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Emerging Infectious Diseases in Perspective to Climatic Conditions

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INTRODUCTION

As per the statement of The World Health Organization (WHO), mankind facing greatest threats in twenty-first century are "climate change and global warming." Posing serious threats to human life and other creatures on the planet earth (WHO 2017). Despite the fact that global warming is one of the many features involved with climate change, the terms "climate change" and "global warming" are frequently used interchangeably. When someone uses the term "global warming," that typically describes the observed increase in normal global temperature over past few years, both in terms of incidence and intensity (Myhre et al. 2019). It is mainly due to the green house effects due to the increased fossil fuel consumption alongwith deforestation mean cutting of trees and forests for the human uses. This rise in temperature is higher near the poles and less close to the equator. According to computer simulation models, it might range between 1.6 to 6°C increase per year and is expected to accelerate in the coming years (Ghazali et al. 2018).

Infectious disease epidemiology changes are connected to global warming and mainly linked with changing habitats, population susceptibility, and greater exposure to etiological agent. These different factors contribute to the higher prevalence of diseases, including both emerging and re-merging infections mostly and more quickly the transboundary diseases (TBDs) and emerging infectious diseases (EIDs) (Khansins et al. 2005; Baker et al. 2022). The geographic distribution of vectors and intermediate hosts, such as rodents, migratory birds, and invertebrate hosts (insects), has also been affected due to global warming (El-Sayed and Kamel 2020). Recently, the WHO has estimated that zoonotic bacterium pathogen i.e., *Chlamydia*, which can be spread by the close connection with parrots, affects more than 90 million people in a single year (WHO 2017). The sickness is connected to bird migration and mobility, which has strong association with the ecological and climatic changes (Nava et al. 2017). Contrarily, "climate change" denotes to long-term, computable variations in the climate that have been observed. Extreme weather events, such as droughts, heat waves, wildfires, tropical cyclones, gradual melting of glaciers, loss of river deltas and towns near the coastal areas, extreme rainfall and flooding, and dust storms are all indicative of the climatic change, in addition to other important changes including the unnecessary cutting of trees and use of massive bushmeat are also responsible for the emerging of infectious diseases (Weilnhammer et al. 2019).

The harm to the human health due to the climate change and global warming is underrated yet. According to estimates, changes in environmental factors are responsible for 36% of all infant and young child mortality around the globe and 34% of total childhood illnesses. Climate change and different environmental factors have a significant impact on outbreaks of majority of newly emerging diseases such as dengue fever, cholera, deadly malaria, diarrhea, and many other diseases (Mutlu and Nacaroglu 2019). Climate change can also affect human socio-demographics and cause a mass emigration of people and domestic animals from dry, hot regions to the places with better living conditions (El-Sayed and Kamel 2020). Along with this, there are global alterations to the traditional geographic circulation of wildlife, insects, and rodents (Buhler et al. 2022). Climate change, ecosystem disruption, exposure to vector insects, and the spread of infectious diseases have a known epidemiological linkage (Goshua et al. 2021). Better understanding of these connections makes it possible to forecast, how upcoming climate changes would affect the ecology of infectious agents, the transmission of infections, vectors (intermediate hosts), reservoir animals, and final hosts etc. (Sellers et al. 2019).

The melting of an ice layer that has been present for thousands of years is one of the most serious underrated effects of global warming in addition to causing several cities and river deltas to vanish from earth. The melting of the ice sheet will unfortunately also reveal other hidden biological components that have been buried under snow in addition to the mammoth carcasses that have been buried for thousands of years. As the year 2012, had witnessed the discovery of an ancient pathogen Virola virus in preserved mummy in Siberia which was 300 years old (Biagini et al. 2015). NASA investigators were also able to resuscitate bacteria that had been frozen in Alaska, thousands of years ago. Other researchers were able to separate the microorganisms from

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some ancient part of the world like Antarctica and still the story is continued (El-Sayed and Kamel 2020). Additionally, it was possible to identify live bacteria from a 25,000-year-old ice sample and Dominican amber (Josefsen et al. 2018). Over 75 years ago, the spores were buried beneath frozen soil, but now they are emerging as the ice melts. Among bacterial pathogens a classical example includes *Bacillus anthracis*, which is a spore-forming bacterium and lead to deadly diseases in warm blooded animals including humans known as "Anthrax". The spores have a high level of environmental resistance and can remain active in a dormant state for 100 years. Floods and insects are two ways that may cause the spread of spores (e.g., tabanid flies). Using the same logic, it is also possible that smallpox virus may be kept in human leftovers buried in frozen soil (Ogden and Lindsay 2016).

