**Scholars Journal of Agriculture and Veterinary Sciences (SJAVS)** **e-ISSN 2348–1854**
***Abbreviated Key Title: Sch. J. Agric. Vet. Sci.*** **p-ISSN 2348–8883**

A Unit of Scholars Academic and Scientific Society, India
www.saspublisher.com

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

**Abriham Kebede*, Yobsan Tamiru, Geremew Haile**
School of Veterinary Medicine, College of Medical and Health Science, Wollega University, P.O. Box, 395, Nekemte, Ethiopia

**Review Article**

***Corresponding author**
*Abriham Kebede*

**Article History**
*Received: 31.03.2018*
*Accepted: 12.04.2018*
*Published: 30.04.2018*

**DOI:**
10.21276/sjavs.2018.5.4.4

**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 indegous 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 Huemui 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$^o$ N and 35$^o$ S [7].

Vesiculo viruses which cause vascular stomatitis can be insect transmitted and has been isolated from species of midges (culicoides species) and phlevotomine flies, including sand flies (*Lutzomyta* species) and black flies (*simuliidae* species) [27]. Anti-bodies to vasculo 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 of 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 aerogene 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 mater- borne transmission. Food poisoning occurs usually when feces contaminate food items. The natural cycle of avian influenza virus in mallard ducks, it's 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 duck 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 anaerobe bacillus authrax bacterium survive for decades in the form spores in the soil [33].

Disease agents transmitted by arthrotods form a distinct, albeit related category. In direct transmission of protozoan disease agents may be facilitated by most tick .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 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 an a making 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 blow by wind across wider geographic areas. These is probably what happened with bluetongue virus introduction in the United kingdom, in the summer of 2006, after the virus had first spread west wards across Belgium [37]. It is possible that also flare up of the *schmallelgberg virus* in the United kingdom in early 2012 resulted from wind carried infected midges arriving from main land Europe [38].

In the direct- indirect transmission spectrum, directly, swiftly transmitted common flue, 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. Artropod pests are strongly modulated by climatic and weather conditions. For example, both the *old world screwworm fly, chrysomya bezziana* and the *new* world screwworm, cochliomyiabominiborax, feature a prominent free living parasite stage .The adult female fly deposits eggs in open wounds and also minor skin lesion or mucus membranes, providing access for the evolving larval stages to life tissue of warm blooded hosts. The later is obligatory for this life cycle stages. 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 nector 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, deposit certain similarities between tsetse and the screwworm fly life history. The tsetse fly also features a pupal stage in soil. However, where as a screwwarm fly egg batch may yield 200 larvae, the female tsetse fly produce 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 screw worm 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 immergence 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 sever 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 methone (from enteric fermentation, decomposition of manure flooded rices 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 in direct 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].

