



Need For Awareness Of Global Warming, Climate Change And Efforts Towards Curbing The Concern: Implication For Curriculum Design In Science, Technology And Engineering Programmes

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ABSTRACT

The paper discussed the problems, causes and meaning of global warming, greenhouse effect and climate change. Reasons for global concern, threats posed and effects of these environmental problems were outlined. Prominent among the human activities to be controlled is burning of fossil fuels for transportation, electricity generation, industrial use and other forms of innovations that were introduced since the period of the first industrial revolution in Britain. Effects such as drought, hurricane, sea level rise, melting of sea ice, habitats and wildlife disruption, challenging health conditions and other hazards were detailed out in the paper. Some efforts being made by International organizations such as United Nations under different umbrella names/bodies and nations' government and agencies in climate and environmental matters were outlined. Nigeria, being a member nation of the global community is at risk of being effected by global warming and climate change problems. Efforts of agencies such as National Environmental Standards and Regulations Enforcement Agency (NESREA), Nigerian Meteorological Agency (NiMet), Department of Climate Change Nigeria, Federal Ministry of Environment and other governmental and non-governmental bodies towards curbing the problem of environmental degradation, global warming and climate change were highlighted. This paper concludes by discussing the implication of these changes in global warming, greenhouse effect and climate on curriculum design in science, technology and engineering programmes.

Keywords: Global warming, Climate change, Environment, Greenhouse effect, Science and Technology, Awareness, Curriculum design

INTRODUCTION

Problems of global warming, greenhouse effect and climate change are lately becoming a source of concern to individual scholars, scientists/ environmentalists, non-governmental organizations and governments of nations. The grave and possible threats posed to living things on earth by these factors of environmental degradation may have triggered off the present discourse on the subjects-matter. The danger is already staring mankind in the face as the whole space-time spectrum is affected. Evidence of steady global rise in temperature and other environmental abnormalities abounds. The debates are mainly centred on raising awareness and also finding solutions to the environmental menace for a sustainable future. It is posited by Nunez (2019) that the controversy nowadays is shifting from the question of whether human activities are causing global warming and tending towards question of how best to respond and curb the problem. Although mean temperatures have fluctuated among regions of the world between seasons and times of the day, months and year, scientist and environmentalists have demonstrated from analysis and reports an upward trend in average temperature of the globe. Within the African continent, Nigeria is regarded as an industrialized

country and contributing a large proportion of emissions of greenhouse gases in Africa, mainly through gas flaring activities. The country is already being threatened by so many environmental hazards such as sparse rainfall in the North which affects food production, uncontrolled logging, oil exploration and spillage, deforestation, flooding, bush burning resulting in acid rain, urbanization, increasing risk of heat-related diseases and rising cost of extreme weather damage (Ogunniran, 2018).

Meaning of Global Warming, Greenhouse Effect and Climate Change

Global warming is the trend at which the average global surface temperature on earth has increased. Macmillan (2016) acclaimed that over the past 50 years, the average global temperature has witnessed the fastest rate of increment in recorded history. According to Nunez (2019), global warming is the rapid rise of greenhouse gas emissions from human activity resulting in dramatic and relatively recent rise in global average temperatures. Other experts and scientists generally see the global-warming emissions trend as accelerating in an unprecedented rate from North to South poles and need curbing urgently. The existence of lives here on earth is being threatened for extinction if the average global temperature increases by up to 10 degrees Fahrenheit over the next century. Global warming also known as thermal pollution is regarded as an increase in the average temperature worldwide and believed to be caused by the greenhouse effect.

To be able to understand global warming adequately, the concept of greenhouse effect need to be understood. Experimental evidence exists showing that carbon dioxide in the atmosphere acts to direct heat back toward the Earth. As radiations from the solar system and sunlight escape into space, the heat released is trapped by air pollutants causing the planet to become hotter. It is noteworthy that these pollutants can last from years to centuries in the atmosphere. A greenhouse is synonymous to a glass house where plants grow. Glass lets light in and keeps heat from escaping. The trapped heat in turn keeps the plants warm even when it is cold outside. In the same vein, the earth's atmospheric gases (carbon dioxide and other gases called greenhouse gases) in the air trap heat energy from the sun. Without these gases, too much heat would go back into space, and living things can be endangered for survival. However, as more greenhouse gases get into the air, they also trap more heat, thereby leading to global warming. Human activity, as posited by Flam (2019) has contributed tremendously to the atmospheric load of carbon dioxide by more than 40% since the time of commencement of industrial revolution.

