

## Review Article

# A Review on Intergovernmental Panel on Climate Change (IPCC) 1<sup>st</sup> to 6<sup>th</sup> report

### **ABSTRACT**

This article reviews the first to sixth report of the Inter-Governmental Panel on Climate Change (IPCC). The types of greenhouse gases, sources of greenhouse gases and the impact of climate change on man, animals and the environment has been identified. The strategies to combat climate change has been studied in these reports. A review of these reports is necessary and it is necessary document to combat the adverse effects of climate change and global warming.

**Keywords: IPCC Report, Global warming, Climate Change**

### **1.0 INTRODUCTION**

#### **BACKGROUND**

**Greenhouse gas:** Greenhouse gases refer to those gaseous constituents of the atmosphere produced both naturally or by human activities. These Greenhouse gases trap energy from the Sun within the atmosphere, making it to warm the Earth's planet. These gases include the following; Water vapour ( $H_2O$ ), Carbon dioxide ( $CO_2$ ), Nitrous oxide ( $NO_2$ ), Methane ( $CH_4$ ), and Ozone ( $O_3$ ) are the primary greenhouse gases in the Earth's atmosphere; while Hexafluoride ( $SF_6$ ), Hydrofluorocarbons (HFCs), and Perfluorocarbons (PFCs) are also of concern. Moreover, the Halocarbons and other Chlorine and Bromine containing substances are regarded as human made greenhouse gases. The depletion of Ozone layer in the stratosphere results in a decrease in radiative forcing due to the presence and magnitude of Chlorofluorocarbons (CFCS) released into the atmosphere over the last decades. The release of Sulphur was assumed to cause a cooling effect within the Northern Hemisphere during the past decades. It was later noted that Sulphur emissions were responsible for acid rain and other environmental issues. The need to carry out more researches in this area was raised and modelling was emphasized for improvement and to clear uncertainties (IPCC, 1991).

### **2.0 THE IPCC WORKING ASSESSMENT REPORTS**

The current Climatic state has raised concern about the Earth's global climate, the role played by human activities and how it is changing. A major contributor to the activities of these finding is the Intergovernmental Panel on Climate Change (IPCC), which was jointly established in 1988 by two organizations under the Chairmanship of Professor Bert Bolin. The Intergovernmental Panel on Climate Change (IPCC) first working group report was setup to address and strengthen global response to the treat of Climate change (IPCC, 1991). The IPCC further setup six tasks to address the issues of Climate Change. They include: Task 1: Assessment of net greenhouse gas emission, their Sources and sinks of greenhouse gases. Task2: Predictions of Climate change distributions across different regions, impact studies and model validation, analyzing the sensitivity of the produced models. The General Circulation Model and other models which work based on physics laws. Task 3: To analyze the Energy and Industrial issues; Task 4: Agriculture and forestry related issues; Task 5: Vulnerability to sea level rise; Task 6: Emission Scenarios. From the findings of the working group, it concluded that emissions which resulted from human activities were substantially increasing atmospheric concentration of greenhouse gases such as: Carbon dioxide, Chlorofluorocarbons, Methane and Nitrous oxide. The designed modelling predicted the sensitivity

analysis and observations and it indicated that global average surface temperature would double the amount of  $CO_2$  in the atmosphere. Moreover, the IPCC working group also predicted that the range of value between of temperatures to be  $1.5^\circ C - 4.5^\circ C$ . The working group also had many uncertainties in predictions due to limited information's in most areas and continents. The Global average air temperature was increased by  $0.3^\circ C$  to  $0.6^\circ C$  over the past 100 years (IPCC, 1991). The IPCC further setup different working groups in subsequent times to handle issues of Climate change globally (IPCC, 1991).

The Working Group II of the Intergovernmental Panel on Climate Change (IPCC) was setup to review the state of knowledge concerning the impacts of Climate Change on ecological and physical systems, human health, socio-economic sectors and reviewing available information on the technical and economic feasibility of a range of potential adaptation and mitigation strategies. To provide scientific, technical and economic information which can be used in evaluating whether projected range of plausible impacts constitutes "dangerous of anthropogenic interference with the climate system. It has been a challenge that human activities have increased the atmospheric concentrations of greenhouse gases which tend to warm the atmosphere and, in some areas or regions and aerosols released which is assumed to warm the planet as well. These changes in greenhouse gases and aerosols, taken together, are projected to lead to regional and global changes in climate and climate-related parameters such as temperature, precipitation, soil moisture and sea level (Adger, et. al., 2014), (AghaKouchak, et. al., 2014), (Creutzig, 2016), (IPCC, 2014).

