ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/25apr2163

Investigating the Interplay between Climate Change and Sustainable Environment Development: Challenges, Strategies and Future Directions

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Publication Date: 2025/05/15

Abstract: Climate change is associated with the long-term effects of adverse weather patterns which could be natural or human-driven. Studies show that human activities in the atmosphere contribute over 95% of the global climate change. Sustainable environment management; a path towards a resilient future for every society finds its root in the benefits of tackling the challenges of climate change. The drivers of climate change pose quite a number of challenges for communities globally such as deforestation, desertification, greenhouse gas emissions, construction and industrial activities which alters the ozone layer and creates extreme weather conditions. This eventually results to disruption in weather events such as bio-diversity loss, rising sea levels and disruptions in agricultural activities and water resources. However, a transitioning to the use of renewable energy sources could help sustain environment management. Research has shown that engaging in sustainable agricultural practices and building climate resilient infrastructure and adaptation measures such as forest management, resource efficiency and a halt in bush burning would help communities to cope with the impacts of climate change. This paper therefore provides an overview of the key causes and consequences of climate change and emphasizes the need to explore the significant approaches that will help mitigate against the unprecedented challenges that hinder sustainable environment management. Additionally, the paper delves into the environmental, social and economic dimensions through which policy frameworks aimed at reducing emissions and adapting to climate change can be integrated into communities in order to enhance sustainable environment management. Finally, the paper spells out practicable recommendations for scientists, governments and communities on how climate change can be slowed down to ensure a sustainable environment management. Using the Sustainable Development and the Resource-resilient World Theories as a framework of analysis, this paper argues that the complex interplay of climate change and sustainable environmental development is a factor of man's interaction with his environment which eventually leads to ecological, social and economic consequences. The paper identifies a mix of policy, education, innovation and sustainable climate-oriented policies as the keys to promoting sustainable environment development. It therefore recommends that the Nigerian Government should factor in climate adaptation and mitigation as the main stream of its development policies; more investment be made into greenhouse technologies such as renewable and climate-smart infrastructures; and local participation be encouraged by increasing climate change awareness at the grass-root level.

Keywords: *Climate, Climate Change, Environment, Sustainable Development, Sustainable Environment Management.*

How to Cite: Efe Grace Oloruntoba; Ibrahim Rotimi Aliu (2025). Investigating the Interplay between Climate Change and Sustainable Environment Development: Challenges, Strategies and Future Directions. *International Journal of Innovative Science and Research Technology*, 10(4), 3801-38011.
https://doi.org/10.38124/ijisrt/25apr2163

I. INTRODUCTION

Nigeria which is Africa's most populous country with the largest economic base projects climate-induced challenges right from its Saharan belts in the north to its Mangrove swamps in the south (Pontianus and Oruonye, 2021). Climate is described as the average weather condition of a place which takes variability in relevant quantities of temperature, precipitation, wind, atmospheric pressure and humidity over a long period of time (American Meteorological Society, 2016). IPPC (2013) observed that overtime; changes in climate occur as a result of long-term

ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/25apr2163

shift in weather patterns caused by either human activities (deforestation, industrialization, agriculture, greenhouse emissions) or nature (volcanic eruptions,ocean currents, solar variations). This leads to climate change which eventually causes ecological imbalances in our physical surroundings felt in form of rising temperatures, extreme weather, ocean acidification and agricultural disruptions (Onuoha, 2012). The later part of 20th century witnessed the onset of unprecedented environmental, economic and social changes which led to an outburst of global climate change reality (Intergovernmental Panel on Climate Change IPCC, 1998; 2013). According to Haines and Dora (2012), climate change refer to the long-term shifts in weather patterns; a factor of rising temperatures and changing precipitation patterns resulting from increased concentrations of greenhouse gases (GHGs) in the earth's atmosphere.

