The Cause and Evidence of Climate Change in Ethiopia

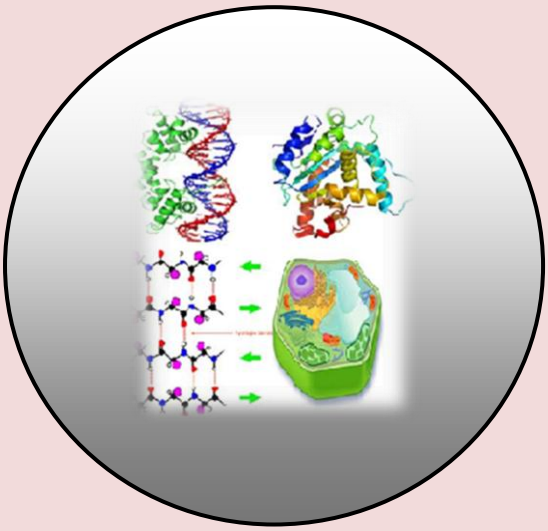
By

Fikru Hissa Kufata and Gemechu Fufa Arfasa

ISSN 2319-3077 Online/Electronic
ISSN 0970-4973 Print

Index Copernicus International Value
IC Value of Journal 82.43 Poland, Europe (2016)
Journal Impact Factor: 4.275
Global Impact factor of Journal: 0.876
Scientific Journals Impact Factor: 3.285
InfoBase Impact Factor: 3.66

J. Biol. Chem. Research
Volume 37 (2), Part A, 2020 Pages No. 142-149



Journal of Biological and Chemical Research

An International Peer Reviewed / Referred Journal of Life Sciences and Chemistry

Indexed, Abstracted and Cited in various International and National Scientific Databases

Published by Society for Advancement of Sciences®

J. Biol. Chem. Research. Vol. 37, No. 2, Part A: 142-149, 2020
(An International Peer Reviewed / Refereed Journal of Life Sciences and Chemistry)
Ms 37/02/9198/2020
All rights reserved
ISSN 2319-3077 (Online/Electronic)
ISSN 0970-4973 (Print)

G.F. Arfasa
http:// www.sasjournals.com
http:// www.jbcr.co.in
jbiolchemres@gmail.com

RESEARCH PAPER
Received: 01/08/2020 Revised: 22/08/2020 Accepted: 23/08/2020

The Cause and Evidence of Climate Change in Ethiopia

Fikru Hissa Kufata and Gemechu Fufa Arfasa
Jimma University, PO box 307, Jimma Ethiopia

ABSTRACT

The most important thing to know from this review there are two determinant factors. Which includes natural and anthropogenic occurrence for the change and it resembles different evidence concerning the change to present in the form of global warming. Humans' activities contribute to large amount of climate change happens because we are burning fossil fuels and that increases gases such as CO_2, methane, and some other gases in the atmosphere. They destroy natural environments through actions like deforestation, pollutions, production of greenhouse gases and also farm animal production sector is the single largest anthropogenic user of land, contributing to soil degradation, dwindling water supplies, and air pollution. Explosive volcanic eruptions can inject large quantities of dust and the gas, sulphur dioxide, high into the atmosphere. There is clear evidence that global warming is currently happening, and we are already experiencing some of its withering effects and ice melt, sea level rise to +5–9 m, and extreme storms in the prior interglacial period that was less than 1°C warmer than today Sea-ice reductions translate into loss of polar bear habitat, putting the species at risk of extinction. Polar ice melt and sea level rise, and drought are the most indicators of climate change.

Keywords: Anthropogenic, Natural, Global, Temperature and Drought.

