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Climate Change and Its Impact on Humans

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ABSTRACT

Humans are slowly awakening to the idea that they are dependent on the environment for their survival and this is derived from the fact that, until recently, human evolution was heavily reliant on the environment for water, food, and good health and will continue to remain so, during the next few decades. These are needed now more than ever, despite modern technology and seeming endurance in the face of often damaged settings. The conditions for human sustainability (water quality and quantity, food security, and health) are now potentially threatened by various human-induced causes, out of which, climate change is one of the more durable. This paper will focus on the likely evolution of climate in the twenty-first century, as well as important climatic implications that may shape the future of human society, such as resource wars, environmental conflicts, and migrations.

Keywords: *Climate, Humans, Environment*

Human beings have contributed to a massive change in the global environment, that is clearly visible in most places. Land-use change, desertification and deforestation, loss of biodiversity, air pollution, ozone depletion, and climate change are among the many elements contributing to global environmental change.[i] Climate change puts pressure on important resources by altering normal and extreme weather patterns. Oddball species emerge, invade, and spread across ecosystems. This synergy increases the stress condition and the negative consequences of a degraded environment on human activities and a region's carrying capacity is a cause of concern.

Humans are not just environmental change absorbers, but also change drivers. Many of the elements causing global change stem from the over-exploitation of resources and unsustainable economic systems. People in less developed countries over-exploit their environment to maintain or increase their resource base and improve their economies.[ii] Without any long-term environmental management strategy, resources will quickly diminish or become ineffective. The industrialized world, in particular, believes that fundamental life-supporting resources (water, food, health, and shelter) are abundant and quasi-unlimited.[iii] There are constant reminders that famine and disease still exist in many parts of the world, and that over 550 million people lack access to adequate drinking water.[iv] Water, food, and health are all basic human requirements,

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even in highly advanced countries. It is important to note that these elements are susceptible to changes in environmental circumstances. Even countries with reliable food security, water quality and quantity, and sanitary conditions may be affected by such shifts. Similarly, the disproportionate spread of these resources have constantly remained a cause of concern and will continue to remain so, considering climate change and its impact on regions.

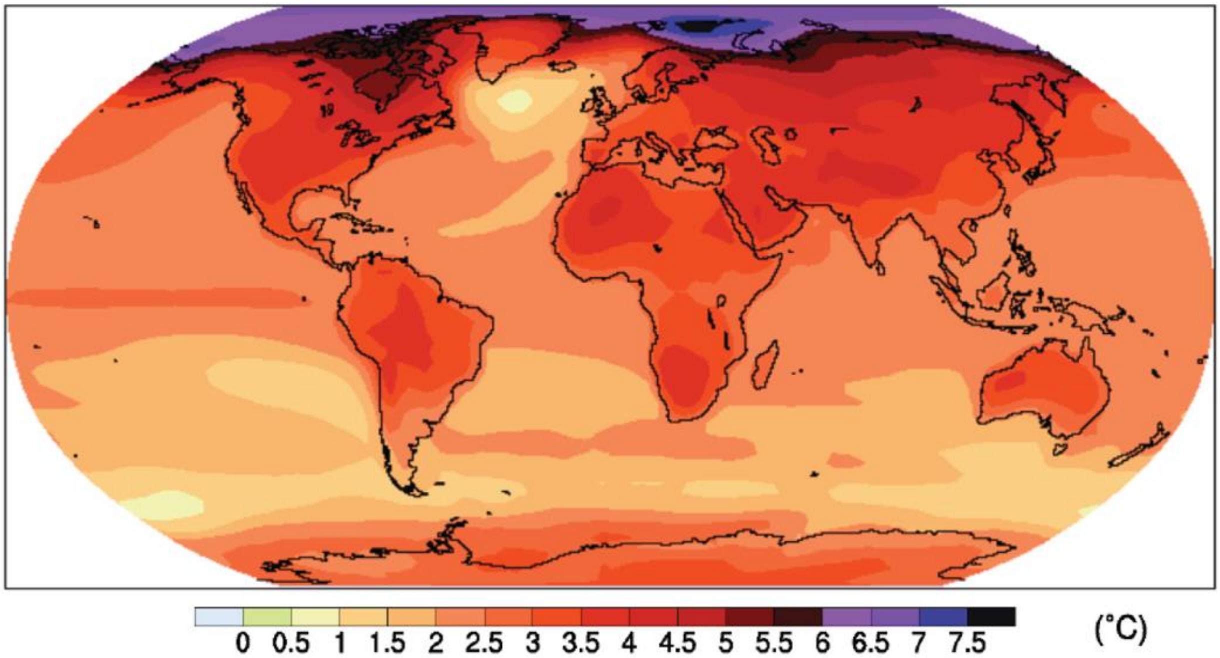
Climate Change in the Twenty-first century

