



A Mini Review on Climatic Change: Causes, Impacts on Wildfires and Human Health

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ABSTRACT

Climate change occurs when climate standards significantly vary, causing environmental and societal problems. Changes in humidity, temperature, and precipitation alter ecosystem balance. Natural causes include volcanic eruptions, rising temperatures, snow melting, and rising sea levels. These changes in climate metrics negatively impact all life forms on Earth, leading to harmful effects on the environment and society. The paper discusses the complex relationship between climate change and wildfires, highlighting the increased global warming caused by deforestation and greenhouse gas emissions. It also discusses the impact of climate change on forest fires and vice versa, aiming to provide a conceptual review of climate issues to improve human health.

Keywords: Climate change, Anthropogenic, Wildfires, Human health, Global warming, Greenhouse gases.

INTRODUCTION

The climate of the Earth has been exceedingly changing, primarily due to anthropogenic causes that affect all forms of life. Scientists predict that this process also abnormally influences human life and the infrastructure. It is evident that natural disasters such as hurricanes, floods, drought, and wildfires have become more common in the last five decades due to the planet's warming and can reach over 0.5°C; with more emissions, these events will be more frequent. The warming is expected to increase four times to 4°C, exposing about 80% of the population worldwide to overheating. The main changes that occur all over the world are those

related to the climate and the atmosphere, including global warming as a result of human activities¹. So, climate variability, recurrence, density, period, spatial extent, extreme weather, and climate events are the outcomes of climate change². Globally catastrophic incidents, such as melting glaciers, sea level rise, increasing temperature, and altering the precipitation system, occur due to climatic change. Climate change is essential for the balance of the ecosystem and human beings. Since this phenomenon increased in recent decades, it is worth noting the causes of climate change, both anthropogenically and naturally. Considering that climate change is the most fundamental health bluster in the twenty-first century, tackling climate change is crucial for health³. Global



warming results from human emissions of methane (CH₄), carbon dioxide (CO₂), and other greenhouse gases (GHG). Consequently, an alteration in the characteristics of the atmosphere is to be observed. The unpleasant human-made effects on climate have become numerous. These effects have led to the production of extra greenhouse gases, thus releasing more pollutants into the atmosphere. Consistently increasing human greenhouse gases (GHG) affect the climate globally and regionally⁴. On the other hand, natural factors like volcanic eruptions, ice melting, wind speed, etc., give rise to adverse climate conditions. The amount of carbon dioxide, methane, and trace gases is increasing in the atmosphere owing to human actions. As long as the ice in the Arctic Ocean is melting, global warming will get aggregated, affecting forests, agricultural lands, and water supplies. Besides, many coastal areas will disappear because of the rising sea level. Changes in the climate would cause the displacement of various species of animals and plants. In addition, it is observed that climate change plays a vital part in wildfires, which, in turn, influences the fire regime that identifies the spread and severity of fires. Climate change has disagreeable impacts on the environment and human health. In consonance with the World Health Organization (WHO), climatic change and global warming are humans' utmost confrontations in the twenty-first century⁵. In the case of facing this disaster and reducing its adverse effects, we need to highlight the causes and effects of climate change to reach our target.

MATERIALS AND METHODS

Causes of climate change, mainly man-made

The climate changes in our world, including global warming, induced many elements. Both natural and anthropogenic activities are drivers of climate change. However, various studies have indicated that human activities cause climate change in the current era^{1,6}.

Climate Change affects wildfire events and vice versa

The study is based on secondary data, so it was gathered via research publications. Numerous research has been undertaken to investigate the implications of climate change on wildfire incidence and human health. These mainly addressed the link between climate change and wildfires, and

the publications demonstrated the strong influence of climate change on forest fires and vice versa. Wildfires are a significant disorder in most forests, and climate greatly influences them, especially in Africa, Australia, North America, China, Russia, and Western Europe. Climate change has lately altered the fire regime in the Northern Hemisphere, resulting in intense wildfire seasons and increased fire frequency in forests. Climate change will raise the threat of wildfires all across the planet. By 2100, the yearly burnt area is expected to expand three to five times more than it is today^{1,6}.

