Rasak, B. (2013). Conceptualizing the Relationship between Climate Changes and Human Health in Nigeria: *Panoply of Readings in Social Sciences; Lesson for and from Nigeria.* Department of Sociology, College of Development Studies. Covenant University, Canaan Land, Ota. pp. 249-266

Conceptualizing the relationship between Climate Change and Human Health in Nigeria

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ABSTRACT

The climate is changing, the effects are already being felt, and human activities are a principal cause. While the reality of climate change can no longer be doubted, the magnitude of consequences and most especially for health can still be reduced. Consideration of the impact of climate change can help political leaders move with appropriate urgency. Climate change endangers human health, affecting all sectors of society, both domestically and globally; study has shown, that diseases do not respect international boundaries. Impacts in one location, such as infectious diseases, epidemics or population displacements caused by droughts or rising sea levels, quickly spread across national borders. If the current climate change and warming trends remain uncontrolled, humanity will face more injury, disease and death related to natural disasters and heat waves; higher rates of food-borne, water-borne and vector-borne illnesses; and death that is more premature and disease related to air pollution. Moreover, in many parts of the world, large populations will be displaced by rising sea level, and many others will be affected by drought and famine. As glaciers melt, the hydrological cycle shifts and the productivity of arable land will change. Prevention is the absolute best policy. Therefore, this study tends to conceptualize the relationship between climate change and human health in Nigeria. This study is guided by the Anthropogenic Global Warning (AGW) Theory and the Human Forcing Theory of Climate Change.

Key words: Climate Change, Global Warming, Ultra Violet (UV) Radiation, Human Health and Greenhouse Gases.

Introduction

Climatic Change is referred to as a change in the state of the climate that can be identified (e.g., by using statistical tests) by changes in the mean and /or the variability of its properties, and that persists for an extended period typically decades or longer (IPCC, 2007). Although the length of time it takes the changes to manifest matters, the level of deviation from the normal and its impacts on the ecology are most paramount. Climate Change is different from the generally known terms like climate fluctuations or climate variability.

These terms denote inherent dynamic nature of climate on various temporal scales. Such temporal scale variations could be monthly, seasonal, annual, decadal, periodic, quasi-periodic or non-periodic. Climate Change is caused by two basic factors, which include natural processes (biogeographical) and human activities (anthropogenic).

The natural processes are the astronomical and the extra-terrestrial factors. The astronomical factors include the changes in the eccentricity of the earth's orbit, changes in the obliquity of the plane of ecliptic and changes in orbital procession while the extra-terrestrial factors are solar radiation quantity and quality among others. On the other hand, the anthropogenic factor in climate change involves human activities that either emit large amount of green-house gasses into the atmosphere that depletes the ozone layer or activities that reduce the amount of carbons absorbed from the atmosphere. The human factors that emit large amounts of green-house gasses include industrialization, burning of fossil fuel, gas flaring, urbanization and agriculture (IPCC, 2007).

Available evidence shows that climate change will be global, likewise its impacts, but the biting effects will be felt more by the developing countries, especially those in Africa, due to their low level of coping capabilities (Nwafor,2007; Jagtap, 2007). Nigeria is one of such developing countries. Researchers have shown that Nigeria is already being plagued with diverse ecological problems, which have been directly linked to the on-going climate change (Ayuba et.al,2007; Chindu and Nyelong, 2004; Mushelia, 2005; NEST 2003; Odjugo 2001a; 2005; Odjugo and Ikhuoria 2003), While Odjugo (2001a, 2005) observe erratic pattern of weather elements in Nigeria, Odjugo and Ikhuoria (2003) show that climate change is impacting in North-eastern Nigeria.

It is generally accepted that global socioeconomic development and health interventions have improved the general standard of living in recent times but the resulting deteriorating global environment conditions or factors are now affecting human health. The major global environment changes significantly affecting health according to WHO (1996) and McMichael (1996) include climate change and ozone depletion. Ozone in the stratosphere is produced by photolytic destruction of oxygen. It is a protective shield to life on earth, preventing much of the sun's Ultraviolet (UV) radiation; especially UV radiation with shorter wavelength from reaching the earth. As a result, any change in atmospheric concentration of ozone causes changes in the radioactive levels. Since the industrial revolution, human activities have increased the atmospheric concentration of what is known today as green-house gases (GHGs).