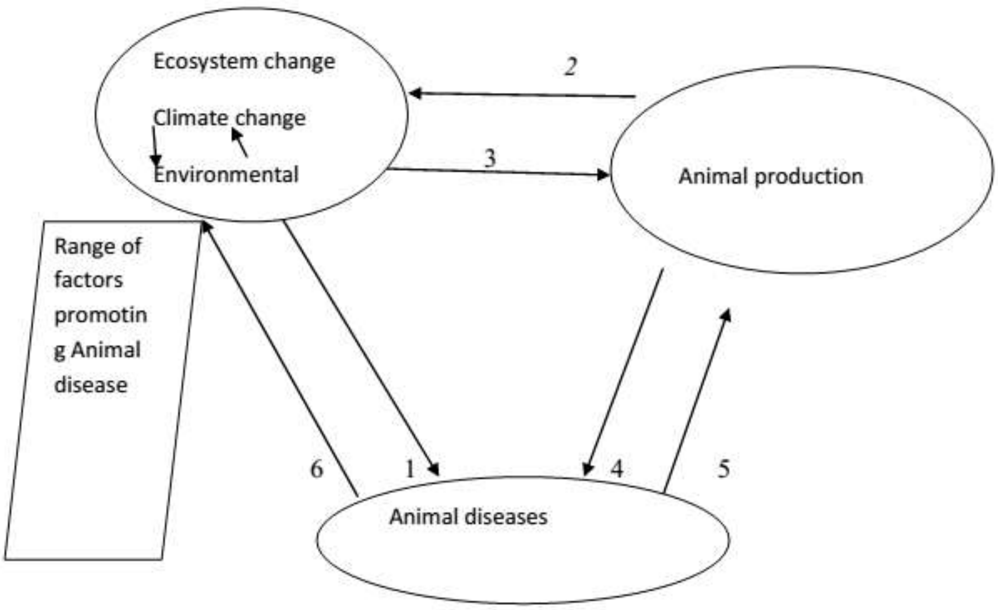


**Fig-1: main relationship between animal diseases, climatic change, environmental change and animal production[50].**

## 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 for 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 loses of bio diversity and chemical population [57].

**CLIMAT 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 rats 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 exotic and invasive species and population- all affect eco system and human health. Climate change can also be viewed within the context of other physical and climatic cycles, such as El Nino Southern oscillation (ELNino), 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 disease are summarized in several areas of scientific study discussed briefly below geographic range and distribution wild life diseases, plant and animal phenology, and patterns of wild life diseases, community and eco system 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 zootomic diseases in North America, has been expanding North in to Southern Ontario and Western Ontario and Manitoba, and more recently, into Quebec and Canada Maritime Province [59, 60].

In Europe, a similar north ward 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 Island, 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].

**Penology 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, in miss match 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 f 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 burgdorferl*, the pathogen or cause of lyme disease, from infected nymphal black legged ticks to un infected larval ticks. When larval and nymphal ticks feed simultaneously, these not only contributes 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 eydes 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 reets 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 masscoral bleaching has been observed worldwide, specially following the major 1998 ELNLWO events, and it has been linked to higher sea surface temperature [76] and to rising $co_2$ 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 rector 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 news 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 carpine pleurapnemonia (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.

## CONCLUSSION AND RECOMMANDETION

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 lode 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, out puts, 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 polices 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 Panelon 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 Carpine Pleurapnemonia
PPR Peste des Petits Ruminants
OECD Organisation for Economic Co-operation and Development
TBE Tick Borne Encephalitis

## ACKNOWLEDGEMENTS

First of all, we would like to praise the Almighty God who helped us in every aspect and condition for our success to review this seminar paper.

We would like to acknowledge School of Veterinary Medicine, Wollega University for its services and all of my partners for their contributions in all aspects for the success of the paper.