INTRODUCTION

Climate is the average weather condition of a place over a long period of time. Climate change is any significant long-term change in the expected patterns of average weather by region. These changes may take tens, hundreds or perhaps millions of years. Global climate change is the long-term changes of weather patterns that characterize the regions of the world (Mahato, 2014). But increased in anthropogenic activities such as industrialization, urbanization, deforestation, agriculture, change in land use pattern, etc. are a global process affecting the lives and well-being of millions of people now and countless number of people in the future (Moellendorf, 2011). Climate change can be initiated by changes in the energy received from the Sun, therefore changes in the amounts or characteristics of greenhouse gases, particles and clouds, or changes in the reflectivity of the Earth's surface,

although climate has significant implications for present lives as well as for future generations and for ecosystems on which humanity depends, such as the burning of fossil fuels and changes in land use, including agriculture and deforestation (Woolf, Amonette, Street-perrott, Lehmann and Joseph, 2010). Humans' activities contribute to climate change because we depend on fossil fuels to produce energy these commonly causes greenhouse gas. A large amount of climate change happens widely because we are burning fossil fuels and that increases, gases such as CO_2, methane, and some other gases in the atmosphere. The global temperature rise of 0.4°C in the past now generally contributes to the greenhouse effect, the increment of atmospheric carbon dioxide through anthropogenic pollution. However, some of the outgoing radiation is re-absorbed by carbon dioxide, water vapors, ozone, methane and other gases in the atmosphere and is radiated back to the surface of Earth (Kaddo, 2016)". The root cause for this is global warming is a continuous rise in temperature of the planet is really upsetting (Shahzad, 2017). Since pre-industrial times, from 280 to 380 parts per million atmospheric CO_2 concentrations have increased (Solomon *et al.* 2007) (Baum, Haqq-Misra and Karmosky, 2012). A change in climate is also associated with a measurable change in a population's risk (Holland (19.86), Freedman (1991). Climate change is a global its negative impacts are more severely felt by poor people and poor countries. They are more vulnerable because of their high dependence on natural resources and limited capacity to cope with climate variability and extremes. Restoring and maintaining key ecosystems can support livelihoods that depend upon, the services of these ecosystems (Adedeji, Reuben and Olatoye, 2014). One of the most important impacts of climate change is the changes of, environment and water resources (Javan, Saleh and Shahraiyni, 2013). Climate changes in Africa have a tremendous impact on ecosystems and human societies. Climate change-related risks are aggravated in Africa by the deficient data availability and research efforts which create major knowledge gaps and uncertainties (Cheddadi *et al.*, 2018). Change in the amount of energy emitted by the Sun is a prime candidate as a cause of climate variability and there is no doubt that for the longest time scales of Earth's geological history, trends in solar output have played a major role in shaping the Earth's climate and will continue to do so in the future (Kelly and Adger, 2000). Evidence for climate change observation and numerical modelling allow geoscientists to show, with increasing confidence how and why climate has changed in the past (Summerhayes *et al*., 2010).

METHOD

The research for this paper was conducted using various new recent evidence accumulated by scientifically credible books, different article and journals, comprehensive scientific explanations regarding climate change evidence and cause phenomena has been made in the paper. All conjectures and theories are supported by officially publicized scientific materials. Each resource is well offered in the reference section and the paper further draws on additional material to provide context for the debate reflected in the systematic literature search. Where additional material is cited that is not drawn from the systematic literature search, this is marked in the text.

CAUSE AND EVIDENCE OF CLIMATE CHANGE

Cause of climate change

Anthropogenic factor

Human lives are directly linked to climate change because we depend on fossil fuels for our energy needs. There has been a continuous rise in global temperature in the last 130 years, which has huge air pollution, occurs as a result of incomplete burning of fuels such as coal, oil, petrol and wood.

It is evident that carbon dioxide (CO_2) and Methane are being dumped into the atmosphere at an alarming rate as a result of the advent of the industrial revolution. Apart from human activities, the gaseous pollutants (include; sulphur dioxide, nitrogen oxides, carbon dioxide, carbon monoxide) emitted into the air can also be by natural occurrences such as biological decay, forest fires or volcanic eruptions (Harcourt, 2015). The emission of greenhouse gases has increased dramatically mostly from the burning of fossil fuels for energy, agriculture, industrial process, and transportation *(*Kaddo, 2016).

