when animals pose a recurring threat to people's livelihoods, leading to retaliation against that species. Habitat loss due to CC invites human-wildlife conflict. As ecosystems change, human and wildlife roam farther in search of food, water and resources. This often results in devastating consequences for the affected animals. Earlier in this review article, human-wildlife conflict is discussed elsewhere. Leopards, cheetahs, jaguars, and tigers occasionally prey on livestock, disrupting local livelihoods and provoking retaliatory killings, which further threaten these already vulnerable wildlife populations. Monkey menace is particularly experienced in urban areas, where crop raiding by ungulates and wild pigs, as well as depredation by elephants, is common. Hence, there is a rise in sudden encounters with wild animals. CC and HWC are both challenging for biodiversity conservation and the well-being of humans in the Anthropocene. Hence, a collaborative approach involving the forest, veterinary, agricultural, and public health sectors is necessary to mitigate the problem. The Worldwide Fund for Nature (WWF) focuses on protecting specific endangered species, including pandas, whales, rhinos, and marine life. Turtles, primates, polar bears, and big cats to sustain other species [52].

2.5.3. Extinction Risk

The challenges above could lead to the extinction of many animals. With ocean habitats in flux due to CC, marine species are among the most affected. The ocean absorbs significant heat and carbon dioxide, leading to warming and other changes in the marine environment acidification. Acidification can make it harder for marine animals to build and maintain their shells and skeletons, while warming can cause coral reefs to bleach and die, ultimately paving the way for extinction. All these have cascading effects on the entire ecosystem. With an estimated population of only 360 remaining, the North Atlantic right whale teeters on the edge of extinction mainly due to human-induced impacts *Viz.* Entanglement in fishing gear, vessel strikes coupled with CC [53]. The speed of climate change is breakneck. Due to this rapid change, especially cold-blooded animals may struggle to find a suitable habitat. CC is threatening to reduce the population of penguins and polar bears, alteration in the sex ratios for sea turtles in the Caribbean. Warmer temperatures produce more female turtle offspring than male [54]. The adverse effects of climate change on flora and fauna within specific ecosystems affect the livelihoods of nature-dependent communities, particularly in Africa. Therefore, besides decreasing emissions of greenhouse gases, practices such as apiculture and assisted migration to designated eco-sensitive zones protected under stringent legislation can help mitigate extinction risks and support the conservation of flora and fauna within a One Health framework. The extinction of a species is not always related to climate change, but the collapse of a population may be intertwined with environmental degradation vis-à-vis ecosystem pollution. An elaborate discussion is beyond the scope of this write-up. One such example is the extinction of the vulture population in the Indian subcontinent, which is due to inadvertent poisoning from diclofenac used as an NSAID in livestock, and this represents the fastest decline in population among any bird species in recorded history. Vultures were once widespread in India, playing a vital role in maintaining ecological balance by scavenging livestock carcasses and helping control human health risks diseases. However, the rise in the use of diclofenac in the 1990s for livestock treatment led to a sharp decline in the vulture population. In 2006, the Government of India (GOI) banned the use of diclofenac. The flesh of dead livestock containing diclofenac causes kidney failure in vultures. Within a decade, Indian vulture populations came down from 50 million to just a couple of thousand [55]. This near extinction of the vultures across India led to the spread of pathogenic organisms from an excess of carcasses, killing more than half a million people from 2000 to 2005 [56]. Even when vultures reached their collapsed population during 2000 to 2005, human mortality increased by more than 4% [57]. Also, faecal bacteria and other pathogenic organisms in the nearby water bodies around disposed livestock carcasses more than doubled. The disappearance of vultures led to an increase in the feral dog population, causing a higher incidence of rabies. This near extinction of vultures in India has a socio-cultural aspect for the Parsi community. They offer their deceased to sky burials on a high Tower of Silence. This ritual requires vultures to consume the body, which is nowadays almost impossible to perform due to the decline in the vulture population [55]. The Parsi community has been forced to change their last rites. The Bombay Natural History Society (BNHS) has established four vulture conservation breeding centres in Haryana, West Bengal, Assam, and Madhya Pradesh for three critically endangered Indian vulture species. In 2020, the GOI launched a Vulture Action Plan (2020–2025) to enhance conservation measures [58]. It could take decades to restore the Indian vulture population to its previous levels through the collaborative efforts of ornithologists, veterinarians, ecologists, public health personnel, and conservationists. This extends beyond the traditional One Health narrative, fostering intersectional thinking and emphasizing the inherently integrative and holistic nature of the One Health approach.

