British Journal of Computer, Networking and Information Technology
ISSN: 2689-5315
Volume 7, Issue 2, 2024 (pp. 68-85)
www.abjournals.org

CURBING THE EFFECT OF CLIMATE CHANGE FOR SUSTAINABLE DEVELOPMENT THROUGH DIGITAL TRANSFORMATION AND ENVIRONMENTAL SUSTAINABILITY

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Cite this article:

Adigun, O. J., Afolaranmi, A. O. (2024), Curbing the Effect of Climate Change for Sustainable Development through Digital Transformation and Environmental Sustainability. British Journal of Computer, Networking and Information Technology 7(2), 68-85. DOI: 10.52589/BJCNIT-VF1XXA11

Manuscript History

Received: 14 Apr 2024

Accepted: 20 Jun 2024

Published: 12 Jul 2024

ABSTRACT: *Climate change has posed a lot of dangers to economic growth and development. Such dangers include hotter temperatures, severe storms, increased drought, inadequate food supply, poverty, displacement of people and many risks to human life. These dangers occur on earth through human activities which release greenhouse gas emissions. Consequently, this paper aims to look at environmental sustainability through digital transformation, in order to reduce the effect of climate change on economies, businesses, governance, and socio-political outcomes in the 21st century. It also identified how digital transformation plays an increasingly significant role in promoting environmental sustainability. The paper adopted a systematic literature review, a qualitative approach, and a historical analysis. Findings revealed that non-conformity with environmental best practices has gross adverse effects on achieving sustainable development. It was also discovered that non-enforcement of environmental laws and regulations poses a danger to environmental sustainability. The paper concluded that adopting digital transformation will be of great advantage to environmental sustainability thus reducing the impact of climate change and accelerating sustainable development in our economies. This paper recommended strict enforcement of environmental laws and regulations. There should be a paradigm shift in the approach to achieving environmental sustainability by improving the circular economy through digital devices (enabling reuse and recycling), extending the lifespan of software and devices, and promoting technologies that help reduce carbon emissions and energy consumption. Also, the importance of less usage of energy by switching to LED light bulbs and energy-efficient electric appliances in our various homes and offices should be emphasized.*

KEYWORDS: Climate Change, Digital Transformation, Environment Sustainability, Sustainable Development.

Article DOI: 10.52589/BJCNIT-VF1XXA11
DOI URL: https://doi.org/10.52589/BJCNIT-VF1XXA11

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INTRODUCTION

Climate change is a global problem which directly affects human life and also destroys property. It is the resultant effect of pollution of the atmosphere; when there is excessive emission of Green-House Gases (GHG) into the atmosphere, it becomes polluted. The atmosphere is the protective blanket that makes life possible on Earth. The atmosphere protects every living organism that lives on the surface of the earth from the Sun's deadly ultraviolet (UV) radiation. Without the atmosphere, Earth's surface would be frozen, and life would not exist on the planet earth (Mathez and Smerdon, 2018). The atmosphere has been called the medium of climate because we live in it and because it connects the different parts of the climate system.

Earth's average surface temperature in 2023 was the warmest on record, with July 2023 being the hottest month ever recorded, hundreds of millions of people around the world experienced extreme heat according to National Aeronautics and Space Administration (NASA) 2024 release (Bardan, 2024, January 12). Between 2011 and 2020, the average temperature of the Earth's surface was 1.1°C warmer than the average temperature in the late 19th century (before the Industrial Revolution) and warmer than at any time in the last 100,000 years. Each of the last four decades has been warmer than any previous decade since 1850. The world is warming faster than at any time in at least the last two thousand years according to Intergovernmental Panel on Climate Change (IPCC, 2022). This has caused widespread and rapid changes to the atmosphere, land, ocean and ice regions. Climate change has resulted in weather and climate extremes on all continents, as evidenced by the increase in the frequency and severity of heatwaves, heavy precipitation, wildfires, droughts and tropical cyclones (IPCC, 2021). An analysis by the World Economic Forum found that by 2050, climate change is likely to result in 14.5 million additional deaths and $12.5 trillion in economic losses worldwide (Wyman, 2024). The earth is being warned up creating a global phenomenon called global warming resulting in climate change.

Climate Change is the defining issue of our time and we are at a defining moment. From shifting weather patterns that threaten food production, to rising sea levels that increase the risk of catastrophic flooding, the impacts of climate change are global in scope and unprecedented in scale. Without drastic action today, adapting to these impacts in the future will be more difficult and costlier (Peace, dignity and equality on a healthy planet, n.d.).