Impact of climate change on vulnerable population

Many papers focus on climate challenges and provide a quick conceptual assessment of climate change to explore the most important and enhance human health. Furthermore, plenty of studies have explored the detrimental impacts on the balance of the ecosystem and differentiated two types of gas emissions that climate change causes, natural and artificial, which lead to unpleasant consequences on all forms of life in the world. There is mounting evidence that the climate is quickly changing. These alterations can potentially have a wide range of effects on human health, severely affecting vulnerable populations. These include a worldwide rise in average temperature, an increase in the frequency of heat waves, meteorological phenomena such as hurricanes, cyclones, and drought spells, and a changed distribution of allergies and vector-borne infectious illnesses. Aside from the respiratory system, the cardiovascular and gastrointestinal systems are susceptible to the negative consequences of global warming^{6,7}.

RESULTS AND DISCUSSION

About the Causes of Climate Change

According to the Environmental Protection Agency (EPA) 2014, natural and anthropogenic factors change the ecosystem's balance and climate change. Any of these factors would convert the amount of received radiation from the sun or prevent the heat from escaping from the Earth to space. So, it is essential to distinguish between artificial and natural climate change.

Anthropogenic Causes

Human activities have increased and

changed the characteristics of the atmosphere. Such actions include logging, burning fossil fuel, building roads, expanding agriculture roads, and engaging in industrial activities. All of which contribute to releasing greenhouse gases (GHG) into the atmosphere.

Deforestation

Forests play an essential role in the Earth's climate system in various ways. They grab carbon dioxide from the atmosphere and alter it through photosynthesis into the living biomass. Forests are natural strainers that absorb carbon dioxide from the atmosphere. Vegetation modulates the temperature of the surface and air by absorbing carbon dioxide. Any reduction in the forest area leads to an increase in the temperature. Thus, increasing the greenery in tropical regions causes more evaporation, which makes the weather cooler. Once the transpiration rises, there will be more relaxed days. After burning or cutting down the forests for different reasons like agricultural purposes, pastoral purposes, urbanization, etc., carbon flowing from the atmosphere to the forests stops. Deforestation has recently raised the amount of carbon dioxide in the atmosphere. Changes in the flora affect the temperature of the Earth's surface. Besides, eliminating the forest cover converts the patterns of global and regional climate, which causes devastating rainstorms followed by long and dry seasons.

Alteration in Land-use Pattern

Changes in land use, the concentration of land use, and climate change have occurred in land degeneration and desertification. Converting land use, such as forests, farms, and cities' land use, affects the amount of reflected sunlight in the space. Unreasonable land use changes forests to agricultural lands and increases carbon dioxide emissions by 10-50%.

Emission of Greenhouse Gases

Greenhouse gas emissions are essential for the world's food production. One of these gases is carbon dioxide, a significant factor in climate change. The sources of greenhouse gases are a more prevalent problem than any other environmental one. Earth's surface air temperature rises due to greenhouse gas emissions. In the last 25 years, the temperature has increased almost everywhere. Globally, more greenhouse gas emissions (methane,

carbon dioxide, carbon monoxide) have increased due to economic sectors, such as industry, fossil fuel combustion, transportation, etc. Fossil fuel is a primary source of greenhouse gases, emitting 22% of anthropogenic greenhouse gases. Increasing the concentration of carbon dioxide is an essential reason for global warming. GHGs, such as CO₂, absorb the surface of Earth's heat. Since the beginning of the industrial revolution, human activities have led CO₂ to grow in the atmosphere by over 40%. A rise in sea level Long accompanies this event-term tide gauge readings, and satellite data suggest that the global sea level is increasing, with the best estimate for the world average rise rate over the previous decade being 3.6mm per year. The rate of sea level rise has accelerated since satellite altimetry determination began in 1992; human-caused warming has been the primary component in global average sea level rise since 1970. Since 1902, the total observed climb has been around 16 cm (Fig. 1)⁸, ocean warming, glacier melting, and extreme weather. Continuous emissions of GHG will cause more climate change, raise the surface Earth's temperature, and change the regional climate⁸.

