

Review on Impact of Climate Change on Animal Production and Expansion of Animal Diseases

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Abstract: Climate change is a subset of the larger set of ecosystem change that is promoting the emergence and reemergence of animal diseases. It is disrupting natural eco systems by providing more suitable environments for infectious diseases causing agents to move in to new areas where they may harm wild life and domestic species, as well as humans. Diseases that were previously limited only tropical areas are now spreading to other previously cooler areas. Pathogens that were restricted seasonal weather patterns can invade new areas and find new susceptible species as the climate warms and / or the winter get milder. Occurrence of tropical infectious diseases in the mild latitudes is linked to global warming is increasing. Insect borne diseases are now pin temperate areas where the vector insects were none existent in the past. Animal production facilities will be affected both directly and indirectly by climate change. The direct effects include the interchange of heat between the animal and its environment, associated with temperature, humidity, wind spread and thermal production. These are factors that influence animal performance (growth, milk and wool production, reproduction), as well as animal health and welfare. The indirect effects include the influence of climate on the quantity and quality of fodder crops and grains, and severity and distribution of diseases and parasites. In our country there is huge problem of animal diseases and production decrement due to climate change. Therefore the objectives of the seminar are:- To identify and create awareness on the impacts of climate change on diseases prevalence and to identify and create awareness on the impacts of climate change on animal production

Keywords: Climate change, Diseases, production.

INTRODUCTION

Climate change is a result of the global increase in average air and ocean temperatures, and rising average sea levels. It has become the main issue affecting global and regional natural eco systems. Based on predictions from the 2007 Inter governmental panel on climate change (IPCC) report [1], global changes in temperature and prediction patterns in different regions may affect the incidence and range of several infectious disease with in endemic areas and their introduction to free areas. These potential changes, however will also be influenced by other factors such as increased animal movements between countries and regions trade in animal products including wild life species, change livestock production systems and changes in land use and land cover(example deforestation, crop cultivation, for fuel production, or drainage of wetlands for public work projects) [2].

Approximately 80% of emerging infectious diseases affecting humans (zoonotic) and a rising number of these diseases (example severe acute respiratory syndrome (SARS), monkey pox, Marburg

diseases and ebola) are spread by contact with wildlife [3].These emerging diseases can have serious consequences for public health, the economy and species conservation. For instance SARS alone has killed over 700 people and has cost the global economy US\$ 50 billion. When such diseases appear and spread unabated, confidence in the structure of civil society designed to protect life and conserve natural resources is eroded [4].

Because arthropods are highly sensitive to environmental and seasonal temperatures, the range of vector-borne diseases such as bluetongue, west Nile fever, Venezuelan equine encephalitis, rift valley fever, African horse sickness and visceral leishmaniasis may be limited by the distribution of competent vectors. For instance, the expansion of the geographical range of *anopheles* vectors and the lack of well-structured and financed public health systems could explain the re-emergence of *malaria* and *dengue* in south America, central Africa and Asia [5].

Similarly, some species *biting midges* known to be vectors for African horse sickness (AHS) and blue

tongue have recently invaded Europe and North Africa [6]. There is a global trend for mosquitoes and biting midges to populate and establish themselves in new ecosystems. Although there are several historical records of bluetongue out breaks in Europe, the recurrent exotic introductions since 1998 have been alarming, with six strains of *bluetongue virus identified* across 12 countries and occurring some 80km further north than ever previously reported [7]. These rapid spread has been driven by climate change, which has increased virus persistence in vector hosts during winter period and the North ward expansion of *culicoides imicola*, an indogenous European midge species, thereby expanding the risk of transmission over larger geographical regions. In addition, animal parasites, including tick- borne diseases in Africa and New world screwworm (*cochliomyia hominivorax*) in south America, have spread to new regions, causing a negative impact on livestock production and causing direct or indirect effects on public health [8].

