



Climate Change in Sub-Saharan Africa: A Review of Political Reactions, Public Awareness and Educational Measures

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Abstract

This paper examines the climate change phenomenon which is a contemporary geophysical and environmental issue as well as a socio-political issue affecting Sub-Saharan Africa. The response of Sub-Saharan Africa was assessed in terms of political reaction, public awareness and educational measures taken. In most Sub-Saharan African countries there is serious evidence of the effect of climate change. The climate change problem being of global political dimension, the Sub-Saharan African leaders can only appeal for the reduction of the green-house-gases emission by the industrialized nations, who are tagged as causing the problem. The Sub-Saharan African people are generally aware of the problem but not much educational measures are yet taken to address the situation except in the non-formal ways of seminars, conferences, workshops and debates. Hence, this paper recommends strengthening the message that the Sub-Saharan Africa should increase its adaptive strategies to contend the onslaught of climate change.

Keywords: Climate change, Sub-Saharan Africa, Awareness.

1.0 Introduction

Climate change is a contemporary global environmental issue that has gripped human civilization for many decades now. It has called for various conferences at the global, regional and local levels to talk on how to combat, abate or manage it. Its threat on the future human existence is forcing all nations to react and address the issue as a matter of expediency. Momah (1995) aptly classified climate change as a major global disorder. Some have described it as “clashing climate catastrophe” (IEEE Spectrum, 2004).

However, there are those who downplay concerns about climate change as overly alarm-raising. Many do not even want to know about climate change or its incipient effect and future problems. This is a dangerous scenario as climate change has however, been brought into recognition by those who should know about it especially climatologists in particular, and they have dutifully warned world leaders and people of the consequences of climate change as global warming is evident in many parts of the world including villages and homes in the Sub-Saharan Africa. This part of the world which appears to be hypersensitive to many world disasters should be

taking the lead in responding to climate change. So, it is always necessary to evaluate the reactions and action of the Sub-Saharan Africa to this important issue from various dimensions.

The view of this paper is that in Sub-Saharan Africa, climate change is real. There is a broad consensus that this region will experience severe climate change effects due to its natural geophysical state, poverty and low adaptive capacity. Sub-Saharan African politicians/leaders must be stirred to purposeful action on adaptation strategies, creating public awareness through adequate educational measures and not to wait for industrialized nations to proffer solutions to climate change. No one is immune to climate change and the likelihood of severe changes for Sub-Saharan Africa is too risky to ignore.

This paper tries to explain the phenomenon of climate change and points out its effects now and in the future. It also examines the degree of public awareness and further discusses the educational measures taken. Since much of life depends on the climate, agricultural production is mostly done under the vagaries of the weather. Often food production in Sub-Saharan Africa has been impaired or hampered by abrupt changes of one climatic element

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or another resulting in famine. From what is happening in the Horns of Africa, any threat to climate should be constantly reviewed. Though a global disaster, climate change and its effects both in the short and long run, may hit Sub-Saharan Africa most disastrously because this part of the world is constantly and presently grappling with serious socio-economic and precarious environmental problems.

The contents of this paper can help build awareness and provide updated information on the climate change issue. It may also motivate behaviour and ideas of how to combat climate change.

From the foregoing scenario, the objectives of this paper are to highlight the phenomenon of climate change and its present and future effects and too, to show what attention is being paid in terms of awareness and education with reference to climate change as it affects Sub Saharan Africa in particular

1.1 Location and Features of Sub-Saharan Africa

Africa, the second largest continent, lies between latitudes 35° South and 35° North of the equator. Its East-West limits are from longitude 50° East to 20° West of the Greenwich Meridian. Within Africa, the Sub-Saharan area is from 20N down to the Southern most fringe of Africa i.e. latitude 35° South.

