Climate Change and its Impacts on Sustainable Food Production in Sub-Saharan Africa Region: Issues, Challenges and Options

Abstract

Human civilization has been depending on agriculture right from the inception and has always been one of the fundamental methods by which humans have been surviving in the world. However, weather and the related temperature, light and water determine to a large extent the human society's ability to feed themselves and the animals they care for. When the weather changes due to variations in climate, there are very serious impacts especially disproportionate impacts on agricultural production which can result in reduction of crop production and these force the farmers to take up new methods of agriculture so that they can cope up with the new situation. Food security of is thus directly affected by the existing climate.

Climate change and its effects therefore directly affect agricultural processes and agricultural production. It is thus important to inform the people of the world about the changes being caused to agriculture due to climate change and the changes in climate due to agricultural processes.

That the climate change could potentially interrupt progress toward a world without hunger and robust and coherent global pattern is discernible of its impacts on crop productivity that could have consequences for food availability. Therefore, the stability of whole food systems may be at risk under climate change because of short-term variability in supply. However, the potential impact is less clear at regional scales, but it is likely that climate variability and change will exacerbate food insecurity in areas currently vulnerable to hunger and under nutrition especially the Sub-Saharan Africa region.

Likewise, it can be anticipated that food access and utilization will be affected indirectly via collateral effects on household and individual incomes, and food utilization could be impaired by loss of access to drinking water and damage to health.

The question now is: How does the Climate Change affect a Sustainable Food Production in Sub-Saharan Africa Region and what are the necessary actions to be taken to contain the situation?

This paper examines the concept of climate change and its characteristics and the subject of food production as it affects the whole world but the Sub-Saharan African region in particular. It goes further to highlight the challenges of climate change impacts on food production and the issue of food security in the world and Sub-Saharan African Region.

Also, the paper discusses the concern of the United Nations Organization which led to the establishment of The Intergovernmental Panel on Climate Change (IPCC) which is an intergovernmental body of the United Nations dedicated to studying and providing the world with an objective, scientific view of climate change, its natural, political and economic impacts and risks and possible response options. This has led to its report which is tagged "Climate Change 1995 – The Science of Climate Change Contribution of the Working Group"

In conjunction with this, the paper makes reference to the relevant SDG goals which include Goal 2. End hunger, achieve food security and improved nutrition and promote sustainable agriculture. When read with SDG13, 'take urgent action to combat climate change and its impacts', and Goal 15. Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss, we have a policy frame of goals, targets and evidence-based progress monitoring towards climate action at all scales.

This evidence supports the need for considerable investment in adaptation and mitigation actions toward a "climate-smart food system" that is more resilient to climate change influences on food security.

In 2015, the UN launched the 17 Sustainable Development Goals (SDGs). Adopted by 193 member states, the goals represent an important international step in setting humanity on a trajectory towards sustainable development.

Keywords: Climate Change, Sustainable Food Production, Intergovernmental Panel on Climate Change (IPCC), Sustainable Development Goals, Sub-Saharan Africa Region.

Introduction.

Climate change has gone from an obscured issue to becoming a global phenomenon and one of the major concerns of the world today, judging from the debate it generated and the urgent attention it garnered by all and sundry. It has become a major global environmental problem that threatens the survival of the entire human race with serious implications on agriculture, natural ecosystem, water supply, health, soil and atmosphere, which are all elements that constitute the support for long term sustainability of life on earth (Emeka, 2008). It has a disproportionate impact on the poor and vulnerable and can become a serious impediment to poverty reduction if not properly attended to.

Although it has strong impacts on various activities that support life on the earth, the most affected is agriculture especially in the developing countries of Sub-Saharan Africa Region with their high sensitivity to climate variability and weather extremes such as droughts, floods and severe storms and where irrigation is seldom practiced.