Anthrax is an acute infectious disease of most warm-blooded animals, including humans, with worldwide distribution. The causative bacterium, *Bacillus anthracis*, forms spores able to remain infective for 10-20 years in pasture. Temperature, relative humidity and soil moisture all affect the successful germination of anthrax spores, while heavy rainfall may stir up dormant spores. Outbreaks are often associated with alternating heavy rainfall and drought, and high temperatures [9]. Blackleg, an acute infectious clostridial disease, mostly of young cattle, is also spore-forming, and disease outbreaks are associated with high temperature and heavy rainfall [10]. There is a substantial scientific literature on the effects of climate change on health and disease, but it has a strong focus on human health and vector borne disease [11, 12].

By contrast, the effects of climate change on animal or non-vector-borne disease has received comparatively little attention but with notable exceptions [13]. Moreover, the global burden of animal diseases, and the contribution made by animal diseases to poverty in the developing world has overdue attention. Therefore the objectives of this seminar are:-

- To identify and create awareness on the impacts of climate change on diseases prevalence
- To identify and create awareness on the impacts of climate change on animal production

IMPACT OF CLIMATE CHANGE ON ANIMAL PRODUCTION AND EXPANSION OF ANIMAL DISEASE

Climate Change and Animal Disease

Specific studies describing the impact of climate change on livestock and wildlife diseases or pathogen emergence are not abundant. Factors such as landscape changes that remove portions of host populations (example habitat alteration or destruction),

alteration of host migration patterns (example habitat fragmentation) or increased host density that are likely to influence disease emergence have been described [14].

The geographical distribution of vector-borne diseases is influenced by the geographical distribution of both vertebrate host (where one exist) and the distribution of the vector [15]; other contagious diseases are also subject to a degree of environmental influence, including parasite life cycles which can be transmitted by wind-borne aerosol spread [16]. Increased precipitation may also cause changes in the prevalence and intensity of parasite infestations, increasing host mortality in wild and domestic species [17].

The more contact between wildlife populations and domestic species the higher the likelihood of exposure to novel pathogens, leading to emergence of new diseases in humans and animals [18, 19]. For example neutralizing anti-bodies against para- influenza PI-3, a virus which is relatively common in cattle, have been found in Huemul deer in Chile (a species which is in danger extinction) [20]. For contagious animal diseases, climate may be associated with seasonal occurrence of diseases rather than with spatial propagation. These is the case for pathogens or parasitic diseases, such as *facioliasis*, in areas with high higher temperatures, when seasonality is extended as a consequence of the increased survival of the parasite outside the host or, conversely, shortened by increased summer dryness that decreases their numbers [16]. For other pathogens, such as parasites that spend part of their life cycle as free stages outside the host, temperature and humidity may affect the duration of survival. Climate change could modify the rate of development of parasites, increasing in some cases the number of generations and then extending the temporal and geographical distribution. New world screwworm infestations increasing in spring and summer and decreasing in autumn and winter in South America [21]. On the other hand, Leishmaniasis in humans has been associated with the increased frequency of drought as this facilitates reproduction and growth of adult *sand flies* [22].

Wild birds are known to be reservoirs for several pathogens, including west Nile virus (WNV), and serve as amplifying hosts for the virus in nature [23]. The migration of birds is driven in part by seasonal climatic factors, and any change in climatic conditions may modify the direction and intensity of spread of disease. Similar disease ecology and wildlife interactions of pathogens associated with birds have been observed for *Newcastle diseases* [24], WNV [25, 26], influenza A virus [23].

The mosquitoes *Culex* species (*Culex pipiens*, *Culex restuans*) play an important role as vectors, for WNV. Bluetongue virus, which is transmitted by

Culicoides species, midges has been historically distributed between latitudes 40° N and 35° S [7].

Vesiculo viruses which cause vascular stomatitis can be insect transmitted and has been isolated from species of midges (Culicoides species) and phlebotomine flies, including sand flies (*Lutzomyia* species) and black flies (*Simuliidae* species) [27]. Antibodies to vesiculo virus have been detected in monkeys, marsupials, bats, carnivores, deer and rodents throughout America [28]. Seasonal variation is observed in the occurrence of virus: it disappears at the end of rainy season in tropical areas and at the time of the first frosts in temperate zone [29].