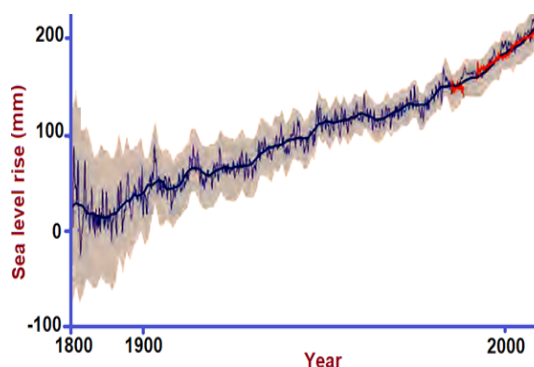


Fig. 1. According to observations sea level has risen quicker in the last decades, with readings from tide measurements (blue) and satellites (red) indicating that the best compute for the average sea level rise over the previous decade is 3.6 mm (0.14 inches per year). The gray region shows sea level uncertainty, which has reduced as the number of gauge sites utilized to calculate worldwide averages and data points has grown⁸

Agricultural Expansion and other human activities

Using composts that contain Nitrogen increases the concentration of nitrogen dioxide (NO₂) in the atmosphere, causing climate change. The expansion of agricultural lands towards forests results in adverse effects on biodiversity. Other human activities like ranching, filling landfills, using

natural gases, etc., lead to a rise in methane (CH₄), a significant factor in climate change.

Natural Causes

As human activities are the main reason for climate change, which influences forest fires, some natural factors lead to climate change and wildfires.

The Intensity of the Sun-Light

The solar energy that reaches the surface of the Earth affects the climate. Many factors influence the reception of heat energy, one of which is the sun's angle, as it is variable based on the location, time of day, and season. All of that is associated with Earth's rotation.

Changes in the Earth's Orbit

The author pointed out that the Earth's climate is affected by its position in the Sun. This factor includes Earth's axial angle tilt and the distances between the Earth and the Sun all year round.

Volcanic Eruptions

Molten rocks (Lava) and greenhouse gases (GHG) erupt during volcanic eruptions, which throw dust, gases, and ashes into the atmosphere. Volcanoes release water vapor and carbon dioxide that highly affect the climate.

Impacts of Climate Change on Wildfires Events

Climate changes heat the planet, mainly due to human activities, as they change the metrics of the atmosphere and lead to an increase in the atmosphere's temperature, oceans, and ice melting. In addition, it has fundamental effects on excessive events⁹. Given that wildfires are one of these destructive events, it is worth noting that the weather plays a critical role in forest fire incidents and growth. The importance of weather in ignition factors, where is lightning a primary agent of the forest fire¹⁰. On the other hand, the weather determines ignition

sources, such as fuel moisture, which determines the possibility of inflammation and whether the fire will grow. Weather conditions, like temperature, wind speed, rainfall, and relative humidity affect fire spread¹¹. Fire growth results from many variables. However, dry fuel and wind speed are the main factors for fire propagation. Climate trends have increased fire frequency, extending to hundreds of thousands of hectares in large geographic areas, destroying the forest's ecosystem, eradicating biodiversity, and extirpating the sources of the forest's raw materials. Climate change contributes to fires worldwide, which will cause more harsh fires in the next decade. Since climate change increases, forest fires' severity, duration, and frequency lead to higher fire seasons. Hence, the fast-paced process of melting ice cover and increasing temperature has increased the incidence and intensity of wildfires. It is worth noting that the increase in temperature causes a high rate of evapotranspiration and reduces humidity^{6,12}. Authors have indicated a relationship between large fires and wind speed. Climate change gives rise to circuitous results related to forest fires⁶, which, in turn, affects vegetation allocation and human health¹². Conversely, the risk of pasture and bush wildfires in climate change conditions is less clear, and active years of wildfires are associated with positive variables in moisture during the growing season before a year or more of the fire season. Except for Australia, all continents saw significant increases in fire season duration and impacted areas. Most biomes, except temperate and montane grasslands, savannas and shrub lands, and boreal forests/taiga and tundra, had significant expands in severe weather season metrics (Table 1)¹³. The most significant changes were noted in tropical and subtropical grasslands, savannas, and shrublands. Regional differences in fire weather season measurements were significantly more substantial than worldwide trends based on continent biome patterns (Table 2)¹³.

