

A Critique of Indicators of Climate Variability and Climate Change and its Variability in Developing World

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Abstract

Various terms have been used to describe variations of the state of climatic conditions of a region. These terms include climatic variability, climatic fluctuations, climatic trends, climatic cycles, and climate change. However, both climate variability and change are interchangeably used in many contexts. This paper reviews the contextual literatures on climate variability and changes over time and a critic of this variability in developing countries of the world. Some consequences attributed to climate change such as high temperature, biodiversity loss, health challenge, and food security are caused by increase in human population, urban growth and development, innovation and technology, industrialization and deforestation in African countries. These indices are indirectly referred to as human induced causes of climate change. This study observed that, using variability in agricultural productivity and running water volume as measure may not accurately and empirically justify climate change but variability. Indicators and causes attached to climate variability and change have been time immemorial but these variables were not earlier recognized. The study recommends controlling measures that can slow down biodiversity loss due to geometric consumption of environmental resources beyond recovery level in developing countries such as Nigeria.

Keywords: Anthropogenic, Biodiversity, Climate, Population, Urbanization, Variability.

INTRODUCTION

Climatic variability that necessitates climate change is always changing naturally but the changes do not usually occur on a time scale that is immediately obvious to man unlike weather variations that can easily be recognized. Climate varies on time scales, from year to year one decade, century or millennium to the next. From Micheal's (2002) point of view, climate variations happen on time scales, as well as spatial scales, from regional to global scale. According to Ayoade (2003), various terminologies are used to describe variations in climate this include climatic variability, climatic fluctuations, climatic trends, climatic cycles and climate change, refer to some appropriate time scales and can only be validly used within such time scales. This summation of assumptions prompted Ayoade (2003) and Odjugo (2010), to state that secular variations in climate occurring between the period of 100 to 150 years may not qualify an area or region to experienced climate change if only the conditions will quickly reverse later, but that a change in climate usually takes place over a long period of time of at least 150

years with clear and permanent impacts on the ecosystem. Every year in a specific time period, the climate of a location is dissimilar. Some years have below average rainfall, while some years have average or above average rainfall. However, these variability results from atmospheric and ocean circulations, caused by differential heating of the earth. The atmosphere moves faster than the ocean, but the ocean stores a large amount of heat and releases it slowly over long period. Thus, the ocean acts as a memory in this circulation. These atmosphere-ocean circulations cause climate to vary in season to-season or year-to-year time periods.

Climate change connotes any change in climatic indicators over time, whether due to natural variability or anthropogenic forces. According to South Eastern Australian Climate Initiative (2013), climate change refers to long-term trends in climate averages such as global warming that has been observed over the past century, and long-term changes in variability (e.g. frequency, severity and duration of extreme events). It is a long-term change in statistical distribution of weather pattern over periods of time that range from decades to millions

of years. Climate change may be limited to a specific region or may occur across the earth (Ibrahim *et al.*, 2011). According to Odjugo (2010), climate change is different from the generally known terms like climatic fluctuations or climatic variability which are the variations in the mean state and other statistics of the climate on all spatial and temporal scales beyond that of individual weather events. Climate change is typically discussed in global terms, yet its effect varies quite dramatically among different regions of the earth (Daniel and Emmanuel, 2012). It was projected that there will be a 1.4 to 5.8°C (2.5 to 10.4°F) increase in global averaged surface temperature between 1990 and 2100 (IPCC, 2007). In the last 100 years, the earth has experienced an approximate 6°C (11°F) increase in global mean annual temperature. According to IPCC (2007), climate change is a change in statistical properties of the climate system when considered over periods of decades regardless of such factors. Change in climate is attributed directly or indirectly to human activities that alter the composition of the global atmosphere which is in addition to natural climate variability observed over comparable time periods (National Framework Convention on Climate Change, 2006).