Climate Change and Transmission Ecology of Animal Disease Dynamics

The survival of climate common flu virus on doorknobs or during airborne transmission or by means of handshakes is influenced by ambient temperature and humidity [30]. The role of environmental pathogen load is perhaps more obvious still in the case of faecal-oral or water-borne transmission. Food poisoning occurs usually when feces contaminate food items. The natural cycle of avian influenza virus in mallard ducks, its for a most natural host, involves ingestion of water containing the virus. Natural avian influenza virus replication occurs mainly in the distal end of the enteric tract [31]. Virus deposited migratory water fowl during summer breeding at higher latitudes may be stored in permafrost conditions in sub-arctic regions and survive for centuries [32]. Likewise does the anaerobic bacillus anthrax bacterium survive for decades in the form of spores in the soil [33].

Disease agents transmitted by arthropods form a distinct, albeit related category. In direct transmission of protozoan disease agents may be facilitated by most ticks. Soft ticks feeding on warthogs play a role in the transmission of African swine fever (ASF) [34]. The causative agent of ASF, a DNA virus, may survive for eight years in the tick vector. There is also a number of midge or mosquito-borne disease complexes that involve a dormant pathogen stage. For example, Rift valley fever (RVF) virus may survive in mosquito eggs for years, until a prolonged heavy rain fall facilitates the hatching of *Aedes* mosquitoes, feeding on ruminants and thus kick-starting a RVF outbreak [35, 36]. Infected ruminants that end up in densely populated irrigation schemes may also attract mosquitoes feeding on humans and thus contribute to the transmission of RVF among humans.

Midges are sometimes blown by wind across wider geographic areas. This is probably what happened with bluetongue virus introduction in the United Kingdom, in the summer of 2006, after the virus had first spread westwards across Belgium [37]. It is possible that also flare-ups of the *Schmallenberg virus* in the United Kingdom in early 2012 resulted from wind

carried infected midges arriving from mainland Europe [38].

In the direct-indirect transmission spectrum, directly, swiftly transmitted common flu, short-lived fevers, faecal-oral, food and vector-borne transmission to more prominent free-living parasite stage can be noted. In this regard ectoparasite and myiasis-causing insects should also be considered. Arthropod pests are strongly modulated by climatic and weather conditions. For example, both the *old world screwworm fly*, *Chrysomya bezziana* and the *new world* screwworm, *Cochliomyia hominivorax*, feature a prominent free-living parasite stage. The adult female fly deposits eggs in open wounds and also minor skin lesions or mucus membranes, providing access for the evolving larval stages to life tissue of warm-blooded hosts. The latter is obligatory for this life cycle stage. Hundreds of larvae may result from a single egg batch, producing an ever-larger wound. Additional screwworm flies are lured to scenes and death of the affected host may eventually result. The larvae leaving the wound fall to the soil, bury themselves 2 cm deep, to turn into a pupa for about a period of one week until a new fly emerges. Adult flies feed on nectar and rely on adequate vegetation [39].

The effect of climate change on the tsetse flies, the vector of human and animal trypanosomiasis, is rather different, despite certain similarities between tsetse and the screwworm fly life history. The tsetse fly also features a pupal stage in soil. However, whereas a screwworm fly egg batch may yield 200 larvae, the female tsetse fly produces only 1 larva every 9 days. During its total life span, a female tsetse fly may produce 6-8 larvae, each of which undergo a pupal development period of about 3 weeks depending on ambient temperatures. Unlike screwworm flies, dispersing over hundreds of kms within weeks, tsetse flies sit and wait for the host to show up. Tsetse fly activity is restricted to 15-20 minutes a day [40].