In the midst of Africa's northern parts lies the largest hot desert-the Saharan desert. Of Africa's 48 sovereign states only 6 lie north of the Sahara. The others lie south of the desert and are therefore descriptively called Sub-Saharan Africa (SSA) or Africa south of the Sahara. Consequently, a part of Sub-Saharan Africa is in the northern hemisphere while the other part is in the southern hemisphere. However, all Sub-Saharan Africa have either the tropical (equatorial) or Sub-tropical climate. Some countries fall into the two climates due to the expanse of their land mass. Others lie in the southern fringes of Mediterranean type of climate. Sub-Saharan Africa comprises all the Western, Eastern, Central and Southern Africa countries plus the adjoining oceanic islands. The entire area is washed by the south Atlantic to the West and South West, and the Indian Ocean to the East and South East. In effect, only 14 of the Sub-Saharan African countries are

land locked. The others are influenced one way or the other by the two oceans.

None of the South-Saharan African countries is industrialized. In fact they are among the least developed and poorest nations of the world. According to the CTA Spore magazine (August 2008), the Sub-Saharan Africa emits only 1.59% of the greenhouse gases (GHG's). It however, noted that GHG does not know any borders, the climate change impacts on the livelihood and agriculture of the countries of the Sub-Saharan Africa in a severer way than those nations tagged to be responsible for the problem. Further, the above reference noted that Africa was particularly susceptible, especially the least developed countries (LDC's) which are already very vulnerable at the social and economic levels. Whereas much of the outcome of climate change is in the perspective, there are notable retrospective signs that things have not always remained the same in Sub-Saharan Africa.

1.2 The Climate Change Phenomenon

Climate-the long term (say, 30 yrs) weather pattern of a place has been known and taken for granted (Best, 1974). It is used to describe a region, a country, etc. Climate gives information as to what to expect-cold or heat, sun shine or rain, of a place, while traveling from one part of the globe to another. Anywhere in the world the one climate element that influences life most is temperature. Its influence on Agriculture cannot be over emphasized.

By climate change, climatologists posit that the earth's average temperature is rising and the earth is becoming warmer. With this, arises the much talked about global warming. Global warming therefore refers to an overall increase in temperature in earth's atmosphere and oceans.

The intergovernmental panel on climate change (IPCC) report of 1995 concluded a very long research work and confirmed, as well as warning that the earth's climate was becoming warmer. That was the first, most authentic scientific report involving more than 2500 climatologists, economists and risk analysis specialists. Thirteen years later, in 2008, the IPCC has stood its ground warning, unequivocally that global warming was a looming danger and that mankind was largely to blame. The questions then

are what are making the earth warmer, with what consequences and why is mankind largely to blame? The following highlights are already known internationally.

1.3 The Greenhouse Phenomenon

The planet earth has one unique thing which the moon (and perhaps other planets) do not have in abundance and that is an atmosphere. Basically our atmosphere is the reason why there is life on earth. The earth's atmosphere acting like the glass or plastic panel of a greenhouse, holds some of the sun's warmth that reaches the earth and lets the rest escape. The trapping of heat is important in warming the earth. If it were not so the earth's temperature would be as low as that of the moon (about -18°C) and the earth would be also as cold and as lifeless as the moon (Both bodies are roughly equidistant and should receive the same quality of heat, from the sun).

Naturally, the atmosphere has and maintains just the right quantities and proportion of gases: oxygen, Nitrogen, Carbon (IV) oxide, trace gases and water vapour, which provide the life cycles and the correct greenhouse effect to keep the earth's temperature at tolerable levels (BBC News 2008). However, over the years especially since the past two centuries, (Ajibade, 2008), human activities and some environmental hazards such as volcanic eruptions, have added much more gases especially carbon dioxide, CO₂, into the atmosphere whose presence has intensified the greenhouse effect, which has resulted in global warming. With what consequences? This question will be answered after examining the greenhouse gases emission process.

1.3.1 The Greenhouse Gasses and Their Sources:

The gasses spewed into the atmosphere where they exert their greenhouse effects are.