Climate change can manifest as fewer wet days and higher rainfall, increasing surface air temperature, sea level rise and accelerated soil erosion depending on the region which results in adverse consequences in human livelihood such as poor yields of crops and animals and loss of income by individuals and communities. It is a contributing factor to food price crises and its impact on agriculture in developing countries like the Sub-Saharan Region is expected to get more serious.

It poses a serious threat to agricultural sustainability in the poorest and most vulnerable regions as impacts affect the dependence on rain fed agriculture and with their low level of human and physical capital development, inequitable land distribution and poor infrastructure development, the result is food insecurity, increased poverty and hunger.

Concept of Climate Change and its characteristics

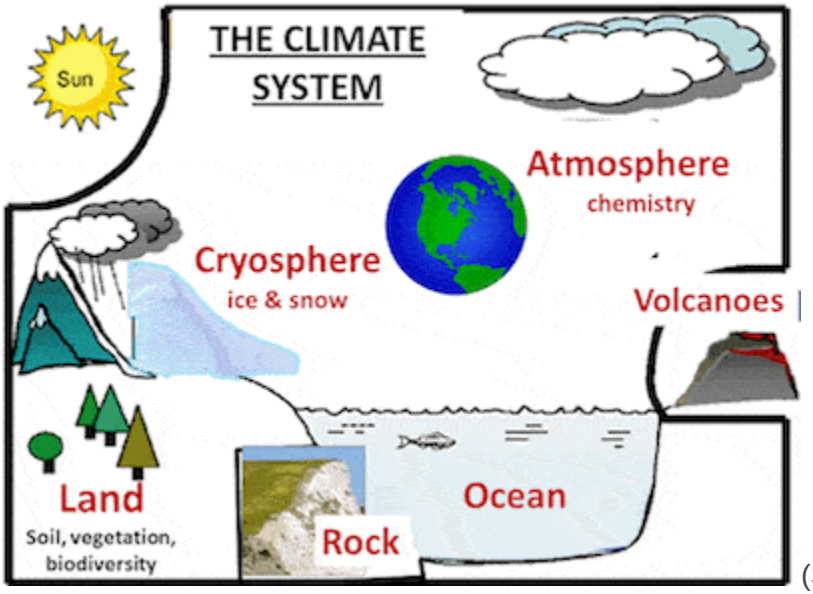
What is Climate Change?

The most general definition of climate change is a change in the climate system when considered over long periods of time regardless of the cause (Wilkipedia). It is a deviation from the normal weather conditions of an area over time, whether due to natural conditions or as a result of human activities which results in degradation of an environment (Nwosu, 2012).

Most often it is used to refer specifically to anthropogenic climate change known as global warming which is caused by human activities as opposed to changes in climate that may have resulted from other natural processes (Wilkipedia). In the context of environmental policy, the term has become synonymous with anthropogenic global warming which in the scientific journals refers to surface temperature increases while climate change per se includes global warming and everything else that increasing greenhouse gas levels affect (Wilkipedea).

In another related term, the World Meteorological Organization (WMO) in 1966 proposed a climate change to encompass all forms of climatic variability on time-scales longer than 10 years, but regardless of cause. During the 1970s, it was focused on anthropogenic causes, as it became clear that human activities had a potential to drastically alter the climate. However, it is presently incorporated in the title of the Intergovernmental Panel on Climate Change (IPCC) and the UN Framework Convention on Climate Change (UNFCCC) and is now used as both a technical description of the process, as well as a noun used to describe the problem (Wilkipedea).

Above all, climate change in the context of the world environment refers to significant, long-term changes in the global climate. It is the connected system of the sun, earth and oceans, wind, rain and snow, forests, deserts and savannas, and everything people do. It is more than the average of the climates of specific places or areas. It is this systemic connectedness that makes global climate change so important and so complicated (Warm Heart Foundation).



(Source: US Environmental Protection Agency)

Note: The earth's atmosphere has always acted like a greenhouse to capture the sun's heat, ensuring that the earth has enjoyed temperatures that permitted the emergence of life forms as we know them, including humans. Without our atmospheric greenhouse the earth would be very cold.