From the above examples, it becomes clear that the effects of climate change on disease complexes may take many different forms, compression and generalization. Whereas the tsetse fly distribution in Ethiopia entails a gradual encroachment of the country's central high and plateau [41], recorded since the 1960s, the old world screwworm fly rather abruptly colonized the Arabian peninsula, first the Mesopotamia valley in Iraq and later parts of Yemen, the course two decades [42].

Contribution of Climate Change to Animal Disease

One consequence of significant and permanent changes to our climate is the alteration of disease patterns in humans and animals. These alterations may include the emergence of new disease syndromes and a change in the prevalence of existing diseases, particularly those spread by biting insects. Vectors may reach out to wider geographical areas, widening their

distribution patterns to non-immune areas, and may recruit new vectors or new strains resulting in the spread to new hosts [6].

Predictions indicate that climate change will result in warmer temperatures and increased humidity which in turn will affect vegetation quality. These changes can influence arthropod patterns of all changes associated to climate, the impact on arthropods and its distribution is the most evident. Warmer temperatures result in increasing vital titers with in vectors as well as vectors survival from season to season and increase in biting frequency [43]. Therefore, increases in temperature can result changes in the number of vector generations and overall abundance of insect populations which in turn can influence vector population dynamics and increase transmission [44].

Understanding vector capacity is the key to diseases dynamics. Many significant livestock diseases have insects (mosquitoes or ticks) as part of their transmission cycle. Bluetongue disease in cattle, African swine fever in pigs and Rift valley fever in ruminants are just to name a few. In humans malaria is most significant. Rainfall patterns may also have clear impact on the life cycle of pathogens and diseases. In particular the expected accumulation of water can result in nesting sites for mosquitoes to breed and expand, and as a result serve as reservoirs and transmitters for diseases. Besides changes in rainfall patterns, climate change can result in increased frequency of severe climatic event which can result an important feature vector distribution [45].

LINKS BETWEEN CLIMATE CHANGE, ANIMAL DISEASE AND ANIMAL PRODUCTION

The links between animal production and climate change

Contribution of Animal Production to Climate Change

According to the IPCC, the agriculture sector contributes between 10% and 12% of global emission of GHG, in terms of carbon dioxide equivalent. It contributes 40% of the total of anthropic emissions of methane (from enteric fermentation, decomposition of manure flooded rice fields) and 65% of the total of anthropic nitrous oxide (agricultural land use of nitrogenous fertilizers, spreading manure and burning biomass) [1].

In the mentioned 2006 report, applying life cycle analysis methodologies FAO calculated that 18% of total emission of GHG were attributable, directly or indirectly contribution from the use of the land for livestock production (mainly deforestation to create pasture and arable land) [46].

A study published by the OECD, states that livestock production is seen as being more intensive in terms of emission than other forms of food production.

Of particular concern the impact of changes in the use of land. The demand for arable land for crop production and pasture land has been the main driver of deforestation in certain developing countries. But, livestock production is vital for millions of persons as the source of food, the generation co-benefits and a source of income. The OECD report acknowledges that for the moment this pastures and pastoral farming provide the only viable option for producers in their agro ecosystems [47].

Impact of Climate Change on Life Stock Production

In IPCC Third Assessment Report [48] there is a section devoted that the vulnerability of animal production, warming those animal production facilities will be affected both directly and indirectly by climate change. The direct effects include the interchange of heat between the animal and its environment, associated with temperature, humidity, wind spread and thermal production. These are factors that influence animal performance (growth, milk and wool production, reproduction), as well as animal health and welfare [48].

The indirect effects include the influence of climate on the quantity and quality of fodder crops and grains, and severity and distribution of diseases and parasites. When the magnitudes (intensity and duration) of adverse climate conditions exceed certain limits, with little or no possibility of recovery, animal functions are adversely affected as a result of stress, at least in the short term. Genetic variation, the stage in the life cycle and nutritional status also influence their vulnerability and resilience to environmental stress. For example milk production from dairy cattle and conception rates can fall dramatically, and vulnerable animals may die as a result of extreme events [1].