## REFERENCES

1. Solomon S, Qin D, Manning M, Chen Z, Marquis M, Averyt KB, Tignor M, Miller HL. Contribution of working group I to the fourth assessment report of the intergovernmental panel on climate change, 2007.
2. Hansen J, Nazarenko L, Ruedy R, Sato M, Willis J, Del Genio A, Koch D, Lacis A, Lo K, Menon S, Novakov T. Earth's energy imbalance: Confirmation and implications. science. 2005 Jun 3;308(5727):1431-5.
3. Daszak P, Cunningham AA, Hyatt AD. Emerging infectious diseases of wildlife--threats to biodiversity and human health. science. 2000 Jan 21;287(5452):443-9.
4. Li W, Shi Z, Yu M, Ren W, Smith C, Epstein JH, Wang H, Crameri G, Hu Z, Zhang H, Zhang J. Bats are natural reservoirs of SARS-like coronaviruses. Science. 2005 Oct 28;310(5748):676-9.
5. Daszak P, Cunningham AA, Hyatt AD. Anthropogenic environmental change and the emergence of infectious diseases in wildlife. Acta tropica. 2001 Feb 23;78(2):103-16.
6. Purse BV, Mellor PS, Rogers DJ, Samuel AR, Mertens PP, Baylis M. Climate change and the recent emergence of bluetongue in Europe. Nature Reviews Microbiology. 2005 Feb;3(2):171.
7. Gibbs EP, Greiner EC. The epidemiology of bluetongue. *Comp. Immuno. Microbiol. Infect. Dis*, 1994; 17:207-220.
8. Rappole JH, Derrickson SR, Hubálek Z. Migratory birds and spread of West Nile virus in the Western Hemisphere. Emerging infectious diseases. 2000 Jul;6(4):319.
9. Parker TH, Ligon DJ. Dominant male red junglefowl (Gallus gallus) test the dominance status of other males. Behavioral Ecology and Sociobiology. 2002 Dec 1;53(1):20-4.
10. Manski CF. Analog Estimation Methods in Econometrics: Chapman & Hall/CRC Monographs on Statistics & Applied Probability. Chapman and Hall; 1988.
11. Hay C. Political analysis: a critical introduction. Palgrave Macmillan; 2002 Apr 30.
12. Randolph J. Environmental land use planning and management. Island Press; 2004.
13. Harvell CD, Mitchell CE, Ward JR, Altizer S, Dobson AP, Ostfeld RS, Samuel MD. Climate warming and disease risks for terrestrial and marine biota. Science. 2002 Jun 21;296(5576):2158-62.
14. Daszak P, Cunningham AA, Hyatt AD. Emerging infectious diseases of wildlife--threats to