The Third Assessment Report Working Groups of the Intergovernmental Panel on Climate Change (IPCC) considers former assessments and merges new results from the previous years of research on climate change. It is confirmed that the earth's climate system has changed both at the global and regional scales. The IPCC Third Assessment further reports that there is a stronger confirmation that warming is mostly attributed to human activities. The Policymakers further summarized and approved the following points;

The global average surface temperature (air temperature over land and sea) over the 20<sup>th</sup> century has increased at the rate of  $0.6^\circ C$ . The 1990s was observed to be the warmest years right from inception when compared with other data collected. New proxy data for the Northern Hemisphere suggests an increase in temperature in the 20th century when compared with previous data of about 1000 years. Although there is limited data for the past 1000 years for the Southern Hemisphere. With the available data, the global increase in temperature from surface satellites at a height of 8km is  $+0.05 \pm 0.10^\circ C$  per decade. Factors such as Atmospheric aerosols, Ozone depletion and El Nino phenomenon is said to have influenced the atmosphere. Global sea level has also risen at the rate of 0.1m and 0.2m since 1950s, snow cover and ice have decreased at 10% - 15% since 1950 within the northern hemisphere. Cloud cover increases by 2%, rainfall rate has increased at about 0.2 to 0.3 % per decade within the tropics. Rainfall rate decreases over the Northern Hemisphere sub-tropics at about 0.3% per decade. Other areas/ regions experience changes in the amount of precipitation; such as changes in atmospheric moisture, thunderstorm. Regions like Asia and Africa are experiencing an increasing level of the intensity of droughts in recent decades while in most areas, intensive rainfall and flooding. It is explained by the policymakers that external factors also influence climate. Radiative forcing is a measure of the influence a factor has in altering the balance of incoming and outgoing energy budget in the Earth-atmospheric system and it is an index of importance of the factor as a potential climate change mechanism. It is expressed in Watts per square metre ( $wm^{-2}$ ). Radiative forcing could be either positive(warming) or negative(cooling). A positive radiative forcing is produced by raising the concentration of greenhouse gases which in turn warms the earth planet while a negative radiative forcing leads to cooling of the earth's surface by the release of airborne particles or aerosols. Aerosols could be released from factors such as volcanic activities, human activities such as industrialization, burning of fossil fuels, to mention but a few. Atmospheric concentration of carbon dioxide  $CO_2$  has been increasing right from 1750 at the rate of 31% at about

1.5ppm over the past two decades. The increase in  $CO_2$  is attributed to the use of fossil fuels, land-use change, deforestation (Alber, et. al., 2008), (Allen et al. 2000), (Collatz et al. 1998). The third assessment confirms that more than half of the atmospheric concentration of methane ( $CH_4$ ) is anthropogenic (fossil fuels, cattle, rice agriculture and landfills) evolving from the use of carbon monoxide. Nitrous oxide  $N_2O$  concentration has increased by (17%) 46ppm since the year 1750 and its emission is confirmed to be anthropogenic. Halocarbon gases are still anthropogenic and was evolved into the atmosphere since 1995. The Halocarbons are gases which are responsible for ozone depletion. Examples are  $CFCL_3$ ,  $CF_2CL_2$ . The stratospheric ozone ( $O_3$ ) layer has been observed to be depleting since 1979 to 2000 and it is estimated to be the cause of negative radiative forcing ( $-0.15 \text{ } \mu\text{m}^{-2}$ ). The troposphere, Ozone  $O_3$  is estimated to have increased at 36% right from the year 1750 and produces a positive radiative forcing of  $0.35 \text{ } \mu\text{m}^{-2}$  (Alber, et. al., 2008), (Allen et al. 2000), (Collatz et al. 1998), (Conway et al. 1994), (Cox, et al. 2000), (Fisher et al. 1994), Fox, (1988).

IPCC Fourth Assessment Report The fourth assessment report observed changes in climates, effects and their causes. It was reported that 89% of data obtained confirms that global warming and Climate Change is existing. Changes are observed within the continents including ocean basin scales, intense rainfall in some areas and draught in others, Cold extremes, less frequencies, heat waves and more frequencies in some landed areas. The Forth IPCC observed Precipitation increased at a higher degree in: eastern parts of North and South America, Northern and Central Asia, Northern Europe, while Precipitation decreased in: Sahel, Mediterranean, Southern Africa and part of southern Asia since 1900 – 2005. Other effects include; Intense tropical cyclone activities around Northern Atlantic, High Precipitation events, occurrences of Natural systems such as ice glacial, snow, lakes, alteration in water quality in terms of temperature, salinity, ice cover changes, oxygen, circulation shift, changes in Phyto plankton, changes in algal, migration of animals both on land and sea. Main drivers of Climate change and Global warming include; both Natural and Anthropogenic activities. Global atmospheric concentrations of  $CO_2$ ,  $CH_4$  and  $N_2O$  have increased markedly due to industrialization (Human Activities). Atmospheric concentrations of  $CO_2$  and  $CH_4$  in 2005 exceeds the natural range over the last 650,000 years. IPCC has identified some relevant areas of concern as temperature changes. The IPCC further concludes that large-scale warming approximately  $3.5^\circ\text{C}$  and above, will increase the likelihood of rigorous, pervasive and irreversible impacts which will be difficult for people to adapt. Risks such as; insufficient access to good water, reduced agricultural productivity, food insecurity, increased rate of loss of livelihood in the rural areas, extreme weather events which may result in breakdown of infrastructures in areas of power supply, network, health and other services. The IPCC further predicts that rising temperature in African will exceed other continents if precautionary measures are not taken.