Links between Climate Change and Animal Diseases

The relationship between climate change and the animal disease shown by the arrow labeled 1 in figure. The most frequently mentioned diseases associated with climate change are listed in table. The climate change responses are broadly consistent with other work that has highlighted the increase in the incidence of vector borne diseases in association with climate change. This increase is due to both the markedly altered vector population size and dynamics, and the increases in pathogen replication rates that are influenced directly by ambient temperatures during infection of the poikilothermic arthropod vector [49].

Links between Animal Production and Animal Disease

In general, intensifying production systems will increase the opportunity for emerging and reemerging animal diseases and management systems need to be developed to minimize their direct and indirect effects on production and profitability. This means that in a response to actual or anticipated

emerging and re-emerging animal diseases, animal production systems will be adjusted or re developed (this is the relationship labeled in figure). The evolution

of relationship 4 and 5 is in fact a continues interplay in which changes in one element of the complex system lead to changes in other parts of a system [50].

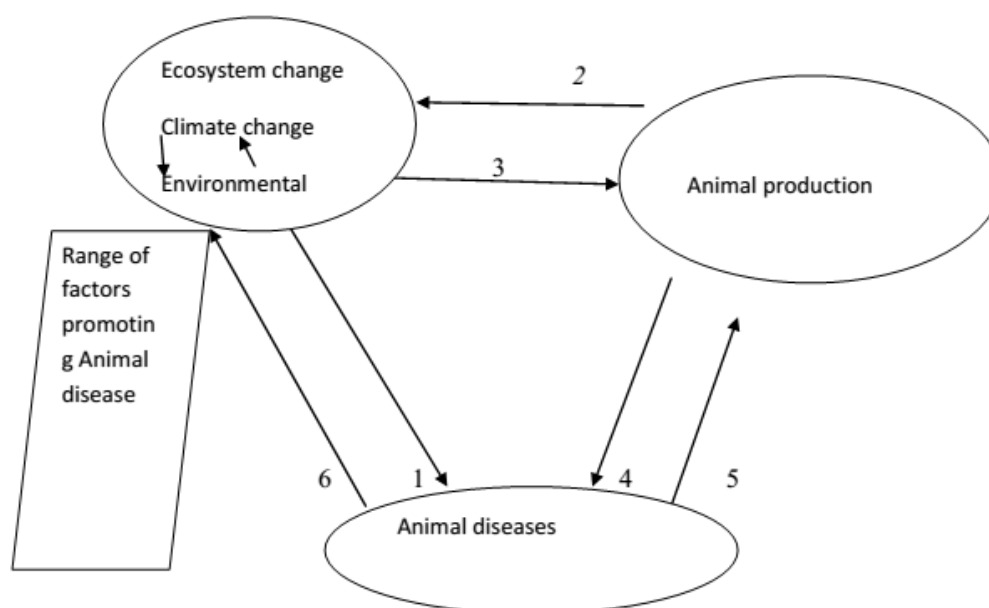


Fig-1: main relationship between animal diseases, climatic change, environmental change and animal production[50].

FARM ANIMALS AND CLIMATE CHANGE

Effects of Climate Change on Emergence and Spread of Farm Animal Diseases

As global temperature increase, the effects will be quite complex and vary from region to region. Though the extent of these effects is uncertain, it is known that those communities and regions with least resources, such as rural agricultural areas will be the most vulnerable to climate change [46].

Warmer and wetter (particularly warmer winters) will increase the risk and occurrence of animal disease, as certain species who serve as disease vectors, such as biting flies and ticks, are more likely to survive year round. Certain existing parasitic diseases may also become more prevalent, or their geographical range may spread, if rain fall increase. This may contribute to an increase in disease spread, including zoonotic diseases [51].