Excess of the greenhouse gases in the atmosphere can result in ozone layer depletion. Ozone layer is the region of the stratosphere with the highest concentration of ozone molecules which by absorbing high-energy solar ultraviolet (UV) radiation protects organisms on earth, also called ozonosphere (HarperCollins, 2010). The ozone layer is the part of the atmosphere, about 15 miles or 24km above the earth's surface and about 20 48 km above the sea level (Encyclopedia Britannica, 2012). Ozone layer protects people by absorbing harmful rays from the sun, but allowing the non-harmful UV radiations to pass. If these harmful UV rays reach earth's surface without being absorbed somehow, the resultant effects on humans are skin cancer, eye disease and other health hazards. Some gases in reaction which are powerfully-anthropogenic in nature and chemically stable in the atmosphere may become harmful when they drift into the upper stratosphere thereby depleting the ozone layer after emission.

Climate change encompasses rising average temperatures and other extreme weather conditions which tend to shift wildlife populations and habitats, also causing sea levels to rise (National Geographic Society, 2015). Global warming and climate change are not synonymous. Climate change is used by Scientists to describe the complex shift that affects the planet's weather and climate systems. These climatic changes are emerging as humans continue to add heat-trapping greenhouse gases to the atmosphere. Some impact of climate change, as documented by scientists and reported by the National Geographic Society include the following: melting of sea ice worldwide, faster rate of rising of global sea level in recent years, collapsing of some population of wildlife and the habitats due to temperature rise, migration of many species farther north or to higher cooler areas, increase in the risk of wildfires, severe drought, crop loss and shortage of drinking water, yet some regions across the globe is experiencing increased rain and snowfall.

Some species are thriving by devastating millions of forested acres across nations of the world, for example, Bark beetles feeding on spruce and pine tree. Hurricanes and other forms of storms are

likely becoming stronger, floods and droughts becoming more common even getting to a level of "mega droughts" by 2100 as predicted. Severe tropical storm called cyclone idai was recently (March, 2019) witnessed in Mozambique, Zimbabwe and Malawi. Fresh water availability is becoming less. Hurricane Florence has caused numerous deaths and damage to infrastructure. Some diseases are spreading, for example, resurgence of the Zika virus in 2016. Ecosystem continues to change, for example, some species that cannot adapt are becoming extinct.

Causes of Global Warming and Climate Change

People and nations dependent on fossil fuels (oil, gas and coal) have changed the situation of the world. Fossil fuels are today burnt in volumes and transformed into their oxidized state. Carbon dioxide (CO_2) is used to power factories, run cars, generate electricity, heat up houses during cold weather and applicable in other forms of innovations. As fossil fuels burn, the burning fuels release carbon dioxide (CO_2), greenhouse gases and other pollutants into the atmosphere. These air pollutants, greenhouse gases and carbon dioxide collect into the atmosphere, and absorb sunlight and solar radiation that have bounced off from the earth's surface, thereby resulting into global warming (Macmillan, 2016). The largest source of heat-trapping pollution in the United States, for example is the burning of fossil fuels and coals to make electricity. About two billion tons of CO_2 are produced every year in US. The transportation sector constitutes the second largest source of carbon pollution in the US. Though, breakthroughs in atomic science have enriched lives, it is not without negative consequences on the environment (Decamous, 2012).