Youra (2019) affirmed that climate is a tale of two paths which could either lead to destruction or rehabilitation. Nothing impacts negatively on human lives and sustainability than the unpleasant implications of climate change on the environment. Rocha et al., (2022) stated that climate change and sustainable environment management is a pressing global issue that has constituted unpleasantness in the environment and human aspects of life such as agriculture, health and economy. Just as Bhatia and Kamble (2019); Khalid et al., (2024) and Onakpojeruo et al., (2024) found in their various studies; climate change have not only threatened human survival but has also significantly disrupted ecosystems, intensified natural disasters and forced the displacement of communities. Similarly, Wu et al., (2016) and Liang and Gong (2017) observe that climate change has a potential impact of spreading human infectious diseases that may be vector-borne (malaria, lyme); water-borne (cholera) or zoonotic (Ebola, Covid-19). Hence, climate change and sustainable environment development are two interconnected global issues that require swift attention from societies worldwide. According to Mensah (2019), sustainable development emphasizes the need to meet present needs of the environment, economy and society without compromising the ability of future generations to meet their own needs. Its interest therefore strives to address the challenges faced by societies by promoting the tenet of human and environmental development (United Nations, 2015) Climate change and sustainable environment development therefore recognizes the need for economic growth while considering social equity and environmental protection.

The United Nations Framework on Climate Change (UNFCC) and the United Nations Sustainable Development Goals (SDGs) are key international initiatives that highlight the importance of addressing climate change and sustainable development at a global level providing a platform for international cooperation and negotiation on climate change mitigation and adaptation (UNFCC 2014; Keitsch, 2018). While the UNFCC aims to stabilize greenhouse gas concentrations to prevent dangerous impacts of human activities on the climate system; the SDGs provide a comprehensive plan for sustainable development in socio-economic and environmental dimensions (Evers, 2018). This collaborative approach is necessary to tackle the complex and interconnected changes posed by climate change while considering the social, economic and environmental dimensions of sustainable development. Therefore, understanding the relationship between climate change and sustainable environment development as a synergy is crucial for fostering harmonious coexistence with our environment, attaining the SDGs and building of resilient societies ultimately contributing to the advancement of inter-generational equity.

Fawzy et al., (2020) in their study “Strategies for mitigation of climate change” found that climate change effects can be cushioned by implementing conventional (reducing fossil-based carbondioxide), negative emissions (capture atmospheric carbon) and radiative force geoengineering mitigation strategies (reduction in global temperatures). However, Jike-wai et al., (2012) opine that it is not evident that mitigation strategies are sufficient enough to tackle climate change effects suggesting the essentials of resilience and adaption strategies. This is in collaboration with the observation of Ozor (2009) who report that while mitigation strategies are necessary to reduce the intensity of the effects of climate change; the adaptation strategies provide precautionary measures like adjustment systems to minimize the harm caused by the effects of climate change. These precautionary measures could be infrastructural (building of climate resilient roads and houses, improving drainage systems), institutional (integrating climate risk into land use planning), behavioural (changing agricultural practices) or nature based (building of green land spaces). Schneider et al., (2000) noted that these play a massive role in minimizing negative environmental impacts, reducing greenhouse emissions and conserving natural resources.

Apparently, this dovetails the role of geography as it focuses on human relationship with the environment (Liverman, 1999). This implies that geography provides a spatial perspective that analyzes the interactions between the physical and human systems that contribute to climate change. In this way, Olga and Jeffreys, 2003) recognize Geographic Information System as a tool that enables researchers to map and model climate change processes, access risks, develop adaptation strategies and make informed decisions that could lead to environmental sustainability. In view of the important place of geography on climate change and sustainable environment management; this paper provides an overview of the key causes and consequences of climate change and emphasizes the need to explore the significant approaches that will help avoid to the barest minimum the unprecedented challenges that hinder sustainable environment management.

II. THEORITICAL UNDERPINNINGS

Theories are analytical tools that establish guiding principles that help researchers to explain the inter-connection that exist between the variables in their analysis, thereby enhancing the clarity and focus of the study (Salihu and Adanmson, 2018). This research builds on both Sustainable Development and the Resource-resilient World

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Theories. The suitability of these theories to the study borders around the aspect of environmental sustainability, climate change and environmental decision making. Sustainable development is a system of operation that aims to satisfy the needs of the present generation without necessarily altering the abilities of the future generations to fulfilling their needs (Brundtland's Report cited in Safwat et al., 2019).