On the health and wellbeing of people and animals, the climatic change has both direct and indirect effects. The increased frequency and length of heat waves have physical and psychological repercussions that might cause stress, pulmonary and circulatory impairment, heat strokes, and squamous-cell carcinomas over the long run. The drastic effects of different calamities like floods have also been observed on the wildlife population. The quantity, survival, and dispersion of diseases and their vectors are all directly impacted by global warming. Famines and the detrimental consequences of large-scale human/animal population migration waves are among the indirect repercussions (Joshi et al. 2020). According to an optimistic scenario, the ensuing ecological shift is expected to result in at least 250,000 more deaths per year between 2030 to 2050. Of these, 48,000 are anticipated to pass away through diarrhea, 60,000 from malaria, and the remaining 28,000 from starvation and heat exhaustion. Unfortunately, despite being the less responsible for CO_2 emissions and the greenhouse effect, poor developing nations are the most susceptible to these climatic effcets (El-Sayed and Kamel 2020).

Keeping in view the zoonosis of animal origin, more than 60% of infectious diseases appeared during 1940 to 2004 affecting humans are of serious concern in terms of public health. It has been documented that six (06) out of every ten (10) human infections are of animal origin and among these many of the diseases are emerging or remerging in the near past and their prevalence is increasing with every passing day. The world economy and public health are both greatly impacted by these outbreaks. Overall, 71.8% among these zoonotic diseases were caused by wildlife, and 22.8% were arthropod-borne illnesses (Zhang et al. 2019). It was surprising that Nepal developed endemic cases of numerous serious diseases which need some vectors for the transmission of diseases like Malaria, filariasis and Japanese encephalitis (Medone et al. 2015).

Emerging Infectious Diseases (EIDs)

Infectious diseases those become more prevalent or dangerous over the time are referred to as emerging infectious diseases (EIDs). The specific features of the EIDs includes (1) newly discovered, previously undiagnosed diseases and (2) long-standing diseases that have evolved or mutated from recognized agents to acquire novel traits (i.e., adaptation to new hosts or target population, new geo-graphic distribution, new clinical picture, new epidemiological profile, new spread pattern, or resistance to used therapeutics). The examples of EIDs in modern days are CCHF, Tuberculosis, brucellosis, and more resistant *E. coli* infection. In addition to this some drug resistant strains of the *E. coli* are also considered to be emerged (Mor et al. 2018).

Ebola virus (Africa), Middle East respiratory syndrome coronavirus (Middle East), Zika virus, chikungunya virus, yellow fever virus, and dengue virus (North and South America) were the main infectious agents that emerged and re-emerged in the past ten years (Antonenko et al. 2013). At least 50 new and reoccurred diseases were listed by the CDC. The diseases are broadly classified into human, animals and both human-animal's communicable diseases termed as zoonotic diseases, the human disease which are emerged and remerged in the present and near past, tuberculosis, hemimorphic colitis, COVID-19, SARS, Malaria, and dengue fever. In case of animals the list of different disease includes *Pasteurella multocida*, Lumpy skin disease (LSD), trypanosomiasis, fascioliasis and zoonotic disease including MRSA, brucellosis, anthrax, avian influenza, rabies, babesiosis, giardiasis and leishmaniasis (Zhang et al. 2017). Social impact of climate change on livelihood, human society and infectious diseases is sown in Fig. 1.