CO_2 is among certain gases that are known to enhance the atmospheric natural "greenhouse effect". Since the time of Industrial Revolutions in Britain, (perhaps from 17th century), a significant amount of CO_2 from fossil fuel use, methane from livestock production and nitrous oxide from agricultural activities are released into the atmosphere (Daggash, 2018). These greenhouse gases have resulted in the rise of global temperatures at an unprecedented rate in geographical era. Physics laboratory experiment by Irish Scientist, John Tyndall supported the theory that the earth radiates the sun's energy back into space in the form of infrared light (Flam, 2019). Infrared light was shone through various gases. It was found by the scientist that oxygen and nitrogen have no heat-trapping effect, but carbon dioxide does. Scientists over the years have learnt how to calculate and measure the amount of CO_2 that was being added to the atmosphere from coal burning. The atmospheric CO_2 is changing the earth's energy balance and superimposed upon a background of natural variation.

The natural variation is caused by the shifting ocean currents that affect surface temperatures of the oceans. The amount of greenhouse gas-related heating going into the ocean depends on currents known as El Nino and La Nina (Flam, 2019). During the El Nino phase, the currents affect the surface temperatures of the oceans with warmer water coming to the surface. La Nina occurs when cooler water comes to the surface, allowing the oceans to absorb heat like a big sponge. These events, according to Natural Geographic Society (2015), work on fairly short and predictable cycles, with effects not lasting beyond few years. Another cause of the natural variation apart from shifting ocean currents described above is the changes in solar output and the effects of volcanic eruptions. Multiple analyses portray the long-term trend of global warming to be upward and unabated.

Another cause of global warming or thermal pollution is deforestation (Asim, 2012). Uncontrolled falling of trees for different purposes has not been helpful to the human environment. The continued reliance on fossil fuel-powered generator by government institutions, businesses and households as alternative source of electricity in the absence of supply from the national grid is a major threat to Nigeria's climate change plans.

Reasons for Concern over Global Warming and Climate Change

Extreme weather condition is having serious consequences for the health and safety of people around the world. Respiratory infections and other health hazards associated with the extreme weather condition are on the increase. Cases of meningitis and other heat related sicknesses are rising particularly in Africa. Recently, heat waves helped create the conditions for large wildfires in the West, leading to the loss of lives and homes (Freeman, 2018). The impact of rising temperature are not just waiting for a far-flung future, but the effects of global warming are appearing right now. Scientists have agreed that the earth's rising temperatures are fueling longer and hotter heat waves, more frequent droughts, heavier rainfall, problem of flooding and erosion and more intense

hurricanes. In 2016, the National Academies of Science, Engineering and Medicine had announced the possibility of attributing certain weather events like the increasing heat waves directly to climate change. Living things are being harmed as the weather becomes increasingly warmer. Rising temperature is disrupting wildlife and their habitats. For instance, specie known as Adelie penguin in Antarctica, Western peninsula has its population dropped by 90 percent or more.

Polar ice caps and glaciers are melting causing sea levels to rise (Encyclopedia Britannica, 2012). Plants, animals and structures/houses along coastlines would be endangered. Ice is melting world over, especially at the Earth's poles. For example, in Montana's Glacier Natural Park, the number of glaciers has declined to fewer than 30 from more than 150 in 1910 (National Geographic Society, 2015). Much of the melting ice contributes to sea-level rise which is occurring at a faster rate in recent years. The real concern with the build-up of greenhouse gases is the earth getting more energy from the sun than the earth is sending back into space. Energy is not only warming the atmosphere, but it is also melting ice and warming the oceans' water.

It is also based on scientific findings that global warming is essentially irreversible, unlike some other pollution problems. This fact is not appreciated in dealing with global warming. In a recent meeting of the American Chemical Society, Caltech Chemist, Nate Lewis estimated through calculation that even if the world stopped burning fossil fuel, it would take 10,000 years for the atmosphere to revert to its pre-industrial composition. In addition, the oceans are undergoing a chemical change that will take even longer to reverse. It cannot easily be predicted exactly how climate change will play out only that it is likely to be much worse if there is no efforts to address carbon emissions.

Gathering of information on climate change assembled over numerous years has uncovered signs of an evolving atmosphere. The planet's normal surface temperature has increased around 1.62 degrees Fahrenheit (0.9 degrees Celsius) since the end of the nineteenth century, caused primarily by expanded carbon dioxide and other man-made emissions into the atmosphere. The warming mostly happened in the previous 35 years with the hottest years on record occurring since 2010 till date. Worldwide ocean level is quickening marginally every year since the commencement of industrial revolution. The sea level expansion according to Conference Series (2018) is the result of pumping more carbon dioxide into the air which is being ingested into the seas.

