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Impact of Climate Change on Livestock Health: A Review

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Abstract: Currently, the world is facing a number of challenges, of which Global climate change is a priority area. Agriculture and livestock are amongst the most climate sensitive economic sectors in the developing countries. Climate change affects livestock health through several pathways. These includes effects on pathogens, such as higher temperatures affecting the rate of development of pathogens or parasites; effects on hosts, such as shifts in disease distribution that may affect susceptible animal populations; effects on vectors, such as changes in rainfall and temperature regimes that can affect both the distribution and the abundance of disease vectors; and effects on epidemiology, such as altered transmission rates between hosts. Furthermore, Climate change influences the emergence and proliferation of disease hosts or vectors and pathogens and their breeding, development and disease transmission. Consequently, it affects distributions and host–parasite relationships and its assemblages to new areas. Higher temperatures resulting from climate change may increase the rate of development of certain pathogens or parasites that have one or more life cycle stages outside their animal host. This may shorten generation times and, possibly, increase the total number of generations per year, leading to higher pathogen/ parasite population sizes. Mammalian cellular immunity can be suppressed following heightenedexposure to ultraviolet B. In particular, there is depression of the number of T helper 1 lymphocytes, the cells involved in the immune response to intracellular pathogens. Therefore, successful adaptations may be shown as better way of coping with the negative consequences of climate change on livestock health. This review work was conducted to explore the likely impacts of climate change on livestock health.

Key words: Climate change · Livestock health · Livestock

INTRODUCTIONS

Livestock systems directly support the livelihoods of at least 600 million smallholder farmers, mostly in sub-Saharan Africa and South Asia [1]. It is a rapidly-growing agricultural subsector and its share of agricultural GDP is 33 percent and rising, driven by population growth, urbanization and increasing incomes in developing countries. Demand for all livestock products is expected to nearly double in sub-Saharan Africa and South Asia by 2050 [2]. On the other hand, changes in climate over the last 30 years have already reduced global agricultural production in the range 1-5 % per decade [3].

Global climate change poses the threat of serious social upheaval, population displacement, economic hardships and environmental degradation [4]. Furthermore, Climate change and global warming now being accepted facts have affected all the ecosystems and will do so if left uncontrolled [5]. Agriculture and livestock are amongst the most climate sensitive economic sectors in the developing countries whilst the rural poor communities are more vulnerable to the adverse effects of climate change [6]. Impacts on some components have gained more attention while others have been neglected. Animals belong to latter. Even among the aspects relating to impacts of climate change on animals, production related impacts have gained attention when the impacts on health in general and on infectious diseases in particular are neglected [5]. Climate change influences the emergence and proliferation of disease hosts or vectors and pathogens and their breeding, development and disease transmission. Consequently, it affects distributions and host-parasite relationships and its assemblages to new areas [4].

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Climate change, in particular global warming, is likely to greatly affect the health of animals, both directly and indirectly. The direct effects of climate on animal disease are likely to be most pronounced for diseases that are vector- borne, soil associated, water or flood associated, rodent associated, or air temperature/humidity associated and sensitive to climate [7]. Indirect impacts follow more intricate pathways and include those deriving from the attempt of animals to adapt to thermal environment or from the influence of climate on microbial populations, distribution of vector-borne diseases and host resistance to infectious agents, feed and water shortages, or food-borne diseases [5]. Furthermore, Climatic changes can influence livestock health through a number of factors, including the range and abundance of vectors and wildlife reservoirs, the survival of pathogens in the environment [4].

Higher temperatures resulting from climate change may increase the rate of development of certain pathogens or parasites that have one or more life cycle stages outside their animal host. This may shorten generation times and, possibly, increase the total number of generations per year, leading to higher pathogen/ parasite population sizes [7,8]. Increase in temperature results in the spatial distribution and intensity of existing pests and diseases which in turn affect livestock productivity or may cause death of livestock in some extreme instances [9].

According to ECARD [10], most diseases are transmitted by vectors such as ticks and flies, the development stages of which are often heavily dependent on temperature. Cattle, goats, horses and sheep are also vulnerable to an extensive range of nematode worm infections, most of which have their development stages influenced by climatic conditions more particular temperature. Understanding of the relation between climate change and livestock disease is critical for better management of animal health problems. However, Current knowledge on the relationship between climate change effects and animal health is lacking particularly in Africa despite of livestock agriculture being economically important [6]. Therefore, the objective of this paper to give an overview on the effects of climate changes on livestock health.

Climate Change and Animal Diseases Linkage: The distribution of infectious diseases, (human, animal and plant) and the timing and intensity of disease outbreaks are often closely linked to climate. Climate change may affect livestock disease through several pathways both direct and indirect. The direct effects of climate on animal disease are likely to be most pronounced for diseases that are vector-borne, soil associated, water or flood associated, rodent associated, or air temperature/humidity associated and sensitive to climate [7]. These directly or indirectly effects by weather and climate may be spatial, with climate affecting distribution, *temporal* with weather affecting the timing of an outbreak, or relate to the *intensity* of an outbreak. Global climate change alters ecological construction which causes both the geographical and phonological shifts [11]. These shifts affect the efficiency and transmission pattern of the pathogen and increase their spectrum in the hosts [12].