The effect of climate change spread across all regions and continents including Africa with Nigeria not left out of the menace. According to the United States Agency for International Development (USAID, 2023) report as Africa's largest economy, Nigeria's wide range of livelihoods, agricultural practices, and commodities are threatened by climate change (Nigeria Climate Change Country Profile, 2023, November 29). Rising sea levels increase vulnerability to flooding and waterborne disease. Additionally, drought and rising air temperatures hinder agricultural production and fishing, reducing food security and negatively impacting health and nutrition (USAID, 2023). Since the first industrial revolution, economic growth has generally been tied to increasing greenhouse gas emissions. A switch from fossil fuel-based to low-carbon energy sources can help sustain the same or even higher levels of production while reducing emissions, thereby enabling the decoupling of growth from emissions. General technological development will also help decouple growth from emissions by reducing input energy or other materials required for production. The digital transformation of the economy

Article DOI: 10.52589/BJCNIT-VF1XXA11
DOI URL: https://doi.org/10.52589/BJCNIT-VF1XXA11

through the development of information and communication technology (ICT) also has a positive impact.

Aim

This paper aims to highlight the causes and challenges of climate change to sustainable development and how these challenges can be addressed through environmental sustainability and digital transformation in order to reduce the effect of the menace of climate change on economies, businesses, governance, and socio-political outcomes in the 21st century. The paper will also present critical evidence related to the impacts of climate change and how it affects sustainable development. It will also highlight ways of curbing the impact of climate change for sustainable development through digital transformation and environmental sustainability. This will be achieved based on the available evidence through the related literature review. The paper will finally recommend what should our reasonability in tackling and curbing the effect of climate change in order to have sustainable development.

Conceptual Clarifications

i Climate Change: Climate change refers to long-term shifts in temperatures and weather patterns. Such shifts can be natural, due to changes in the sun's activity or large volcanic eruptions. But since the 1800s, human activities have been the main driver of climate change, primarily due to the burning of fossil fuels like coal, oil and gas. Burning fossil fuels generates greenhouse gas emissions that act like a blanket wrapped around the Earth, trapping the sun's heat and raising temperatures (Climate Action, United Nations, n.d.). Climate change refers to a shift in average weather conditions, including measures such as temperature, humidity, rainfall, cloudiness and wind patterns and changes in the frequency or severity of these conditions.

ii Digital Transformation: Technology is reshaping our world in profound ways and the choices we make today hold the power to influence the future of our planet. Digital Transformation encourages the development and use of technologies with sustainability considerations in mind i.e. sustainability by design. This ensures that technological advancements prioritize ethical considerations and environmental sustainability throughout their lifecycle (Digital Transformations. UN Environmental Programme, n.d.). Digital transformation is the integration of digital technology into all areas of a business, fundamentally changing how you operate and deliver value to customers. It's also a cultural change that requires organizations to continually challenge the status quo, experiment, and get comfortable with failure.

iii Environment Sustainability: According to the United Nations (UN), defined sustainability as "meeting the needs of the present without compromising the ability of future generations to meet their own needs" (Academic Impact, United Nations, n.d.). Environmental sustainability refers to the responsible management of natural resources to fulfill current needs without compromising the ability of future generations to meet theirs. It aims to balance ecological, economic and social goals, such as reducing carbon emissions, promoting renewable energy and ensuring equitable resource access (United Nations). Environmental sustainability focuses on sustainability within the natural environment. This includes conserving the natural environment as a whole, including resources within nature such as clean air and clean water, as well as wildlife, for future generations. Governments,

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companies, and members of the public can all contribute to environmental sustainability (Climate Change and Sustainability, n.d.). Environmental sustainability is one of the essential principles of sustainability, which warrants that the quest for satisfying our needs should not compromise the quality of the environment, and the ecosystem should be sustained for the sake of future generations

iv Sustainable Development: According to the United Nations, Sustainable development is meeting the needs of the present without compromising the ability of future generations to meet their own needs. Sustainable development calls for concerted efforts towards building an inclusive, sustainable and resilient future for people and the planet. In order for sustainable development to be achieved, it is crucial to harmonise three core elements: economic growth, social inclusion and environmental protection. These elements are interconnected and all are crucial for the well-being of individuals and societies (Sustainable Development Goals, n.d.).

There is a significant connection between climate change and sustainable development. Firstly, they are both factors that impact society and the environment. Climate change is presently a major, global issue that impacts the environment and society in several ways, and sustainable development aims to reduce the impacts of climate change that affect the environment and society.