Causes of Climate Change

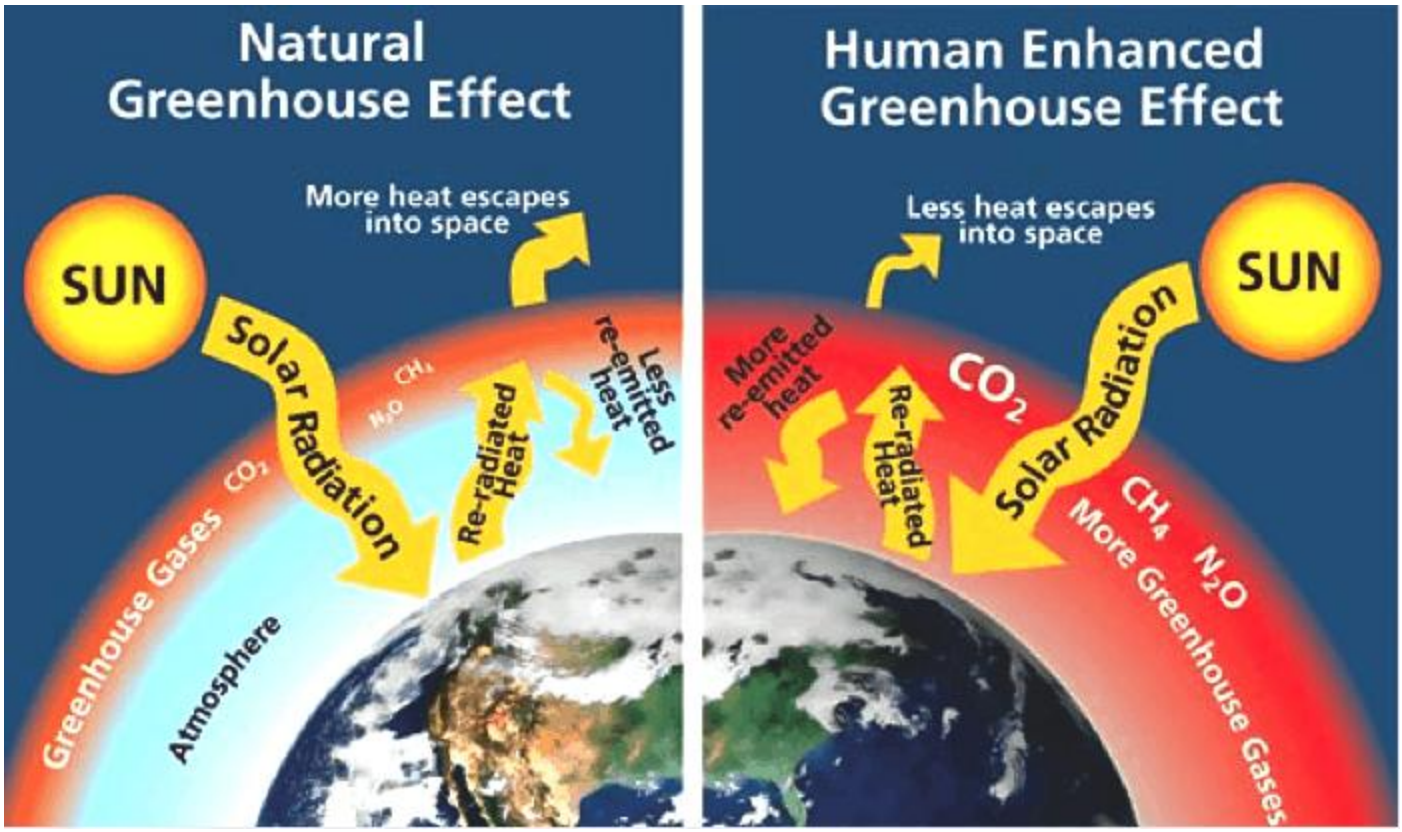
The major causes of global climate change can conveniently be summarized into two-the natural process of Greenhouse gases and the greenhouse effect and human activities induced by the era of Industrial Revolution (Climate Change Primer).