However, it was shown that not all vectors are affected equally by climate fluctuations. For example, the geographic spread of mosquitoes is influenced by factors such as relative humidity, wind speed and direction, and rain that falls in the opposite direction from ticks. This is due to the mosquito life cycle, which depends on stagnant water for egg laying and larval stage development. In Asia and Africa, reports on the rise in malaria prevalence due to climatic changes have already been released (Andreassen et al. 2012). The aquatic ecology also exhibits the infiltration of novel parasites and their appearance in uninhabited places. At least 182 non-native parasite species have been found invading Canada's Laurentian Great Lakes area, meaning a new invader species appears once in every 4 months (Bojko et al. 2021). Coral reefs began to die as a result of severe diseases brought on by the rise in seawater temperature. For several fish species, coral reefs were the source of both a haven and food. The amount of diffused oxygen in the water likewise decreases as water temperature rises. All these elements cause a lot of disruption in the aquatic ecology which in returns possess a great threat not only to the human health but also to the economies along with many trade restrictions (Belter et al. 2020; Brugueras et al. 2020).

Neglected Tropical Diseases (NTDs)

In contrast to EIDs, another nomenclature of the diseases "Neglected Tropical Diseases" is also in use. Most of the diseases on the published database are known as neglected tropical diseases (NTDs). A category of bacterial, viral,

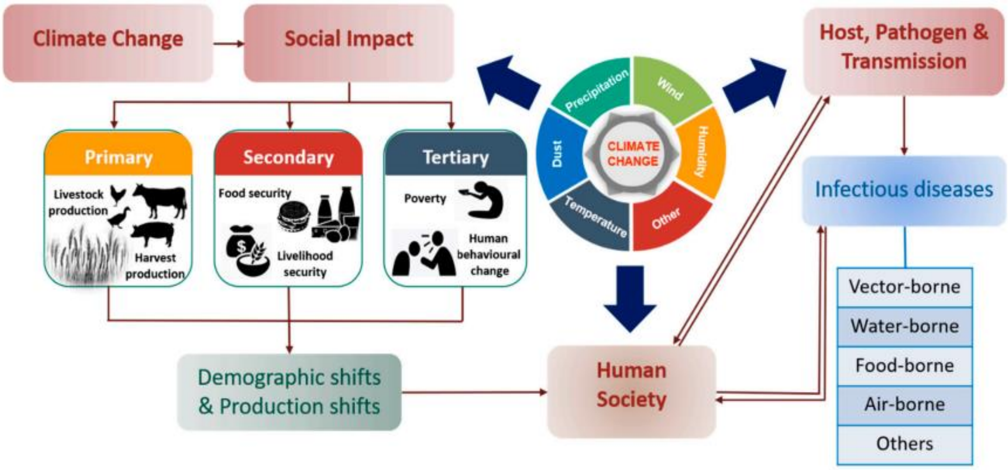

Fig. 1: Social impact of climate change affecting livelihood, human society and infectious diseases (Khan et al. 2019)

parasitic, and fungal infections known as NTDs are typically endemic to developing nations. Until such diseases started to spread and pose a significant threat to the civilized economies, the pharmaceutics industries did not spend enough money to find a cure for them because they were restricted to the developing nations, only (Huürlimann et al. 2011).

More precisely, the neglected tropical diseases are such diseases which historically possess no attention or given very less attention as compared to the other diseases. The influx of asylum-seeking refugees and illegal immigrants from nations suffering from war and famine in recent years has raised the prevalence of numerous NTDs or speed up their emergence in western nations (Liu et al. 2019). The human scabies infection caused by *Sarcoptes scabiei* mites is among the greatest instances. Despite having a global spread, the parasitic disease had a very low frequency in Europe. In the past ten years, outbreaks of scabies have been seen in Europe, including UK nursing home for elderly population (Ariza et al. 2013; Cassell et al. 2018).

NTDs are extremely susceptible to climate factors, which regulate their pattern of expansion. For instance, floods, heavy rain, rising temperatures, and increased humidity all contribute to survival of parasites at different infected stages (larva/metacercaria), which ultimately raises the occurrence of disease.There are five trematode species in the genus *Schistosoma* that need snails as intermediate hosts, including those that cause schistosomiasis, swimmer's itch and bilharzia. The parasite enters the body of host through skin (Wu et al. 2014; CDC 2017). Such disease with higher prevalence has also been reported from the different regions of the world including Europe (Morgan et al. 2021). One of the common worm parasites from the sheep and goats is *Fasciola hepatica* which is ignored but causes the illness in ovine and bovines because these are mainly grazing species and spend hours in grazing fields. It has also been categorized as zoonotic disease. The climate change and global warming may favor the growth of such domestic pathogenic parasites (Agache et al. 2022).

