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Global Warming: Impact on Animal Diseases

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ABSTRACT

Global warming is one of the major concerns of recent years owing to its multiple impacts on human beings and animals. Most of the discussions are focussed on the contribution of livestock on increasing the temperature, while a less concern has been given on its impact on emergence of different animal diseases. The present paper puts on record the effects of global warming on epidemiology of animal diseases, important animal diseases and the challenges faced by the veterinarians and public health personnel during the current scenario.

KEYWORDS : Global warming, vectors, animal diseases, IPCC

INTRODUCTION

Global warming is a phenomenon where an increase in the average temperature of the earth's near-surface air and oceans since the mid-20th century and its projected continuation. The earth's temperature is in delicate balance between the energy it receives from sun and the energy it radiates into space. Significant changes in physical and biological systems have already occurred on all continents and in most oceans, and most of these changes are in the direction expected with warming temperature. The global air temperature from the pre industrial era(1850-1899) to the present time increased by 0.76 ºC(+/- 0.19 ºC) and growth rate has progressively accelerated ,the linear rate in the last 50 yrs in double the centennial rate, and 11 of the last 12 years rank among the 12 warmest years since 1850. In the present scenario the effects of this increasing temperature on the livestock are varied. The effects of global warming on animals diseases has been a neglected area, but has gained importance owing to the zoonotic importance of different animal diseases (Epstein, 2004) and extensive studies has been taken place in the last two decades (World Health Organization, 2005).

Global warming and generalized effects on livestock

Livestock systems in developing countries are changing rapidly in response to a variety of drivers. Water vapour accounts for 60% of the green house effect, while other trace gases like long life green house gases (CO2, CH_4, N2O) make variable contributions to green house effect. Temperature and moisture are the two most important environmental parameters for the terrestrial organisms, while the temperature and the pH are important for aquatic species. In the predictions reported by Intergovernmental Panel on Climate Change (IPCC) profound changes in the temperature would occur precisely during the spring and end of summer. Temperature fluctuation has major effects on the vectors of different animal diseases and it signals the following processes (Reiter, 1998).

- The release of eggs or larvae by parasites and vectors
- Embryonic development and hatching rates
- The longevity of the free living stage
- Infectivity to intermediate hosts
- The development of either microorganisms or macro parasites in these hosts
- The infectivity to definitive hosts
- Time until maturation
- Life span and mortality

Importance of vector borne diseases

Warm temperature and surface water are essential for insect breeding (especially mosquito). Stagnant water with humid condition is both necessary for breeding (Harvell et al., 2002).

Warmer temperature leads to:

- Enhance vector breeding
- Increase vector survival
- Increase vector biting rate
- Reaching higher altitude
- Reduce the pathogen's maturation period with the vector. (Githeko et al., 2000).

Changes in climatic patterns and in seasonal conditions may affect disease behavior in terms of spread patterns diffusion range amplification and persistence in novel habitats. Pathogens adhering to an r-type strategy (e.g. RNA viruses) may be more inclined to encroach on a novel niche resulting from climatic change. Climatic factors can have a direct impact on infectious diseases that have a development stage outside the final host (i.e. or in an intermediate host or vector). Within an arthropod, pathogen replication rate and kinetics may be affected by insect body temperature and as a result the infection process in different organs of insect (intestines, salivary glands, ovaries) and the duration of cycle affected. Vector competence, a higher temperature experienced during larvae rearing may help to overcome the innate genetic barriers for virus dissemination within the insect and thus induce vector competence as seen in blue tongue virus.

Climate related animal diseases

Leishmaniosis:

Vectored by haematophagous females of one or few sand fly species among reservoir host including rodents, marsupials, edentates, monkeys, wild canids and domestic dogs. Climatic change affects leishmaniosis in

3 ways 1) directly by the effect of temperature or parasite development and vector competence. Female sand flies seek sheltered resting sites for blood meal digestion. Temperature affects the development of infective forms of Leismania sp in sand fly guts (cold blooded), 2) indirectly by effect of temperature and other environmental variables on the range and abundance of the sand fly species that act as vectors. 3) Indirectly through socioeconomic changes that affect the amount of human contact with the transmission cycles.

Rift valley fever:
Principally affect sheep and goat. Climatic change may affect three fundamental components of epidemiological cycle of RVF namely vectors, host and virus. Global warming could affect the biology of vectors, by increasing feeding frequency and egg production and decreasing the length of development cycle and extrinsic incubation period. This may result in higher vector density and higher vector capacity to transmit the virus and a higher transmission rate.