The increased spectrum of pathogens increases the disease susceptibility of the animal and thus, supports the pathogenicity of the causative agent. The livestock systems are susceptible to changes in severity and distribution of livestock diseases and parasites as potential consequences. Incidence of external parasite (43.3%) was first ranked as the problem in the warm temperate [13].vector-borne diseases are especially sensitive to climate change. Changes in rainfall and temperature regimes may affect both the distribution and the abundance of disease vectors, as can changes in the frequency of extreme events. Arthropod vectors tend to be more active at higher temperatures; they therefore feed more regularly to sustain the increase in their metabolic functions, enhancing chances of infections being transmitted between hosts. Small changes in vector characteristics can produce substantial changes in disease [7].

There is a link between climate and epidemiological conditions of disease agents. Temperature, precipitation, humidity and other climatic factors are known to affect the reproduction, development, behavior and population dynamics of the helminthes, arthropod vectors and the pathogen they carry. Climate change influences the emergence and proliferation of disease hosts or vectors and pathogens and their breeding, development and disease transmission [4]. The OIE Scientific Commission has concluded that climate changes are likely to be an important factor in determining the spread of some diseases, especially those that are vector-borne. The two most mentioned emerging and re-emerging cattle diseases in a recent OIE survey are Catarrhal fever (Bluetongue) and Rift Valley fever [14]. The global distribution of Bluetongue virus infection changed drastically in recent years [15] and climate change may be partly responsible for this profound change in the global distribution of the

Bluetongue virus [15, 16]. Studies have demonstrated that the vectors of the disease are affected by temperature and have indicated a possible role of humidity [17] and precipitation [15].

Impact of Climate Change on Livestock Health: Climate change may have significant impacts on the emergence, spread and distribution of livestock diseases. For example, the distribution and impacts of vector-borne diseases of animals such as Rift Valley fever, African horse sickness and bluetongue vary considerably with seasonal and longer-term climatic variations [18]. Climate change may affect infectious diseases of livestock in several ways [19]. These include effects on pathogens, such as higher temperatures affecting the rate of development of pathogens or parasites; effects on hosts, such as shifts in disease distribution that may affect susceptible animal populations; effects on vectors, such as changes in rainfall and temperature regimes that can affect both the distribution and the abundance of disease vectors; and effects on epidemiology, such as altered transmission rates between hosts.While there is no general consensus that a warmer world is necessarily a more disease-ridden world [20].disease risks may be increasing for a variety of other reasons, such as the increasing complexity and scale of market chains and the inevitable intensification of production systems in particular places.

Impact of Climate Change on Vectors: Arthropod vectors are cold-blooded (ectothermic) and thus especially sensitive to climatic factors. Temperature, precipitation, humidity and other climatic factors influence the survival, production, development, behavior and population dynamics of the arthropod vectors. Subsequently, climate factors influence habitat suitability, distribution and abundance; intensity and temporal pattern of vector activity (particularly biting rates) throughout the year [4].

There are several processes by which climate change might affect disease vectors. First, temperature and moisture frequently impose limits on their distribution. Often, low temperatures are limiting because of high winter mortality and a relatively slow rate of population recovery during warmer seasons. By contrast, high temperatures are limiting because they involve excessive moisture loss. Therefore, cooler regions which were previously too cold for certain vectors may begin to allow them to flourish with climate change. Warmer regions could become even warmer and yet remain permissive for vectors if there is also increased precipitation or humidity conversely, these regions may become less conducive to vectors if moisture levels remain unchanged or decrease, with concomitant increase in moisture- stress [19].

Changes in climate will influence arthropod vectors, their life cycles and life histories, resulting in changes in both vector and pathogen distribution and changes in the ability of arthropods to transmit pathogens. Therefore animals will be exposed to different parasites and/or diseases, as indicated by the predicted change in the distribution of, for example, the Tsetse fly in Africa, putting an even greater pressure on production and the survival of livestock breeds [21]. Research studies from India have found that meteorological parameters like temperature, humidity and rainfall explain 52 and 84% variations in the seasonality of Foot and Mouth (FMD) disease in cattle in hyper-endemic division of Andhra Pradesh and meso-endemic region of Maharashtra states, respectively [22]. The hot-humid weather conditions were found to aggravate the infestation of cattle ticks like, Boophilusmicroplus, Haemaphysalisbispinosa and Hyalommaanatolicum [23].

The feeding frequency of arthropod vectors may also increase with rises in temperature. Many vectors must feed twice on suitable hosts before transmission is possible - once to acquire the infection and, after the EIP, once to transmit it. For many blood-feeding arthropods, feeding frequency is determined by the time required for egg development. For example, C. sonorensis females feed every three days at 30 °C but only every ~14 days at 13°C. At the warmer temperature, the vector is more likely to take the two feeds on suitable hosts that are required for successful transmission [19].