The Sustainable Development Theory (SDT) is based on five stages- the stage of evolution of sustainable development thoughts (from 1972-1987) to the fifth stage which is the stage of integration through inclusive approaches (2010 - present). SDT is marked by the fifth stage (stage of symbolic events) integrated into the global agenda of the SDGs which has significant impact on mitigating and adapting to the effects of climate change on our environment. This paper divides the symbolic events period of SD theory into the integration period (2010 - 2014), the implementation period (2015 - 2022) and the localization period (2022 - present). The integration period witnessed commitment to poverty eradication, implementation period witnessed adoption of the SD-goals while the localization period is presently witnessing the involvement of communities in ensuring green transitions.

In using SDT, emphasis on the need to integrate climate and environmental development policies especially in nations that struggle with poverty and poor technological ability. According to Salihu (2020), the theory explains how environmental development can be sustained while addressing the risks posed by climate change. By creating a balance between economic growth, social inclusion and environmental protection; the sustainable development theory addresses climate change and environmental sustainability. With climate change as its central goal, it has not only led to the initiation of climate issues into national policies but has also provided channels to sustainable city building.

According to Brundtland who propounded the SD theory, nations are to protect the earth from destruction as the results of abusing the global earth in which humans are living on and enjoying the resources it provides has grave consequences. The report brings to limelight the fact that the activities of man if not controlled can be detrimental to the Earth's natural resources making the earth to loose its balance, eventually responding through natural consequences. As rightly identified by Khalid et al., (2024) and Shi et al., (2019), climate change, rising sea levels, extreme weather, biodiversity loss and resource depletion are some of the consequences of man's uncontrolled activities on the earth. These among others will prevent the earth from providing the products and services that humans are demanding from it (Klarin, 2018). The report further insists that practical steps must be undertaken to either mitigate the effects of climate change or adapt to its inevitable impacts through resilient infrastructure, sustainable practices and community-based strategies.

The essentials of this theory is that it is an exposure to an understanding of the phenomenon of climate change, sustainable environmental development and targeted polices which provides credible counter to the consequences of climate change. Furthermore, Salihu and Adamson (2018) observe that this is more relevant in developing nations like Nigeria where the tendency to be hit harder by climate change is evident due to the lack of finances, low level of technology, and high reliance on environment for survival.

According to Ozili (2024), the Resource-Resilient World Theory of sustainable development posits that the current resources undergoing depletion are those which the world must rely on to combat the global threats of the future. Therefore, the theory emphasizes a dare need to preserve the world's resources for future gains and more especially, to mitigate the effects of climate change. For instance, Ferguson and Wollersheim (2023) in a study of the evolution of resilience in climate and development policy discourse; view resilience as a pre-requisite for sustainable environment development. The authors suggest that a shift toward resilience-focused strategies targeted at innovation in building materials, farming, energy and urban design would strengthen sustainable environmental development. In the same vein, Perry et al., (2023) in their study of global conservation targets argue that an understanding of the complex interactions between the society and the environment they live in is crucial for effective environmental sustainability development. This on the long run would not only build defence against the present challenges of climate change but also its future threats.

Quite a number of the future threats of climate change which include extreme weather conditions, heat stress, forced migration, loss of bio-diversity and sea level rise are presently evident around the globe (Werndl, 2012). For instance, Raza et al., (2024) identified crop failures due to drought or floods, changes in solar radiation, volcanic eruptions and human-induced increases in green house concentration as part of the of external shocks witnessed globally. Additionally, the author observe shift in ocean currents and unpredictable natural variability in form of chaotic changes as identifiable internal shocks globally. The theory operates on the premise that the possibility of achieving sustainable environment development rests solely on the willingness of the society to develop adaptive capacities to withstand resource-related stresses. The theory therefore (i) clarifies continuous innovation, adaptive resource governance and institutional flexibility, (ii) identifies less reliance on non-renewable resources, diversification and ecosystem restoration; (iii) preserve the functionality of the critical systems of agriculture, water and human livelihoods, (iii) facilitate a transition towards sustainability among resource owners, and (iv) build future-oriented adaptive capabilities of resilience in steps to mitigate climate change threats. The theory of sustainable environment development therefore depends on the continuous ability of societies to innovate, adapt and preserve the critical systems of agriculture, water, energy and human livelihoods. These must be preserved to secure essential resources and stable environments for the present generation while ensuring that resilient functioning systems are made available for future generations.