Theoretical Framework

Theoretical frameworks for this paper are the Astronomical theory of climate change, the Greenhouse theory of climate change, the Milankovitch theory of climate change and the UN framework convention on climate change.

i Astronomical Theory of Climate Change: The astronomical theory argues that long-term variations of the earth's orbital parameters are the fundamental cause of the succession of ice ages during Quaternary or even earlier geological periods (Berger, n.d.). Climatic variations occur with quasi-periodicities lying between tens and hundreds of thousands of years. Such variations are recorded in deep-sea sediments, in ice sheets and continental archives (Berger and Loutre, 2004)

ii Greenhouse Theory of Climate Change: According to the greenhouse theory of climate change, the climate system will be restored to equilibrium by warming of the surface troposphere system and cooling of the stratosphere. The predicted changes, during the next few decades, could far exceed natural climate variations in historical times.

iii Milankovitch Theory of climate change: A century ago, Serbian scientist Milutin Milankovitch hypothesized the long-term, collective effects of changes in Earth’s position relative to the Sun are a strong driver of Earth’s long-term climate, and are responsible for triggering the beginning and end of glaciation periods (Ice Ages). Specifically, he examined how variations in three types of Earth orbital movements affect how much solar radiation (known as insolation) reaches the top of Earth’s atmosphere as well as, where the insolation reaches. These cyclical orbital movements, which became known as the Milankovitch cycles, cause variations of up to 25 per cent in the amount of incoming insolation at Earth’s mid-latitudes (NASA, 2020).

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iv UN Framework Convention on climate change: The United Nations Framework Convention on Climate Change (UNFCCC) was established in 1992 to combat dangerous human interference with the climate system. The United Nations Framework Convention on Climate Change (UNFCCC) was signed by about 150 countries in Rio de Janeiro in June 1992 indicating widespread recognition that climate change is potentially a major threat to the world's environment and economic development. The ultimate objective of the Convention is to stabilize greenhouse gas concentrations in the atmosphere at a level that would not jeopardize climate (Kuh, 2018). To boost the effectiveness of the 1992 UNFCCC, the Kyoto Protocol was adopted in December 1997. It committed industrialized countries and countries in transition to a market economy to achieve quantified emissions reduction targets for a basket of six GHGs. The Kyoto Protocol's first commitment period took place from 2008 to 2012. The 2012 Doha Amendment established the second commitment period from 2013 to 2020. In December 2015, parties adopted the Paris Agreement, which requires all parties to determine, plan, and regularly report on the nationally determined contribution (NDC) that it undertakes to mitigate climate change. Parties also submit aggregate progress on mitigation, adaptation, and means of implementation, which are reviewed every five years through a Global Stock take (UNFCCC, n.d.).

METHODOLOGY

The writers adopted a systematic literature review from existing literature, books, journal articles and internet sources. The researchers also adopted the historical approach while writing this paper on the climate change on economies, businesses, governance, and socio-political outcomes in the 21st century.

LITERATURE REVIEW

Facts about Climate Change

According to the International Labour Organization (ILO), Climate change creates a 'cocktail' of serious health hazards for 70 per cent of the world's workers (ILO, 2024, April 22).

Global temperature is rising, the planet's average surface temperature has risen about 2 degrees Fahrenheit (1 degree Celsius) since the late 19th century, a change driven largely by increased carbon dioxide emissions into the atmosphere and other human activities. Most of the warming occurred in the past 40 years, with the seven most recent years being the warmest. The years 2016 and 2020 are tied for the warmest year on record (NASA, Evidence, n.d.).

The Ocean is getting warmer, the ocean has absorbed much of this increased heat, with the top 100 meters (about 328 feet) of the ocean showing warming of 0.67 degrees Fahrenheit (0.33 degrees Celsius) since 1969. Earth stored 90% of the extra energy in the ocean (NASA, Evidence, n.d.).

The concentration of carbon dioxide (CO2) in our atmosphere, as of May 2022 is 421 parts per million being the highest in human history (NOAA, 2022).

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Year 2023 was the hottest year on record analysis by NOAA shows that average global temperatures in 2023 were 2.12 degrees F (1.18 degrees C) warmer than the 20th-century average and higher than any other year since records began in 1850 (NOAA, 2024).

Humans activities due to deforestation caused 20 per cent of all global greenhouse gas emissions exceeding the emissions from all of the passenger vehicles on the planet (World Economic Forum, 2022).

Over 3.6 billion people live in areas of high vulnerability to climate change impacts such as droughts, floods, heat waves, extreme weather events and sea-level rise (IPCC, 2022). Research shows that 3.6 billion people already live in areas highly susceptible to climate change. Between 2030 and 2050, climate change is expected to cause approximately 250,000 additional deaths per year, from undernutrition, malaria, diarrhoea and heat stress alone (WHO, 2023).

Based on today's insufficient global commitments to reduce climate polluting emissions, a rebound in greenhouse gases from a return to high-carbon societies after the pandemic may push 2030 emissions even higher up to 60 GtCO2e (UNEP, 2024). In 2019, total greenhouse gas emissions, including land-use change, reached a new high of 59.1 gigatonnes of carbon dioxide equivalent (Andersen, 2020).