Along with the parasitic diseases already mentioned, this list of NTDs also includes many viral diseases including the following: (1) Rabies, a lethal and unnoted NTDs, is one of the most difficult diseases to control due to the freedom of the movement of wild animals (El-Sayed and Kamel 2020) (2) Dengue Fever, another most important and crucial disease, which causes 96 million new infections each year worldwide and is transmitted by mosquitoes. Only 500,000 of them get severe symptoms, resulting in 1250 causalities across the globe (Dhar-Chowdhury et al. 2017). (3) Marburg fever and highly associated Ebola hemorrhagic fever, both zoonotic viral infections are deadly and have connections with the environmental variations, particularly the seasonal patterns of rainfall and aridity. Consequently, it is expected that climate changes have impacts on the illness and global distribution of the viral diseases (Dhimal et al. 2015). In addition to parasitic and viral diseases, the leprosy may be among the most dangerous newly emerging bacterial NTDs. The pathogen responsible is *Mycobacterium lepra*. Even though leprosy has already been eradicated from Europe for centuries, some European countries have recently seen a partial resurgence of NTDs. In Spain, 168 leprosy cases were reported between 2003-2013. 40 of them were Spanish patients, with the remaining being undocumented immigrants (Sabourin et al. 2018).

Factors Contributing towards Outbreaks in Perspective to Climate Change

There are many factors responsible for the outbreaks of zoonotic infectious diseases. Source of disease transmission is one of the major contributing factors, so it has been discussed in detail here.

Food and Water Borne Diseases

Food- and water-borne illnesses pose a severe threat to global public health. Food and waterborne outbreaks are directly linked to climatic changes and ecosystem disruptions. These are more prevalent in the summer and become more prevalent as the temperature and humidity rises (Kumar et al. 2022). The frequency and intensity of floods and high rains has been increased due to ocean warming and hurricanes. Due to this the water-borne illnesses such as cryptosporidiosis, giardiasis, outbreaks with pathogenic *E coli*, *Shigella*, cholera, *Salmonella*, and viral hepatitis has also been increased (Pal et al. 2018). This is might be due the reason that floods and a rise in water level has affected the sewage drainage systems due to overloading and overflowing which ultimately becomes a source of contamination of drinking water and spreading of such infections among the human and animal population consuming that contaminated water (Portier et al. 2017).

Hence, the prevalence of the enteric/diarrheal illness has been increased manifolds around the globe and will continue to increase in coming years. In addition to these, global warming can also generate fatal epidemics, such as those brought on by the fatal thermophilic free-living amoeba *Naegleria fowleri*, which causes meningoencephalitis (Daisy 2019). The literature suggested that most water-borne outbreaks in the USA began during periods of heavy rainfall (Pal et al. 2018). Cholera, an illness brought on by *Vibrio cholerae*, is the most well-known water-borne illness. The disease is spread by consuming contaminated water. Cholera is a temperature-dependent illness that gets worse as the temperature of the water rises. *Vibrio spp.* infections are a classical illustration of how ecology and global warming affect the emergence of diseases. The number of plankton in the sea is impacted by the rise in water temperature. Vibrio population growth is caused by the symbiotic connection between plankton and vibrio. Swimmers with broken skin and shellfish eaters are more susceptible to contracting the virus. Both zooplankton and *Vibrio cholera* will also grow tremendously as water temperatures rises (Anas et al. 2021) As a result of global warming, the prevalence of Vibrio-associated infections has obviously increased over the past several decades and had been reached to many nations in Northern Europe (WHO 2021). During the hot summers, such illnesses spread through swimming pools and coastal communities (Leng et al. 2019). Leptospirosis and other water-borne illnesses like gastroenteritis are frequently linked to severe rain and flooding (Alcayna et al. 2022).

Selective fungal adaptation to higher ambient temperatures that mimic those of mammals will occur because of the temperature increase. Due to mammals' body temperatures, pathogenic fungi that are currently not pathogenic to them will therefore be able to infect them in the future (Shokri et al. 2020). Non-infectious diseases can spread due to climatic conditions as well, such as the diseases related to bovines and poultry. For such kind of pathogens, the climate change and global warming are very favorable. The reason might be that due to climate changes including heavy rainfall and high humidity increases the growth of such pathogenic fungi and increase the mycotoxins associated problems in the animals and humans. In addition, there is an increase in food poisonings during the hot summer because of a number of correlated causes, including increased bacterial survivability, an increase in dining out frequency and a higher number of insects and rodents during the hot season (Paterson et al. 2018; El-Sayed and Kamel 2020).