These are carbon dioxide (CO), methane (CH_4), nitrous oxide (N_2O) and chlorofluorocarbons (CFCs) (WHO, 1996).Nigeria is particularly sensitive to the effects of climate change. A large part of our economy depends on natural resources which-like our people-

are particularly vulnerable to climate change. When those resources are affected, whole communities are implicated. Disease, loss of livelihoods and settlements can force entire communities into relocation and even refugee status. It is on this premise that this study conceptualizes the relationship between climate change and human health in Nigeria with the aim of compiling and synthesizing them holistically.

GENERAL OVERVIEW OF THE WIDE-RANGING IMPACTS OF CLIMATE CHANGE ON HUMAN HEALTH IN NIGERIA

Increasing temperature (global warming) and decreasing precipitation in most parts of the world are the greatest impacts of climate change. These bring about either negative or positive ecological impacts in different parts of the world. The increasing temperature has led to increased land based ice instability and its melting. The thawing of the arctic, cool and cold temperature ice, the increasing rainfall in some parts of the world and expansion of the oceans as water warms has started impacting on sea level, coastal inundation and erosion. The current global estimate of sea level rise is 0.2m and it is projected to increase to 1m by the 2100 (Bush, Edward and Hengeveled, 2002; Hengeveld and Whitewood, 2005). The implication is that the present 0.2m sea level rise has inundated 3,400km^2 of the coastal region of Nigeria, and if the sea level rise attains the projected 1m on or before 2100 then 18,400km^2 of the coastal region may be inundated (NEST, 2003). Coastal region settlements like Bonny, Forcados, Lagos, Port Harcourt, Warri and Calabar among others that are less than 10m above the sea-level would be seriously threatened by a meter rise in sea level. It is estimated that a meter rise in sea level will displace about 14million people from the coastal areas of Nigeria (Abu, 2007).

The excessive heat, increasing water stress, air pollution and suppressed immune system occasioned by climate change will result in increasing incidence of excessive death due to heat exhaustion, famine, water related diseases (diarrheal, cholera and skin diseases), inflammatory and respiratory diseases (cough, asthma), depression, skin cancer and cataract.

Health impact of ozone depletion and climate change

a. Increase levels of Ultra Violet (UV) radiation due to ozone depletion may have serious consequences for living organisms.
b. Adverse impact of Ultra Violet-Beta (UV-B) rays has been reported on terrestrial plant growth and photosynthesis.
c. Increase UV-B has also been shown to have a negative influence on aquatic organisms, especially small ones such as phytoplankton, larval crabs, shrimps, and juvenile fish.

d. Since many of these organisms are at the base of the marine food chain, increased UV-B may seriously affect aquatic ecosystem.
e. Increased UV-B radiation affects troposphere air quality and may cause damage to materials such as wood, plastic and rubber.

Climate change is associated with multitude of effects such as:

a. Climate change has been associated with shift in the composition and geographical distribution of many ecosystems (e.g. forests, deserts, coastal systems) as individual species respond to changed climatic conditions, with likely reduction in species diversity and agricultural yield.
b. Climate change will lead to an intensification of the global hydrological cycle and may affect regional water resources.
c. Additionally, climate change and the resulting sea-level rise can have a number of negative effects on energy, industry and transportation infrastructure, human settlements and tourism (IPCC, 1996).

Problems associated with climate change and ozone depletion are numerous and interrelated. For instance, the depletion of ozone layer in the stratosphere because of greenhouse effect causes global warming (World Metrological Organization (WMO), 1987). Such changes in the concentration of greenhouse gases are projected to lead to regional and global changes in climate and climate-related parameters: temperature, humidity precipitation etc. This is to the extent that IPCC (1996) has projected an increase of global mean surface temperature of more than 1℃ by the year 2100 as earlier stated.