The Fifth IPCC Report Group Focuses mainly on the effects of climate change and global warming only in African continent. The bone of contention is; Changing Climate and its implications. The fifth IPCC reports that further Climate Change may occur if measures are not being put in place and these will hinder the growth and development of the continent IPCC (2013). The IPCC fifth assessment report further recommends that Mitigation and Adaptation of Climate Change are the recommended strategies to combat Climate Change. Mitigation is the process of reducing emissions or enhancing sinks of greenhouse gases (GHGs), so as to limit future climate change. Adaptation is simply a process of adjustment to actual or expected climate and its effects in order to either lessen or avoid harm or exploit beneficial opportunities. Adaptation and Mitigation are both strategies suggested to reduce and manage the risks of Climate Change impacts in Africa. IPCC fifth assessment.

The Fifth Assessment Report of the Intergovernmental Panel on Climate Change (IPCC) Research still confirms that the Earth's Climate is still warming since 1950s and Africa will experience a widespread impacts and changes in its environment such as changing rainfall or melting snow, ice altering freshwater systems, results in poor water quality and quantity, IPCC (2013), IPCC (2014) as it confirmed earlier. The IPCC confirms a 95% certainty to Climate Change and global warming is as

a result of the concentration of greenhouse gases in the atmosphere due to human activities. It has been projected that the impact of Climate Change will affect water availability in some areas, food production and human health in Africa which will as well hinder economic development, food chain, trading investment, human security and economic growth IPCC (2014). Strong evidence of global warming is presented by the fifth assessment report over Africa for the past 50 to 100 years as surface temperature is already increasing at the rate of 0.5 to 2.0 °C and the warming is very likely to keep its pace. Temperature changes play a major role, increasing the rate of diseases like; malaria in eastern Africa and has affected farmers in southern Africa. Increased annual rainfall is experienced in some parts of Africa to be between 5mm to 50mm for each decade and rainfall trend varies for different locations. It could be heavy rainfall in some areas which may result in flooding or draught in order areas as the case may be. The impact of extreme weather makes the following vulnerable of Africans; ecosystem, freshwater, terrestrial and marine species. Humans most especially women and children may experience a higher vulnerability risk as a result of susceptibility to infectious diseases, death. The elderly is likely to experience physical harm and death due to heat stress, droughts and wildfires (large destructive fire that spreads quickly). Most humans may tend to migrate while other face psychological and emotional stress, reduction of food consumption and negative health outcome. These variations make it necessary to put adaptation measures in order to manage the risk of changing rainfall on forestry. Effective adaptation will help; strengthen human security, livelihood, improve health services and wellbeing of the African continent and will reduce high level of poverty. IPCC confirms that adaptation is the only way to reduce risk of Green House Gases emission. It is the responsibility of the African governments to promote global actions on Climate Change mitigation and to avoid delay on adaptation as it will end up increasing cost and will create difficulties eliminating global emission of carbon 9. The Fifth Assessment IPCC global Report's on carbon budget states that: For the average global warming to be limited, world emission should be less than 2°C of its total emissions from human activities and should not exceed the range of 800–1,000 Gigatons of carbon dioxide. Presently, the world's Carbon dioxide emission is about 500 Gigatons. The bone of contention for the IPCC fifth assessment is to limit warming below 2°C in Africa as warming beyond such rate will hinder economic growth and human development. The rate of warming appropriate for Africa is 1.5°C. It is certain that human influence has warmed the atmosphere, ocean and land. There are rapid changes in the atmosphere, ocean, cryosphere and biosphere. Recent changes are occurring across the climate system over centuries to thousands of years. Evidences of observed changes in extremes such as; heavy precipitation, droughts, heat waves and tropical cyclones and it is attributed to human activities (IPCC, 2003), (IPCC, 2007), (IPCC, 2011), (IPCC, 2012), (IPCC, 2013), (IPCC, 2014).