Transportation of animals for personal, entertainment, or agricultural purposes also increases possibility for the introduction and subsequent presence of diseases and pests, including ticks and parasites, previously considered exotic. The viral infection bluetongue disease, for example, was once only a threat in Africa, now affects cattle and ship in the whole of Europe [1].

Effects of Climate on Farm Animals

Animals are intrinsically dependent on the environment, and any fluctuation in weather and climate can affect them through water and large

changes such as desertification, and feed and water availability, access, and appropriateness. Climate change will not only impact the health and welfare of animals, but also the more than billion people who depend on them. Desertification and climate change are inextricably linked through feed backs between land degradation and precipitation. Less rain leads to soil compaction and hardening, making the land an able to absorb rain water. These could have disastrous effects as rain becomes less frequents but heavier [52].

The increased use of chemical- based agricultural inputs, including artificial fertilizers, pesticides, and herbicides, and their impacts on soil and water quality will likely exacerbate the effects of climate change by further degrading other ecosystems, such as Coral reefs and rivers, decreasing the land's ability to produce food. It is much easier set farmers in developed countries to endure a climatic set back than those in poorer nations such as malaria, where 80% of the popular lives in rutar areas [53] and approximately 40% of the economy is supported by rain- fed agriculture [54]. For example as grazing areas dry up in sub- sheep, and wild life dependent on access to grazing areas for food will suffer. This will lead to greater conflict between people and between people and animals [55].

Effects of Farm Animals Agriculture On climate Change

Livestock agriculture accounts for 35-40 % of methane and nearly 70% of nitrous oxide worldwide,

gases that rise mainly from the digestive processes of animals, and animal's waste. Levels will continue to rise as animals numbers grow to meet the increasing demands for meat and milk from developing countries. Agricultural emissions of nitrous oxide from manure and the production of artificial fertilizers are projected to increase by 35-60 % by 2030. Some developing regions will have very large increases, including parts of East Asia with an increase of 35% from enteric fermentation and 86% for manure management [56].

Deforestation for animal production accounts for 85.5% of all carbon oxide life stock related emission and 34% of carbon dioxide, methane and nitrous oxide emission. The increased production of beef in South America and Soybean production for feed transported to Europe is leading to deforestation of the rain forest, which has a great impact on the emission of GHG. Soybean production for feed also causes losses of biodiversity and chemical pollution [57].

CLIMATE CHANGE AND WILD LIFE HEALTH **Direct and Indirect Effects of Climate Change on Health of Wild Life**

The inter-governmental panel on climate change projects that unprecedented rates of climate changes will result in increasing average global temperatures, rising sea levels, changing global precipitation patterns including increasing amounts and variability, and increasing mid continental summer drought. Increasing temperatures, combined with changes in rain fall and humidity, may have significant impacts on wild life, domestic animal and human health and diseases. When combined with expanding human populations, these changes could increase demand on limited water resources, lead to more habitat destruction and provide yet more opportunities for infectious diseases to cross from one species to another [1].

Climate change, habitat destruction and urbanization, the introduction of exotic and invasive species and population- all affect the ecosystem and human health. Climate change can also be viewed within the context of other physical and climatic cycles, such as El Niño Southern oscillation (ENSO), the North Atlantic oscillation, and cycles in solar radiation that have profound effects on the earth's climate. The effects of climate change on wild life diseases are summarized in several areas of scientific study discussed briefly below: geographic range and distribution of wild life diseases, plant and animal phenology, and patterns of wild life diseases, community and ecosystem composition, and habitat degradation [58].

Geographic Range and Distribution of Wildlife Diseases

In Northern Hemisphere, global warming has likely played a role in geographic shifts of disease vectors and parasitic diseases that have life cycles. For example the black legged tick carries and transmits

Lyme disease and several other tick borne zoonotic diseases in North America, has been expanding north into Southern Ontario and Western Ontario and Manitoba, and more recently, into Quebec and Canada Maritime Province [59, 60].