3. Conclusion and Recommendations

This review highlights the urgent need for more comprehensive, collaborative, and standardized modelling methods to understand better and predict both the direct and indirect effects of climate change on humans, animals, and environmental health. As climate change poses a global emergency, it necessitates urgent and coordinated action. It is no longer a concern limited to environmentalists or climatologists. Still, it is now a shared responsibility across all disciplines and sectors from veterinary and public health to agriculture, forestry, and urban planning.

The degradation of ecosystems and the cascading health effects across species boundaries can only be effectively addressed through the One Health approach, which integrates human, animal, and environmental health in a unified framework. This transdisciplinary model not only improves our ability to identify and address emerging threats but also boosts resilience against future climate-related crises.

Recommendations:

1. Encourage collaboration across veterinary, medical, ecological, agricultural, and environmental agencies at local, national, and international levels.
2. Create integrated One Health surveillance platforms to monitor climate-sensitive diseases, zoonotic risks, and changes in biodiversity.
3. Invest in climate-resilient infrastructure such as eco-sensitive zones, sustainable agriculture, and wildlife corridors to help reduce human-animal conflicts and safeguard biodiversity.
4. Support research and development of predictive climate-health models and eco-epidemiological tools to improve risk forecasting.
5. Increase community awareness and build capacity on the interconnected impacts of climate change through inclusive education and public health communication.
6. Incorporate the One Health framework into national climate action plans and disaster preparedness strategies to enforce policy integration.

Only by embracing such collaborative, systems-based action we can ensure sustainable health for current and future generations in the face of a rapidly changing climate.

Contribution of Authors

All the authors contributed during the preparation of the manuscript. Dr. Utpal Das contributed to Visualization and Conceptualization, drafting the original manuscript, Dr. Mahendra Pal conceptualized the topic and contributed to the final editing of the draft. Dr. Ravindra Zende conducted a detailed review of literature and drafted the manuscript and ensured comprehensive coverage of the topic. Dr. Aishwarya Nair contributed to the sections, edited the language and clarity of the manuscript.

Conflict of Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Source of Funding

No financial support was received from any organization

References

[1] Rabinowitz P., & Conti L. Links among human health, animal health, and ecosystem health. Annual Review of Public Health, 2013: 34 (1): 189-204.

[2] Whitmee S., Haines A., Beyrer C., Boltz F., Capon A.G., de Souza Dias B.F. Safeguarding human health in the Anthropocene epoch: report of The Rockefeller Foundation–Lancet Commission on planetary health. The Lancet, 2015: 386(10007): 1973–2028.

[3] Lee H., Calvin K., Dasgupta D., Krinner G., Mukherji A., Thorne P., Ruane A.C. Climate change 2023 synthesis report summary for policymakers. Climate Change 2023 Synthesis Report: Summary for Policymakers, 2024: 1(1): 1–36.

[4] Kumar A. Disaster response under “One Health” approach: contribution of veterinary public health. Management of Animals in Disasters, 2022: 1 (1): 245–261.

[5] Stephen C., Carron M., Stemshorn B. Climate change and veterinary medicine: action is needed to retain social relevance. Canadian Veterinary Journal, 2019: 60 (12): 1356.

[6] Protopopova A., Ly L.H., Eagan B.H., Brown K.M. Climate change and companion animals: identifying links and opportunities for mitigation and adaptation strategies. Integrative and Comparative Biology, 2021: 61(1):166–181.