biodiversity and human health. science. 2000 Jan 21;287(5452):443-9.
15. Pallister JL. La Corriveau et Anne Hébert: état d'études. Les Cahiers Anne Hébert 4: Anne Hébert et la critique. 2003:103-9.
16. Baylis M, Githeko AK. The effects of climate change on infectious diseases of animals. Report for the Foresight Project on Detection of Infectious Diseases, Department of Trade and Industry, UK Government. 2006;35.
17. Daszak P, Cunningham AA, Hyatt AD. Infectious disease and amphibian population declines. Diversity and Distributions. 2003 Mar 1;9(2):141-50.
18. Bonačić-Koutecky V, Veyret V, Mitrić R. Ab initio study of the absorption spectra of Ag n (n= 5–8) clusters. The Journal of Chemical Physics. 2001 Dec 8;115(22):10450-60.
19. Pinto J, Bonacic C, Hamilton-West C, Romero J, Lubroth J. Climate change and animal diseases in South America. Rev. Sci. Tech. 2008 Aug 1;27(2):599-613.
20. Montt JM, Bonacic C, Celedon MO, Bustos P, Saucedo C, Montero E. Serologic levels of antibodies against bovine viral diarrhea, infectious bovine rhinotracheitis and parainfluenza 3 viruses in southern Huemul deer (Hippocamelus bisulcus) in the Tamango National Reserve, Cochrane, XI Region, Chile. InProc. of the 10th Symposium of the International Society for Veterinary Epidemiology and Economics, Viña del Mar, Chile. International Society for Veterinary Epidemiology and Economics (ISVEE) 2003 (Vol. 10, p. 674).
21. Madeira NG, Amarante AF, Padovani CR. Effect of management practices on screw-worm among sheep in São Paulo State, Brazil. Tropical animal health and production. 1998 Jun 1;30(3):149-57.
22. Cardenas R, Sandoval CM, Rodriguez-Morales AJ, Franco-Paredes C. Impact of climate variability in the occurrence of leishmaniasis in northeastern Colombia. The American journal of tropical medicine and hygiene. 2006 Aug 1;75(2):273-7.
23. Reed KD, Meece JK, Henkel JS, Shukla SK. Birds, migration and emerging zoonoses: West Nile virus, Lyme disease, influenza A and enteropathogens. Clinical medicine & research. 2003 Jan 1;1(1):5-12.
24. Kaleta EF, Baldauf C. Newcastle disease in free-living and pet birds. InNewcastle disease 1988 (pp. 197-246). Springer, Boston, MA.
25. Bosch I, Herrera F, Navarro JC, Lentino M, Dupuis A, Maffei J, Jones M, Fernández E, Perez N, Pérez-Emán J, Guimarães AÉ. West nile virus, Venezuela. Emerging Infectious Diseases. 2007 Apr;13(4):651.
26. Pinochet L, Flores C. Lengua azul: Estudio serologico en rumiantes (Chile) in Resumenes del VI Congreso Nacional de Medicina Veterinaria. *Avances Cienc vet*, 1986; SA- 048.
27. McCluskey K. The Fungal Genetics Stock Center. from molds to molecules. 2003 Dec 2;52:245-62.
28. Rodriguez J. Physical and chemical properties of bimetallic surfaces. Surface Science Reports. 1996 Jan 1;24(7-8):223-87.
29. World Organisation for Anima Helth (OIE).World Animal Health Information Database (WAHID) 2007.
30. Lowen AC, Mubareka S, Steel J, Palese P. Influenza virus transmission is dependent on relative humidity and temperature. PLoS pathogens. 2007 Oct 19;3(10):e151.
31. Jourdain E, Gunnarsson G, Wahlgren J, Latorre-Margalef N, Bröjer C, Sahlin S, Svensson L, Waldenström J, Lundkvist Å, Olsen B. Influenza virus in a natural host, the mallard: experimental infection data. PloS one. 2010 Jan 28;5(1):e8935.
32. Zhang G, Shoham D, Gilichinsky D, Davydov S, Castello JD, Rogers SO. Evidence of influenza A virus RNA in Siberian lake ice. Journal of Virology. 2006 Dec 15;80(24):12229-35.
33. Dragon DC, Rennie RP. The ecology of anthrax spores: tough but not invincible. The Canadian Veterinary Journal. 1995 May;36(5):295.
34. Kleiboeker SB, Scoles GA. Pathogenesis of African swine fever virus in Ornithodoros ticks. Animal Health Research Reviews. 2001 Dec;2(2):121-8.
35. Mondet B, Diaïté A, Ndione J, Fall AG, Chevalier V, Lancelot R, Ndiaye M, Ponçon N. Rainfall patterns and population dynamics of Aedes (Aedimorphus) vexans arabiensis, Patton 1905 (Diptera: Culicidae), a potential vector of Rift Valley Fever virus in Senegal. Journal of Vector Ecology. 2005 Jun 1;30(1):102.
36. Pinault L. Consulting demons: Inside the unscrupulous world of global corporate consulting. Harper Collins; 2009 Oct 13.
37. Gloster J, Burgin L, Witham C, Athanassiadou M, Mellor YS. Bluetongue in the United Kingdom and northern Europe in 2007 and key issues for 2008. Veterinary Record. 2008 Mar 8;162(10):298-302.
38. Chappell NL, Schroeder B, Gibbens M, Keating N. Respite for rural and remote caregivers. Rural ageing: a good place to grow old?. 2008:53-62.
39. Spradbery JP. A manual for the diagnosis of screw-worm fly. Commonwealth Department of Primary Industries and Energy (AGPS Press); 1991.
40. Ford J. The role of the trypanosomiases in African ecology. A study of the tsetse fly problem. The role of the trypanosomiases in African ecology. A study of the tsetse fly problem.. 1971.
41. Slingenbergh J. Tsetse control and agricultural development in Ethiopia. World Animal Review. 1992;70(71):30-6.
42. Siddig A, Al Jowary S, Al Izzi M, Hopkins J, Hall MJ, Slingenbergh J. Seasonality of Old World screwworm myiasis in the Mesopotamia valley in Iraq. Medical and Veterinary Entomology. 2005 Jun 1;19(2):140-50.