Table 1: Duration of fire weather season–impacted areas and variation in biomes¹³

Biome	Mean fire weather season (days/year)	Fire season affected area (% per year)
Tropical forests	0.089	-
Temperate broadleaf and mixed forests	0.103	0.0464
Temperate conifer forests	0.184	0.0150
Tropical and subtropical grasslands, savannas and shrublands	0.220	0.0628
Temperate and montane grasslands, savannas and shrublands	-	0.0255
Boreal forests/taiga and tundra	-	-
Mediterranean forests, woodlands, and scrub	0.159	0.0105
Xeric shrublands	0.151	0.0535

Table 2: Fire season duration and impacted areas variation by continental versus biome¹³

Continent	Biome	Mean fire weather season (days/year)	Fre season affected area (% per year)
Africa	Tropical forest	0.1321	-
	Tropical and subtropical grasslands, savannas and shrublands	0.1899	0.3181
	Mediterranean forests, woodlands and scrub	0.2292	0.5642
	Not significant: (i) Temperate and montane grasslands, savannas and shrublands; (ii) Xeric shrublands		
Eurasia	Tropical forest	0.0833	-
	Temperate broadleaf forests	0.1362	0.517
	Temperate conifer forests	0.1295	0.6211
	Temperate and montane grasslands, savannas and shrublands	0.0875	0.3798
	Mediterranean forests, woodlands and scrub	0.2877	0.7607
	Xeric shrublands	0.1435	0.4243
	Not significant : (i) Tropical and subtropical grasslands, savannas and shrublands; (ii) Boreal forests/taiga and tundra		
Australia/New Zealand	Not significant in all types: (i) Tropical forest; (ii) Temperate broadleaf forests; (iii) Tropical and subtropical grasslands, savannas and shrublands; (iv) Temperate and montane grasslands, savannas and shrublands; (v) Mediterranean forests, woodlands and scrub; (vi) Xeric shrublands		
	Tropical forest	0.3297	0.454
	Temperate conifer forests	0.184	0.4215
	Xeric shrublands	0.4156	0.6618
	Not significant: (i) Temperate broadleaf forests; (ii) Tropical and subtropical grasslands, savannas and shrublands;(iii) Boreal forests/taiga and tundra; (iv) Mediterranean forests, woodlands and scrub; (v) Temperate and montane grasslands, savannas and shrublands		
	Tropical forest	0.1461	-
	Temperate broadleaf forests	0.1143	-
South America	Tropical and subtropical grasslands, savannas and shrublands	0.5027	0.9297
	Temperate and montane grasslands, savannas and shrublands	1.4452	1.1156
	Xeric shrublands	0.4307	0.6813

It is essential to mention that the significant climate variables affecting wildfires point out a temperature rise and reduction in precipitation, especially in summer¹⁴. The author noted that forest deprivation due to wildfires lead affects the Earth's ability to absorb carbon dioxide (CO₂) and so cool the climate. Besides, wildfires release greenhouse gases (GHG) into the atmosphere, such as carbon dioxide (CO₂) and methane (CH₄), Fig. 2 illustrates the connection between climate change and wildfire⁹.