Fossil carbon dioxide (CO2) emissions (from fossil fuels and carbonates) dominate total GHG emissions including LUC (65 per cent) and consequently the growth in GHG emissions. Preliminary data suggest that fossil CO2 emissions reached a record 38.0 GtCO2 (range: ±1.9) in 2019 (Andesren, 2020).

Causes of Climate Change

In reality, the causes of climate change in Nigeria are largely Anthropogenic (man-made) in nature and as well as and natural causes. Human causes have been influenced by the industrial revolution of the 19th century, which saw the large-scale use of fossil fuels for industrial activities. Natural resources are being used extensively for construction, industries, transport and consumption. The overwhelming consensus of scientific studies on climate indicates that most of the observed increase in global average temperatures since the latter part of the 20th century is very likely due to human activities, primarily from increases in greenhouse gas concentrations resulting from the burning of fossil fuels.

Greenhouse gas emission is a major human causes of climate change, and their sources include transportation, electricity production, burning fossil fuel in industries, commercial and residential application, agriculture, and land use. There are four major gases contribute to the greenhouse effect.

Carbon Dioxide: A vital component of the atmosphere, carbon dioxide (CO2) is released through natural processes (like volcanic eruptions) and through human activities, such as burning fossil fuels and deforestation.

Methane: Like many atmospheric gases, methane comes from both natural and human-caused sources. Methane comes from plant matter breakdown in wetlands and is also released from landfills and rice farming. Livestock animals emit methane from their digestion and manure. Leaks from fossil fuel production and transportation are another major source of methane, and natural gas is 70% to 90% methane.

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Nitrous Oxide: A potent greenhouse gas produced by farming practices, nitrous oxide is released during commercial and organic fertilizer production and use. Nitrous oxide also comes from burning fossil fuels and burning vegetation and has increased by 18% in the last 100 years.

Chlorofluorocarbons (CFCs): These chemical compounds do not exist in nature they are entirely of industrial origin. They were used as refrigerants, solvents (a substance that dissolves others), and spray can propellants.

Burning of fossil fuels like coal, oil and gas are the largest contributor to global climate change, accounting for over 75 per cent of global greenhouse gas emissions and nearly 90 per cent of all carbon dioxide emissions. Greenhouse gas emissions blanket the Earth, they trap the sun's heat. This leads to global warming and climate change. The world is now warming faster than at any point in recorded history. Warmer temperatures over time are changing weather patterns and disrupting the usual balance of nature. This poses many risks to human beings and all other forms of life on Earth. The increased concentration of carbon has been caused by the emission of GHGs as a result of economic activities.

During the Industrial Revolution, Britain increased its use of coal as a fuel source. Coal became a key factor in the Industrial Revolution, and its popularity as a fuel source spread in Europe, Asia and the United States. Coal helped power new factories, ships and trains, as well as smelt iron and provided heat for many homes. At the same time, it increased the amount of CO2 in the air (Little, 2023, April 18). Gas flaring introduces toxic pollutants such as sulfur dioxide into the atmosphere, which can lead to environmental problems such as acid rain, as well as the generation of greenhouse gases which contribute to global climate change. Machines used in the manufacturing process often run on coal, oil, or gas; and some materials, like plastics, are made from chemicals sourced from fossil fuels. The manufacturing industry is one of the largest contributors to greenhouse gas emissions worldwide. The usage of these equipment needs to be regulated in order to control the greenhouse emission.