Impact of Climate Change on Pathogens: Higher temperatures and greater humidity generally increase the rate of development of parasites and pathogens that spend part of their life cycle outside the host. Changes to wind can affect the spread of pathogens. Flooding that follows extreme climate events provides suitable conditions for many water-borne pathogens. Drought and desiccation are inimical to most pathogens [7, 8]. Increased the rate of development due higher temperatures may shorten generation times and, possibly, increase the total number of generations per year, leading to higher pathogen/ parasite population sizes [6]. Conversely, some pathogens are sensitive to high temperatures and their survival may decrease with climate warming. Pathogens and parasites that are sensitive to moist or dry conditions may be affected by changes to precipitation, soil moisture and the frequency of loads. Changes to winds could affect the spread of certain pathogens and vectors. Some pathogens/parasites and many vectors experience significant mortality during cold winter conditions; warmer winters may increase the likelihood of successful overwintering [24].

Lengthening of the warm season may increase or decrease the number of cycles of infection possible within one year for warm- or cold-associated diseases respectively. Arthropod vectors tend to require warm weather so the infection season of arthropod-borne diseases may extend. Some pathogens/parasites and many vectors experience significant mortality during cold winter conditions; warmer winters may increase the likelihood of successful overwintering [19, 25]. Extreme weather events, for example, flooding can carry a risk of Cryptosporidium parasites and/or enterohaemorrhagic Escherichia coli emerging as diffuse pollution in a run-off from agricultural land. This poses an obvious threat to other livestock and is also a zoonotic risk to humans through contamination of water supplies. Future challenges in the control of parasitic zoonoses, including those related to climate change; deserve increasing attention alongside production-limiting disease [25].

Impact of Climate Change on Hosts: Some livestock will be exposed to new pathogens and vectors as their range increases and impacts can be severe. Climate stress (heat, inadequate food and water) can also lower host immunity [7]. Climate change may bring about substantial shifts in disease distribution and outbreaks of severe disease could occur in previously unexposed animal populations (possibly with the breakdown of endemic stability) [27]. Endemic stability occurs when the disease is less severe in younger than older individuals, when the infection is common or endemic and when there is lifelong immunity after infection. Certain tick-borne diseases of livestock in Africa, such as anaplasmosis, babesiosis and cowdriosis, show a degree of endemic stability [28]. If climate change drives such diseases to new areas, non-immune individuals of all ages in these regions will be newly exposed and outbreaks of severe disease could follow [6]. According to Aucamp [29, 30] Mammalian cellular immunity can be suppressed following heightened exposure to ultraviolet B (UV-B) radiation an expected outcome of stratospheric ozone depletion. In particular, there is depression of the number of T helper 1 lymphocytes, the cells involved in the immune response to intracellular pathogens. In terms of animal disease, such pathogens include viruses, rickettsia (such as Cowdria and Anaplasma, the causative agents of heart water and anaplasmosis) and some bacteria, such as Brucella, the organism causing brucellosis [19].

Impact of Climate Change on Epidemiology: Climate change may alter transmission rates between hosts by affecting the survival of the pathogen/parasite or the intermediate vector, but also by other, indirect, forces that may be hard to predict with accuracy [6]. For example, a series of droughts in East Africa between 1993 and 1997 resulted in pastoral communities moving their cattle to graze in areas normally reserved for wildlife. This resulted in cattle infected with a mild lineage of rinderpest transmitting disease both to other cattle and to susceptible wildlife such as buffalo and impala, causing severe disease and devastating certain populations [32]. Climate change may affect the abundance or distribution of hosts or the competitors/predators/parasites of vectors and influence patterns of disease in ways that cannot be predicted from the direct effects of climate change alone. Climate change-related disturbances of ecological relationships, driven perhaps by agricultural changes, overgrazing, deforestation, construction of dams and loss of biodiversity, could give rise to new mixtures of different species/strains, thereby exposing hosts to novel pathogens and vectors and causing the emergence of new diseases [32]. In general sense epidemiology of many diseases are based on transmission through vectors such as ticks, lice, mites, mosquitoes and lies, the developmental stages of which are often heavily dependent on temperature and humidity. Changes in rainfall and temperature regimes may affect both the distribution and the abundance of disease causing vectors, as can changes in the frequency of extreme events [27].

CONCUSSIONS

Climate change has negative effect on livestock health in many aspects. It may influence livestock health through a number of factors, including the range and abundance of vectors and wildlife reservoirs, the survival of pathogens in the environment. Climate change can exacerbate disease in livestock and some diseases are especially sensitive to climate change. Indeed a better understanding of the effect of climate change on animal health is crucial and good for recommendations on how to lessen its potential impact. Unfortunately, the determinants of resilience and adaptation that already reduce this impact are often poorly understood even though they are not unique but are needed regardless. For example, adaptive capacity could be increased in the broader context of developing appropriate policy measures and institutional support to help the livestock owners to cope with all livestock health problems. In fact, the development of an effective and sustainable animal health service, with associated surveillance and emergency preparedness systems and sustainable animal disease control and Prevention programme is perhaps the most important and most needed adaptive strategy. This will safeguard livestock populations from the threats of climate change and climate climate variability. Therefore, successful adaptations may be shown as better way of coping with the negative consequences of climate change and associated drivers of disease.

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