- Carbon (iv) oxide (or Carbon dioxide), CO₂
- Sulphur dioxide, SO₂
- Dinitrogen oxide (or Nitrous oxide) N₂O
- Methane, CH₄, and
- Chlorofluorocarbons, CFC's

The main sources of these gases are:

- Power-generating plants that use fossil fuels such as coal, petroleum (oil) natural gas etc.
- Gas flaring at petroleum flow stations

- Machines in factories, motor vehicles, trains aero-planes that use fossil fuels
- Forest fires and bush burning for agricultural or other purpose
- Livestock dung's and gases from the digestive system of ruminants
- Decaying/Decomposing vegetable materials and swamp farms and litter of large herds of livestock.
- Escape of sequestered CO₂ in the soil during tillage
- Domestic fires while cooking with firewood or any of the usual fossil fuel used in the kitchen.
- Volcanic eruptions
- The chlorofluorocarbons are a group of felons (Ababio, 1998) used in refrigerators, air conditioners, aerosol spray cans, cleaning agents and in the manufacture of fast food containers and other plastic foam products.

Either in making or usage of these products, CFC's are emitted into the atmosphere and they drift up to the stratosphere where they attack the ozone layer. There is no doubt about the emission of these gases to the atmosphere, nor, are their sources just speculations. What some have questioned is whether the presence of these gases in the atmosphere is the cause of the symptoms scientists have called global warming. Some researchers say that global warming is due to the sun's variability; that the sun has been emitting greater energy in recent time.

1.4 Ozone Layer Depletion

There exists a thick layer of a gas in the stratosphere, composed of O₃ molecules, called the ozone layer. The ozone layer is important because it acts like a protective shield absorbing the ultra-violet (UV) radiation from the solar radiation. Thus the ozone layer drastically reduces the UV light reaching the earth, (Ababio, 1998).

In 1994 scientists Rowland and Moline, discovered that a group of man-made chemical called the chlorofluorocarbons (CFCs) react with the O₃ molecule to form the ordinary oxygen, O₂ in the stratosphere, the CFCs release their chlorine atoms, each chlorine atom reacts with thousands of O₃ molecules, thus destroying the ozone constitution. Measurements and monitors from satellites have

revealed definite drops in ozone level and holes in the ozone layer, especially over the Antarctic region.

As a result, the ultraviolet radiation reaching the earth is said to be increasing, leading to:

- Greater incidence of skin cancer
- Increase in sunburn
- Increase in cataracts
- Reduced productivity of single-cell organisms that form the base of the oceanic food chain.
- Reduction in the yield of many crops, thus posing a threat to world food supply. Like with the greenhouse gasses effect, scientists predicted and sounded warning's many years before the necessary political and economic reactions put a world wide ban on the use of CFC's in the production of goods.

1.5 Current Observed Indicators and Effect of Climate Change

Some specific examples of the signs of climate change in Sub-Saharan Africa are cited below, but it is pertinent to consider the global problems of global warming which also encompasses Sub-Saharan Africa.

- The primary outcome of climatic change is in the form (or line) of global warming. Generally, high ambient temperature is a main cause of discomfort, distress, and low work output, reduced livestock feeding (Singh and Dillon 2004).
- Chukwuocha and Iheanacho (2003) on characterization of impact of climate change in Nigeria, reported that the prominent indicators were:
 - Temperature rise
 - Altered rainfall patterns and intensity
 - High sun intensity
 - Changing harmattan regimes
 They concluded that the Nigeria forestry section was particularly found to be undergoing decline in size, density and composition following climate change.
- The Spore magazine of August 2008 on climate change supplied the following already observed effects of climate change:
 - More frequent and more violent cyclones in the Caribbean's
 - Floods in Africa.

- The gradual sinking of islands in the Pacific
- Heat waves in Europe
- Melting of glaciers (as observed from the rapid rate of Arctic melting which has amazed many climatologists).

