A Monthly e Magazine
ISSN:2583-2212
Dec 2023 3(12) 4270-4274

Popular article

Impact of Climate Change on Parasitic Disease Infecting Livestock

Aditi Malviya, G. Ramya Bharathi, Sandhana Krishnan S., Anandu S
Division of Parasitology, ICAR-Indian Veterinary Research Institute
https://doi.org/10.5281/zenodo.10447464

Introduction

Climate change encompasses alterations in the Earth's climate, whether resulting from natural variations or human-induced activities. It manifests as prolonged shifts in temperature and weather patterns, impacting various aspects of our environment. The factors contributing to climate change are categorized into natural causes, such as solar radiation, ocean currents, forest fires, volcanic eruptions, meteorites, and methane gas emissions. Anthropogenic causes include the use of synthetic fertilizers, chemicals, deforestation, changes in land use, greenhouse gas emissions, industrialization, unplanned urbanization, and numerous other human behaviours. The anticipated impacts of climate change include changes in weather patterns, increased frequency of cyclonic disturbances, rising sea levels, shifts in agricultural yields, alterations in freshwater supply, effects on forests and natural ecosystems, and impacts on human and animal health.

Climate change also induces modifications in disease transmission, impacting the rates of development, mortality, and reproduction of free-living stages of parasites. Behavioural changes in both parasites and hosts occur, along with alterations in host susceptibility through modifications in immune and stress responses and physiology. For instance, in ruminants, gastrointestinal nematodes, specifically the free-living stages of Haemonchus, are sensitive to changes in temperature and humidity, indicating a negative influence of climate change on the infection patterns in ruminants.

Climate change on livestock health

This phenomenon encompasses both direct and indirect consequences on animal health. Direct effects are particularly pronounced for diseases linked to vectors, soil, water, floods, rodents, and air temperature/humidity associated and sensitive to climate (Grace *et al*., 2015). Indirect impacts follow complex pathways, including animal attempts to adapt to thermal environments, climate influences on microbial populations, vector-borne disease distribution, host resistance to infectious agents, feed and water shortages, and food-borne diseases (Yatoo *et al*., 2012).

According to Forman *et al.,* (2008), climate change influences animal health in four key ways

1. Heat-related diseases and stress
2. Extreme weather events
3. Adaptation of animal production systems to new environments
4. Emergence or re-emergence of infectious diseases

The rise in temperature, atmospheric carbon dioxide (CO_2) concentration, and precipitation variability has adverse effects on animal performance, feed crop and forage quality, water availability and consumption, disease transmission, reproduction, and biodiversity. Thermal adaptation to temperatures above 30°C requires additional energy, leading to impaired productivity, potential harm to animal health, compromised product quality, and reproductive issues. Extreme weather events like droughts, heatwaves, storms, and desertification pose significant risks to the future well-being of animals.

Among small ruminants, goats are considered more tolerant to warmer climates due to exceptional phenotypic characteristics. Goats efficiently utilize minimal energy to maintain a constant core temperature by desiccating their faeces, concentrating urine, reducing evaporative water loss, and utilizing the rumen as a water reservoir. They exhibit resilience within a temperature range of 24-28°C, with a minimum temperature of -0.5-7.5°C and relative humidity between 68-79%, correlating with a robust antiparasitic response in the herd.

Direct Effects of Climate Change on vectors:

1. **Temperature:** Fluctuations in temperature induce alterations in distribution, impact the biology and physiology of organisms, expedite the development of pathogens, and extend the geographic range of vectors. Elevated temperatures accelerate the development and reproduction of vectors, shorten the incubation period of pathogens within vectors, and result in increased transmission rates. Furthermore, these temperature shifts can prompt behavioral changes in vectors, making them more active and prone to more frequent feeding.

2. **Global Wind Patterns:** Changes in global wind patterns influence the migration patterns of vectors, leading to shifts in their distribution and potential impacts on disease transmission.

3. **Global Precipitation Patterns:** Variations in global precipitation patterns affect the duration of seasons conducive to vector survival and provide breeding sites, particularly water sources for vectors. Increased rainfall can lead to a surge in vector populations, while heavy

Official Website
www.thescienceworld.net
thescienceworldmagazine@gmail.com
Published 31.12.2023

rainfall followed by drought conditions creates an environment favorable for vector breeding, subsequently increasing the transmission of diseases. Post-rain periods facilitate vector activity and feeding.

4. **Change in Relative Humidity:** Alterations in relative humidity have direct effects on the lifespan of vectors. Specific vector species are adapted to particular humidity ranges and extreme conditions. Higher humidity levels enhance vector activity, feeding, and reproduction, creating favorable conditions for vector breeding. Moreover, high humidity contributes to the survival of vectors under varying environmental conditions.