In man, the health impact of ozone depletion and climate change cannot be separated since both have adverse effects on human health. For instance, with increased UV-B radiation on earth, the human immune system is likely to be affected and this will reduce the affected population's resistance to infectious and parasitic diseases. Broadly speaking, the various potential health effects of global climate change upon human health can be divided into direct and indirect effects (Nwoke et al. 2009), according to whether they occur predominantly via the impacts of climate variable upon human biology, or are mediated by climate induced changes in other biological and biogeochemical systems.

In the healthy individual an efficient regulatory system enables the body to cope effectively with thermal stress. Temperature exceeding comfortable limits, both in the warm

and cold range substantially increases the risk of (predominantly cardiopulmonary) illness and death.

DIRECTLY: An increase in temperature would mean a shift of these thermal related diseases and deaths. An increased frequency or severity of heat waves will also have a strong impact on these diseases. If extreme weather event (droughts, flood, storms etc.) were to occur more frequently, increases in rates of deaths, injury, infectious diseases and psychological disorder would result.

INDIRECT: One of the major indirect impacts of global climate change upon human wealth could occur via effects upon cereal crop production. Cereal grains account for around 66% of all foodstuffs consumed by humans, (McMichael, 1996). These impacts would occur via the effects of variations in temperature and moisture upon germination, growth, and photosynthesis, as well as via indirect effects upon plants diseases, predators-pest relationship, and supplies of irrigation water.

A further important indirect effect on human health may well prove to be a change in the transmission of vector-borne diseases. Temperature and precipitation changes might influence the behaviour and geographical distribution of vectors, and thus change the incidence of vector-borne diseases, which are major causes of mortality and morbidity in most tropical countries. Increase in non-vector-borne infectious diseases such as cholera, salmonellosis, and other food-and water-related infectious diseases could occur, particularly in tropical and sub-tropical regions, due to climate impact on water distribution, temperature and proliferation of micro-organism.

The health impacts of climate damage on the Nigerian population are far ranging. Water resources are extremely vulnerable. Incidences of meningitis have been on the increase in Nigeria for the past one-year as a result of excessive heat (Akingbade, 2010). In 2011, it was unbearably hot in Nigeria and countries in sub-Saharan Africa. In Nigeria the eleven frontline states in the north that have suffered from desert encroachment have been suffering from heat related ailments. Investigation revealed that over 200 people were killed by meningitis in Nigeria in one week in the year 2010. There was an outbreak of meningitis and in76 areas; there were 25,000 suspected cases and 1,500 deaths in the first quarter of 2009.

Although meningitis is a disease caused by an infection of the meanings, which is the thin lining that surrounds the brain and the spinal cord, experts have found a correlation between the weather and this disease (Akingbade, 2010). It is generally known that the disease attacks more people during the dry season because of dust, wind and cold nights. There were indications in the

past that many people were treated for acute pneumonia in some hospitals as a result of the erratic and unpredictable weather which has also confused farmers about planting seasons raising fear about food production and security (IPCC, 2007).

Apart from heat rashes that had been noticed amongst the population within the period of intense heat, there has been an upsurge in Tuberculosis (TB) in the past one month (Macaulay, 2010). Macaulay was of the opinion that those who are at risk are those who were not immunized against TB and that when a tuberculosis patient spits on the ground, the TB virus can hang in the air for 42 days unlike other viruses such as gonorrhoea that can die within one hour. When one breathe in the tuberculosis virus in the air through dust it's very hazardous and can be in the air because of a lot of dust. The Federal government raised an alarm that tuberculosis is on the increase and that about one million Nigerians are afflicted by the disease. Nkom (2010) opine that the dusty and hazy weather would trigger certain ailments amongst the populace who were not ready for the unusual weather and that the dust in the atmosphere would trigger droplet infection because the dust will become the medium of propagating the various viruses and bacteria that are airborne.