[7] Kiran D., Sander W.E., Duncan C. Empowering veterinarians to be planetary health stewards through policy and practice. Frontiers in Veterinary Science, 2022: 9(1): 775411.

[8] Abeles S.R., Kline A., Lee P. Climate change and resilience for antimicrobial stewardship and infection prevention. Current Opinion in Infectious Diseases, 2024: 37(4):270–276.

[9] Grace D., Bett B., Lindahl J., Robinson T. Climate and livestock disease: assessing the vulnerability of agricultural systems to livestock pests under climate change scenarios. CCAFS Working Paper, 2015: 116(1): 1–49.

[10] Health T.L.P. Health and climate policy. The Lancet Planetary Health, 2024: 8(8): e521.

[11] The Royal Society, National Academy of Sciences. The challenge of feeding the world sustainably: summary of the US-UK scientific forum on sustainable agriculture. National Academies Press, 2021: 1(1): 1–48.

[12] Lee H., Calvin K., Dasgupta D., Krinner G., Mukherji A., Thorne P. Climate change 2023 synthesis report summary for policymakers. Climate Change 2023 Synthesis Report: Summary for Policymakers, 2024: 1(1): 1–36.

[13] UNDRR. Mobile-based early warning systems: effective and inclusive alerting. United Nations Office for Disaster Risk Reduction, 2022: 1(1): 1–20.

[14] Schmutz S., Moog O. Dams: ecological impacts and management. Riverine Ecosystem Management: Science for Governing Towards a Sustainable Future, 2018: 1(1): 111–127.

[15] Bonilla-Aldana D.K., Jimenez-Diaz S.D., Arango-Duque J.S., Aguirre-Florez M., Balbin-Ramon G.J., Paniz-Mondolfi A. Bats in ecosystems and their wide spectrum of viral infectious potential threats: SARS-CoV-2 and other emerging viruses. International Journal of Infectious Diseases, 2021: 102 (1): 87–96.

[16] Dave S.D., Dave P.D., Pal M. The impact of climate change on emergence and re-emergence of vector-borne human diseases. International Journal of Livestock Research, 2015: 5 (1): 1–12.

[17] Pal M., Tariku F., Upadhyay D., Zende R. Current innovations in the diagnosis and immunization of emerging and reemerging zoonoses. American Journal of Epidemiology and Infectious Disease, 2024: 12 (2): 23–28.

[18] Peša I., Ross C. Extractive industries and the environment: production, pollution, and protest in global history. The Extractive Industries and Society, 2021: 8(4): 100933.

[19] Koytcheva M.K., Sauerwein L.K., Webb T.L., Baumgarn S.A., Skeels S.A., Duncan C.G. A systematic review of environmental sustainability in veterinary practice. Topics in Companion Animal Medicine, 2021: 44(1): 100550.

[20] Serwecińska L. Antimicrobials and antibiotic-resistant bacteria: a risk to the environment and to public health. Water, 2020: 12(12): 3313.

[21] Parmesan C., Morecroft M.D., Trisurat Y. Climate change 2022: impacts, adaptation and vulnerability. GIEC, 2022: 1(1): 1–200.

[22] Milman O. The insect crisis: the fall of the tiny empires that run the world. WW Norton & Company, 2022: 1(1): 1–352.

[23] Liu J., Varghese B.M., Hansen A., Zhang Y., Driscoll T., Morgan G. Heat exposure and cardiovascular health outcomes: a systematic review and meta-analysis. The Lancet Planetary Health, 2022: 6(6): e484–e495.

[24] Fuller R., Landrigan P.J., Balakrishnan K., Bathan G., Bose-O'Reilly S., Brauer M. Pollution and health: a progress update. The Lancet Planetary Health, 2022: 6(6): e535–e547.