In Europe, a similar northward expansion of the European Castor bean tick, which also carries and transmits Lyme diseases, tick borne encephalitis (TBE), and other diseases, has been reported in Norway [61] and Sweden [62]. On both continents migrating birds carrying feeding ticks are likely the source of long range expansion of the tick vectors [63, 64], and increasing environmental temperatures have likely permitted the tick to become established in larger geographic areas [65].

Scientists also expect change in disease distribution with changes in latitude. For example, climate warming may lead to year round transmission of mosquito borne avian malaria at higher elevations in the Hawaiian Islands, further threatening enlarged native Hawaiian birds that have little or no resistance to introduced diseases. Currently on the Island of Hawaii, avian malaria, caused by the parasite *Plasmodium relictum*, is limited to warmer elevations below 1500m. If the higher elevations become warmer as projected, mosquito activity and parasitic development in these areas will increase. Conservationists are concerned that climate change may lead to increased avian malaria transmission throughout the year at increasing higher elevations [66].

Phenology Effect on Wildlife Diseases

Timing of recurring seasonal biologic cycles of some plants and animal species has already been affected by climate change [58]. The study of these seasonal cycles is called phenology. The timing of biological cycles, such as the arrival of a bird species in spring and the availability of its preferred food source, is critical for successful breeding and survival. Several studies in Europe show that some migratory birds have changed their migration patterns in response to climate change by arriving earlier than records show historically [67, 68]. Significant population declines were reported recently for bird species that have not responded with earlier arrival, and the population declines have been interpreted as indicating the magnitude, and negative effect, of a mismatch between bird arrival time and the onset of plants emerging from dormancy in spring [69].

Variability in the timing of these biological cycles also can lead to increase or decrease in the risk for infectious disease, particularly disease transmitted by mosquitoes or ticks. In Europe, transmission of TBE to humans often increases when warmer temperatures in the early spring result in the overlap of feeding activity of virus infected nymphal and uninfected larval European castor bean ticks. Under this condition, TBE

is more readily passed ticks feeding on small rodents. The period of viral infection is brief in tick infested rodents, so when both stage of tick feed at the same time, more larval ticks become infected, and the risk for human infection increases. Cooler spring temperatures result in less likely to pass the virus to feeding larval ticks [70].

At the sites in North America, the same seasonal temperature effect has been observed in the transmission of the bacterium *Borella burgdorferi*, the pathogen or cause of lyme disease, from infected nymphal black legged ticks to uninfected larval ticks. When larval and nymphal ticks feed simultaneously, these not only contribute to the successful transmission of the pathogen to larvae, it also results in greater genetic diversity in this zoonotic pathogens. Climate change by altering seasonal weather patterns, has the potential to affect this natural cycles [71].

Changing Patterns of Wild Life Diseases

In nature pathogens can be transmitted directly between animals or indirectly through intermediate host such as effected prey or biting insects. Indirect transmission cycles are often affected by environmental conditions such as temperature and rain fall. Higher temperatures associated with climate change may contribute to an increase in pathogens with intermediate hosts and vectors or in erased survival of animals that labor disease. For example warmer summer temperature in the arctic how allow the lung nematode larvae often found in muskoxen to develop to the infectious stage with in the intermediate hosts, the marsh slug, at a rat that has reduced the parasites life cycle from two years to one years [72].

Survival of another nematode, the brain worm of white tailed deer, may also be increased recently warmer temperature and milder winters in the north central United State and northern Canada. The parasite which over winters as larvae in snails is accidentally eaten with plants causes neurological disease in moose. Moose are already heat stressed by climate change [73] and may be more susceptible to parasitic and infectious disease including the brain worm of zolite tailed deer [74].

Community and Ecosystem Change

Determining the effects of climate change on communities and ecosystem is difficult because the effects are likely to be highly variable and these may be especially true for marine ecosystem. Since the 1980s coral reefs in the western Atlantic have suffered massive declines due to disease [75]. It is likely that coral mortalities were initially due to wide spread mortality of sea urchins, which allowed a legal over growth of reefs, followed by environmental degradation and increase coral accessibility to disease. Since the early 1980s mass coral bleaching has been observed worldwide, specially following the major 1998

ELNWO events, and it has been linked to higher sea surface temperature [76] and to rising CO₂ levels that increase acidifications of the oceans which further weakens the coral structure [77]. Elevated temperature will likely increase which can lead coral die off [78].