Based on the Fourth Assessment of IPCC (2007), it was established that anthropogenic activity is responsible for most of the indices of global warming, with radioactive forces from anthropogenic sources being over 10 times larger than all-natural components combined. There is awareness by some studies that Nigeria climate is under change instead of variation. Also, intermittent interchange of climate variability and climate change concept, evidences and effect with one another is pronounced in Africa. This study focused more on the clarification of the controversies between the concept of climate change and variability, causes and their associated evidences in Nigeria. Also, it distinguishes between the two concepts in relation to the evidence that have been in existence before the inception of the term “climate change” which people still attribute to it.

CONCEPTUAL ISSUES

Producers of Climatic Variability and Climate Change

Though, climate change is attributed to both natural and human activities but variation in climate parameters is generally attributed to natural causes.

According to Fisher *et al.* (2007), over the last three decades of the 20th century, the Gross Domestic Product (GDP), per capita income and population growth were the main drivers of increases in greenhouse gas emission. According to Odjugo (2010), climate change is caused by two basic factors, which include natural processes (biogeographical) and human activities (anthropogenic). According to Ezirin and Onuola (2012), climate change is caused by increasing concentration of greenhouse gases (GHG) in the atmosphere. The natural processes are the astronomical and the extraterrestrial factors. The astronomical factors include (a) the changes in eccentricity of the earth's orbit, (b) changes in obliquity of the plane of ecliptic and (c) changes in orbital procession while the extra-terrestrial factors are (a) solar radiation quantity and (b) quality among others. On the other hand, the anthropogenic factor in climate change involves human activities that either emit large amount of greenhouse gases into the atmosphere that depletes the ozone layer or activities that reduce the amount of carbons absorbed from the atmosphere. Anyadike (2009) pointed out the three major causes of climate change which are (i) astronomical, (ii) volcanic eruption and (iii) change in the earth's environment as a result of human socio-economic activities. However, because of changes in the earth's climate since the pre-industrial era, some of these changes are now considered to be caused by human activities. Studies over decades have shown that anthropogenic factors that emit enormous amounts of greenhouse gases are (i) deforestation for agriculture, (ii) burning of fossil fuel, (iii) gas faring, (iv) urbanization and industrialization, (v) population growth which are causes of ozone layer depletion, (vi) global warming and (vii) climate change (Olaniran, 2002; Ayoade, 2003; IPCC, 2007; Odjugo, 2010). But the study of Micheal (2002), attributed natural climatic variability to three types of phenomena such as, (i) variation that is directly driven by a purely periodic external force, (ii) variation due to non-linear interplay of feedbacks within the climate system and (iii) those associated with random fluctuations in physical or chemical factors.

According to IPCC (2010), the world's climate varies naturally as a consequence of the interaction between the ocean and the atmosphere, change in the Earth's orbit and energy received from

the sun. Climate change is global in its causes but its consequences are far more reaching in developing countries of Africa, particularly Nigeria. However, it can be accelerated by series of human activities such as: extensive deforestation and landuse system, increase exploration and exploitation of natural resources beyond their rate of formation and replenishment and over-reliance on the use and abuse of fossil fuel. The most common negative effect of climate variability and climate change in subtropical countries can be inferred from (Reilly,1999; Abaje and Giwa, 2007; Ishaya; Abaje, 2008 and Odjugo, 2010) as follows: (i) frequent drought, (ii) increased environmental damage, (iii) increased infestation of crop by pests and diseases, (iv) depletion of household assets, (v) increased rural-urban migration, (vi) increased biodiversity loss, (vii) depletion of wildlife and other natural resources base, (viii) changes in the vegetation type, (ix) decline in forest resources, (x) decline in soil conditions, (xi) increased health risks and the spread of infectious diseases, (xii) changing livelihood system.