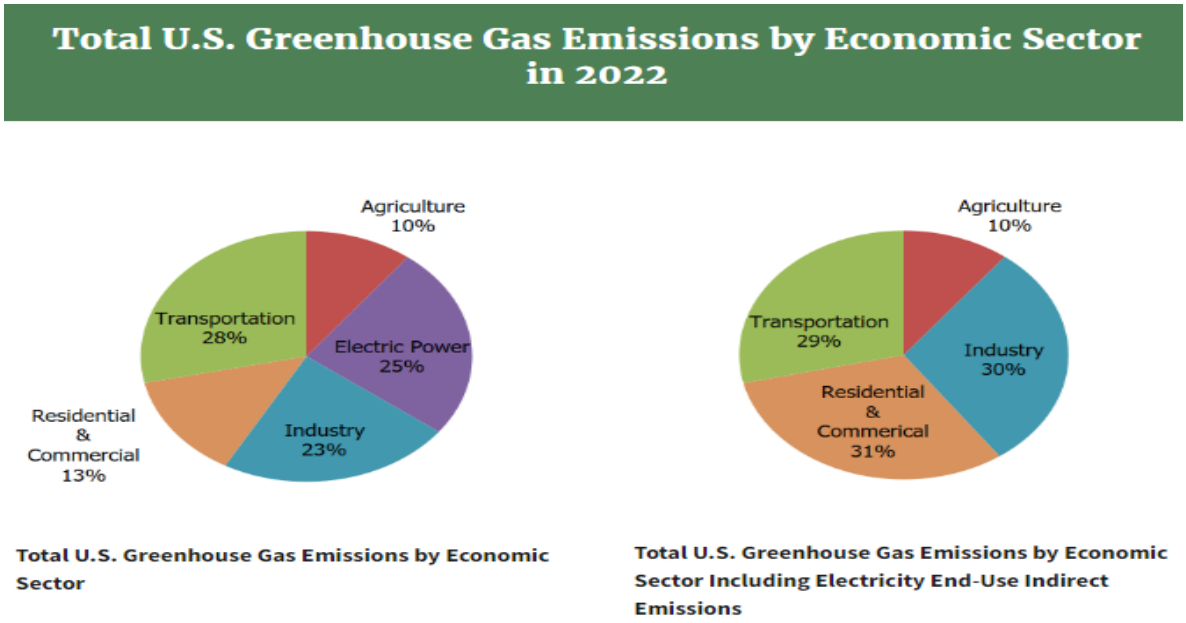

Figure 1: Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990–2022. Source: https:// www.epa.gov/ghgemissions /sources -greenhouse-gas-emissions.

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Solid waste is another human activity contributes directly to greenhouse gas emissions through the generation of methane from the anaerobic decay of waste in landfills, and the emission of nitrous oxide from our solid waste combustion facilities. Nigerians get rid of their waste is by burning. This unwholesome practice releases greenhouse gases, air pollutants, reactive trace gases, toxic compounds, and short-lived climate pollutants, which include black carbon. Black carbon emissions have a climate change impact up to 5,000 times greater than CO2 (Waste management and climate change, 2023, October 27). Waste disposal remains a national challenge in Nigeria. The population of the country, currently estimated at over 200 million, has made things worse. Adetolaju Joel noted in his 2023 article that rapid urbanization has compounded this problem, making it a daunting task for the government to manage (Adetolaju, 2023, March). According to punch newspaper report stated that 33 states lack landfills, dispose waste openly, only three states of the country have sanitary landfills and the remaining 33 states operate open dumping, the just-released State of the Nigerian Environment 2022 Report (Nnodim, 2022, December 12).

Nigeria falls among the 30 countries with the worst waste management practice out of 180 countries in the world, according to the Yale Center for Environmental Law and Policy (Gambo, 2024, March 25). With a score of 12.7 out of 100, Nigeria performed way below average compared with the performances of its neighbours in Sub-Saharan Africa - Seychelles and Equatorial Guinea with scores of 69.10 and 63.10 respectively (Babatunde, 2023, June 15).

Nigeria Environmental Performance Index (EPI) scores

A score of 100 indicates high performance while a score of 0 indicates low performance

EPI	Rank	Scores
Waste Management	152	12.70
Unsafe Sanitation	174	6.00
Recycling	171	4.70
Controlled Solid Waste	123	16.70
Ocean Plastic	124	12.70

The 2022 EPI provides a quantitative basis for comparing and analyzing environmental performance for 180 countries

Table: Dataphyte • Source: EPI • Created with Datawrapper

Figure 2: Nigeria Environmental Performance Index (EPI) Scores. https://epi.yale.edu/epi-results /2022/country/nga

Deforestation: Deforestation is another major human activity causes climate change. Forests store large amounts of carbon, trees and other plants absorb carbon dioxide from the atmosphere as they grow. This is converted into carbon and stored in the plant's branches, leaves, trunks, roots and in the soil. When forests are cleared or burnt, stored carbon is released into the atmosphere, mainly as carbon dioxide lead to an increase in carbon dioxide, thereby increasing global warming, which contributes to climate change

According to the United Nations Food and Agricultural Organization, nearly four million hectares of forest are cut down each year in Africa. In 2010, Nigeria had 10.9 million hectares of natural forest, extending over 12% of its land area, but in 2021, it lost 96.5 thousand hectares of natural forest, equivalent to 58.5 Million tonnes (Mt) of CO2 emissions. Also, in 2005,

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Nigeria had the world's highest deforestation rate (3.5%), with more than 55.7% of its forest already destroyed by logging, subsistence farming and collection of fuel wood[5]. From 2000 to 2005, the country lost 81% of its old-growth forest, as most of its population largely depended on wood for heating and cooking. Between 2002 and 2020 the Akure-Ofosu Forest Reserve alone lost 44% of its primary trees. This predicament threatens food security (Proshare, 2022). In another report, Nigeria has lost 96 per cent of its forest due to deforestation, according to the Director-General, Nigerian Conservation Foundation (NCF), Dr Muhtari Aminu-Kano (Deforestation: Nigeria has lost 96% of its forest, 2018).