CLIMATE CHANGE AND LIVESTOCKS IN ETHIOPIA

Climate change is expected to affect disease and pest distributions, range prevalence, incidence and seasonality but the degree of change remains highly uncertain. It is expected to affect both pathogen and vector habitat. Suitability through changes in temperature, precipitation humidity and wind patterns [79]. Heat stress and drought are likely to have further negative impacts on animal and human health and disease resistance [1].

Animal in the Afar regional state already suffer from the burden of endemic and new emerging varieties of animal disease which can be linked to the changing climate and the extreme weather conditions. Cold-blooded vectors are sensitive to direct effects of climate such as temperature, rain fall patterns and wind. Rising temperature influence the production and maturity rate of infective agents as well as the survival rate of the vector organisms, thereby further influencing disease transmission [1]. Climate also affects their distribution and abundance through its effects on host plants and animals [80].

Livestock, particularly cattle, are the first victims of drought. The lack of nutrition pasture and the resultant under nutrition of cattle expose livestock to virus drought and water-borne vector diseases. Opportunistic diseases are mostly internal or external parasites and infections. Diseases are common challenges during drought seasons. New and unidentified disease also causes more illness and livestock deaths. For example, camels which are considered most resistant to drought are affected and during from newly emerging and unidentified diseases. Tick and skin diseases on camels, cattle goats and sheep are increasingly becoming, problems during drought crisis. According to them the distribution impacts of the virus animal diseases very considerably with seasonal and longer term climate variations some diseases such as contagious caprine pleuropneumonia (CCPP), PPR and goat pox because of climate change are moving in to new areas and expanding fast more over during severe droughts the pastoralists will be focused to move their livestock to away places, potentially exposing them to different environments with healthy risks to which they have more been exposed occasionally flooding also exposes livestock to water borne infection diseases.

CONCLUSION AND RECOMMENDATION

Livestock production, animal diseases are closely related to climate change and are influenced

through different mechanisms. Livestock contributes to global warming but land use modifies their context (land and pasture availability, density, altitude and temperature, water resources) and the environmental load of or exposure to, animal pathogens. The distribution and incidence of animal diseases, specifically vector borne disease are directly influenced by climate because the geographical distributions of vectors are pre-determined by temperature and humidity. Based on the above conclusions the following recommendations were forwarded:-

- Include strategies on husbandry management system, outputs, and reducing the numbers of farm animals reared and killed for food production for cutting emissions on global, national, and regional scales.
- Implement policies to reduce development and expansion of all animal agriculture systems.
- Incorporate education in sustainable land use as a central part of poverty alleviation plans.
- Encourage low intensity or density farming system policies and strategies.
- Develop sustainable adaptation techniques and farming strategies in collaboration with farmers, agriculture extension agents, farm animal welfare experts and advocates, and political bodies.
- Integrate veterinarians and animal protection experts in disaster assessment teams
- Conduct joint disaster trainings and exercise with humanitarian and animal protection experts.
- Require animal shelters and veterinary clinics to be wind earth quake resistant and locate at an appropriate distance from storm surge areas where possible.

LIST OF ABBREVIATIONS

DNA	Deoxy Ribonucleic Acid
IPCC	Intergovernmental Panel on Climate Change
SARS	severe acute respiratory syndrome
WNV	west Nile virus
AHS	African horse sickness
ASF	African swine Fever
RVF	Rift valley fever
GHG	Green House Gas
CCPP	Contagious Caprine Pleuropneumonia
PPR	Peste des Petits Ruminants
OECD	Organisation for Economic Co-operation and Development
TBE	Tick Borne Encephalitis

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