1. Greenhouse gases and the greenhouse effect:

Greenhouse effect is a natural process that warms the Earth's surface. When the Sun's energy reaches the Earth's atmosphere, some of it is reflected back to space and the rest is absorbed and re-radiated by greenhouse gases. The absorbed energy warms the atmosphere and the surface of the Earth (Climate Change Primer).

Greenhouse gases are those that absorb and emit infrared radiation in the wavelength range emitted by Earth which include Water vapor (H_2O) and Clouds, Carbon dioxide (CO_2), Methane (CH_4), Nitrous oxide (N_2O), Ozone (O_3), Chlorofluorocarbons (CFCs), Hydrofluorocarbons (HCFCs and HFCs), while Non-greenhouse gases are the major atmospheric constituents that do not absorb infrared radiation and do not contribute significantly to the greenhouse effect and often are omitted from greenhouse gases. They include the most common gases in the Earth such Nitrogen (78%), Oxygen (21%) and Argon (0.9) which contain two atoms of the same elements while the next common gases are the infrared radiate such as Carbon dioxide, Nitrous oxide, Methane etc that can be traced to the effect of human activities especially in agricultural production.

how individual components of the atmosphere contribute to the total greenhouse effect. They estimated that water vapor accounts for about 50% of Earth's greenhouse effect, with clouds contributing 25%, carbon dioxide 20%, and the minor greenhouse gases and aerosols accounting for the remaining 5%. In the study, the reference model atmosphere is for 1980 conditions (NASA).



(Source: Center for Climate and Energy Solutions)

- Industrial Revolution:

During the pre-industrial age, concentrations of existing gases were roughly constant, because the large natural sources and sinks roughly balanced. In the industrial era, human activities have added greenhouse gases to the atmosphere, mainly through the burning of fossil fuels and clearing of forests. Since the beginning of the Industrial Revolution, the concentrations of most of the greenhouse gases have increased and recent data also shows that the concentration is increasing at a higher rate. In the 1960s, the average annual increase was only 37% of what it was in 2000 through 2007, but today it has increased the more as a result of human activities by burning fossil fuels, deforestation and forest degradation in tropical and boreal regions which is called anthropogenic factor for climate change (Warm Heart Worldwide).

It has had a discernible influence on many physical and biological systems and projected to have a range of impacts , including sea level rise, increased frequencies and severities of some extreme weather events, loss of biodiversity and regional changes in agricultural productivity (Warm Heart Worldwide). .

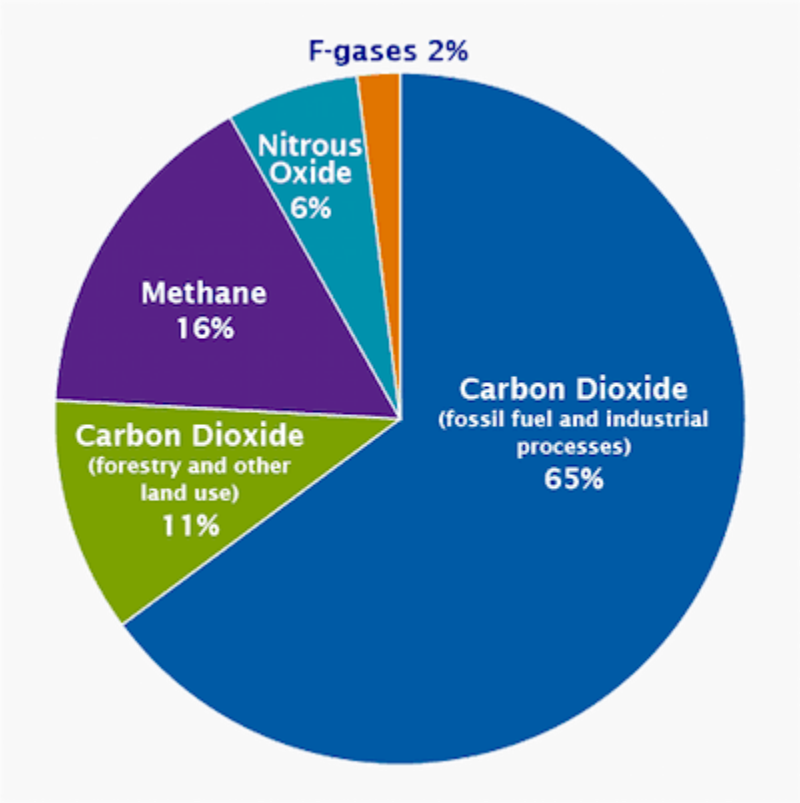
The main s of greenhouse gases due to human activity are:

- burning of fossil fuels and deforestation leading to higher carbon dioxide concentrations in the air and land use change mainly deforestation in the tropics which accounts for almost one third of total anthropogenic CO2 emissions.
- livestock enteric fermentation and manure management, paddy rice farming, land use and wetland changes, man-made lakes, pipeline losses, and covered vented landfill

emissions leading to higher methane atmospheric concentrations. Many of the newer style fully vented septic systems that enhance and target the fermentation process also are sources of atmospheric methane.

- use of chlorofluorocarbons (CFCs) in refrigeration systems, and use of CFCs and halons in fire suppression systems and manufacturing processes.
- agricultural activities, including the use of fertilizers, that lead to higher nitrous oxide (N_2O) concentrations.

According to the IPCC, human-caused global warming is driving climate changes which impact both human and natural systems on all continents and across the oceans.



(Source: US Environmental Protection Agency)

Climate Change and its Global Impacts

As earlier mentioned global climate change is a connected system and therefore its impact s are felt everywhere in the world. For instance, millions of people are already suffering from the catastrophic effects of extreme disasters exacerbated by climate change – from prolonged drought in sub-Saharan Africa to devastating tropical storms sweeping across Southeast Asia, the Caribbean and the Pacific. During the summer months for the northern hemisphere in 2018, communities from the Arctic Circle to Greece, Japan, Pakistan and the USA experienced devastating heat waves and wildfires that resulted in the deaths of hundreds of people(Kumi Naidu Amnesty Int. 2019).

Therefore, among the most important impacts that the world face today are the following:

- Rising Sea Levels in the Coastal Regions
- Melting Ice in the Glacier and Antarctic Region
- Torrential downpours and more powerful storms across the world
- Heatwaves and Droughts in the Desert Region
- Changing Ecosystems (Fisheries and Forest Trees)
- Reduced Food Security
- Changes on Human Health (Risk of Malaria)

Climate Change and its impacts on Global Food Security

One of the most striking impacts of climate change is on global agriculture which is felt differently in the largely temperate developed world and in the more tropical developing world thereby changing the ecosystems. Different crops grow best at quite specific temperatures and when those temperatures change, their productivity changes significantly. For example, farmers in temperate zones are finding drier conditions difficult for crops such as corn and wheat and their production is now being threatened and it increases fishermen's catches as the water becomes warmer. But it may expand production and productivity north of the border in Canada.

Similarly, in the developing world like the sub-Saharan Africa Region, climate change result in scenarios like drought , erosion, excessive rainfall, flooding, excessive temperature, rising sea levels and water scarcity which affect agricultural production and cause rises in food prices. The consequences of this are high levels of hunger and poverty.