Climatic Changes Effects on Diseases Prevalence

As already described above that Climatic conditions have drastic effects on disease prevalence. Following are described in detail:

1. Insects and Insects Borne Diseases

The spatiotemporal extension of the vector host dimensions, and the onset of the diseases are both influenced by global warming in a complicated but balanced manner (Kholoud et al. 2018). Pathogens that are transmitted by vectors are typically localized to regions where those vectors are found. However, it makes logical sense that the spread of these vector-borne illnesses and the introduction of transmitting vectors to new geographic areas is a main problem. This can be further explained through the spread of diseases to those regions of the world where these parasites were not present earlier (Kading et al. 2018). Due to the spread of their vectors, various diseases, including dengue fever, West Nile fever, chikungunya fever, malaria, leishmaniasis, Lyme disease, and tick-borne encephalitis, have been able to appear in Europe in recent years (Gossner et al. 2018). It is important to not underestimate the potential of new infectious diseases to emerge as a result of the geographic invading of the pathogen harboring vectors. For example, one vector such as the mosquito *Aedes albopictus,* is capable of transmitting at least 22 different arbovirus species, as well as a number of parasitic illnesses (Kading et al. 2018). Several typical instances of newly discovered and remerged diseases that have affected the people and animals or both have been discussed in Table 1.

In North America and Scandinavia, VBDs first appeared because of migration of vectors like ticks. Babesiosis, anaplasmosis, and Powassan encephalitis are among the illnesses transmitted by ticks, while dengue fever and malaria are transmitted by mosquitoes. Other insects, like sandfly spread diseases including leishmaniasis, Boutonneuse fever, and Lyme disease. Similar to this, health records indicate that the southern spread of the eucalyptus in Australia has increased the prevalence of diseases which are co-related to the parasites, bacteria and viruses and considered to be the possible economic losses threats and trade restrictions on animals/animals products in the region (Caminade et al. 2019).

2. Tick Borne Diseases (TBDs)

In Europe and Asia, there are ample evidence linking to the spread of different emerging TBDs (Rubel et al. 2018; Wikel 2018; Michelitsch et al. 2019). Long - term research over

Table 1: Summary of some important (Emerging and Remerging) Human, animal, and zoonotic diseases of bacterial, viral and parasitic origin (Khan et al. 2019)

	Bacterial	Viral	Parasitic
Human	• Bovine Tb • Hemorrhagic colitis (HC) • *Eserchia Coli* (STEC)	• (COVID-19) • (MERS) • SARS • Ebolavirus infection	• Schistosomiasis • Toxoplasmosis • Malaria • Dengue Fever
Animal	• Swine edema • *E. coli*) • *B. henselae* • *Pasteurellosis*	• Swine acute diarrhea syndrome coronavirus (SADS-CoV) • Lumpy Skin Disease	• Fasciolosis • Trypanosomiasis
Zoonoses	• MERSA • Brucellosis • Leptospirosis • Anthrax • Tuberculosis	• West Nile fever • Rabies • Avian influenza • CCHF • Dengue Fever • HIV Infection • Chikungunya virus	• Leishmaniasis • Ascariasis • Babesiosis • Toxoplasmosis • Amebiasis • Giardiasis • Malaria