When the climate change discussion began in the late 1980s, predictions of world average temperature rise predicted 1.5–5 degrees Celsius by the end of the twenty-first century.[v] The Intergovernmental Panel on Climate Change (IPCC) estimates the likely range of global atmospheric temperature increase to be 1.5–5.8 degrees Celsius (IPCC).[vi] In 1897, Svante Arrhenius, a Swedish physical chemist and Nobel laureate, calculated the effect of greenhouse gases on Earth's temperature and concluded that doubling CO2 in the atmosphere would result in a 4-degree Celsius warming, a figure that is still well within the bounds of today's most sophisticated climate models.[vii]

Climate models of increasing complexity were used to assess the climate system's response to anthropogenic forcing in the twenty-first century.[viii] For example, simplified models built to explore a specific system aspect like the global carbon cycle or incorporate far further forward in time than more computationally intensive general circulation models. 'Ensemble simulations' have been carried out to capture the model results' uncertainty and examine the climate system's variability. Using a set of models with the same forcing scenario but slightly different initial circumstances.[ix] Small changes in the beginning conditions cause internal climate variability, resulting in different results for each member of the ensemble simulation. These reflect the system's natural variability, with a large anthropogenic signal on top. Lambert and Boer indicate that the ensemble approach successfully reproduces observed pressure, temperature, and precipitation distributions under present climate conditions.[x]

Figure 1 shows the temperature difference between the baseline (1980–1999) and the scenario (2080–2099). The Arctic Ocean's predicted changes in snow cover and sea ice are likely to significantly alter the energy balance at the surface, particularly in terms of albedo (reflectivity). Less change in the surface properties of the surface is expected in high latitudes, which would result in higher positive feedback on the climate system. The exception is tropical deforested areas where managed crops and trees replace rainforests, changing regional and continental temperatures. Temperature change is also more pronounced over land than oceans due to water's higher heat capacity.

Changes in precipitation show a dual-mode. The drier mid-latitude ocean areas and continent boundaries, the drier inter-tropical zone, and the increased precipitation in the mid-and high latitudes are noteworthy traits. The future climate reduces average precipitation levels in the Mediterranean Basin, from North Africa to Central Europe and beyond to the Middle East.[xi] Rain-bearing systems become less active as the equator-to-pole temperature difference shrinks.



Source: *Changes in temperature between current (1980–1999) and future (2080–2099) climates based on ensemble model simulations (Source: IPCC, 2007).*

However, short-lived but intense systems may increase in the future. The models predict increased precipitation at higher latitudes in the Northern Hemisphere due to the enhanced hydrological cycle and shifting storm paths. Mountain regions, which provide over half of the world's surface water, will likewise see varying degrees of change.[xii] In mid-latitudes, winter precipitation may be more rain than snow, thereby affecting runoff regimes in mountain river basins in terms of quantity and timing. These changes would affect the water supply in the more populous lowlands downstream of the mountain ranges.[xiii] In some areas, such as tropical cloud forests, a persistent rise above current condensation levels would be detrimental to the ecosystems that rely on clouds for moisture, and hence to other environmental regimes such as surface runoff quantity and quality.

Impact of Climate Change

Rising sea levels are a result of both the thermal expansion of water and the addition of freshwater from melting mountain glaciers and ice sheets. Sea-level rise by the end of the century is estimated to be 50–100 cm depending on the amplitude of warming. The waters would rise above 120 m if Antarctica and Greenland's ice caps melted completely. Despite recent evidence that ice-cap dynamics are moving faster than expected (particularly in Greenland), a significant rise in sea level is not expected in the coming decades due to the long lag times involved in cryosphere–climate interactions, and especially because Antarctica is expected to expand in volume – a warmer climate may cause more snow to fall there, thus increasing.

Rising sea levels may be one of the most significant repercussions of climate change on society and economies. Many people live on or near the coast, frequently less than a meter above sea level, as in the Maldives in the Indian Ocean, the Marshall Islands in the Pacific, and parts of Bangladesh in the Ganges delta, to name a few.[xiv] Water supplies will likely be increasingly stressed due to shifting climate and precipitation patterns, as well as global population trends. Climate change will impact demand, supply, and water quality. Water shortages will enhance competition for water use for a wide range of economic, social, and environmental purposes in countries already susceptible to water stress. Population growth will increase the need for irrigation and even industrialization, typically at the expense of drinking water. Water availability per capita is expected to decline globally by the 2020s, even in areas with abundant water resources.