Controversial Issues on the Indicators of Climate Change in Africa

Various evidences and effects of climate change have been cited and explained beyond reasonable doubt, especially in developed countries of the north as well as those areas nearness to the poles. Enger and Smith (2006) identified sea level rising, health effects, disruption of hydrologic cycle, loss of biodiversity, challenges to agriculture food supply and unanticipated changes as the consequences of global warming and climate change. There is a growing indicator that climate change, particularly increasing temperatures, is already having significant impacts on the world's physical, biological and human systems, and it is expected that these impacts will become more severe (Jekayinfa and Yusuf, 2012).

According to Ahmad and Ahmed, 2000; IPCC, 2001; NEST, 2003; Hengeveld *et al.*, 2005; and Odjugo, 2010), indicators of climate change in Nigeria are increasing temperature, increasing evaporation, decreasing rainfall amount in the continental interior, increasing rainfall in the coastal areas, increasing disruption in climate patterns and increasing frequency and intensity of unusual or extreme weather related events such as thunderstorms, lightning, landslides, floods,

droughts, bush fires, unpredictable rainfall patterns, sea level rise, increase desertification and land degradation, drying up of rivers and lakes and constant loss of forest cover and biodiversity.

According to Alabi and Fasasi (2012), climate change in Nigeria, has been affecting people adversely and emphasized that the factors of; seasonal cycles, agriculture, water supply and food production and as well as the activities of floods, hurricane, droughts, fire disasters, poverty, malnutrition and health problems are major indicators of climate change. By and large, all these stipulated indicators are not categorically caused by climate change but due to anthropogenic activities different from intend context of climate change. It is worthy of note that most of these phenomena do not occur due to the generalize factors attributed to them. The predominant and domineering factors in Africa can be linked to abject poverty and inability to compete favourably with the developed world in terms of development. Meanwhile there may be slight deviation from the globally accepted evidences of climate in relation to developing countries. Africa countries are majorly recipient of climate change consequences due to absence of political-atmospheric boundaries. Indicators and causes of climate change have been from time immemorial but were not recognized then. But as a result of the development in science and technology, loss of life and properties, and involved financial implication at global scale, they are attributed to the side effect of climate change. Among the serious issues before the advent of the term "climate change" is flooding; river Hang-Ho (China) and Ogunpa (Ibadan), shrinking and death of inland drainage lakes and seas such as Lake Chad within Chad, Nigeria, Niger and Cameroon and Aral sea between Uzbekistan and Kazakhstan in the former Soviet Union, series of volcanic eruption and aftermath effect of earthquake, tremor and land slide and others. River Hang-Ho in China had been nicknamed as "China Sorrow" over century due to annual sporadic floods and usual destruction to life and property.

Monsoon rain in Southern Asia is associated with regional weather phenomenon but aggravated due to increase in landuse pattern and population growth and destroys more than before. The eruptions of many volcanic mountains like Krakatoa, Vesuvius, Mayor, Pelee had been over centuries with their environmental problems. There

were many earthquakes before and after 1755 Great Libson record but the effect of these natural disasters was minimal due to low population and economic activities of the then. Circum-Pacific Ring of Fire associate with lithospheric phenomenon is not changed neither shifted from their specific geological and geographical location. Despite the problems associated with this zone, large number of inhabitants converges, develop and carry out their daily activities because of the enormous economic prospect of the area. Hence, sudden occurrence of any form of disaster usually claims millions of life and property of which arbitrarily account to the consequence of climate change. It is worthy of note that environmental disaster is not synonymous with the natural causes of climate change.