Deforestation

Forests are one the main factors that determine climate such as weather patterns and amount of CO_2 of an area with rapid industrialization and urbanization, there is a significant increase in deforestation and as a consequence rise in global mean surface temperatures. Rapid and unchecked cut down of forest cover has resulted in some of the worst disasters during the last decades (Ali *et al*., 2015). Deforestation is the act of cutting down or burning the trees in an area. It is the loss/removal of tree cover, as a result of forests being cleared for other land uses such as farming or ranching activities which affect carbon fluxes in the soil, vegetation, and atmosphere. **(**Ali *et al*., 2015) Deforestation and forest degradation mainly affected by fuel wood collection/charcoal, farmland expansion, land fires and construction wood harvesting were caused due to population growth, insecure land tenure and poor law enforcement(EFRL, 2016) Removal of forest covers alters soil, plant composition, global and regional climate patterns (Strasser *et al., 2014*). Deforestation happens all over the world and the vast majority of deforestation takes place in rainforest around the globe, mostly concentrated in the tropics (*Be*nnett, 2017). It results soil degradation, carbon emission, plant decomposition left on the forest floor, albedo effect, and intensification of hydro-meteorological hazards, carbon stores held in soil to be released (Stern and Kaufmann, 2014) Deforestation on the other hand increases temperature, rates of carbon dioxide emission, soil degradation and surface runoff resulting in flash floods.

Agricultural input

Rising demand for agricultural products such as food, feed and bio-energy is a primary driver of forest clearance globally. The expansion of agriculture into tropical forests releases substantial amounts of carbon to the atmosphere (Baumann *et al*., 2017).Agriculture is responsible for 10–12% of the total global increase of anthropogenic emissions and greenhouse gas (GHG) emissions (B. Lin, 2011). Carbon emissions and sequestration from production of fertilizers, deforestation, etc. (Le Quéré *et al*., 2014). Industrial agriculture contributes significantly to global warming, representing a large majority of total agriculture-related GHG emissions. Alternatively, ecologically based methods for agricultural production, predominantly used on small-scale farms, are far less energy-consumptive and release fewer GHGs than industrial agricultural production.

CO_2 is emitted from agricultural systems through a variety of mechanisms, including plant respiration, soil efflux, through the use of fossil fuels in machinery and the production of agricultural inputs (e.g. fertilizers and pesticides). CO_2 efflux or soil respiration is a combination of microbial and root processes that transfer the C in soil organic matter (SOM) back to gaseous CO_2. Soil respiration rates are governed by factors similar to other soil functions: temperature, water content, microbial density, diversity and structure, and the biochemical composition of plant material decomposing in the soils (B. B. Lin *et al*., 2011). Between 2000 and 2010, around 13 million hectares of forest were converted to other uses or naturally lost, compared to 16 million hectares per year during the earlier decade (Joseph et al. 2004).

Livestock production

The farm animal production sector is the largest anthropogenic user of land, contributing to soil degradation, dwindling water supplies, and air pollution. Animal farming contributes to GHG emissions through several routes. The most significant are carbon dioxide from land use and its changes (32 percent), nitrous oxide from manure and slurry (31 per cent) and methane from animal digestion (25 per cent) (Sejian, Gaughan, Baumgard and Prasad, 2015). Animal manure contains organic compounds such as carbohydrates and proteins. During the decomposition of livestock wastes under moist, oxygen free (anaerobic) environments, the anaerobic bacteria transform the carbon skeleton to methane. Animal wastes also contain nitrogen in the form of various complex compounds. The microbial processes of nitrification and denitrification of animal waste form nitrous oxide, which is emitted to the atmosphere (Sangeeta *et al.,* 2015).

Natural factor

The Earth's climate has always been driven by the amount of incoming and outgoing energy. Without the influence of humans, the Earth has natural cycles that drive the climate. One natural warming phenomenon is the greenhouse effect. The greenhouse effect is a blanketing effect by which atmospheric greenhouse gases keep the earth's surface warmer. Clouds, aerosols, and parts of the earth's surface reflect about one third of the sun's light that reaches the Earth.

Volcanic eruption

The global temperature rise of 0.4°C in the past now generally contributes to the greenhouse effect, the increment of atmospheric carbon dioxide through anthropogenic pollution. The warming trend is sharp temporary cooling events, usually 1 to 3 years in duration that coincide with large volcanic eruptions (Seymour, Strange, Cayan and Nathan, 1984). These events mark a massive natural pollution of the stratosphere, resulting in backscattering from solar radiation and cooling of the earth [Hansen *et al*., 1981].