1.6 Predicted Future Effects of Global Warming

During the next century if things continue as they are, it is possible that the temperature could increase by as much as 3.5°C (IPCC 2007). The following are what many scientists predicted could happen.

- Regional extremes in weather. This will be manifested in longer drought in some areas and heavier rainfall in other areas giving rise to serious floods and famine.
- Increase risk to health. According to the World Health Organization (WHO) the range of insect carriers of tropical diseases such as malaria and dengue fever would be extended. Some water-borne and food-borne disease and parasites will increase when there is drought and reduced water supply.
- Natural habitats could be endangered if not greatly affected already, e.g. when forests and wet lands that act as filters of air and water are damaged, then forest fires could be more frequent and more intense.

As already happening in some ocean islands, the sea level would rise further and some islands would be completely submerged. Charting the future from the above account one could see that the future changes in climate may not be certain. But changes in weather pattern are certainly inevitable. They will affect all aspects of food production, infrastructure and lifestyle.

According to the Spore magazine (August, 2008).

- One fifth of the world people will face starvation
- Millions will be forced by heat drought and rising sea levels to abandon their land.
- New climate zones will put stages on agriculture, shifting crop patterns that will generally benefit the northern temperature areas and damage the tropical area.

- Food production in Africa could halve by 2020.

The 4th assessment report of the IPCC indicated that particularly the Sub-Saharan Africa is extremely vulnerable to these outcomes due to the fact that these countries economies are highly dependent on natural resources and rain-fed agriculture, and they generally have low level adaptive capacity (Muller, 2009, Iheanacho and Nnaji, 2003).

At our local level our communities now witness delayed rain and hence planting of crops are delayed till the rain are stable and there is enough moisture for the crops to grow and develop.

2.0 Recognition of the Reality of Climate Change by Sub-Saharan African Leaders

Largely the Sub-Saharan African politicians and diplomats acknowledge there is climate change. There is no record of any SSA leaders who have opposed the actual or perceived evidence of climate change. They are seen to be more forceful about the threat of climate change than those of other regions. The following Nigeria newspaper excerpts are notable.

- Climate change is not an abstract or future threat. It is happening now with damaging consequences. Failure to take meaningful action in Copenhagen will not only fail those who are suffering today but will also jeopardize the well being of our planet and future generation (Kofi Annan, 2009).
- Nelson Mandela led a group of eminent global elders' coalition to halt climate change.

They agreed to demand the following at Copenhagen

- All heads of states should attend
- Agreement is to be agreed towards reducing temperature rise to 2° as the outer limit.
- Greenhouse gasses emission must be reduced by at least 50% by 2050 to stop further global warming. (Akanbi, 2009)

2.1 What the Sub-Saharan African Politicians Have Done

The informed take climate change seriously knowing that the consequences of global warming can only spell disaster. Climatologists, Ecologists, Agricul-

turists, medical practitioners, Environmentalists and policy makers, all would wish they had their way to revert or avert the situation and the adverse effects of climate change. However, the policy makers are those in position to make or influence decisions that can help abate or contain climate changes. Their reactions in and outside the Sub-Saharan Africa matters a great deal.

Much of the political reactions on the part of the Sub-Saharan Africa politicians have been in the form of urging the industrialized nations to take steps to back out from emission of green house gases in order to reduce the rise in earth's temperature and global warming. What they want to do from all indications are:

- Mandatory limits on fossil fuel emissions by all countries
- Penalties for offenders or defaulters
- Green energy and environmental conservation.
- The introduction of more environmentally friendly technologies.

The Sub-Saharan countries leaders acknowledge that they have been grappling with poverty, civil unrests and underdeveloped economies, but they have understood and stoop up to the problems of climate change, knowing that its environmental effects will occasion and exacerbate the existing problems more than anything else (Ezeala, 2010).