Summary of impact of climate change and ozone layer depletion (Horton and McMichael, 2008)

Thermal stress

- Mortality (especially cardiopulmonary) increases with cold andwarm temper
- Older age group and people with underlying organic diseases areparticularly vulnerable
- Mortality increases sharply during heat wave

Vector-borne diseases

- Climate conditions (particularly temperature) necessary for somevectors to thrive and for the microorganisms to multiply within thevectors are relatively well known

Water/food-bornedisease

- Survival of disease organisms (and insects which may spread them) is related to temperature
- Water-borne diseases most likely to occur in communities with poorwater supply and sanitation
- Climate condition affects water availability

- Contamination of portable water, particularly following extreme rainfall;seepage of contaminants from illegal dumping of solid waste and otherwaste into underground aquifers

Food production

- Temperature, precipitation, solar radiation and carbon dioxide areimportant for crop production
- The potential indirect effect of increased UV-B level reaching the earthlead to impairment of photosynthesis on land (food crops) and in the sea(phytoplankton), reducing the world's food production.
- Crop failure may lead to malnutrition
- Undernourishment may increase susceptibility to infectious diseases

Skin cancer

- Skin cancer is related to UV expose (both melanoma skin cancer and non-melanoma skin cancer), people with lightly pigmented skin being most susceptible
- Aging increases the risk of skin cancer

Cataracts

- UV radiation damages the eye, more particularly the lens
- Different types of cataracts will react differently to changes to UV radiation
- Aetiology of cataracts is assisted with age, diabetes, malnutrition, heavy smoking, hypertension, renal failure, high alcohol consumption, and excessive heat

Immune suppression

- UV suppresses immune system in animal models, and may adversely affect various infections
- In man, serial UV radiation may cause proper immunization to fail
- UV- induced immuno-suppression appear to be a risk factor for skincarcinomas

THEORETICAL FRAMEWORK

This study is guided by the Anthropogenic Global Warning (AGW) Theory and the Human Forcing Theory of Climate Change.

ANTHROPOGENIC GLOBAL WARNING (AGW) THEORY

This theory of climate change contends that human emissions of greenhouse gases, principally carbon dioxide (CO2), methane, and nitrous oxide, are causing a catastrophic rise in global temperatures. The mechanism whereby this happens is called the enhanced greenhouse

effect. This theory is called "anthropogenic global warming or AGW for short. Energy from the sun travels through space and reaches Earth. Earth's atmosphere is mostly transparent to the incoming sunlight, allowing it to reach the planet's surface where some of it is absorbed and some is reflected back as heat out into the atmosphere (Bast, 2010). Certain gases in the atmosphere, called "greenhouse gases," absorb the outgoing reflected or internal thermal radiation, resulting in Earth's atmosphere becoming warmer than it otherwise might be.

Water vapour is the major greenhouse gas, responsible for about 36 to 90 percent of the greenhouse effect, followed by CO2 (<1 to 26 percent), methane (4 to 9 percent), and ozone (3 to 7 percent) (IPCC, 2007). During the past century, human activities such as burning wood and fossil fuels and cutting down or burning forests are thought to have increased the concentration of CO2 in the atmosphere by approximately 50 percent. Continued burning of fossil fuels and deforestation could double the amount of CO2 in the atmosphere during the next 100 years, assuming natural "sinks" don't grow in pace with emissions (NOAA, 2007).

Earth's climate also responds to several other types of external influences, such as variation in solar radiation and in the planet's orbit, but these "forcings," according to the proponents of AGW, cannot explain the rise in Earth's temperature over the past three decades. The forcing caused directly by man-made greenhouse gases is also small, but the AGW theory posits that positive feedbacks increase the effects of these gases between two- and four-fold (Algore, 2006). A small increase in temperature causes more evaporation, which places more water vapour in the atmosphere, which causes more warming. Global warming may also lead to less ice and snow cover, which would lead to more exposed ground and open water, which on average are less reflective than snow and ice and thus absorb more solar radiation, which would cause more warming. Warming also might trigger the release of methane from frozen peat bogs and CO2 from the oceans (IPCC, 2007).