"We have only four per cent of our original forest cover now and we think that is catastrophic and requires massive efforts to increase that coverage to at least 25 per cent across the country in 30 years. "We want to see more trees everywhere because they will help to save humanity from global warming as they breathe in what we breathe out and then they breathe out what we breathe in for survival.''

The Effect of Climate Change on Sustainable Development

Sustainable development is a means of maintaining development to ensure the needs of society are met presently but also in the future. Human development can negatively impact the natural environment as advances in science and technologies cause environmental harm. However, sustainable development attempts to reduce the development impact created on the environment and promotes ways in which society can adapt to the issue that climate change presents. The three main elements of sustainable development are social, economic, and environmental with 17 goals. Goal 13 is directly focused on action to address climate change and its impacts. A changing climate poses a significant threat to the long-term sustainability of the planet, and the systems of consumption and production which are responsible for driving climate change also present challenges for the wider sustainability of society.

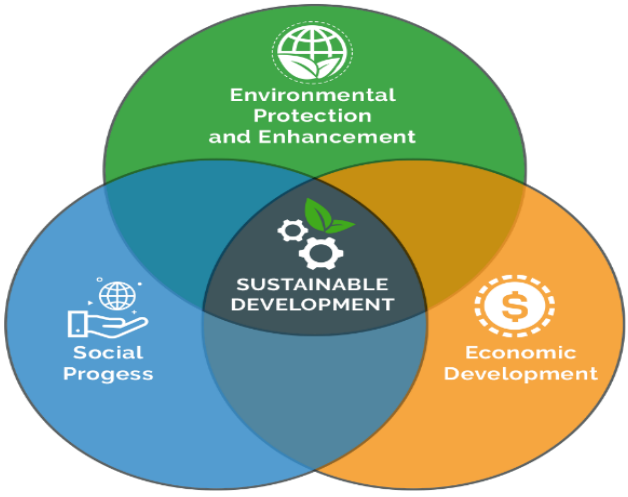

Figure 3: Pillars of Sustainable Development. Source: https://images.app.goo.gl/WeuVGqPhEWdfETK68

The sustainable development goals (SDGs) has 17 global goals adopted by United Nation (UN) members' states in September 2015. The aim of ending poverty must go hand-in-hand with

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strategies that build economic growth and addresses a range of social needs including education, health, social protection, and job opportunities, while tackling climate change and environmental protection.

1) No Poverty- End poverty in all its forms everywhere
2) Zero hunger - End hunger, achieve food security and improved nutrition, and promote sustainable agriculture
3) Good health and well-being - Ensure healthy lives and promote well-being for all at all ages
4) Quality education - Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all.
5) Gender equality - Achieve gender equality and empower all women and girls
6) Clean water and sanitation - Ensure availability and sustainable management of water and sanitation for all.
7) Affordable and clean energy - Ensure access to affordable, reliable, sustainable and modern energy for all
8) Decent work and economic growth - Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all
9) Industry, Innovation and Infrastructure - Build resilient infrastructure, promote inclusive and sustainable industrialisation, and foster innovation
10) Reduced inequality - Reduce inequality within and among countries.
11) Sustainable cities and communities - Make cities and human settlements inclusive, safe, resilient, and sustainable
12) Responsible consumption and production - Ensure sustainable consumption and production patterns
13) Climate action - Take urgent action to combat climate change and its impacts by regulating emissions and promoting developments in renewable energy
14) Life below water - Conserve and sustainably use the oceans, seas and marine resources for sustainable development
15) Life on land - Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss.
16) Peace, justice and strong institutions - Promote peaceful and inclusive societies for sustainable development, provide access to justice for all and build effective, accountable and inclusive institutions at all levels

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17) Strengthen the means of Implementation and revitalise the global Partnership for sustainable development goals (Sustainable Development Goals, n.d.).

Figure 4: Pictorial Representation of Each of the Sustainable Development Goals. https://images.app.goo.gl/zvxMV1fBefMu8BRw8

Climate change is caused by human activities and threatens life on earth as we know it. With rising greenhouse gas emissions, climate change is occurring at rates much faster than anticipated. Its impacts can be devastating and include extreme and changing weather patterns and rising sea levels. If left unchecked, climate change will undo a lot of the development progress made over the past years. It will also provoke mass migrations that will lead to instability and wars. Climate change is already impacting public health, food and water security, migration, peace and security. Climate change, left unchecked, will roll back the development gains we have made over the last decades and will make further gains impossible (The Sustainable Development Agenda, n.d.).