Biodiversity loss, health and food supply problems have been regarded as the consequences of global warming and climate change but in reality, they are not almost true due to the fact that these situation occasionally dance to the tune of rapid population growth, urbanization and low level of technological development and unsustainable utilization of the available resource. An attempt to meet up with the demand of the teeming population range from family to the entire society at large definitely requires more resource and enormous natural biophysical environment is at the receiving end. One of the general attributes of Africa is that the growth and development of natural resources is inversely proportional to the rate of population growth, especially in Nigeria where implementation of population controlling measures are not applicable. Furthermore, urban landscapes alter the local hydrologic cycle by generating excessive surface runoff compared with rural landscapes (Hall, 1984; Lazaro, 1990). Urban soils are compacted during construction and by vehicular traffic. Reduced vegetation and litter not only increase surface runoff but also accelerates soil loss during erosion. Urban runoff and flooding are also attributed to the population growth. Due to urbanization during last four decades resulting in increase of paved area and decrease in the agricultural land which used to act as a percolation zone as well as rapid unplanned population growth are also key causes of flooding (www.unescap.org). Inefficiency, ineffective and absence of physical planning policies cum indiscriminate waste disposal and illegal structures across the water channels

bring about urban flooding which is usually attributed to the consequence of climate change.

Climate variability in the last 40 years has had a profound influence on the hydrology of the Lake Chad Basin and the declining rainfall levels over the West Africa region have contributed to low water levels and a reduction in areal extent of the Lake from 25,000km² in 1963 to less than 2,000km² in 2003 (Ibrahim and Nichol, 2011). Also, annual reduction in Lake Chad size and area coverage despite the centripetal recharge from the flowing of rivers is aided by indiscriminate and seasonal dam couple with high rate of withdrawal for agricultural activities ever than before. Yet studies have shown that the reading of climatic elements such as rainfall, temperature, evaporation have changed completely. At the beginning you drink water, at the end you drink poison is an old Uzbek proverb about living on the wrong end of a watershed. The success of cotton production by large farmland cultivated taken the advantage of available water easily withdrew for irrigation and other economic activities beyond the capacity of *Sry Dar'ya* and *Amu Dar'ya* rivers that recharge Aral sea, however, spelled the end for the Aral Sea (Enger and Smith, 2006). The seas once served as a fishing port turned to waste land due to more pressure from the populace, extension and expansion of irrigated farmland.

Disruption of water cycle also depends on the rate of usage and watershed management strategies. The major source of dispute between many Nations in Africa today has direct connection with the utility of the volume of river water that drained their political terrain into other countries and this has been before the advent of the term "climate change" and its related problems. Prominent examples are Nile river (Egypt, Ethiopia and Sudan), Lake Chad (Nigeria and Chad Republic), Niger (Nigeria and Mali), and Okavango (Namibia, Angola and Botswana). Insufficiency due to increase in human population in relation to extensive irrigated farms with annual increase in sizes, in order to meet up with the demand of the teeming population and the nation economic survival cannot be underscored on the dwindle of the river water especially in Africa. Generally, shrinking and dwindling in the volume of river water may not be the best criteria for the justification of climate change where increase in the

thirst for irrigation agriculture is predominant, especially in sub-Saharan Africa.

CONCLUSION

There is no doubt about the contextual issue on climate change globally. However, from environmental perspective, it is obvious that climate change may not be empirically equivalent to climatic variability in context and impacts on the environment especially in developing countries of Africa. It is clear from the empirical point of view that persistent in climatic variability usually results to climate change over a considerable period of time. Despite the fact that climatic parameters are oscillating across the globe; the entire world climate is not in the same of alteration, changing in climate is regional and elements in change varies from one geographical location to other, the cause mainly linked to the anthropogenic activities. The fact remains that African countries are more susceptible to the effects of climate change than developed countries of the north due to their developmental backwardness. Thus, there is need for Africa to prepare for the unanticipated change in all ramifications because the effects of climate change do not recognize status or political boundaries. Aside industrial revolution, escalation in climatic variability in agrarian nations of Africa maybe linked with their crude and inordinate effort to meet up with daily need of rapid population. Pronouncement of climatic variability is regionally induced so also its implication on environment. Southward extension of savannah in Nigeria is beyond farming and overgrazing activities but pressure on forest resources to meet up with the daily need. Initially deforestation for lumbering and farming was pronounced but now production of charcoal from immature trees is the order of the day in North central part of Nigeria especially in Kwara and Niger States.

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