The African continent also stands the risk of being struck by the impact of climate change, according to the United Nations Environment Programme (UNEP). By 2020 as estimated by UNEP, between 75 and 250 million people on African continent are projected to be exposed to increased water stress due to climate change; and, agricultural yields from rain-fed agriculture can be reduced by up to 50 per cent (Punch, 2018). Global warming of 2° C would subject over 50 per cent of the continent's population to risk of undernourishment. Of all human activities, agriculture is the most sensitive to weather. Normal weather conditions are associated with good crop yield and positive economic impact. The weather and climate characteristics of any place on earth determine the types of crops that are grown for food, animals that are reared, mode of dressing, types of shelter and even religious beliefs of the inhabitants

The Federal Government of Nigeria also has climate change as one of her focal areas, considering the global awareness being raised on threats to the existence of living things. Nigeria is a member of the global community and also shares in the risk facing the world as a result of global warming and climate change. Nigeria presently is confronted with the problem of desertification advancing southward, potential submergence of coastline stretch along the Atlantic Ocean, biodiversity, aridification impacting agriculture and water quality (Department of Climate Change, FME, 2015). The 2014 World Climate Change Vulnerability Index grouped Nigeria among the 10 most climate-vulnerable countries, and Lagos as the 10th most vulnerable city in the world (Punch, 2018). The on-going oil spillages constitute a threat to living beings. Species are being destroyed and resources necessary for survival depleted or degraded. The ecosystem is being destroyed. Therefore, there is need for an urgent change of attitude among the citizenry to climate and environmental-degradation related issues.

Creating Awareness on Global Warming and Climate Change through Conferences

Despite the signing of the UN framework convention on climate change more than 20 years ago, the world remains backward in finding solutions to the problem of human induced climate change. The challenge is on how to reduce the emissions of all greenhouse gases, CO₂ emissions from fossil fuel

use and de-carbonizing the world's energy system. Also included is the question of reducing certain industrial gases with high warming potentials and reduction in methane emissions from the oil and gas sector. Scientists have devised methods of directly looking at the atmosphere of the earth's environment in the past. Discoveries made have enabled the present knowledge that the concentration levels of greenhouse gases since the industrial revolution are higher than what was obtained some hundreds of thousands of years ago (National Geographic Society, 2015). Computer and climate models, furthermore, have enabled scientists/environmentalists to understand and be able to predict the earth's climate and long-term weather patterns. This can be achieved, for instance, by simulating how the atmosphere and oceans absorb energy from the sun and transport it around the globe.

Several conferences have been held on annual basis to tackle the problem of environmental degradation, global warming and climate change under different international and national umbrella bodies. Such conferences on environment include the International Conference on Resource Sustainability (ICRS), the United Nations Conference on Environment and Development (UNCED), the International Conference on Sustainable Natural Resources Management under Global Change, the United Nations Climate Change Conference etc. The agenda of these conferences on environment aimed to arouse people's awareness and instill positive attitude, values and skills that promote effective management of the environment (UNCED, 2019). The conferences also laid emphasis on the need for environmental education by nations of the world (Nwankwo, Esemua and Orefor, 2015).

These international and national conferences aimed at bringing together leading climatologists, meteorologists, marine biologists, oceanographers, ecologists, environmental researchers, business entrepreneurs and societies, even Nobel laureates to exchange and share their experiences and research results about all aspects of climate change and global warming. Topics usually focused on in the conference include climate change as it affects climatology, health, oceans etc. global warming effects and causes, biodiversity, carbon cycle, energy policy, renewable energy to mitigate climate change.

The worldwide alleviation programme was set in 1992 by the United Nations Framework Convention on Climate Change (UNFCCC) and it was meant to proffer solution by harnessing global co-operation on moderation activities intended to lessen discharges and increase the measure of ozone harming substances expelled into the atmosphere. The UNFCCCs have formal and yearly conferences held in the framework of the United Nations. The parties involved meet to assess progress made by member nations in dealing with climate change. The conference tries to negotiate and establish legally binding obligations for developed countries to reduce their greenhouse gas emissions. The first UN Climate Change Conference of the parties was held in 1995 at Berlin.