There have been calls for conversation. Beyond this, the political class in SSA seems to be helpless since they have little or no control over the main cause of the problem. Even to conserve natural resources in the ways of extensive afforestation, arrest of forest fires, conservation of species and adopting environment friendly farming practices e.t.c, could hardly be enforced by the SSA political leaders. Granted, conservation is not easy, yet as Ezeala put it "conservation talks without action/funding is tantamount to conversation." But that is exactly what the Sub-Saharan African policy makers have been limited to doing about climate change and its consequences.

2.2 Conferences on Climate Change

Much of what the Sub-Saharan African politicians want to be done about climate change was repre-

ssed at the various international conferences to discuss climate change and related issues. Prominent among those prompted by alarming reports of the Intergovernmental panel on climate change (IPCC) and the UNO since 1988 are:

- The Earth Summit in Rio de Janeiro, Brazil, 1992, when representatives of the Sub-Saharan Africa joined others to sign a treaty affirming their commitment to reduce greenhouse gas emission being enforced in 1994.
- The Kyoto Protocol in Japan, Dec. 1997, where more than 2,200 delegates from 161 countries, and, when the industrialized countries, were committed to cutting greenhouse gas emission by an average of 5.2% by 2012.
- The U.N. Climate Change Conference in Bali (Indonesia). Agreed on a roadmap aimed at producing a new treaty in 2009 in Copenhagen (Denmark) to replace the Kyoto protocol by 2012 (Spore magazine Aug. 2008).
- The Copenhagen Conference December, 2009.

The Copenhagen meeting was reported as the 15th conference of the parties in the UN sponsored climate change conferences.

In all the conferences what the SSA politicians and other well meaning world leaders have always wanted was a legally-binding treaty that would force the industrialized countries to cut their greenhouse gas emission. But this has never been achieved. In some instances stalemates on talks on emissions have often prompted African nation representatives to walk out in protest, (Ohia, 2009).

So far the best the Sub-Saharan leaders have achieved is political agreements, even though the U.K. Energy and Climate Change Secretary, Mr. Ed Miliband and others have always insisted that the developed countries reduce theirs by 25 to 40% over the next decade to prevent global warming. As reported Ohia, Dr. Autur Range-Metzger and E.U. commission's chief negotiator said that it was simply too difficult to get different nations to sign up legally-binding targets. "People are waiting for each other to move first, so, it is very difficult to blame any one

country". Earlier in November, before the Copenhagen conference, Joss Garman, a climate campaigner for Green Peace said that the politicians seemed determined to blow up the talks on climate change. And they did just that.

Paradoxically, the "USA advocates support for global warming fund" (Anonymous, 2008), yet, as German noted, big industries in America prevent the world from moving forward in effecting the main way of abating global warming, that is by cutting greenhouse gases emission drastically. Report has it that in 2008, that US Treasury secretary Henry Paulson urged other group of 8 industrialized nations to back special funds up to 10 billion to help developing countries fight global warming. But with sky high chimneys the same industrialized countries export their pollution to neighboring lands and the Sub-Saharan Africa.

3.0 Awareness

3.1 Public Awareness

In the Sub-Saharan Africa many people acknowledge that the earth (at least their own part of the earth) is warming. But they are mostly at a loss to both the causes and effects. Many informed persons questioned for this paper agree that human activities may be a factor but not necessarily the principle one. And just as some did in the early years of the AIDs epidemic, some people tend to put their own spin on the available scientific data. Interestingly, farmers across the Sub-Saharan Africa show great Awareness of the effects of climate change more than other groups whose occupation indoors might not have a direct impact of the problem.