[25] Pal M., Yirgalem M., Anberber M., Giro B., Dasgupta R. Impact of environmental pollution on animal health. Journal of Natural History, 2015: 11 (1): 4–21.

[26] Sanderfoot O.V., Bassing S.B., Brusa J.L., Emmet R.L., Gillman S.J., Swift K., Gardner B. A review of the effects of wildfire smoke on the health and behaviour of wildlife. Environmental Research Letters, 2022: 16(12): 123003.

[27] Jessup D.A., Miller M.A. Prescriptions for reducing ocean pollution and saving southern sea otters. Wildlife Disease and Health in Conservation, 2023: 1(1): 1679.

[28] Alcayna T., Fletcher I., Gibb R., Tremblay L., Funk S., Rao B., Lowe R. Climate-sensitive disease outbreaks in the aftermath of extreme climatic events: a scoping review. One Earth, 2022: 5(4):336–350.

[29] Rocklöv J., Dubrow R. Climate change: an enduring challenge for vector-borne disease prevention and control. Nature Immunology, 2020: 21(5): 479–483.

[30] Doelle M., Puthucherril T.G. Nature-based solutions to sea level rise and other climate change impacts on oceanic and coastal environments: a law and policy perspective. Nordic Journal of Botany, 2023: 2023(1): e03051

[31] Stauffer K.E., Conti L. One Health and emergency preparedness. Veterinary Record, 2014: 175(17): 422–425.

[32] Hwang J., Lee K., Walsh D., Kim S., Sleeman J.M., Lee H. Semi‐quantitative assessment of disease risks at the human, livestock, wildlife interface for the Republic of Korea using a nationwide survey of experts: a model for other countries. Transboundary and Emerging Diseases, 2018: 65 (1): e155–e164.

[33] Roth F., Zinsstag J., Orkhon D., Chimed-Ochir G., Hutton G., Cosivi O. Human health benefits from livestock vaccination for brucellosis: case study. Bulletin of the World Health Organization, 2003: 81(1): 867–876.

[34] Abakar M.F., Seli D., Lechthaler F., Crump L., Mancus A., Tran N., Zinsstag J., Muñoz D.C. Evaluation of the feasibility and sustainability of the joint human and animal vaccination and its integration to the public health system in the Danamadji health district, Chad. Health Research Policy and Systems, 2021: 19(1): 1–13.

[35] Paternoster G., Babo Martins S., Mattivi A., Cagarelli R., Angelini P., Bellini R. Economics of One Health: costs and benefits of integrated West Nile virus surveillance in Emilia-Romagna. PLoS One, 2017: 12 (11): e0188156.

[36] Schmutz C., Mäusezahl D., Bless P.J., Hatz C., Schwenkglenks M., Urbinello D. Estimating healthcare costs of acute gastroenteritis and human campylobacteriosis in Switzerland. Epidemiology & Infection, 2017: 145(4): 627–641.

[37] Nyokabi N.S., Moore H., Berg S., Lindahl J., Phelan L., Gimechu G. Implementing a One Health approach to strengthen the management of zoonoses in Ethiopia. One Health, 2023: 16 (1):100521.

[38] Ruscio B.A., Brubaker M., Glasser J., Hueston W., Hennessy T.W. One Health – a strategy for resilience in a changing arctic. International Journal of Circumpolar Health, 2015: 74 (1): 27913.

[39] Bechir M., Schelling E., Bonfoh B., Seydi M., Wade S., Moto D.D., Tanner M., Zinsstag J. Seasonal variations in the nutritional status of nomad and sedentary children less than 5 years of age living in the Sahel in Chad. Medecine Tropicale: Revue du Corps de Sante Colonial, 2010: 70 (4): 353–358.

[40] Fahad S., Bajwa A.A., Nazir U., Anjum S.A., Farooq A., Zohaib A. Crop production under drought and heat stress: plant responses and management options. Frontiers in Plant Science, 2017: 8 (1): 1147.