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Applying the resource resilient world theory of sustainable development to this study provides a framework for analyzing both the challenges posed by climate change and the future directions that can be taken by societies to ensure that they build resilience and adaptive capacities to mitigate the threats of climate change globally.has some merits. It also informs initiation of policies that build long-term resilience into environmental and socio-economic systems. On the basis for this study however, the resource-resilient world theory of sustainable development could be criticized for its emphasis on innovation and technological solutions without considering the complexity of societies and the need for equitable distribution of resources in the global context.

III. CHALLENGES OF CLIMATE HANGE TO ENVIRONMENTAL SUSTAINABILITY

World Meteorological Organization (WMO, 2024) opine that the atmospheric concentration of the three greenhouse gases which are carbon-dioxide (CO_2), methane (CH4) and Nitrous Oxide has in the last decade increased by 2.4ppm, 1934ppb and 336.9ppb respectively. This means that emissions from these gases are increasingly released into the atmosphere and present a threat to sustainable environment development. While climate insights are vital to achieving renewable energy targets as established by the SDGs; the incessant impact of climate change on environmental sustainability cannot be over emphasized. For instance, alterations resulting from human activities such as burning of fossil fuels, deforestation, construction, mining and industrial processes are associated with resource depletion, rising temperatures and threat to agriculture which are more obvious in a country like Nigeria (Yusuf, 2012). This is supported by Salihu (2020) who opine that most African countries depend more on climate-sensitive resources for their sustenance.

According to the International Union for the Conservation of Nature (IUCN, 1980), climate change knows no boundaries, and its effects are felt globally. The primary causes of climate change are anthropogenic activities that release significant amounts of greenhouse gas emissions into the atmosphere causing increase in global warming which eventually affects the ozone layer (World Health Organization (IPCC, 2021; WHO, 2018). According to IPCC (2018), greenhouse gas emissions arising from burning of fossil fuels such as coal, oil, transportation, heating and industrial processes contribute about 65% to the global climate change. Also, the Food and Agriculture Organization of the United Nations in a global forest resources assessment in 2010 observed that deforestation and urbanization which leads to increased carbon dioxide levels in the atmosphere contributes approximately 10% of the global gas emissions. Additionally, Smith et al., (2014) recognizes agricultural practices such as use of fertilizers for food cultivation and livestock production causing nitrous oxide and methane emissions respectively as contributing about 10 – 12% of the gas emissions into the atmosphere. Furthermore, UFCCC (2010) reports that industrial processes such as cement production, mineral exploration, quarrying activities and chemical manufacturing account for about 6 – 8% of the global gas emissions. Based on the observation of the U.S Environmental Protection Agency (EPA, 2022), the improper disposal of wastes into water plants and landfills which causes the decomposition of wastes in aerobic conditions contributes to about 3 -5% of the total global gas emissions.

In a related context, Riebeek (2007), identifies nature as a contributor to climate change as a result of emission of CO_2 from volcanoes into the atmosphere. Though the far-reaching consequences of the contributive effect of nature as against human activities to climate change can hardly be compared; National Aeronautics and Space Administration (NASA, 2022) report that on a global scale, volcanoes naturally emit between 130 and 230 million tons of $CO_{2..}$ More hazardous is the fact that burning fossil fuels releases in excess of 100 times more, which is about 26 billion tons of CO_2 into the atmosphere every year (Han et al., 2020). Despite the attributed impact of the aforementioned human activities on climate change and sustainable development, the global space (especially Africa) is yet to take drastic steps to cushion the severity of the consequences in the future of the environmental space.