The United Nations Climate Change Conference (UNCCC) had the popular Paris Agreement in 2015 and held at Paris, France. The Paris Agreement, as reported by Daggash, (2018), is a global treaty to limit temperature rise to "well below 2 C relative to pre-industrial levels" by the end of the century. That of 2016 was held at Marrakesh, Morocco. The conference, UNCCC negotiated a global agreement on the reduction of climate change. The commitments were estimated to limit global warming to 27 degrees Celsius by 2100. For example, the European Union (EU) suggested a term known as 'Intended Nationally Determined Contributions (INDCs)'. The suggested INDC by the EU is a commitment to 40 percent reduction in emissions by 2030 compared to 1990. During the 2018 United nations Climate Change Conference held at Katowice, Poland, the World Meteorological Organization released a report stating that 2017 atmospheric carbon dioxide levels reached 405 parts per million (ppm), a level not seen in three to five million years (Wikipedia, 2019). On 3rd December, 2018, the renowned British naturalist, Sir David Attenborough told delegates at the conference that "Right now, we are facing a man-made disaster of global scale, over greatest threat in thousands of years: climate change. If we don't take action, the collapse of our civilizations and the extinction of much of the natural world are on the horizon."

Another 15 year-old climate change activist, Greta Thunberg posited during the 2018 conference on 4th December "What I hope we achieve at this conference is that we realize that we are facing an existential threat. This is the biggest crisis humanity has ever faced. First we have to realize this and then as fast as possible do something to stop the emissions and try to save what we can save." Other Environmentalists that spoke to the 2018 conference participants include Dalai Lama, Al Gore, Antonio Guterres (the Secretary General of the United Nations) all told delegates that the world faced the single most important moral choice in history of humanity. The grave consequences of global

warming beyond 1.5 degrees will mean disaster for billions of people around the world (Wikipedia, 2019). A US energy expert and environment official, Preston Wells Griffith said on 10th December, 2018 that "Alarmism should not silence realism." Nations of the world should stop concentrating efforts on economic prosperity and energy security, but should also give commensurate/ complementary practical attention to pursuit of environmental sustainability. The 2018 conference agreed on rules to implement the Paris Agreement of 2015 which centred on how governments of nations will measure and report on their emissions-cutting efforts and ways to provide financial help for poor countries.

Curbing the Problem of Global Warming and Climate Change

The harsh weather condition affects everyone regardless of political affiliation. To reduce global warming emissions, policy makers and government must find solutions that are free of partisan politics. Swift, significant and equitable actions need to be taken urgently to curb heat-trapping emissions worldwide. Policies, behaviour and technologies that encourage less waste, economical use of the earth's resources and protection of the environment must be put in place. Scientists say the world have roughly few decades left to avoid the most severe consequences of climate change. Protecting our environment from dangerous climate change and CO₂ emissions requires the use of alternatives to fossil fuels; and cuts in emissions worldwide. The use of energy-efficient technology and cleaner fuels must be embraced. Use of environmentally friendly fuels such as bio-fuels is recommended in lieu of fossil fuels and coal. Scientists need to develop new ways to modernize power plants, generate cleaner electricity and burn less gasoline while driving. Human beings have to reduce activities that emit gases into the atmosphere. Tree planting must be encouraged to enhance the process of photosynthesis which will consequently reduce the amount of CO₂. Conservation of heat energy through geo-engineering is to be encouraged.

Several nations and regions of the world have lately established climate policies aimed at curbing global warming and climate change problems (Union of Concerned Scientists, 2019). But the recent announcement by President Trump of the withdrawal of United States of America from the Paris agreement of 2015 is not encouraging. It is heart-warming, however, that millions of citizens across US pledged their loyalty to the agreement and efforts to limit future warming stepped up (Denchak, 2017). The US has a big role to play in limiting global warming to 1.5 C. All hands must be on deck to curb the environmental menace. Governments of nations of the world must find ways to limit the amount of greenhouse gases emitted into the air.