Impacts of Climate Change on Human Health

Climate change is anticipated to affect

human health in the coming decades. It is expected that the Earth's surface temperature will increase to 2°C. The authors indicated that climate change directly and/or indirectly affects global health and is noticeable in food and water insecurity, threats to shelters and human settlements, population growth and migration, and extreme climate incidents. In addition, there will be an increase in vector-borne diseases and a rise in fatalities, especially among older adults. Since human health is sensitive to variations in weather patterns, as mentioned above, the impacts of climate change are classified into two groups: direct and indirect effects. Direct effects

occur due to extreme weather incidents, such as changes in rainfall, temperature, floods, heat waves, drought, and fires. Indirect effects occur due to crop failures, migration, food insecurity, higher prices, etc. Increasing temperatures have raised the risk of death and illnesses related to rising temperatures. Local alters in precipitation and temperature led to a change in the distribution of some disease vectors and water-borne illnesses, as well as decreased food production. If the climate keeps changing as expected, it will lead to a greater risk of death and ailments spreading. As mentioned above, the population's food insecurity, unemployment, and low labor productivity are all affected by climate change^{15,16}. Besides, the increasing temperature

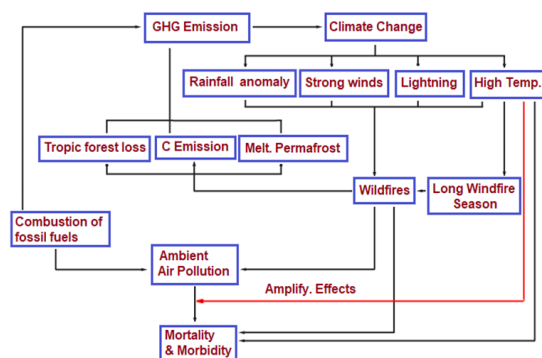


Fig. 2. Interaction between climate change and wildfires is strengthening and synergetic. The red line refers that high temperatures could aggravate, or improve, the impacts of surrounding air pollution on morbidity and mortality¹⁰

CONCLUSION

The influence of volcanoes and changes in solar activity would result in cooling off rather than warming over the past 50 years. Global warming that has been witnessed over the past 150 years matches nearly perfectly what is expected to occur due to greenhouse gas emissions and other human activities. In other words, the accurate estimate of the human contribution to modern warming is around 100%, as wildfire estimates show that 85% are human-made. Over the past 100 years, wildfires have risen by 57%, mainly due to climate change. After covering all climate change causes, and since climate change, together with other natural and human-made health stressors, affect human health and disease spread in numerous

of the sea surface led to the blooming of the alga, which may cause cholera outbreaks and reduce the availability of potable water. Converts in climate parameters lead to growth in respiratory diseases and death rates among people who suffer from chronic lung diseases, such as asthma^{3,17}, chronic obstructive pulmonary disease (COPD), and cardiovascular diseases. Respiratory system diseases grow among children during heat waves since high temperatures and high humidity cause the emergence of symptoms of asthma. Similarly, cold weather and exposure to cold conditions lead to infections in the respiratory system among people who suffer from (COPD)¹⁷. Some examples of how climate change may affect health are demonstrated in Figure 3.

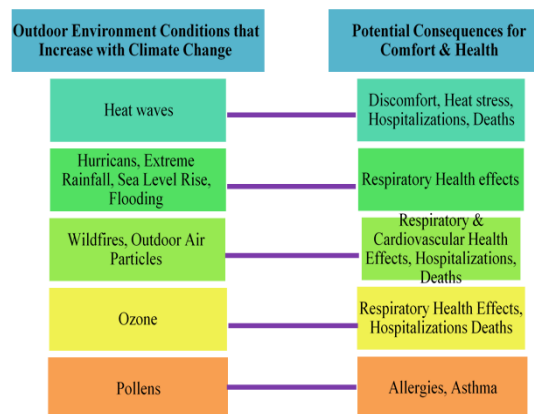


Fig. 3. Examples showing the effect of climate change on human health¹

ways, which leads to the extinction of animal and plant species, we need to take action to protect the environment because we cannot assume how much the adverse effects on natural sources are. We are facing critical issues, so we must take precautions towards human activities to reduce the disagreeable impacts on the environment and health.

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Conflict of interest

The authors declare no competing interest.

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