Murdiyarso (2000) noted that the degradation of the natural environment through human activities resulting from construction, quarrying, deforestation and release of pollutants into land and water reflect the ignorance of many who lack the awareness of the need to be environment friendly. Meredith (2021) further asserted that the rise in climate change which dates back to the industrial revolution period had widespread industrialization and increased use of fossil fuels eventually contributing to a significant increase in greenhouse emissions, resulting in an alteration of the earth's climate system. The author noted that since then, human activities around the globe have continued to accelerate the pace and impact of climate change as a threat to sustainable environmental management. This is in agreement with the observation of Pidwirny (2006) who noted that the global atmospheric concentration of carbon dioxide has been on an exponential increase since the 18th century (see Figure 1). (Kwan et al., 2011) recounts that this kills the potency of the ozone layer to absorb the ultraviolent rays from sunlight therefore increasing the risk of skin cancer, reduction in crop yields and resulting toe ecosystem imbalance.

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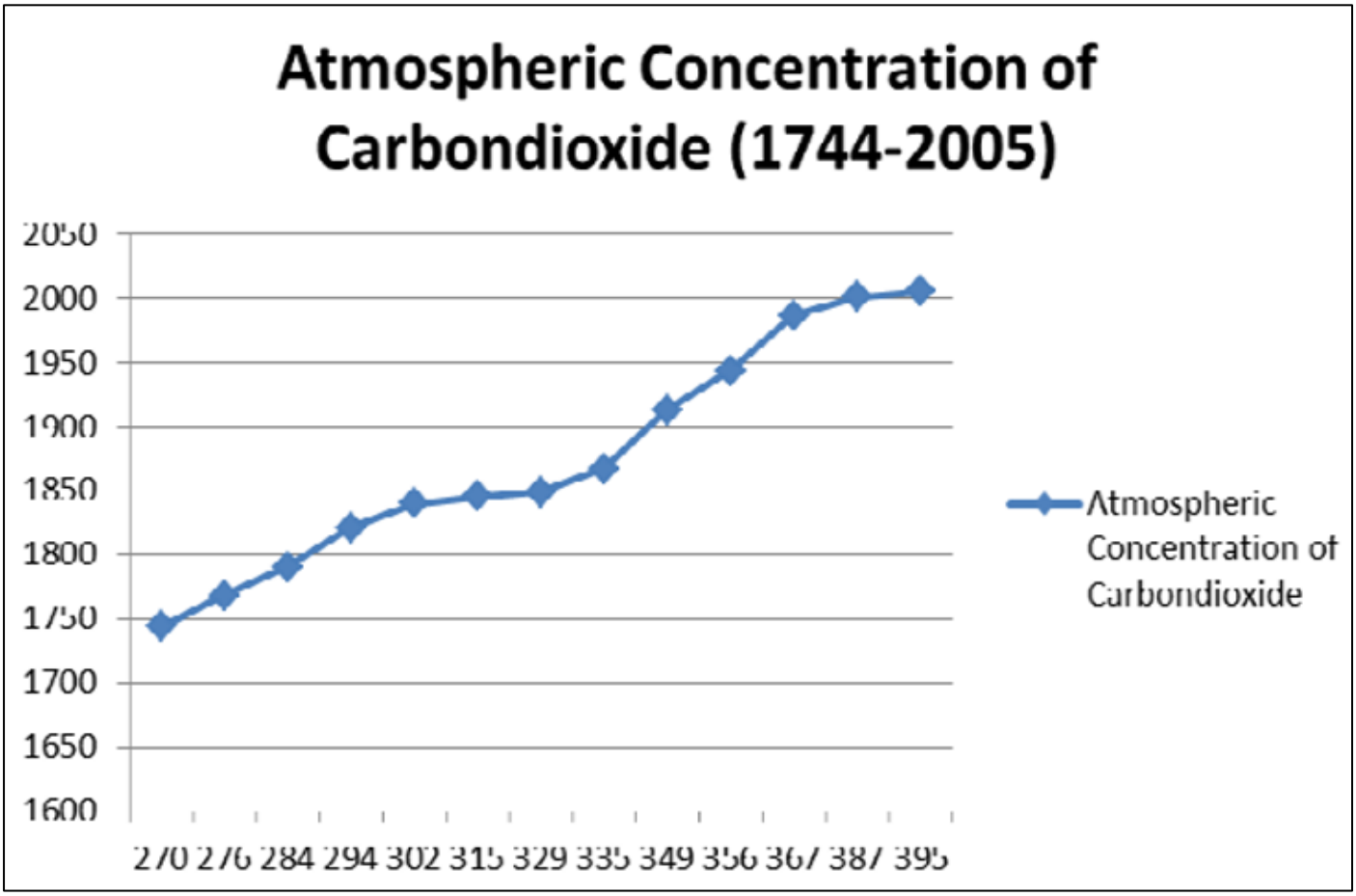