Sixth Assessment Report: West Africa is already experiencing widespread losses and damages from climate change. Human activity has been the major reason behind it. The Sixth Assessment Report of the Intergovernmental Panel on Climate Change (IPCC) attest that most African countries have contributed to global greenhouse gas emissions causing climate change. Presently, West Africa is already facing loss of lives and impacts on human health, reduced economic growth, water shortages, reduced food production, biodiversity loss, and adverse impacts on human settlements and infrastructure as a result of human-induced climate change, increase in temperature at 1.5°C, 2°C and 3°C warming. It is predicted that the average annual surface temperatures in West Africa will be higher than the global average. Extreme heat and heat waves: In West Africa, the potentially lethal heat days has increased to 50–150 per year at 1.6°C warming and 100–250 per year at 2.5°C warming, the highest in coastal regions and it is likely to affect children born in 2020 within the 1.5°C warming. Over the tropics of West Africa mortality risk from heat waves is 6–9 times higher than the 1950–2005 average at 2°C global warming (IPCC, 2014). Rainfall is forecasted to decrease in the western Africa and increase in the east (medium confidence) of West Africa. A reduction in length of the rainy season is projected over the western Sahel by 4 to 6 days at warming of 1.5°C and 2°C.26 Extreme rainfall events will become more frequent, intense with very high emissions, increasing exposure to flooding (high confidence). At 2°C global warming, West Africa is projected to

experience a dry, more drought and insufficient rainfall in most areas, especially in the last decades of the 21st century. It is expected that future Climate Change is projected to have a very large negative effect on African countries and their economy. The IPCC's Sixth Assessment Report identifies mitigation and adaptation as key areas to support sustainable development for all. Adaptation options include: improving access to climate information, developing agroforestry systems and conservation agriculture, agricultural diversification and growing of drought resistant crop varieties (when low-income farmers can access seeds). Agriculture techniques like; drip irrigation, pits planting and techniques to control erosion can improve soil fertility, increase yield and increase household food security, while increasing farmers' resilience (IPCC, 2021).

### **3.0 DISCUSSION OF RESULTS**

Historical data shows that observed global surface temperature has been increasing since 1850– 2019 as a function of cumulative Carbon dioxide, Chlorofluorocarbons, Methane and Nitrous oxide. Increase in magnitude and the global temperature of the earth may be of the order 1.5°C – 4.5°C if precautionary measures are not adequately implemented. The Intergovernmental Panel on Climate Change (IPCC) confirms that greenhouse gases in the atmosphere are due to human activities (deforestation, land-use-change, use of fossil fuels, industrialization and others). The Intergovernmental Panel on Climate Change (IPCC) provides a high level summary of the current state of the climate, the changes occurring, the role of human influence, provides knowledge about possible climatic effects ( heavy rainfall , flooding or draught, extreme weather, ecosystem, freshwater, terrestrial and marine species extension, vulnerability risk as a result of susceptibility to infectious diseases, psychological and emotional stress, reduction of food consumption, negative health outcome, death). Relevant information's about regions and possible ways of combating climate change were discussed. They include; Mitigation and Adaptation method. Both methods can be effective if applied simultaneously rather than applying them individually. Effective Adaptation will help; strengthen human security, livelihood, improve health services and wellbeing of the African continent and will reduce high level of poverty. The Sixth Assessment report on Climate Change attest that African countries are also contributors and it predicts that the level of temperature increase in Africa may exceed 2°C and 3°C, except mitigation and adaptation measures are adopted.

### **4.0 SUMMARY AND CONCLUSION**

Historical data reveals that observed global surface temperature is increasing steadily. Carbon dioxide, Chlorofluorocarbons, Methane and Nitrous oxide emission is increasing in magnitude and the global temperature of the earth's surface is eventually shifting towards 4.5°C. There is a very strong confirmation of the presence of greenhouse gases in the atmosphere and these is due to human activities (deforestation, land-use-change, use of fossil fuels, industrialization and others). A summary of the of the current state of the climate, the changes occurring, the role of human influence, provides knowledge about possible climatic effects, relevant information's about regions and possible ways of combating Climate Change has been provided by the IPCC. Possible ways of control suggested by the IPCC are; Mitigation and Adaptation method. The Sixth Assessment report on Climate Change attest that African countries have contributed to Global warming due to human activities and it predicts that the level of temperature increase may exceed 2°C and 3°C, if mitigation and adaptation strategies are not applied. Further work required to be done in some areas with uncertainties. They include; Estimation of future emissions and biogeochemical cycling (including sources and sinks) of greenhouse gases, aerosols and aerosol precursors and projections of future

concentrations and radiative properties. How to present of climatic processes using models, particularly feedbacks associated with clouds, sea, ice, oceans and vegetation, to help improve patterns of climate change, A collection of long-term proxy observations of climate system variables (e.g., hydrological cycles, solar output, atmospheric energy balance components, ocean characteristics and ecosystem changes) for model testing and for detection and attribution studies.

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