43. Tamura H, Takasaki A, Miwa I, Taniguchi K, Maekawa R, Asada H, Taketani T, Matsuoka A, Yamagata Y, Shimamura K, Morioka H. Oxidative stress impairs oocyte quality and melatonin protects oocytes from free radical damage and improves fertilization rate. Journal of pineal research. 2008 Apr 1;44(3):280-7.
44. De La Rocque S, Hendrickx G, Morand S. Climate change: impact on the epidemiolgoy and control of animal diseases; 2008.
45. Slingenbergh J, Gilbert M. Do old and new forms of poultry go together. InProceedings of the International Conference on Poultry in the 21st Century 2008.
46. Steinfeld H, Gerber P, Wassenaar TD, Castel V, De Haan C. Livestock's long shadow: environmental issues and options. Food & Agriculture Org.; 2006.
47. Stephenson J. Livestock and Climate Policy: Less Meat or Less Carbon? Round Table on Sustainable Development; 2010.
48. IntergovernmentalPanelonClimateChange IPCC. Third Assessment Repor IPCC, Geneva; 2001.
49. Mack A, Choffnes ER, Hamburg MA, Relman DA, editors. Global climate change and extreme weather events: Understanding the contributions to infectious disease emergence: Workshop summary. National Academies Press; 2008 Oct 23.
50. Nunn M, Black P. Intensive animal production systems–How intensive is intensive enough. InEleventh Symposium of the International Society for Veterinary Epidemiology and Economics, Cairns, Australia 2006.
51. Epstein PR, Mills E. Climate change futures: health, ecological and economic dimensions. The Center for Health and the Global Environment, Harvard Medical School; 2005.
52. Clarke J. Climate change pushes diseases north: expert. Reuters; 2007 March 9.
53. Rosset P. The multiple functions and benefits of small farm agriculture. Policy brief. 1999 Sep;4.
54. Finer LB, Henshaw SK. Disparities in rates of unintended pregnancy in the United States, 1994 and 2001. Perspectives on sexual and reproductive health. 2006 Jun 1;38(2):90-6.
55. Das NR. Human Development Report 2007/2008 Fighting Climate Change: Human Solidarity in a Divided World, UNDP, New York. Social Change. 2009 Mar;39(1):154-9.
56. Norse D. Fertilizers and world food demand implications for environmental stresses; 2003.
57. Smeraldi R. The cattle realm: a new phase in the livestock colonization of Brazilian Amazonia; 2008.
58. Walther GR, Post E, Convey P, Menzel A, Parmesan C, Beebee TJ, Fromentin JM, Hoegh-Guldberg O, Bairlein F. Ecological responses to recent climate change. Nature. 2002 Mar;416(6879):389.
59. Ogden NH, Lindsay LR, Morshed M, Sockett PN, Artsob H. The emergence of Lyme disease in Canada. Canadian Medical Association Journal. 2009 Jun 9;180(12):1221-4.
60. Ogden NH, Bouchard C, Kurtenbach K, Margos G, Lindsay LR, Trudel L, Nguon S, Milord F. Active and passive surveillance and phylogenetic analysis of Borrelia burgdorferi elucidate the process of Lyme disease risk emergence in Canada. Environmental Health Perspectives. 2010 Jul;118(7):909.
61. Hasle G, Bjune G, Edvardsen E, Jakobsen C, Linnehol B, Røer JE, Mehl R, Røed KH, Pedersen J, Leinaas HP. Transport of ticks by migratory passerine birds to Norway. Journal of Parasitology. 2009 Dec;95(6):1342-51.
62. TäLleklint L, Jaenson TG. Increasing geographical distribution and density of Ixodes ricinus (Acari: Ixodidae) in central and northern Sweden. Journal of medical entomology. 1998 Jul 1;35(4):521-6.
63. Ogden NH, Lindsay LR, Hanincová K, Barker IK, Bigras-Poulin M, Charron DF, Heagy A, Francis CM, O'Callaghan CJ, Schwartz I, Thompson RA. Role of migratory birds in introduction and range expansion of Ixodes scapularis ticks and of Borrelia burgdorferi and Anaplasma phagocytophilum in Canada. Applied and Environmental Microbiology. 2008 Mar 15;74(6):1780-90.
64. Zhou J, Brinckerhoff C, Lubert S, Yang K, Saini J, Hooke J, Mural R, Shriver C, Somiari S. Analysis of matrix metalloproteinase-1 gene polymorphisms and expression in benign and malignant breast tumors. Cancer investigation. 2011 Oct 24;29(9):599-607.
65. Lindgren E, Tälleklint L, Polfeldt T. Impact of climatic change on the northern latitude limit and population density of the disease-transmitting European tick Ixodes ricinus. Environmental health perspectives. 2000 Feb;108(2):119.
66. van Riper C, van Riper SG, Goff ML, Laird M. The epizootiology and ecological significance of malaria in Hawaiian land birds. Ecological monographs. 1986 Feb 1;56(4):327-44.
67. Lehikoinen ES, Sparks TH, Zalakevicius M. Arrival and departure dates. Advances in ecological research. 2004 Jan 1;35:1-31.
68. Thorup K, Tøttrup AP, Rahbek C. Patterns of phenological changes in migratory birds. Oecologia. 2007 Apr 1;151(4):697-703.
69. Saino N, Ambrosini R, Rubolini D, von Hardenberg J, Provenzale A, Hüppop K, Hüppop O, Lehikoinen A, Lehikoinen E, Rainio K, Romano M. Climate warming, ecological mismatch at arrival and population decline in migratory birds. Proceedings of the Royal Society of London B: Biological Sciences. 2011 Mar 22;278(1707):835-42.
70. Randolph SE. Tick-borne disease systems emerge from the shadows: the beauty lies in molecular detail, the message in epidemiology. Parasitology. 2009 Oct;136(12):1403-13.