Backers of the AGW theory contend the ~0.7°C warming of the past century-and-a-half and ~0.5°C of the past 30 years is mostly or entirely attributable to man-made greenhouse gases. They dispute or disregard claims that some or perhaps that entire rise could be Earth's continuing recovery from the Little Ice Age (1400-1800). They use computer models based on physical principles, theories, and assumptions to predict that a doubling of CO2 in the atmosphere would cause Earth's temperature to rise an additional 3.0°C (5.4°F) by 2100 (Bast, 2010). When these climate models are run "backwards" they tend to predict more warming than has actually occurred, but this, the theory's backers argue, is due to the cooling effects of aerosols and soot,

which are also products of fossil fuel combustion. Proponents of the AGW theory believe man-made CO2 is responsible for floods, droughts, severe weather, crop failures, species extinctions, spread of diseases, ocean coral bleaching, famines, and literally hundreds of other catastrophes. All these disasters will become more frequent and more severe as temperatures continue to rise. Nothing less than large and rapid reductions in human emissions will save the planet from these catastrophic events.

HUMAN FORCINGS THEORY

This theory of climate change holds that mankind's greatest influence on climate is not its greenhouse gas emissions, but its transformation of Earth's surface by clearing forests, irrigating deserts, and building cities. Pielke, (2009) opine that "although the natural causes of climate variations and changes are undoubtedly important, the human influences are significant and involve a diverse range of first-order climate forcing, including, but not limited to, the human input of carbon dioxide (CO2)".

HUMAN FORCING BESIDES GREENHOUSE GASES

Urban Heat Islands

Cities tend to be warmer than suburbs, and suburbs warmer than rural areas, because they have greater concentrations of energy-producing machines and vehicles and large amounts of concrete, asphalt, and other building and road materials that absorb solar energy and then re-emit thermal energy (Matsui and Pielke, 2006).

Aerosols and ozone

Anthropogenic aerosols and ozone have shorter lifetimes than greenhouse gases, and therefore their concentrations are higher in source regions and downwind. Pielke and Matsui (2006) estimate the effect of human aerosols on the gradient of radioactive heating on regional scales "is on the order of 60 times that of the well-mixed greenhouse gases." With many surface-based temperature stations located in urban or near-urban areas, it is likely they are registering the warming effects of these aerosols and ozone, not CO2 (Bast, 2010).

Deforestation

Removing trees by burning, a common practice in developing countries releases CO2 into the atmosphere and prevents forests from sequestering carbon in the future. The pasture or crop land that replaces the forest lacks the shade created by a forest canopy and tends to be warmer. The IPCC has estimated that between one-quarter and one-third of anthropogenic CO2 emissions are due to deforestation, not the burning of fossil fuels (IPCC, 2007).

Coastal development

Anthropogenic activities in coastal areas such as logging, agriculture, construction, mining, drilling, dredging, and tourism all can increase or (more rarely) decrease surface temperatures of nearby bodies of water. For example, storm runoff from city streets following heavy rains can result in seawater dilution and temperature increases. Development can produce sediment that reduces stream flow and damages coral reefs by reducing the penetration of sunlight or by direct deposit on the coral, causing damage mistakenly attributed to global warming (Bast, 2010).

Jet contrails

Anyone living in or near a large city knows that jets often leave trails behind them, called contrails (short for "condensation trails"). Composed of water vapour, they precipitate the creation of low clouds that have a net warming effect. According to Travis (2006) contrails "may cause a net warming of the surface rivalling that of greenhouse gases" and "in certain regions, contrails already may contribute as much as the present anthropogenic CO2 forcing on climate." Several of these "human forcings" have local and regional effects on climate equal to or even exceeding that of anthropogenic greenhouse gas emissions.

CONCLUSION AND RECOMMENDATIONS

Scientists agree that more extreme weather patterns are on the horizon. A range of forecasts predict increased drought in some parts of Africa and flooding in others. Rising sea levels and tropical cyclones threaten small island states. Nothing can stop the march of climate change, but there is still time to temper its effects (Horton and McMichael, 2008).

Global socioeconomic development and health interventions have improved the general standard of living in recent times but the resulting deteriorating global environmental conditions or factors are now affecting human health. The major global environmental changes significantly affecting health include climate change and ozone depletion. While, we can work for an end to gas flaring, most activities we can do are to adapt to the impacts of climate change. A lot can be done at the individual, legislative (through government policies), and technological levels. The proliferation of disease carrying pests can be reduced in many ways, including promoting repellent use and undertaking education campaigns.