Individual citizens have roles to play in reducing global warming emissions. Individuals can reduce home energy consumption by using better energy efficient appliances. Even when cars and motorbikes are used in travelling, efficiency in fuel combustion must be ensured. Emission of carbon monoxide or fumes of carbon dioxide due to incomplete combustion of fuel from exhaust pipes need to be checked. Elected officials in government must enact policies and laws on environment that will reduce environmental degradation and emissions into the atmosphere (Freeman, 2018). Individuals must voice concerns through the social media by speaking up and sending messages to legislatures and policy makers to make laws that limit carbon emission. For example, sanctions could be placed on organizations or nations that fail to utilize the renewable energy options.

United Nations Climate Change Conference (UNCCC) targets and indicators include de-carbonizing the energy system to ensure clean energy for all, and improve energy efficiency with targets for 2020, 2030, and 2050. This includes reducing non-energy related emissions of greenhouse gases through improved practices in agriculture, forestry, waste management and industry; adopting incentives to curb climate change and promote technology transfer to developing countries.

Nigeria has given serious attention to handling climate change issues since 1992, through the establishment of the defunct Federal Environmental Protection Agency (FEPA) in 1988. Nigeria joined the party to the UN framework Convention on Climate Change (UNFCCC) in 1994 and ratified its Kyoto Protocol in 2004. In September, 2012, according to Punch (2018), approval was given to create the Nigeria Climate Change Policy Response and Strategy, whose strategic goal is to foster low carbon, high growth economic development and build a climate-resilient society. Much impact has not been felt from that. Today, the Department of Climate Change, Nigeria co-ordinates activities towards the implementation of the climate change convention and UNFCCC Conference of Parties 23 Kyoto protocol agreement. This is being done in collaboration with other relevant government

organizations, non-governmental organizations, academia and private sector. Nigeria signed the Paris Agreement on Climate change, under the leadership of President Muhammadu Buhari at the UN General Assembly in New York, 2016. In addition to the role played by the Department of Climate Change, Nigeria, other agencies and organizations empowered with the responsibility of securing and ensuring healthy environment in Nigeria include: National Environmental Standards and Regulations Enforcement Agency (NESREA), Nigerian Meteorological Agency (NiMet), Nigerian Nuclear Regulatory Authority (NNRA), Climate Change Network Nigeria (CCNN) a non-profit...organization, Human Orientation Movement for Environment (HOME) and so many others.

National Environmental Standards and Regulations Enforcement Agency (NESREA) was established 2007 as an agency of the Federal Ministry of Environment. NESREA has been charged with the responsibility to protect and develop the environment's biodiversity, conservation and sustainable development of Nigeria's natural resources and environmental technology. Her duty also includes co-ordination and liaison with relevant stakeholder in compliance with international agreement on matters of enforcement of environmental standards and regulations covering desertification, forestry, oil and gas, chemicals, hazardous wildlife, pollution and sanitation (NESREA, 2018).

On the other hand, the Nigerian Meteorological Agency (NiMet) was established as an agency and presently under the Federal Ministry of Aviation to observe Nigerian weather and climate. NiMet also provides meteorological, hydrological and oceanographic services in support of National needs and within the framework of global practice in science of meteorology. For example, on 24th March, 2019, the Nigeria Meteorological Agency (NiMet) has warned African countries to brace up and be prepared for hotter weather and water shocks as temperature rises in 2019 and that Nigeria should expect thunderstorms, lower than normal rainfall and flooding etc. This was disclosed in Abuja by the DG of NiMet, Prof. Sani Mashi during the celebration of 2019 World Meteorological day with the theme: "The sun, the east and the weather" (Mashi, 2019). Farmers were advised on what to do to avoid crop loss because lots of diseases flourish under high temperatures. Therefore, avoid overcrowded rooms and over congestion. Allow access to outdoor air, Mashi (2019) has asserted. People need to modify their way of living. NiMet also generates services and products (such as seasonal rainfall prediction used in agriculture, marine transport, hydroelectric power generation, construction, health, insurance and commerce. NiMet came into existence by an act of the National Assembly enacted in May, 2003 and became effective on 19th June, 2003 following presidential assent. It has the duty to advise the Federal government on all aspects of meteorology, issue weather (and climate) forecasts for the safe operations of aircrafts, ocean going vessels and oil rigs.