71. Gatewood AG, Liebman KA, Vourc'h G, Bunikis J, Hamer SA, Cortinas R, Melton F, Cislo P, Kitron U, Tsao J, Barbour AG. Climate and tick seasonality are predictors of Borrelia burgdorferi genotype distribution. Applied and environmental microbiology. 2009 Apr 15;75(8):2476-83.
72. Kutz SJ, Hoberg EP, Polley L, Jenkins EJ. Global warming is changing the dynamics of Arctic host–parasite systems. Proceedings of the Royal Society of London B: Biological Sciences. 2005 Dec 22;272(1581):2571-6.
73. Lenarz MS, Nelson ME, Schrage MW, Edwards AJ. Temperature mediated moose survival in northeastern Minnesota. Journal of Wildlife Management. 2009 May;73(4):503-10.
74. Murray DL, Cox EW, Ballard WB, Whitlaw HA, Lenarz MS, Custer TW, Barnett T, Fuller TK. Pathogens, nutritional deficiency, and climate influences on a declining moose population. Wildlife Monographs. 2006 Dec:1-30.
75. Porter JW, Dustan P, Jaap WC, Patterson KL, Kosmynin V, Meier OW, Patterson ME, Parsons M. Patterns of spread of coral disease in the Florida Keys. InThe Ecology and Etiology of Newly Emerging Marine Diseases 2001 (pp. 1-24). Springer, Dordrecht.
76. Hoegh-Guldberg O. Climate change, coral bleaching and the future of the world's coral reefs. Marine and freshwater research. 1999;50(8):839-66.
77. Kleypas JA, Yates KK. Coral reefs and ocean acidification. Oceanography. 2009 Dec 1;22(4):108-17.
78. Baker AC, Glynn PW, Riegl B. Climate change and coral reef bleaching: An ecological assessment of long-term impacts, recovery trends and future outlook. Estuarine, coastal and shelf science. 2008 Dec 10;80(4):435-71.
79. García JE. Historia de la Psicología Clínica en el Paraguay. Fundamentos en Humanidades. 2011;12(23).
80. World Health Organization. The world health report 2003: shaping the future. World Health Organization; 2003.