3.2 Farmers Awareness

The following accounts were drawn partly from the Spore magazine of August 2008 a special issue on climate change while others are from other sources as cited

- Juma N. Macharia from Muringara, 100km west of Nairobi, Kenya said that when he was young the rainy season in Kinanagop area was known to start in mid April, but that it has shifted to June when it used to end. Thus he indicated knowledge of the changing weather patterns.
- In South Africa, farmers are already delaying

planting of maize to take account of changing rainfall pattern

- In some places farmers often select crop combination that will survive harsh condition, such as maize- beans, cowpea- sorghum and millet- groundnuts. These underscore the ability of small scale farmers to weather climate change.
- In Malawi, increased incidence of flash floods have convinced some communities to revive their ancient but long abandoned practice of making bunds to avoid soil erosion and run off.
- Albert Bonda of Tani river district, Kenya complained that the temperature became higher, water evaporation from the ground was so fast and there was a spread of agricultural pests on their crops.
- In Burundi, a farmer Amatole Misango was reported to have lamented: how is it that dry season starts in April.” There the crops were beginning to wither when the rains stopped abruptly after a hurricane. Misango thought that it was perhaps due to their many sins and God was trying to punish them. This shows that some have interpreted the disaster called climate change as a divine chastisement.
- Cape Verd, in West Africa: a recent Voice of America’s (VOA) analysis of the situation is that the climate has changed that the island scarcely receives enough rainfall to see a cropping season through. There is also fresh water storage due to low replenishment of ground water.

3.3 Scope of awareness

Public awareness of the climate change phenomenon transcends agriculture activities. Even children have shown so much awareness that they accuse the world government of doing nothing about it. For example, a report by Laulu Akande entitled “it’s time to act, children tell summit on climate change, marked how world children criticized world leaders for not deciding already on a deal that would curb greenhouse gas emissions and stop the potential devastation of climate change (Akande, 2009).

Advertising practitioners in Cannes France 2007 were urged by the former vice president of the USA

to play the central role in bringing about change in building awareness in reaching consumers with powerful ideas that will motivate behavior and eradicate climate crises (Tunmise, 2007).

The much publicized conferences/summit and protocols on climate change/global warming in the media (electronic and print) bring the issue closer to the public. Many people of the Sub-Saharan Africa have seen the effect of climate change with their own eyes while some can only vaguely discern what it is all about. Yet some people do not understand even the simplest explanations of greenhouse gases intensification and how it causes global warming.

To many others nothing is real until life experiences or the circumstances around them illustrate it. This was found through personal discussions with people in Owerri, Nigeria. It was also found that in Nigeria some who are quite aware of the climate change problem are not worried. They like Austin Ezaze, contend that our earth was not designed to expire. (Ezaze, 2009).

4.0 Educational Measures Taken

Education is conceptualized to take place formally, informally and non-formally. With an issue like climate change, these three philosophical concepts of education should be applied simultaneously. Thus the education measures taken to stimulate knowledge and motivate behaviour towards containing or contending climate change, and disseminating such in the SSA were evaluated under these three dimensions of education.

Though the three forms of education are distinct, there are still areas of overlap and none is more important than the other when qualitatively applied to the problem in question since it is more or less a social problem. The following discussions bear examples mainly from Nigeria for reasons of accessibility of information and space. But it can well be assumed that the findings in Nigeria is a replica of the situation else where in the Sub-Saharan Africa.

4.1 Measures Taken In the Formal Educational Sectors

Formal education pertains to the school system involving students, scholars, teachers’ curricula.

Inquires for this paper found the following situation as obtained in and around Owerri, Imo state, Nigeria.

- Unlike other contemporary socio-economic issues the primary and secondary schools curricula do not yet incorporate the subject of climate change.
- Many teachers at the two school levels do not themselves know much about climate change or global warning in the context defined in the paper.
- In the tertiary institutions discussions on climate change is limited to the science schools or departments, climate change forming a part of the course in such fields as Agriculture, Environmental studies, Ecology, Biology, Climatology, Biogeography etc.
- Much research work on climate change by scholars and students of the higher institutions remain restrictive in respect of academic pursuit and private studies.

This finding concluded that there are no little or no inputs from this sector of education to make for serious political interest or public awareness arousal and reaction to the problems envisaged from climate change.