Fig 1 The Global Atmospheric Concentration of Carbon Dioxide (Pidwirny, 2006)

The global mean temperature of the earth has risen by over 0.7^0C in the 20th century and continues on an upward trend. Suffice to note is that the consequences of these are not far fetched as climate change has far-reaching impacts on various facets of life. For instance, Oyeranmi (2012) observed that the threats associated with climate change are nearly as severe as those posed by nuclear weapons. The author proposes that floods and drought which had continued and still continues to ravage many African countries is a resultant effect of climate change. This poses a ripple effect on the often hard and irreversible consequences and risks to human health and environmental sustainability. Moreover, Kaddo (2016) opine that climate change exacerbates extreme weather events such as hurricanes and droughts, affects ecosystems and biodiversity, leads to rising sea levels, alters precipitation patterns, and impacts agriculture and food security. Drawing inspiration from the works of Vanderhoof and Alexander (2016), extreme weather events can lead to habitat destruction, causing the loss of plant and animal species. This loss of biodiversity disrupts the delicate balance of ecosystems and can result in long-term ecological consequences that could affect sustainable environmental management. It is no gainsaying that ecosystems provide valuable services such as clean air, water filtration, pollination, and carbon sequestration. However, Schmidtlein et al., (2017) observed that extreme weather events can disrupt these services, leading to water pollution, reduced air quality, decreased agricultural productivity, and increased greenhouse gas emissions, among other negative impacts.

WHO (2018) projects that between 2030 to 2050; climate change will cause approximately additional 250,000 deaths from malaria, diarrhea and heat stress. This buttresses the fact that health related health issues like asthma as well as other cardiovascular diseases associated with extended periods of extreme high temperatures will also be on the increase globally. Additional impacts on health and environmental sustainability are some of the consequences that climate change has on air quality. For instance, the Centre for Diseases Control (CDC, 2021) opine that adverse weather patterns and rising temperature as a result of burning of fossil fuels and deforestation contributes to higher levels of air pollution. In a similar report by WHO (2018), a global estimate of 7 million premature deaths is linked to air pollution yearly. IPCC (2018) in its report acknowledges that vector-borne diseases such as lyme and dengue fever which are primarily transmitted by insects like mosquitos and ticks whose populations are driven by climate change contribute to increased morbidity and mortality rates.