Implication for Curriculum Design in Science, Technology and Engineering Programmes

Students and teachers' knowledge, perceptions, attitudes and behaviours as well as teaching-learning approaches towards climate change and the mitigation strategies must be well articulated in the science and technology curriculum design. The design of learning experience and activity must be such that motivate and inculcate positive impact on students' willingness to take action for conservation. Environmental friendly behaviours such as recycling, afforestation, reducing energy use and exploration into alternative source of energy apart from fossil fuel (biodiversity) must be practiced among students. The implication in the long run is that students will be able to demonstrate high level of awareness and positive attitudes towards climate change and global warming issue. Students' knowledge, motivation and critical thinking ability about the issue will be encouraged if the curriculum emphasizes active experimentation, providing them context to explore and make sensible meaning of the concrete real life experiences. Also, science teacher education curriculum can be designed to support teachers in climate change education.

The climate change education and related issues can either be approached through a single subject discipline (for example, Geography) or be engaged from an interdisciplinary social studies perspective, Lambert and Hopkin (2014) postulated that in making curriculum of climate change in science and technology education, consideration must be given to three factors: the student's attributes, the way the subject-matter is taught and the broad social purposes of education. The way the subject matter is taught is usually influenced by teacher's knowledge and attitudes.

The challenge as put forward by Chang and Pascua (2017) was a call for science and technology curriculum design that takes into account more research on Climate Change Education (CCE) which in turn would impact practice in geographical and environmental education. In teaching topics on

climate change, there is need to develop learners who can critically and accurately engage findings and discourse about natural phenomena; and be able to take action towards making the living environment safe and conducive. Curriculum designers must prove the relevance of climate change discourse by making learning less complex and uncertain. Specifically, schools can be engaged to teach recent changes in climate such as global warming, greenhouse effect and related issues on environmental degradation such as deforestation practices and environmental legislations to deal with these concerns. The aim is to equip learners with functional knowledge and capacities on how to take responsible action in addressing, mitigating and become adapted in dealing with these concerns. If students are not critically and properly engaged in climate change discourse and taking action on conservation, chances are high that they might likely lose out in a climate changing world (Chang & Pascua, 2017).

CONCLUSION AND RECOMMENDATIONS

Nigeria must adjust her energy plans and shift from being part of the problem creator to being part of the problem solver. Efforts should be made to improve energy efficiency of renewable electricity and to end natural gas flaring. The need to transit from dependence on fossil fuel to dependence on renewable energy sources must be emphasized. The need to switch over to energy sources such as solar and hydro power must be embraced. The Federal Government of Nigeria has affirmed that 64 million tons of carbon dioxide being emitted per year can be saved by 2030 if gas flaring is eliminated. To this effect Nigeria must firstly work on the mind-set of her citizenry to support efforts aimed at curbing global warming. Solutions such as reforestation and forest protection must be integrated.

One other way of solving the problem is by educating the populace on the threats and the need to desist from practices that endanger the eco-system. This can be achieved through the formal and informal education sector. The subject of environmental education must be included in the curriculum learning contents of schools right from the Basic education level classes. There and then, pupils and students should be enlightened on the dangers, need and efforts to protect the environment. Workshops, symposia and research work on environmental protection must be encouraged at all levels. The rest of the populace who are not in school can be enlightened through public media links, radio, television and social media awareness campaign on environmental issues. People have to be enlightened on problems of bush-burning, dumping refuse on water paths, deforestation, over-fishing, irregular hunting of wild-life and other harmful practices that upset the ecosystem. When students and the larger populace are knowledgeable and empowered through the school curriculum and enlightenment campaign on the need for a sustainable environment, the results reduce the vulnerability to risk associated with the environment.