[41] Bogale G.A., Erena Z.B. Drought vulnerability and impacts of climate change on livestock production and productivity in different agro-ecological zones of Ethiopia. Journal of Applied Animal Research, 2022: 50 (1): 471–489.

[42] Makoye K. Tragic short-sighted approach: as Namibia plans to cull wild animals, conservationists raise alarm. Down to Earth, 2024: 1 (1):1–3.

[43] Johnson C.K., Hitchens P.L., Pandit P.S., Rushmore J., Evans T.S., Young C.C.W., Doyle M.M. Global shifts in mammalian population trends reveal key predictors of virus spillover risk. Proceedings of the Royal Society B, 2020: 287(1924): 20192736.

[44] Chultemsuren T., Dierkes J. Mongolia in 2023 and 2024: economic recovery and international attention. Asian Survey, 2025: 65 (2): 348–358.

[45] Mwachui M.A., Crump L., Hartskeerl R., Zinsstag J., Hattendorf J. Environmental and behavioural determinants of leptospirosis transmission: a systematic review. PLoS Neglected Tropical Diseases, 2015: 9 (9): e0003843.

[46] Squire S.A., Ryan U. Cryptosporidium and Giardia in Africa: current and future challenges. Parasites & Vectors, 2017: 10 (1): 1–32.

[47] Flütsch F., Heinzmann D., Mathis A., Hertzberg H., Stephan R., Deplazes P. Case-control study to identify risk factors for bovine cysticercosis on farms in Switzerland. Parasitology, 2008: 135 (5):641–646.

[48] Huehn S., Eichhorn C., Urmersbach S., Breidenbach J., Bechlars S., Bier N. Pathogenic vibrios in environmental, seafood and clinical sources in Germany. International Journal of Medical Microbiology, 2014: 304 (7): 843–850.

[49] Dudley J.P., Hoberg E.P., Jenkins E.J., Parkinson A.J. Climate change in the North American Arctic: a One Health perspective. EcoHealth, 2015: 12 (4): 713–725.

[50] Van Eeden L.M., Nimmo D., Mahony M., Herman K., Ehmke G., Driessen J. Impacts of the unprecedented 2019–2020 bushfires on Australian animals. 2020: 1 (1): 1–12.

[51] Gunawansa T.D., Perera K., Apan A., Hettiarachchi N.K. Identifying human-elephant conflict hotspots through satellite remote sensing and GIS to support conflict mitigation. Remote Sensing Applications: Society and Environment, 2024: 35 (1): 101261.

[52] Nyhus P.J. Human–wildlife conflict and coexistence. Annual Review of Environment and Resources, 2016: 41(1): 143–171.

[53] Moore M.J., Rowles T.K., Fauquier D.A., Baker J.D., Biedron I., Durban J.W. Assessing North Atlantic right whale health: threats, and development of tools critical for conservation of the species. Diseases of Aquatic Organisms, 2021: 143 (1): 205–226.

[54] Laloë J.O., Esteban N., Berkel J., Hays G.C., Sand temperatures for nesting sea turtles in the Caribbean: implications for hatchling sex ratios in the face of climate change. Journal of Experimental Marine Biology and Ecology, 2016: 474 (1): 92–99.
[55] Vulture Conservation Foundation (VCF). Vulture Conservation Foundation Annual Report 2024. VCF, 2024: 1(1): 1–60.
[56] Oaks J.L., Gilbert M., Virani M.Z., Watson R.T., Meteyer C.U., Rideout B.A., Khan A.A. Diclofenac residues as the cause of vulture population decline in Pakistan. Nature, 2004: 427 (6975): 630–633.
[57] Frank E., Sudarshan A. The social costs of keystone species collapse: evidence from the decline of vultures in India. American Economic Review, 2024: 114 (10): 3007–3040.
[58] Ishwar N.M., Das S. Economics of conserving endangered birds: the case for Gyps vultures in India. Environment, Development and Sustainability, 2024: 1 (1): 1–23.