Urbanization and economic expansion add to the pressure on water supplies in many countries, as do shifting precipitation belts. Population pressures may affect per capita water availability more than climate change in some areas, while the reverse may be true in others.[xv] Worst-case situations are expected in several of the world's poorest countries, where population expansion and climate change will reduce water availability. Climate change will affect the power balance between upstream and downstream neighbors in a given hydrological basin, which is already a source of rivalry and conflict in many areas. Indirectly, climate change threatens food security by reducing agricultural areas due to rising sea levels, increased wind and water erosion, pests, and diseases. Moreover, human-induced land-use change due to deforestation and desertification has already diminished many regions' agricultural potential.

The global food system is a dynamic network of producers and consumers linked by global marketplaces. While agricultural output has increased to keep up with global population growth over the previous century, almost a billion people are still hungry. Temperature, precipitation, soil moisture, carbon dioxide levels, disease, and pests are all major controls on agricultural productivity (themselves largely climate-dependent). Altering any of these variables can have substantial nonlinear effects on production. The FAO has cautioned that agricultural production will need to nearly quadruple by 2020 to keep up with demographic changes and consumer diversity.[xvi] Even if new technology like genetic engineering is considered, the ‘green revolution' of the twentieth century is unlikely to be reproduced, as land rivalry and climate change may negate or reduce agricultural productivity. Climate change will impact agricultural production. Gradual change allows political and social structures to adapt. Natural biota may adapt to slow change. Climate change estimates rely on many untested assumptions. This means that a crop's exposure to drought or heat affects its growth stage. Regardless of long-term climate trends, temperature and seasonal rainfall patterns vary year to year and area to region. Climate change-induced temperature and rainfall fluctuations may interact with carbon dioxide levels, fertilizers, insects, plant diseases, weeds, and soil organic matter in unexpected ways. Warmer temperatures and longer heat periods will stress various crops in several places of the world. For example, temperatures above 35 degrees Celsius for any time might cause lasting physiological harm to corn. The Midwest, one of the world's major cereal-producing regions, may be particularly sensitive to extended heat, raising the risk of worldwide food shortages. Due to the 1988 Midwest drought, the US became a net importer of cereals rather than an exporter for the first time since WWII. A warmer and drier climate during important seasons may increase crop failures.

The key limiting element in crop growth and production is rainfall. Moisture is vital to plant growth, especially germination and fruit development. Changes in rainfall patterns will also dehydrate the soil. A warmer climate, with higher evaporation, less precipitation, and consequent losses in soil moisture recharge, would be disastrous for locations where agriculture is already marginal. Extreme weather events may increase in frequency and intensity in some regions of the world, adding to the stress of a rising average climate. Drought, fire, and heat waves are examples of extreme weather that must be considered, as might heavy rain and hail. In colder climates, less frequent spring frosts, which can harm plants at the start of their growth cycles, may help offset these events.

Climate vulnerability is lower in areas where agriculture is well adapted to contemporary climate variability, or where the market and institutional variables allow for redistribution of agricultural surpluses to make up for deficits in production.[xvii] Long-term agricultural policy alternatives should be adopted concurrently with other concerns such as erosion, loss of topsoil, salinization, and soil and water pollution. Moreover, better water management and irrigation methods will help lessen the consequences of droughts and heatwaves, which are projected to worsen as the world's temperature rises.

Forecasting climate change consequences on the third factor of human well-being, health, is complicated because people are vulnerable to change and sickness. These are influenced by general hygiene, clothing, housing, medical, and agricultural traditions. The ability to adapt to disease transmission is determined by a population's economic status, medical service quality and coverage, and environmental integrity.[xviii] Human biology and psychology are important variables, but so are ecological and planetary systems, as well as economics and health care access. Changes in environmental conditions can have a substantial influence on disease agents' biology. Changes in land use affect disease carriers like rodents and insects, while climate affects outbreak timing and intensity. Changing social and environmental factors are now contributing to the spread of infectious illnesses.