4.2 Measures Taken In the Informal Education Sector

Informal education can take place in the following places or circumstances: Homes, Religious congregations, Market places –Work places-the street, among commuters and other social gatherings. Investigations in this aspect revealed the following points.

- Climate change has not yet become the house hold words or thing of frequent public discussions in Nigeria as did the AIDS epidemic, for instance.
- Only some conventional churches make mentions of changing weather conditions from the pulpit, but nothing in the form of preventive measures to their congregation. Some religions just remark of the persistent rough weather conditions as signs of the end time.
- Among commuters and work mates, sparking of discussion on climate change would meet with disinterested, passive listeners who see it as distance thing of

scientific interest. Many do not understand it beyond the discomfort that might impair sleep when there is power outage.

- The overall issue of the climate change sounds impersonal to many uniformed Nigerians. This may be because the situation is not at once resulting in wide spread deaths and debilitations.
- Hence informal education, which is usually effective in creating public awareness and enforcements of contemporary, social, issues has not been of much use in case of climate change in Nigeria and therefore, much of the Sub-Saharan Africa.

4.3 Measures Taken In The Non-Formal Educational Sector

Seminars –debates – workshops – conferences – publications in the media (Newspaper, magazines, radio television etc). Slogan bill board advertisement, fliers, etc. the above list constitutes some of the non-formal ways of education. The investigation in this area found as follows

- In Nigeria, the non-formal form of education has been the most applicable measure in creating public awareness and stressing the impacts and strategies for coping with climate change.
- Volumes of papers and articles in journals have been written and/ or presented by various scholars and researchers of environment related disciplines, professional association and societies.

For instance a review by Nwankwo (2003) informed us of what areas are expected to be affected adversely by climate change, which includes:

- Hydrology and water resources
- Agriculture and food security
- Terrestrial and fresh water ecosystems
- Human health and settlement.

Likewise, national dailies and local papers have published many activities on climate change in order to educate the masses on the issues surrounding it. So have some radio and televisions stations given programmes that focused on climate change. On the other hand, billboard and fliers have not been used to any reasonable degree to tell the public about climate change like it was done for AIDS.

5.0 Summary

Climate change is a contemporary global issue. To the informed person, it is a remarkable environmental, geophysical phenomenon of this millennium. It is also coated with socio-political implications. The threat of climate change to the present and future existence of man and other organisms on the planet earth are seen as not at all palatable. On this note, no country is immune to climate change.

The Sub-Saharan Africa and some other parts of the world are already receiving some adverse impacts of climate change in the forms of long, severe drought, high floods, changes in rainfall pattern temperature increase and submergences of coastal lines and ocean islands.

The cause of climate change has been attributed to too much emission of such gases as carbon (IV) oxide (CO₂), sulphur dioxide (SO₂), dinitrogen oxide (N₂O) and methane (CH₄), into the atmosphere by burning fossil fuels and other sources. These gases act as trappers of heat that would normally have gone out into space. Thus they intensify the greenhouse effect of the atmosphere above normal causing the earth to get warmer. Thus global warming is the deviation of the change in climate as presently perceived.

The scientific evidence of global warming and warning as to future consequences alert world governments to do something to abate it and save mankind a future climatic catastrophe. The Sub-Saharan Africa is said to be more vulnerable than most other regions of the world to the adverse effects of climate change. Its leaders, therefore, support and anticipate in various summits and conferences to discuss or debate on climate change. At such conferences as the Kyoto protocol in 1997 and Copenhagen in 2009, the Sub Saharan African leaders had tried to press on the industrialized nations to cut back the emission of the greenhouse gases. But all they get for their efforts has been political agreements on paper. They had at times had to walk out in protest. Apart from these political reactions, the scope and level of awareness of the Sub-Saharan Africa, of climate is gradually increasing. This paper has identified among other things that many farmers have seen the evidence of climate change with their own

eyes and raised their voices to it. But the rate of public awareness is rather slow.