REFERENCES

- Asim, A. E. (2012) *Global warming (thermal pollution)*. Unpublished Lecture Monograph. Faculty of Education, Nasarawa State University, Keffi
- Chang, C. & Pascua, L. (2017) The state of climate change education-reflections from a selection of studies. In *Journal of International research in geographical and environmental education*. Vol26, 2017 Issue3 climate change education (pages 177-179)
<https://doi.org/10.1080/10382046.2017.1331569>
- Conference Series (2018) *World conferences on climate change*. Downloaded on 28th March, 2019 from www.climatelinks.org/events-5th-world-conference.climate
- Decamous, G. (2012) *The issue of global warming due to the modern misuse of techno-scientific applications*. Retrieved on 2nd June, 2019 from www.intechopen.com/books/global_warming/
- Daggash, H. (2018) *Nigeria and climate change global trends and local challenges*. Downloaded from The Republic online from www.republic.com.ng/ on 28/03/2019
- Denchak, M. (2017) *How you can stop global warming*. Downloaded on 25th March, 2019 from www.nrdc.org/stories/how_you_can_stop_global_warming
- Department of Climate Change, FME (2015) *Nigerian efforts*. Department of Climate Change, Federal Ministry of Environment Abuja downloaded from climatechange.gov.ng/Nigeria/

- Encyclopaedia Britannica (2012) *Britannica student encyclopedia* Vol.5 &9 USA
- Flam, F. (2019) *Four reasons to worry about global warming: beyond scientific consensus*. Forbes Media LLC and downloaded on 26th March, 2019 from www.forbes.com
- Freeman, D. (2018) *Science new climate report show*. Downloaded on 24th March, 2019 from www.nbcnews.com/mach/science/new-climate-report-show
- HarperCollins (2010) *Collins English Dictionary & Thesaurus*
- Lambert, D. & Hopkin, J. (2014) A possibilist analysis of the geography national curriculum in England. *International research in geographical and environmental education*, 23 (1) 64-78. Downloaded online from Taylor & Francis google scholar on www.tandfonline.com/pdf
- Macmillan, A. (2016) *Global warming*. Downloaded from www.nrdc.org/stories/global.warming101
- Mashi, S.(2019) Nigerian meteorological agency (nimet). Downloaded on 29th March, 2019 from <https://nimet.gov.ng> . 2019 world meteorological day
- Nwankwo, M. C., Esemua, O. M. & Orefor, J. A. (2015). Secondary school students' level of awareness of the need for conservation of natural resources. In Z. C. Njoku (Ed.): *Towards Effective Application of STEM Education Research*. STAN 56th Annual conference 239-245
- National Geographic Society (2015) Environmental degradation and global warming. Downloaded on 22nd Mar, 2019 from www.nationalgeographic.com/environment/global.warming
- NESREA (2018) *Powers of national environmental standards and regulations enforcement agency (nesrea)*. Downloaded on 17/03/2019 from www.nesrea.gov.ng/category/environmental.protection
- Nunez, C. (2019) *Is global warming real?* Downloaded on 25th March, 2019 from www.nationalgeographic.com/environment/global.warming
- Ogunniran, BI. (2018) Ozone layer depletion and climate change in Nigeria problems and prospects. In *Global journal of research and review*. Vol5, No1:2
- Punch (2018) Nigeria under the spotlight as world tackles global warming. In Punch Newspaper, Published 18th March, 2018 and downloaded on 28 March, 2019
- Sustainable Development Solutions Network (2019) *A global initiative for the united nations*. Downloaded on 26th March, 2019 from unsdsn.org/resources/goals.and.targets/goal8.curb.human
- UNCED (2019) *Sustainable development goals*. Downloaded from un.org/milestones/unced. on 16/03/2019 Earth summit
- Union of Concerned Scientists (2019) *Science for a healthy planet and safer world*. 2 Brattle Square, Cambridge. MA021383780 and downloaded on 23rd March, 2019 from <https://www.ucsusa.org/our-work/global.warming/solutions/globe>
- Wikipedia (2019). *United nations climate change conference (unfccc)2018*. Downloaded on 16th March, 2019 from en.m.wikipedia.org/wiki/2018-united-nations-climate-change