The prevalence of disease-causing parasites and pathogens adapted to the vectors, as well as the human or animal hosts' resistance to disease, determine the occurrence of vector-borne diseases like malaria.[xix] The local climate, notably temperature and humidity, affects Anopheles mosquito establishment and reproduction.[xx] The disease's prospective spread to mountain regions is important because communities in uplands where malaria is not already endemic may confront a new threat when malaria spreads to new areas with ideal climate conditions.[xxi]

Vector-borne diseases occur in all climate zones, from the tropics and subtropics to the temperate zones. They are rare in cold climes and absent above certain altitudes in tropical and equatorial mountain ranges.[xxii] Because the Anopheles mosquito cannot grow or live above 1,300–1,500 m in Africa and tropical Asia, malaria is almost nonexistent in many tropical highlands.[xxiii] Vectors need specialized habitats to survive and reproduce. Many of these are climatically controlled. Changes in any of these characteristics will impact vector survival and thus dispersal.[xxiv] Climate change may thus have a significant impact on disease distribution. A persistent change in an abiotic component might affect the ecosystem's equilibrium, creating more or less favourable vector habitats. The expected increase in average temperature will certainly produce more favourable conditions for vectors in terms of both latitude and altitude, allowing them to breed in greater numbers and invade formerly inhospitable locations.

The infection rate for malaria is exponentially related to temperature, and slight increases in temperature can drastically reduce incubation time. The disease-free highlands of Ethiopia and Kenya, for example, maybe invaded by vectors if the annual temperature rises. If this happened, the number of malaria patients would skyrocket. The disease intensified in Colombia during El Nino events when temperatures rise and precipitation falls compared to typical conditions.[xxv] Links between abrupt but major climate changes and the annual cycle of malaria growth and transmission may help us comprehend the linkages between environmental and epidemiological factors, both short and long term (ENSO cycles) (climate change).

While malaria is commonly associated with Africa, it is not the only continent experiencing an increase in vector-borne diseases. Malaria is re-emerging in places where it was eradicated during the twentieth century. Malaria has been reported among low- to medium-elevation highland populations in Turkey, the Middle East, and Central Asia.[xxvi] It's difficult to link changes in one environmental component to changes in illness occurrence. Environmental health risks must be viewed in the context of age, hygiene, socioeconomic status, and health. These processes may contribute to disease spread by causing migration from rural to urban regions.[xxvii] The effects on human health would be exacerbated if climate change was accompanied by increased intensity of natural hazards including cyclones, floods, and drought. Moreover, such disasters might cause huge refugee and population movements, necessitating resettlement in already crowded places.

CONCLUSION

Population growth increases resource demand, and ongoing inequalities in resource access suggest that scarcities would impact many environmentally sensitive locations in unprecedented ways, mostly due to climate change. Many countries lack the social institutions required to develop social and technical solutions to shortage issues. Population displacement in reaction to major external stress frequently implies social disintegration. Displacement and coping methods are extreme manifestations of vulnerability in food security.[xxviii] Coping mechanisms are largely involuntary and rarely reduce a population's vulnerability to future famines. Contexts with dwindling resources can cause conflict and instability, but the causal pathways are generally indirect. Cropland, water, and forest scarcity limit agricultural and economic productivity. Such conditions can cause population shifts. As environmental scarcities worsen, this might contribute to local or regional conflicts. They can influence international trade relations, cause humanitarian disasters, and increase refugee movements.[xxix]

In the twenty-first century, it will become increasingly important to distinguish between voluntary and coerced migration. Voluntary migration occurs for many reasons, including economic, political, and ideological. On the other side, forced migration has various fundamental causes in the political and economic realms, notably war and ethnic unrest. In this perspective, environmental conditions for migration are a result of political and/or economic decisions. This is a result of a warming global climate, which is a result of economic and industrial policies that increase greenhouse-gas emissions.

As a result of several interconnected fundamental causes ranging from politics and economics to severe environmental changes (sea-level rise, deforestation, soil degradation, and climate change), water, food, and human health will certainly become increasingly scarce. The extent to which reduced water supply, lower agricultural yields, or shifting disease patterns may cause widespread out-migration is debatable. In the ‘greenhouse world' of the twenty-first century, Myers predicted that around 150 million ‘environmental refugees' would be one of the primary repercussions. This amount is uncertain and may be overstated. But it raises awareness and encourages thought and action to prepare institutionally and legally for increasing numbers of refugees. The need of the hour is for countries to address climate change and take active measures to deal with the consequences, such as reducing emissions and shifting to renewable sources of energy, which most of them are doing. There needs to be a legal framework for dealing with forced migration and the border issues that rising sea levels would cause. While countries must prepare their infrastructures in a way that withstands climate change, they must also take a stock of the impact on the agricultural sector and start taking measures to secure food sources. Further, they need to actively fight again deforestation and ensure they are restoring forest lands.

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