Blue tongue virus:
Warm temperature enhances the recruitment, development activity and survival rates of culicoides vectors. Extension of transmission from vectors to normally non vector species enhanced by warm temperatures (Purse et al., 2005). Within traditional vectors warm temperature increase viral replication rates. When temperature increases virus present in vector, undergo leakage into midgut barriers allowing virus replication and dissemination (Randolph, 2004). Precipitation governs the size and persistence of semi aquatic breeding sites for larvae. Overall increase in temperature (esp. night time and precipitation in summer /autumn and in dry areas) lead to increased geographical and seasonal incidence of BTV transmission.

Avian influenza:
The inadequate food availability during nesting is a great stressor that increases disease prevalence. At the same time, climate change may narrow available habitats, forcing birds of several species to crowd into ever smaller areas of remaining resources and increasing the chance of within-species and cross-species disease transmission. This scenario is a likely explanation for the recent dispersion of highly pathogenic H5N1 avian influenza.

Trematodiasis:
Trematodes showing by increased cercarial production and emergence associated with global warming esp with Schistosoma japonicum. Temperature, water body type, rainfall, water velocity and altitude has significant effect on schistosomes ,their fresh water snail hosts and the geographical distribution (Morgan et al., 2001). Higher temperatures accelerate trematode development in snails resulting in an earlier and more severe disease situation. Higher population of snails may correlate with higher levels of algae leading to higher cercarial density in water. The fasciolosis fluke will develop strategies to favour its transmission in global warming phenomenon by its longer cercarial shedding period greater cercarial production per snail and longer survival of infected snails (Mas-Coma et al., 2001)

Cestodiasis:
Only cestode disease that climate change have been found influence is alveolar Echinococcosis. It is transmitted by rodents and the definitive host include coyotes and foxes. It cause severe pathogenecity in humans. Environmental parameters act on two targets i.e. sufficient ground moisture increasing egg survival in the environment and certain vegetation types providing the habitat for large densities of suitable rodent species

Nematodiasis:

a) Heterakiasis:-
Caecal pseudogeohelminth parasite of chicken. A temperature increases (external temperature) resulted in linear increase in development rate of eggs, larva develop inside egg in external environment.

b) Trichostrongylosis:-
Normally they enter a period of arrested development called hypobiosis. Warming reduces the larval arrest and this expands the period of the year, during which the free living larval stage would be active.

c) Ancylostomosis:-
Increased local temperature and global warming may give rise to the emergence of cutaneous larva migrans due to ubiquitous presence of these zoonotic hookworm.

d) Dirofilariosis:-
Existence of appropriate climatic conditions to support abundant mosquito populations and filarid larval development are key factors in the spread of these organisms. Culex sp able to adapt widely different environments and the filarids can adapt to species that have been recently introduced like Aedes albopictus (Cancrini et al., 2000).

Challenges of global warming for disease prevention
By understanding that this global warming and their effects we should plan to reduce the effects by various means.

- Strong political support and funding for animal health services along with effective legislative and governance frameworks
- Productive engagement of industry and consumers
- Improved public communication systems leading to community familiar with risk and actions that may need to be taken. E.g. World animal health information services (WAHIS)
- Use of geographical information systems to delineate possible habitats and increase understanding of animals and associated pathogenic agents in their environment
- Adoption and implementation of 'one health' interdisciplinary approaches
- International collaboration of a practical and applied nature, including research and development
- Ongoing training programmes have to be strengthened
- Provision of ongoing support and guidance from international organizations such as OIE, FAO and WHO.
- Scientific underpinning of the system with veterinary leadership in technical animal matters in the areas of epidemiology, surveillance, diagnostics, pathology, technology transfer, risk analysis and foresight.
- Changes in the education and training of livestock producers to encourage and to apply adaptive strategies to minimize the negative impacts of climate change on the environment, agricultural production and animal production and health.

CONCLUSION
Changes in infectious disease transmission patterns are the major consequence of climate. Climatic change in the form of temperature increase is expected to bring a relaxation of the restricting effects of low temperatures on vector survival, dispersal and disease transmission in colder climates .This makes temperate environment more receptive to more tropical, mainly vector borne diseases. Understanding vector capacity is the key to understanding disease dynamics. Even when linkages between diseases and climate are relatively strong, non climatic confounding cofactors are often numerous which include socio-economic, demographic factors etc. Vulnerability to climatic change is highly variable in different ecozones in the world, due to the differential capacity to adapt and respond. Hence it is the time to increase the collaboration between the experts in the field like UNEP, FAO, IPCC, WHO, OIE, Millenium Ecosystem Assessment, International Mechanism of Scienthific Expertise on Biodiversity etc.

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