Explosive volcanic eruptions can inject large quantities of dust and the gas, sulphur dioxide, high into the atmosphere. Whereas volcanic debris in the lower atmosphere falls out or is rained out within days, the veil of pollution in the upper atmosphere is above the weather and may remain for several years, gradually spreading to cover much of the globe. The volcanic pollution results in a substantial reduction in the stream of solar energy as it passes through the upper layers of the atmosphere, reflecting a significant amount back out into space (Shahzad *et al*., 2017).

Volcanic eruptions discharge carbon dioxide, but they may also emit aerosols, such as volcanic ash or dust, and sulfur dioxide. Aerosols are liquids and solids that float around in the air. They may also include soot, dust, salt crystals, bacteria, and viruses. Aerosols scatter incoming solar radiation, causing a slight cooling effect. Volcanic aerosols can block a percentage of sunlight and cause a cooling that may last for 1-2 year. volcanism clearly affects climate, it appears that this effect is not simply related to the magnitude or the explosively of the eruption, i.e., the production of volcanic ash, but rather to some other properties of the magma (Seymour *et al*., 1984).

Climate change evidence

There is clear evidence to show that climate change is happening. Measurements show that the average temperature at the Earth's surface has risen by about 1°C since the pre-industrial period. 17 of the 18 warmest years on record have occurred in the 21st century and each of the last 3 decades has been hotter than the previous one.

The change in temperature has been varied everywhere; the increase has been less over the ocean when compared to over the land and has been particularly fast in the Arctic (Department for Business, Energy and Industrial Strategy, 2017). Some of the most visible indicators of climate change come from mountain areas, such as the widespread retreat of glaciers that has been observed from polar to tropical regions in recent decades.
Ancient ice from the polar ice sheets reveal natural temperature changes over tens to hundreds of thousands of years. Air bubbles trapped in the ice show that levels of greenhouse gases in the atmosphere is closely linked to global temperatures. Rises in temperature match closely with an increase in the amount of greenhouse gases (Department for Business, Energy and Industrial Strategy, 2017). The short-term cooling effects of volcanic eruptions that can be seen in the 20th century temperature record, as can the global temperature variations associated with strong El Niño and La Niña events, but an overall warming trend is still evident (Studies, 2012). The evidence of climate change is compelling: sea levels are rising, glaciers are retreating, precipitation patterns are changing, and the Earth is getting warmer.

Global Temperature Increase

What most people do not understand is that global warming is currently happening, and we are already experiencing some of its withering effects. The period from 1983-2012 was likely the warmest 30-year period of the last 1,400 years in the northern hemisphere. The global average combined land and ocean surface temperature has increased by 0.85 ^{O}C between 1880 and 2012 (NASA, 2014). It is and will severely affect ecosystems and disturb the ecological balance. Global warming is a long-term trend, but that does not mean that every year will be warmer than the previous one. Day to day and year to year changes in weather patterns will continue to produce some unusually cold days and nights, and winters and summers, even as the climate warms. Climate change means not only changes in globally averaged surface temperature, but also changes in atmospheric circulation, in the size and patterns of natural climate variability, and local weather. La Niña events shift weather patterns so that some regions are made wetter, and wet summers are generally cooler. Stronger winds from Polar Regions can contribute to an occasional colder. Continued emissions of greenhouse gases will cause further climate change, including substantial increases in global average surface temperature and important changes in regional climate (Royal Society, 2010). The burning of these fuels produces gases like carbon dioxide, methane and nitrous oxides which lead to global warming so Deforestation is also leading to warmer temperatures. The hazard of global warming is continuously causing major damage to the Earth's environment. Most people are still unaware of global warming and do not consider it to be a big problem in years to come. Because of the treacherous effects of global warming, some solutions must be devised (Shahzad *et al*., 2017).