thirty years of tick development monitoring in Sweden also supported these findings (Rubel et al. 2018). Due to global warming, some tick species in Canada and Europe have moved their habitat to higher altitudes and toward the north, extending their active season and improving their chances of survival in the environment. As a result, tick-borne illnesses like anaplasmosis, Babesiosis, Powassan virus, *Rickettsia helvetica*, *Neoehrlichia mikurensis*, and *Borrelia miyamotoi* disorders have been proliferated (Kayacan and Akgul 2022). Despite the fact that ticks can spread a wider variety of pathogens than any other arthropod vector, luckily, tick-borne diseases typically develop considerably slower than mosquito-borne infections, those have more severe effects on the host and quicker in action TBDs (Wikel 2018). In USA, it has been roughly estimated that about 95% of the emerging diseases have transmitted through the tick bites and these diseases were included in the category of TBDs (Esser et al. 2019). The main tick that is most importantly involved in the spreading of the disease in the Europe, Eurasia, UK and in Germany is *Ixodid racinous*. *Dermacentor reticulatus*, the tick species that transmits the tick-borne encephalitis virus, the Omsk haemorrhagic fever virus, *Rickettsia slovaca*, *Rickettsia raoultii*, *Anaplasma marginale*, *Babesia canis*, *Babesia caballi*, and *Theileria equi*, were also observed to be expanding across Europe and Eurasia (Michelitsch et al. 2019). Similar kind of reports of different parasites emerging from the different area of these regions have also been reported (Jsaenson et al. 2018).

Babesiosis instances in humans have lately been recorded in Canada, Europe, and Japan (Vannier and Krause 2020). Due to global warming, the warmer winters of the past ten years have encouraged tick proliferation (Sergeev et al. 2022). About 11 bacterial tick-borne human diseases, including Rickettsial and Borrelia species, have been identified in Europe in recent years (Pennisi 2021). The infections are propagated epidemiologically by the ticks those are carried by migratory birds. According to literature, at least one tick was present on 16 of the 43 species of migratory birds. Along with *Babesia microti*, *B. capreoli*, and *B. venatorum* to varying degrees, the ticks tested positive for *C. burnetii*, *Rickettsia spp.*, and *R. helvetica* (Lu et al. 2016). In addition to birds, ticks have recently been found to play an epidemiological role in the spread of the zoonotic bacteria *Coxiella burnetii* (Koehler et al. 2019). Additionally, ticks have the ability to spread a wide range of dangerous zoonotic infections (Tokarz et al. 2018; Anas et al. 2021).

Crimean Congo hemorrhagic fever (CCHF) is a second zoonotic tick-borne viral illness that has emerged in Europe and the causative agent of this disease has been transferred from tick and causes many complications in the host body and sometime leads to the death of the host. Due to high mortality in humans, the CCHFV poses a serious threat to public health in Europe. The virus is transmitted to ruminants by the *Hyalomma* tick, and it is currently endemic in Asia, Eastern and Southern Europe, the Middle East, Africa, and the Balkan Peninsula. This tick population have the potential to infiltrate and emerge in new areas due to warmer climatic conditions. Emergence of Piroplasmid (such as *Babesia* and *Theileria*) have also been linked with the tick prevalence in the region. The most significant protozoal disease transmitted by ticks to the cattle is babesiosis and other large ruminants as well as in small ruminants characterized by the onset of high fever and destruction of the red blood cells. As a result of this condition there is hemoglobinuria, which is also the pathognomonic symptom of this particular disease. Babesiosis is a widespread animal health problem that has caused significant financial losses in the veterinary industry. Having zoonotic potential, now it poses risk to the human health also. Human babesiosis is also transferred from the infected animals and its transmission is directly related with the geographic expansion of tick's host induced by the climate changes (Baylis 2017). Babesia have more than 100 identified species and among these *B. microti*, *B. duncani* and *B. divergens have* zoonotic potential (Vannier and Krause 2020). Along with Babesia, other significant infections include *Anaplasma* and *Ehrlichia* (Reaser et al. 2021) those have zoonotic implications. Humans, cattle, horses and dogs all are susceptible to the deadly illness caused by *Anaplasma phagocytophilum* that is transmitted through ticks. Different tick species those are indigenous to Europe (*Ixodes ricinus*), North America (*Ixodes scapularis, Ixodes pacificus* and *Ixodes spinipalpis*), and Asia (*Ixodes persulcatus*) are the possible vectors for the spread of the disease (Vannier and Krause 2020).

Ehrlichia, a similarly related pathogen carried by ticks, can also infect people and animals. *Ehrlichia chaffeensis* and *Ehrlichia ewingii* (Monocytes Ehrlichiosis) can cause the disorders in humans, whereas *Ehrlichia ruminantium* can cause the disease in cattle (Wang et al. 2020). Other Ehrlichia species, such as *Ehrlichia canis*, *Ehrlichia muris*, and *Ehrlichia mineirensis*, can also cause some other types of ehrlichiosis (Ganta 2022).