Climate Change and its impacts on Food Security in sub-Saharan Africa Region

Agriculture is the most important sector of the economy of the countries of the Sub-Saharan Africa Region. Majority of the people and especially the poor women depend on agriculture for their livelihood which is primarily subsistence farming and which are the most affected group within agricultural households because of the social division of responsibilities and differences in access to land resources (Cannon, 2002)

There is a scientific consensus on climate change reports that sub-Saharan Africa has been adjudged as the most vulnerable region to the impacts of climate change because of its reliance on agriculture which is highly sensitive to weather and climate variability such as changes **in** average temperatures, rainfall, and climate extremes (e.g., heat waves); changes in pests and diseases and changes in the nutritional quality of foods and low capacity for adaptation (Kotir, 2011).

Furthermore, the effect of climate change varies across the Sub-Saharan African region. The existing cropping systems are not in harmony with the rainfall pattern and about 50% of the annual rainfall is lost due to low water intake rate and lack of suitable soil management practices (Kotir, 2011). Climate change therefore has become a serious threat for the farmers of the area and the farmers sometimes faced huge financial losses due to crop failure. All these result in reduced agricultural productivity with substantial impact on food security (IPCC 2001).

The reports also revealed that climate will negatively affect agricultural production in Sub-Saharan Africa as the area suitable for agriculture, the length of growing seasons and yield potential, particularly along the margins of semi-arid and arid areas, are expected to decrease (Kotir 2011). These impacts will affect all components of food security: food availability, food accessibility, food utilization and food stability and hence increase the risk of hunger in the

region **(**Kotir 2011), (IPCC 1995)**.** This thus confirms the general consensus that Sub-Saharan Africa is the most vulnerable region to climate change **(**Kotir 2011).

The solution now is that, policymakers and development agencies should focus on formulating and implementing policies and programs that promote farm level adaptation strategies currently being practiced by farmers across the region (Kotir 2011) as achieving food security means understanding, among other things, the ways in which farmers make agricultural decisions and adapt to environmental shocks (Burnham and Ma, 2016;Harmer and Rahman, 2014).

For instance, adaptation practices being observed in Sub-Saharan Africa include diversification of livelihood activities, institutional architecture (including rules and norms of governance), adjustments in farming operations, income generation projects and selling of labour (e.g., migrating to earn an income and the move towards off or non-farm livelihood incomes in parts of the region repeatedly surface as key adaptation options , Bryceson, 2004; Benhin, 2006; Osman-Elasha et al., 2006).

Therefore, reducing risks with regard to possible future events will depend on the building of stronger livelihoods to ensure resilience to future shocks (IFRCRCS, 2002). The role of migration as an adaptive measure, particularly as a response to drought and flood, is also well known. Recent evidence, however, shows that such migration is not only driven by periods of climate stress but is also driven by a range of other possible factors the dominant of which is seasonal migration which provides a critical livelihood source (Boko M.I. et al).

The role of the United Nations Organization and the Intergovernmental Panel on Climate Change (IPCC)

To strengthen the global response to the threat of climate change, the United Nations Organization established the Intergovernmental Panel on Climate Change (IPCC) which is an intergovernmental body dedicated to studying and providing the world with an objective, scientific view of climate change, its natural, political and economic impacts and risks and possible response options.

Incidentally the body came up with three post-2015 agendas for action to achieve its objectives– the Paris Agreement, the 2030 Agenda for Sustainable Development and the Sendai Framework for Disaster Risk Reduction which provides the foundation for sustainable, low-carbon and resilient development under a changing climate.

The Paris Agreement at the COP21 in Paris went into force in November 2016 and was adopted by 175 countries as their national plans for responding to climate change. Nigeria signed her own on September 22, 2016 Hence, achieving the primary goal of the Paris Agreement is to keep the average global temperature rise well below 2C degrees and as close as possible to 1.5C above pre-industrial levels which is vital to the achievement of all the three Agendas. In the agreement, all countries agreed to work to limit global temperature rise to well below 2 degrees centigrade.