Polar ice melt

Sea-ice reductions translate into loss of polar bear habitat, putting the species at risk of extinction. Melting of polar ice caps will lead to floods which can cause mayhem everywhere. Rise in sea levels will devastate agricultural and fishing activities (Shahzad et al., (2017). A recent synthesis of evidence from marine, terrestrial and atmospheric studies show that the climate of the Arctic has warmed significantly in the last 30 years (Serreze *et al*., (2000). In terrestrial systems, the thermal regime controlling the abrupt threshold and phase change from ice to water at 0°C limits variety of biophysical processes, which operate at multiple spatial and temporal scales and may respond to change at varying orders of linearity.

Ice Melt and Sea Level Rise

The global sea level is very sensitive to changes in global temperatures. Ice sheets grow when the Earth cools and melt when it warms. Warming also heats the ocean, causing the water to expand and the sea level to rise (Summerhayes *et al.*, 2010). Climate change causes melting of ice sheets, which in turn sends water into the oceans and causes sea level rise. The magnitude of this sea level rise remains uncertain (Baum et al., 2012). ice melts, sea level rise to +5–9 m, and extreme storms in the prior interglacial period that was less than 1 °C warmer than today. One important source of uncertainty is the increase in ice stream velocity that comes from lubrication from ''surface melt'': ice on the surface of ice sheets that melts and falls to the bottom of the sheets (Zwally *et al.* 2002).

Drought

Changes in global climate will have enormous consequences for living nature as well as the economy. Even a small rise in mean annual temperature can have a major impact on a region's ecology and biological diversity (Pounds and Puschendorf, 2004). Biodiversity is of crucial importance for the stability of ecosystems as well as for human health (Harvard, 2002). The economic impact of drought, floods and other climate change effects will become quite substantial. Drought will bring obvious human suffering. Droughts may cause a shortage of water for human and industrial consumption, hydroelectric power, recreation and navigation. Water quality may also decline and the number and severity of wildfires may increase. Severe droughts may result in the loss of agricultural crops and forest products, undernourished wildlife and livestock, lower land values, and higher unemployment. Therefore, not only are agricultural businesses vulnerable to drought, but also hydro-electric power and other water-dependent industries, such as forestry and tourism.

CONCLUSION

Climate change is a complex and important issue existing research finds that there is very strong evidence that the climate is changing, that these changes are driven primarily by human activity, and that the changes will have a very large impact on natural and social systems and it is a problem that is facing our planet and it has progressed a lot after the industrial revolution. The emission of greenhouse gases has accelerated the progress of climate change and made our weather more intense. However, the world's dependence on fossil fuel for energy, transportation, and manufacturing has created a major obstacle for us to switch to renewable energy. The burning of these fuels produces gases like carbon dioxide, methane and nitrous oxides which lead to global warming so Deforestation is also leading to warmer temperatures.

Generally, what is of importance is not only how much the sea level rises, but also how fast this rise occurs, because a rapid rise gives humans and ecosystems less time to adapt to the change. There is presently much concern that an abrupt ice sheet collapse could cause a rapid sea level rise. A recent synthesis of evidence from marine, terrestrial and atmospheric studies shows that the climate of the Arctic has warmed.

Recommendation

Forest management can be used an effective tool used to cope with the increasing impacts of climate change, particularly in the mountainous terrain. Community awareness and training must be organized for effective afforestation and forest conservation.

Any mitigation of emissions from livestock must be based on high animal welfare standards to enhance the potential for reducing emissions. Land use and forest protection regulations should be implemented with sincerity and with the consent of the community.

REFERENCES

Adedeji, O., Reuben, O. and Olatoye, O. (2014). Global Climate Change, (April), 114–122.

Ali, A., Riaz, S. and Iqbal, S. (2015). Deforestation and its Impacts on Climate Change an Overview of Pakistan, 51–60. https://doi.org/10.1515/igbp-2015-0003

Baum, S. D., Haqq-Misra, J. D. and Karmosky, C. (2012). Climate Change: Evidence of Human Causes and Arguments for Emissions Reduction. Science and Engineering Ethics, 18(2), 393–410. https://doi.org/10.1007/s11948-011-9270-6

Baumann, M., Gasparri, I., Piquer-Rodríguez, M., Gavier Pizarro, G., Griffiths, P., Hostert, P. and Kuemmerle, T. (2017). Carbon emissions from agricultural expansion and intensification in the Chaco. Global Change Biology, 23(5), 1902–1916. https://doi.org/10.1111/gcb.13521

Bennett, L. (2017). Deforestation and Climate Change, (April).