Due to the spread of ticks, Lyme disease and tick-borne encephalitis (TBE) appeared in Europe. Even in Scandinavia, cases of both diseases have been documented. The prevalence of the disease is rising at alarming level as a result of global warming and the northward spread of the tick vector (Healy et al. 2020). Scandinavian winters have gotten warmer since the middle of the 1980s. Tick borne encephalitis (TBE) has become more prevalent, uniformly, and consistently. Many factors, including climatic change, are thought to be the true cause of this increase (Gilbert 2016; Efstratiou et al. 2021). Lyme borreliosis, incidence in Europe grew over the past ten years, not just in endemic regions but also in new geographic areas, particularly in the Netherlands and Belgium. According to estimates, at least 85,000 persons in Europe contract Lyme borreliosis each year (Hofhuis 2015). In Europe, *Borrelia burgdorferi* and *Borrelia mayonii* are the major pathogens that causes the disease. However, other Borrelia species have been identified as powerful zoonotic spirochetes transmitted by the *Ixodes ricinus* complex in North America and Europe (Nah 2020).

Rabbit fever (tularemia) is another emerging zoonotic disease which is particularly transmitted by the ticks and flies and has been recognized under the umbrella of TBDs (Kukla et al. 2022). Additional ectoparasites like fleas, triatomine bugs, and blood sucking flies including deerfly (*Chrysops spp.*), horsefly (*Tabanus spp.*), and sandfly (*Phlebotomus and Lutzomyia spp.*) were also implicated in the introduction of emerging diseases like tularemia, plague, Leishmaniasis, and trypanosomiasis (El-Sayed and Kamel 2020). Sandfly of the Phlebotomus genus can spread both forms of leishmaniasis. The infections first appeared in European nations, where they afflicted both humans and canines (Bennai et al. 2018). The discovery of sandflies was linked to the growth of leishmaniasis, mostly in dogs and the global warming was documented as a possible factor for their spread around the globe (Kukla et al. 2022).

T. brucei gambiense and *T. brucei rhodesiense*, the protozoa that cause African trypanosomiasis (sleeping sickness), are spread by tsetse flies. It is predicted that 30,000 people would contract the parasite during this century as a result of the vector growth linked to global warming, while 70 million people will be at danger (Moreno et al. 2019). A second type of trypanosomiasis known as Chagas disease, which is induced by *Trypanosoma cruzi* and spread by the bite of the kissing bug, *Triatoma infestans*, or by ingesting water or food contaminated with the feces of the infected bugs, began to appear in Latin America. It was reported that the sickness has spread throughout Central and North America. At the time, the number of Americans who have the illness is estimated to be 300,000 (Montgomery 2016) The plague-causing agent *Yersinia pestis* is transmitted by the flea *Xenopsylla cheopis*. The flea vector and *Yersinia pestis* both benefit from warmer and humid weather (Levy et al. 2021).

3. Rodents and Rodents Borne Diseases

In the epidemiology of disease onset and reemergence, rodents are crucial. They have the capacity to disseminate a variety of zoonotic disease agents, either directly or indirectly (as with plague). Around the globe, the growth and infection graph of rodents is increasing day by day and they are also held responsible for the emergence and re-emergence of many zoonotic diseases (Göotz et al. 2018; Khanal et al. 2022).

Conclusion

As a result of climatic change, the global atmosphere is currently undergoing accelerated destruction, which must be stopped or at least slowed down. In addition to the introduction of infectious diseases, the disruption of healthy ecosystems has long-term, direct and indirect negative repercussions that endanger the lives of people, animals, and plants. In coming years, human and animals are at risk not only in terms of food security but emergence and re-emergence of deadly pathogens outbreaks. Efforts should be made to preserve the natural balance between ecosystems. Humans should play a sensible role to preserve the flora and fauna of the system and avoid making the drastic environmental changes just for their own comfort. Positive contributions should be made to keep the climate safe, and this can only be achieved if all the nations join hands without any discrimination. All the professionals (Doctors, veterinarians, Scientists, and environmental engineers) should join hands and work for the global health.

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