However, pursuing climate action and sustainable development in an integrated and coherent way offers the strongest approach to enable countries to achieve their objectives efficiently and

quickly under the Paris Agreement and the 2030 Agenda for Sustainable Development. Therefore, by the early entry into force of the Paris Agreement and successful operationalization through achievement of the Katowice Climate Package, the world has entered a new era in its collective efforts on climate change, focusing on urgently increasing ambition and implementation, at all levels of government, business and civil society

Today, the global average temperature has already increased by around one degree, since then underlining the urgency of action if we are to stay as close as possible to 1.5C degrees. To achieve this, the IPCC under the Paris Agreement has built on the UN Framework Convention on Climate Change, bringing all nations into a common cause to reduce greenhouse gas emissions rapidly and to strengthen the ability of countries to build resilience and adapt to the impacts of climate change, including through ensuring adequate support for developing countries. Affordable, scalable solutions are now available to enable countries to leapfrog to cleaner, more resilient economies. The pace of change is quickening as more people are turning to renewable energy and a range of other measures that will reduce emissions and increase adaptation efforts (United Nations Climate Change).

Climate Change and SDGs Agenda 2030

Climate change presents the single biggest threat to Sustainable Development Goals 2030 Agenda as its widespread and unprecedented impacts affect the lives of the people disproportionately especially the poorest and most vulnerable. It is affecting every country and every region of the world and disrupting the national economies. Weather patterns are truly changing, sea levels are rising, weather events are becoming more extreme and greenhouse gas emissions are now at their peak in history.

Invariably, there is need for urgent action to halt it and deal with its impacts which is an integral part of successfully achieving all Sustainable Development Goals (SDGs). In reference to the three relevant SDG goals mentioned in this paper Goals 2, 13 and 15, there are also 12 of the 17 Goals that directly involve taking action on climate change with Goal 13 basically on the lead and having its own goal. A strong climate agreement backed by action on the ground will help us achieve the Goals to end poverty, build stronger economies and safer, healthier, and more liveable societies everywhere.

Incidentally, there were three post-2015 agendas for action to achieve this which are -the Paris Agreement, the 2030 Agenda for Sustainable Development and the Sendai Framework for Disaster Risk Reduction that are to provide the foundation for sustainable, low-carbon and resilient development under a changing climate. The primary goal of the Paris Agreement is to keep the average global temperature rise well below 2C degrees and as close as possible to 1.5C above pre-industrial levels which is vital to the achievement of all the three Agendas.
However, the global average temperature has already increased by around one degree since then underlining the urgency of action if we are to stay as close as possible to 1.5C degrees.

Goal 13-Taking urgent action to combat climate change and its impacts

The fact today is that climate change is affecting every country and every region of the world. It is disrupting national economies and affecting the lives of the people. Weather patterns are truly changing, sea levels are rising, weather events are becoming more extreme and greenhouse gas emissions are now at their highest levels in history. Without action, the world's average surface temperature is likely to surpass 3 degrees centigrade this century and the poorest and most vulnerable people are going to be affected the most.

Affordable and scalable solutions and a range of other measures that can reduce emissions and increase adaptation efforts and enable countries to leapfrog to cleaner, more resilient economies need to be coordinated at the international level to help developing countries move toward a low-carbon economy. . As of April 2018, 175 parties had ratified the Paris Agreement and 10 developing countries had submitted their first iteration of their national adaptation plans for responding to climate change. Pursuing climate action and sustainable development in an integrated and coherent way offers the strongest approach to enable countries to achieve their objectives efficiently and quickly under the Paris Agreement and the 2030 Agenda for Sustainable Development.

SDG Goal 13 Target: Facts and Figures

- As of April 2018, 175 parties had ratified the Paris Agreement and 168 parties had communicated their first nationally determined contributions to the UN framework convention on Climate Change Secretariat.
- As of April 2018, 10 developing countries had successfully completed and submitted their first iteration of their national adaptation plans for responding to climate change.
- Developed country parties continue to make progress towards the goal of jointly mobilizing $100 billion annually by 2020 for mitigation actions.

Global climate change is a global issue, and responses require global co-operation, especially to help developing countries adapt to the adverse impacts of climate change.

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