Climate change is globally acknowledged as one of the most significant development challenges facing humanity. There is increasing evidence that climate change is directly affecting the social, economic and human development of countries.

i Effect of Climate Change on Human Health

The health effects of climate change include respiratory and heart diseases, pest-related diseases like Lyme disease and West Nile Virus, water and food related illnesses, injuries and deaths. Climate change has also been linked to increases in violent crime and overall poor mental health. Health outcomes involve both direct and indirect consequences of these events some of which only appear months, and even years, after the event. Immediate impacts include deaths, physical injuries, malnutrition, respiratory and cardiovascular ailments and exposure to infectious diseases, such as cholera, dysentery and typhoid, which result from drinking contaminated water or eating contaminated food. The stress, trauma and displacement caused by climate-related disasters can be expected to produce a surge in mental health illnesses, including anxiety, depression and post-traumatic stress disorder (PTSD) (Wyman, 2024).

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The global workforce is facing a serious health crisis due to the negative impacts of climate change. The climate crisis could expose 2.4 billion workers to health hazards like cancer, cardiovascular illness, kidney dysfunction and physical injury, says a new ILO report.

The World Economic Forum's Quantifying the Impact of Climate Change on Human Health report forecasts how the climate crisis will impact the global health landscape over the next 20 years (Wood, 2024).

ii Effect of Climate Change on The Planet's Ecosystems

Climate change could lead to expansions, reductions, or extinctions of some populations. These changes, in turn, can affect the overall biodiversity of a region. Plants and animals may also change the geographic range they inhabit in response to changing climatic conditions (Climate Change Impacts on Ecosystems, n.d.).

iii Effect of Climate Change on the Economy and Business

Nigeria is currently experiencing one of the catastrophic effects of climate change across the country - flooding according to the daily trust. The effect according the newspaper stated low crop yield, food shortage, reduction in livestock production, loss of income due to destruction of farmlands by climate change, decreased hydroelectric power supply and loss of shelter, road networks due to the negative impact of flooding (Seven Major Ways Climate Change Affects Nigerians, 2022, October 30). The physical impacts of climate change affect most aspects of human welfare and the economy. In some regions of the world, rising temperatures will harm worker productivity and crop yields, and lead to more cardiovascular and respiratory problems and higher mortality rates; although cold-related mortality rates are likely to fall.

iv The effect of climate change on Sustainable Development

Climate change is caused by human activities and threatens life on earth as we know it. With rising greenhouse gas emissions, climate change is occurring at rates much faster than anticipated. Its impacts can be devastating and include extreme and changing weather patterns and rising sea levels. If left unchecked, climate change will undo a lot of the development progress made over the past years. It will also provoke mass migrations that will lead to instability and wars. The impacts of climate change disrupted the natural, economic and social systems we depend on. This disruption will impact global food security, damage infrastructure and jobs, and harm human health

How to Reduce the Effect of Climate Change

i Net zero emissions describes the state where emissions of carbon dioxide due to human activities and removals of these gases are in balance over a given period. It is often called simply net zero. In some cases, emissions refer to emissions of all greenhouse gases, and in others it refers only to emissions of carbon dioxide (CO_2). To reach net zero targets requires actions to reduce emissions. One example would be shifting from fossil fuel energy to sustainable energy sources (Fankhauser et al., 2022). Net zero refers to a state in which the greenhouse gases going into the atmosphere are balanced by removal out of the atmosphere. The planet will only stop warming when we reach 'net-zero' carbon dioxide emissions. Achieving net-zero means reducing global greenhouse gas emissions to a much

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lower level than today and balancing the remaining emissions by reabsorbing the same amount from the atmosphere

ii Leadership and Innovation: Emissions of the anthropogenic greenhouse gases (GHG) that drive climate change and its impacts around the world are growing. According to climate scientists, global carbon dioxide emissions must be cut by as much as 85 percent below 2000 levels by 2050 to limit global mean temperature increase to 2 degrees Celsius above pre-industrial levels. Temperature rise above this level will produce increasingly unpredictable and dangerous impacts for people and ecosystems. As a result, the need to accelerate efforts to reduce anthropogenic GHG emissions is increasingly urgent. Existing government policies will not sufficiently solve the problem. Leadership and innovation from business is vital to making progress (Greenhouse Gas Protocol, n.d.).

iii Strengthen the Weak Law Enforcement: Across the country, waste is moved from one point to another. The government moves waste from densely populated areas, where it is mainly generated, to places not yet inhabited or are sparsely inhabited by humans. Regulations and policy guidelines the effective waste management. It is, however, concerning that improper and indiscriminate waste disposal has continued across the country in the presence of laws and policies. All tiers of government have requisite laws governing waste management at their levels (Ajayi, 2023).