On the other hand, not sufficient educational measures are taken to teach the students in the primary and secondary schools and indeed the masses, the causes and effects of climate change. The non-formal education seminars, the media etc have contributed more than the other forms of education in informing the public about climate change in the Sub-Saharan Africa, using Nigeria as a typical example. The governments of the countries of Sub-Saharan Africa need to do more in this aspect. They can still think globally and act locally. Granted, there is also a measure of uncertainty as to the impact of climate change in Sub-Saharan Africa. This makes it very hard to define specific adaptation strategies (Muller, 2009). However, that is the challenge about which this paper has made a few recommendations.

6.0 Conclusion

Sub-Saharan Africa has all along benefited from the product, if not, the process of industrialization and enjoyed modern life style. As it is the means of generating modern life style, it is proving to upsetting the delicate balance of the earth's atmosphere in what is now seen as climate change.

The Sub-Saharan Africa policymakers have more than just a rough idea of the consequences of doing nothing to halt or minimize global warming. For one thing, this region has been identified as being vulnerable to climate change because of its location in the already hot tropical and subtropical climates, high poverty level, and low adaptive state of its countries.

Political leaders of the Sub-Saharan Africa also yearn to be viewed as environment friendly like the industrialized countries. So they are involved in conferences and debates on climate change. But for all their efforts to see that greenhouse gases emissions are reduced, what they get is political agreements on paper.

On the home front the Sub-Saharan Africa countries are doing enough in directing educational measures needed to create awareness to the public about

climate change and its dire consequences on the nature, health and food production.

Finding solutions, making decisions and taking action on developing adaptation strategies against climate change will make a huge difference in reducing tomorrow's problems. Doing nothing, waiting and enlisting the help of industrialized world, is gambling with the future of their children, their health, their food production and their very existence.

7.0 Recommendations

Climate change as defined in this paper is an ongoing process in the direction of global warming. Since it is a global problem, it calls for global solutions. But the Sub-Saharan Africa can, in addition, take measures to improve its adaptive capacity to climate change. Therefore the recommendations of this paper are two pronged

- Intensification of global strategies against climate change.
- Increasing the adaptive capacity of the Sub-Saharan Africa.

For the first recommendation the following steps are suggested:

- Intensification of global strategies to step down global warming and checking environmental degradation.
- Wide spread use of pollution-free forms of energy. For example, harnessing energy from the sun (solar energy), wind, river, geothermal energy and nuclear energy generation.
- Pressure industrial countries to cut back emission of green house gases, by insisting on mandatory rather than voluntary cut back. That is to put "teeth" to international agreements.
- The Sub-Saharan countries themselves should pass laws to reduce heat-trapping gases emission. For example, Nigeria should enact laws limiting gas flaring and limiting the number of cars an individual should possess. Furthermore constant electricity supply will limit use of generating plants by large members of people.
- Educational measures should be widened and all encompassing to make for public awareness of climate change. In doing so

the governments could elicit sponsorship by firms and voluntary actions by non-governmental organization (NGO's) in project concerning contending climate change and other environmental issues. Farmers particularly need special attention in this regard so that they can be induced to adopt sustainable practices in food production.

For increasing the adaptive capacity of Sub-Saharan Africa the suggestion below could help.

- Diversification of their income and be less dependent on production systems that depends on environmental conditions such as arable cropping.
- Increase and improvement of techniques for rain-water harnessing to capacities that can take care of times of insufficient precipitation.
- Extension of irrigation to major cropping areas and for major staples to buffer adverse weather conditions. Because with climate change the seasonality of rainfall will be more uncertain and extreme dry or wet conditions are bound to occur.
- Governments should encourage and sponsor extensive research in sustainable agricultural systems and food storage techniques to save for the rainy days.
- Global warming is just one of the many environmental challenges of Sub-Saharan Africa. Others such as deforestation, water pollution, etc, should be addressed along side global warming. In other words concerted efforts to contend all envisaged environmental problems should be made.

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