Cheddadi, R., Bouimetarhan, I., Carré, M., Rhoujjati, A., Benkaddour, A. and Nourelbait, M. (2018). Climate change in Africa : Evidence , mechanisms and impacts - Past and present, 5(1), 2018.

Department for Business, Energy and Industrial Strategy U. (2017). Climate change explained. Retrieved from https://www.gov.uk/guidance/climate-change-explained

EFRL (2016). Ethiopia'S Forest Reference Level, (January).

Harcourt, P. (2015). Causes of Climate and Environmental Changes : The need for Environmental-Friendly Education Policy in Nigeria, 6(30), 224–234.

Javan, K., Saleh, F. N. and Shahraiyni, H. T. (2013). The Influences of Climate Change on the Runoff of Gharehsoo River Watershed, 2013 (December), 296–305.

Kaddo, J.R. (2016). Parkland College Climate Change: Causes, Effects, and Solutions. Retrieved from http://spark.parkland.edu/ah/164

Kelly, P.M. and Adger, W.N. (2000). Theory and Practice in Assessing Vulnerability To. Climatic Change, 47, 325–352. https://doi.org/10.1158/0008-5472.CAN-11-2495

Le Quéré, C., Peters, G. P., Andres, R. J., Andrew, R. M., Boden, T. A., Ciais, P. and Zaehle, S. (2014). Global carbon budget 2013. Earth System Science Data, 6(1), 235–263. https://doi.org/10.5194/essd-6-235-2014

Lin, B. (2011). Effects of industrial agriculture on climate change and the mitigation potential of small-scale agro-ecological farms. CAB Reviews: Perspectives in Agriculture, Veterinary Science, Nutrition and Natural Resources, 6(020). https://doi.org/10.1079/PAVSNNR20116020

Lin, B.B., Chappell, M.J., Vandermeer, J., Smith, G., Quintero, E., Bezner-kerr, R. and Mcmichael, P. (2011). Effects of industrial agriculture on climate change and the mitigation potential of small-scale agro-ecological farms, (020). https://doi.org/10.1079/PAVSNNR20116020

Mahato, A. (2014). Climate Change and its Impact on Agriculture, 4(4), 4–9.

Moellendorf, D. (2011). Climate Change Justice review. Environmental Values, 20(2), 285–296. https://doi.org/10.3197/096327111X12997574391887

NASA. (2014). The evidence for rapid climate change, 2014–2015. Retrieved from http://climate.nasa.gov/evidence/

Sejian, V., Gaughan, J., Baumgard, L. and Prasad, C. (2015). Climate change impact on livestock: Adaptation and mitigation. Climate Change Impact on Livestock: Adaptation and Mitigation, (January), 1–532. https://doi.org/10.1007/978-81-322-2265-1.

Seymour, R.J., Strange, R.R., Cayan, D.R. and Nathan, R.A. (1984). Influence of El Niños on California's wave climate. Coastal Engineering Proceedings, 1(19), 2018. https://doi.org/10.1061/9780872624382.040

Shahzad, U. (2017). Global Warming : Causes , Effects and Solutions Global Warming : Causes , Effects and Solutions, (August 2015).

Stern, D. I. and Kaufmann, R. K. (2014). Anthropogenic and natural causes of climate change Anthropogenic and natural causes of climate change, (November). https://doi.org/10.1007/s10584-013-1007-x

Studies, L. (2012). Climate Change: Evidence, Impacts, and Choices. https://doi.org/10.17226/14673

Summerhayes, C., Cann, J., Cohen, A., Francis, J., Larter, R., Lowe, J. and Wolff, E. (2010). Climate Change: Evidence from the geological record, (November), 1–12. https://doi.org/10.1111/j.1365-2966.2005.09494.x

Woolf, D., Amonette, J. E., Street-perrott, F. A., Lehmann, J. and Joseph, S. (2010). ClimateChange.

Corresponding author: Gemechu Fufa Arfasa, Jimma University, PO box 307, Jimma Ethiopia
Email: feragemechu@gmail.com