Indirect Effects of Climate Change on vectors:

1. **Desertification and Drought:** The progression of desertification and drought leads to arid conditions, causing a loss of vegetation and a subsequent reduction in breeding sites. Some vectors adapt to breeding in small, temporary water sources formed during sporadic rainfall. Notably, when drinking wells become sources, there is an increased risk of guinea worm transmission. Additionally, these environmental changes influence the distribution of rodent reservoirs, sand flies, and other vectors.

2. **Changes in Vegetation:** Alterations in vegetation have a notable impact on the distribution of the tsetse fly. This fly, typically associated with woodland and savannah ecosystems near water bodies, faces habitat challenges due to changes in vegetation, including deforestation. Such alterations affect tsetse fly breeding grounds, thereby impacting bacterial, viral, and tick-borne diseases.

3. **Hydrological Changes:** Shifts in hydrological conditions, such as the formation of more brackish water, contribute to the extension of breeding grounds for vectors. Changes in riverbeds have repercussions for the ecology of the tsetse fly, and a reduction in water levels can lead to the retention of free-living infective stages, influencing the dynamics of disease transmission.

4. **Changed Agricultural Practices:** Modifications in agricultural practices, encompassing alterations in irrigation, cropping patterns, and pesticide application, exert an influence on mosquito-borne and soil-borne diseases. These changes impact the habitats and breeding sites of disease vectors, consequently affecting the prevalence and transmission of diseases associated with mosquitoes and soil-borne pathogens.

Effects of Climate Change on Parasites:

Effect of Temperature:

1. Parasite Development and Reproduction: Elevated temperatures expedite the development and reproduction of parasites.

2. Shortened Life Cycle: Higher temperatures reduce the generation time, leading to an increased number of generations per year and a subsequent rise in the parasite population.

3. Increased Pathogenicity: Some parasites exhibit higher pathogenicity at elevated temperatures. Additionally, high temperatures weaken the host's immune response, rendering it more susceptible to parasitic infections.

4. Geographic Distribution: As temperatures rise, parasites expand their range into new areas.

5. Resistance & Adaptation: Prolonged exposure to high temperatures results in the selection of parasite strains that are resistant to heat.

Effect of Moisture:

1. Parasite Survivability: Certain parasitic stages are sensitive to desiccation and require a specific level of humidity for survival.

2. Habitat Suitability: The humidity level in a given environment determines its suitability for different parasites.

3. Egg Hatching: The development of eggs of some parasites, like Trichostrongylus and Haemonchus, occurs in dung, which requires a specific moisture level. Nematodirus and Fasciola eggs develop in soil, surrounded by a layer of water-retaining soil particles.

4. Life Cycle & Development: Adequate moisture supply is essential for various stages of the life cycle, including eggs, infection of snails by miracidia, shedding of cercaria, and larvae development outside the host.

5. Migration of Larvae: Certain parasites, like Ostertagia and Haemonchus, cannot escape from desiccated dung. The sudden migration of larvae is made possible by the arrival of rain.

Effect of Irradiation:

- Increased ultraviolet (UV) radiation directly damages parasites.
- Heightened exposure to ultraviolet B radiation can suppress mammalian cellular immunity, a consequence of stratospheric ozone depletion.

Parasite Survival in Different Climatic Environments - Hypobiosis: It refers to the temporary cessation of development at a specific point in the life cycle, often seasonal. Arresting larvae at early in-host development stages ensures enhanced survival of parasite populations during adverse climatic conditions.

Climate change can have significant impacts on parasitic diseases infecting livestock (Conclusion)

1. Altered Geographic Distribution: The rise in temperature and shifts in precipitation patterns extend the parasite range, exposing livestock in new regions to diseases.

2. Vector-Borne Disease: Climate change impacts the distribution and behavior of vectors,

Official Website
www.thescienceworld.net
thescienceworldmagazine@gmail.com

Published 31.12.2023

increasing the likelihood of disease transmission.

3. Increased Disease Intensity: Warmer and more humid conditions create a favorable environment for the survival and reproduction of parasites, resulting in an upsurge in parasitic diseases in livestock.

4. Seasonal Shift: Climate change disrupts traditional seasonal patterns, making it challenging for farmers to predict when parasitic diseases might peak.

5. Resistance Development: The stress on livestock caused by climate change weakens immune systems, making animals more susceptible to infections. Overuse of antiparasitic drugs further leads to the development of drug-resistant parasites.

6. Economic Impact: The increased prevalence of parasitic diseases results in reduced livestock productivity, including decreased weight gain, milk production, and reproductive issues. This, in turn, leads to economic losses.

References

Sudhakar, K., 2018. Impact of climate change on animal parasitism. Bioved, 29(2), pp.379-380.

Nejash, A. and Kula, J., 2016. Impact of climate change on livestock health: A review. Global Veterinaria, 16(5), pp.419-424.

Van Dijk, J., Sargison, N.D., Kenyon, F. and Skuce, P.J., 2010. Climate change and infectious disease: helminthological challenges to farmed ruminants in temperate regions. Animal, 4(3), pp.377-392.

Official Website
www.thescienceworld.net
thescienceworldmagazine@gmail.com

Published 31.12.2023