iv Awareness of impact on human health and climate change: There is little awareness on the effects on climate change and human health. There must be a meaningful working partnership between the government, the private sector, and civil society. A public awareness campaign must be intensified and tailored to make the populace understand the effect of climate change on the sustainable development. Raising awareness and thereby understanding of the effects of climate change on health will facilitate both behavioural change and societal support for the actions needed to reduce greenhouse gas emissions (Raising awareness on climate change and health, n.d.)

v In an era marked by technological advancements and the urgent need for environmental conservation, the synergy between digital transformation and environmental sustainability must be center stage. The marriage of these two seemingly distinct realms has given rise to innovative solutions that hold the potential to mitigate ecological challenges and create a more sustainable future.

vi Digital transformation brings with it the power to collect, analyses and interpret vast amounts of data. This capability proves invaluable in the realm of environmental sustainability. Organizations are now equipped to monitor energy consumption, carbon emissions, and resource usage in real-time. With data-driven insights, they can make informed decisions about optimizing operations. As a result, reducing waste, and adopting greener practices. For instance, smart sensors in industrial settings can track energy usage patterns, allowing for adjustments that lead to significant energy savings and reduced carbon footprints (Axiata Digital Labs, n.d.)

vii Digital transformation has paved the way for the circular economy to flourish. Through interconnected systems, products can be designed for durability, repairability, and recycling. Smart tags and blockchain technology can track the lifecycle of products, thus ensuring their proper disposal and recycling at the end of their usability. This approach not

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only reduces the burden on landfills but also promotes responsible consumption and production, aligning with sustainable development goals (Axiata Digital Labs, n.d.)

viii The rise of remote work and virtual collaborations, accelerated by digital transformation, has unexpectedly contributed to environmental sustainability and this must be sustained. With fewer employees commuting to offices, there's a noticeable reduction in carbon emissions associated with daily commutes. Video conferencing and virtual meetings have replaced the need for frequent business travel, further curbing greenhouse gas emissions. This shift not only showcases the power of digital tools but also highlights their role in reshaping work culture for a more sustainable world (Axiata Digital Labs).

ix The use of renewable energies such as solar, wind, wave, biomass, and hydroelectric must be adopted. This type of energy is clean because it does not produce greenhouse gas emissions. These sustainable energies will therefore reduce the amount of pollution and greenhouse gas emissions. Ultimately, helping to reduce the effects of climate change.

x Use less energy by reducing your heating and cooling use, switching to LED light bulbs and energy-efficient electric appliances, washing your laundry with cold water, or hanging things to dry instead of using a dryer. Improving your home's energy efficiency, through better insulation for instance, or replacing your oil or gas furnace with an electric heat pump can reduce your carbon footprint (Actions for a healthy planet, n.d.)

xi Reduce, reuse, repair and recycle: Electronics, clothes, plastics and other items we buy cause carbon emissions at each point in production, from the extraction of raw materials to manufacturing and transporting goods to market. To protect the climate, buy fewer things, shop second-hand, and repair what you can (Act Now, United Nation)

CONCLUSION

Everyone can make choices to protect nature, tackle climate change, and take care of the planet. Climate change is having a catastrophic impact on human and ecosystems all around the world. It is important that immediate action is taken to reduce carbon emissions, protect the planet, and safeguard the future.

RECOMMENDATIONS

Based on the findings of the study, some recommendations and suggestions are proposed to reduce the effect of climate change. Therefore, the below recommendations will reduce the emission of greenhouse gas and in turn reduces climate change and fostering sustainable development.

i The less usage of energy by switching to LED light bulbs and energy-efficient electric appliances in our various homes and offices including our university should be encouraged.

ii Introduction and encourage carpooling. Carpooling is the process that group of people travelling together in a car to their offices, sharing a ride with one or more people. This

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will significantly reduce the number of cars on the road, which in turn reduces the number of carbon emissions released into the atmosphere.

iii Improving the circular economy through digital transformation (technology) to turn waste to wealth in production lifecycle, this involves sharing, leasing, reusing, repairing, refurbishing and recycling existing materials and products as long as possible.

iv Remote work and virtual collaborations such as online meeting, lectures, conference, symposium etc should be encouraged. This will be accelerated by digital transformation, has unexpectedly contribution to environmental sustainability. This will reduce the number of cars on the road and subsequently reduces the number of carbon emissions generated by vehicles.

v Governments need to be up to the task by ensuring strict enforcement of all relevant laws and regulations to protect the environment from indiscriminate waste disposal.

vi Planting of tree should be encouraged. Tree help stop climate change by removing carbon dioxide from the air, storing carbon in the trees and soil, and releasing oxygen into the atmosphere.

vii Avoid paper wastage, reduce printing in our offices and schools, encourage correspondence by e-mail, encourage paper duplexing while printing. This will reduce rate of deforestation.

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