Less reliance on mono-cultural farming (relying on one crop) and developing climate-adjusted plant species can help. Many personal adaptive steps can be taken to counteract the ill effects of climate change. Increasing water intake during hot weather; reducing skin cancer risk by avoiding sun exposure and wearing protective clothing; making the use of sunscreen and

water intake habitual; moving to new locations and away from river beds, oceans and low-lying areas in response to local climate change; immunization (a public policy and program on immunization against cerebro-spinal meningitis), improved treatment of diseases, and the use of bed nets can help to mitigate adverse effects of climate change.

More shade trees can be planted, efficient and safe water treatment systems as well as try to reduce our demand for water, where possible. Heat-resistant and well-insulated homes and buildings with provision made for reduced cooling and lighting demand elements, and limit work hours for outdoor workers. Mitigation measures should be taken to ameliorate human-induced global environmental processes that provoke climate change such as deforestation, desertification, depletion of fresh water resources, and loss of biodiversity as well as use of fossil fuel. For instance, if our communities depend heavily on activities, which require burning of fossil fuel, not only would these increase greenhouse gas production but also would increase pollution. Reduction in energy consumption must be a key part of the strategy of protecting health from climate change.

Education and mass media campaigns strong enough to spark commitment and action among governments, international organizations donors, civil society, business and communities, especially among the young people, should be put in place. There should be creation of awareness and public of the global and locally relevant the health consequences of climate change. Also advocacy for interdisciplinary and inter-sectoral partnership from the local to international level that seek to improve health through rapid deployment of mitigation strategies, in order to stabilize climate change and development of proactive adaptation programmes to minimize health impact (Nwoke, *et al.* 2009).It is clear that perhaps the biggest obstacle concerning the health impacts of climate change on the Nigerian population is lack of awareness and knowledge. Nigerians need to be educated and informed about climate change and how it can change lives drastically.

Nigerians have been working and managing the land in ways that always protect food production yet there is an inability and reluctance to adopt new farming strategies, land scarcity also contributes to a reliance on unsustainable farming practices. Widespread poverty includes heavy and total dependence on the immediate environment for livelihoods. Lack of information (awareness) and knowledge (education) about climate change also mean that many Nigerians are reluctant to accept the reality of climate change. As well, there is a lack of public policy, government preparedness and commitment to promoting climate change adaptation strategies in

this country. There is a dearth of public policies that target adaptation, and those that do exist are inadequate. Certainly, a lack of dedicated research institutions makes it difficult to study, comprehensively, the growing negative effects of climate change in Nigeria.

All tiers of government, health professionals and other stakeholders should be able to marry the socioeconomic development of our generation and the global ecosystems. Protecting health from climate change depends on how we address the challenges posed by climate change and ozone layer depletion. It is difficult for man to stop the natural causes of climate change but much can be achieved in either to stop or drastically reduce the human causes of climate change. If human activities that deplete the ozone layer are to a very large extent reduced and the carbon sinks are well-managed and protected, then the on-going global warming will seriously decline.

To reduce the emission of greenhouse gases, clean and environment friendly technologies are needed. Industrial productions should convert to machines that emit limited or no greenhouse gases. Automobiles and industrial machines should be improved upon to use only ethanol, solar engines, electric engines or hybrid electric engines. Gas flaring especially in the Niger Delta region of Nigeria should be reduced to the barest minimum; Nigeria should encourage the use of renewable energy sources such as photovoltaic cells in a small scale; the use of fuel cells that convert hydrogen fuel directly into electricity without first burning it to produce heat should be encouraged (Singer and Avery, 2007).

Pielke (2009) concludes, that the IPCC in 2007 “did not sufficiently acknowledge the importance of these other human climate forcings in altering regional and global climate and their effects on predictability at the regional scale. It also placed too much emphasis on average global forcing from a limited set of human climate forcings.” Therefore, it is as a matter of importance that emphasis should be paid on human forcings in order to reduce the effect of climate change on human health.

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