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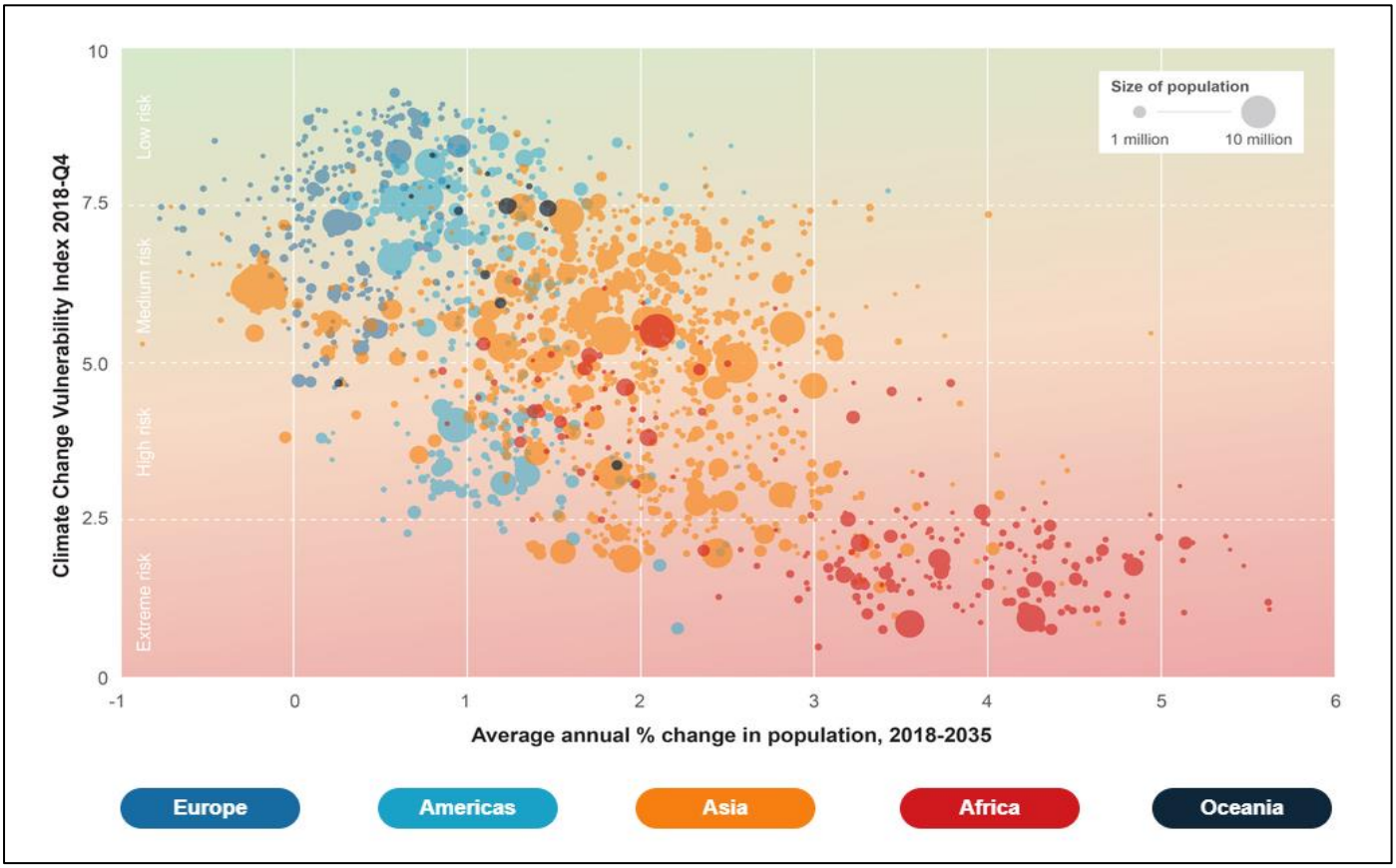

Fig 2 Global Report on Climate Change and Vulnerability Index (Maplecrof, 2021)

Maplecrof (2021) in a global report on climate change and vulnerability index evaluates the vulnerability of human populations to extreme climate events and changes in climate over the next 30 years. This suggests that here is an indication that most developing continents have low ratings for climate change exposure, sensitivity and adaptive capacity see Figure 2). This invariably suggests that these regions are particularly vulnerable to the impacts of climate change which implies that they may face significant challenges with adapting to and effectively mitigating the adverse effects of climate change. It therefore highlights the urgent needs of the regions to engage in targeted interventions and support to enhance their resilience to cope with the environmental changes and achieve sustainable environmental management.

According to the United Nations General Assembly (2015), the 13th, 14th and 15th part of the Sustainable Development Goals (SDGs) is targeted at climate change and sustainable environmental management. For instance, SDG 13 strengthens resilience and adaptive capacity to climate change hazards integrating measures into national policies for regulatory planning strategies. SDG 14 on the other hand, speaks on increasing technological knowledge and research capacity in order to conserve the global coastal and marine areas. Additionally, SDG 15 reviews the measures that can be taken to implement the sustainable management of all types of forests, reduce deforestation, increase afforestation and reforestation.

IV. STRATEGIES AND FUTURE DIRECTIONS TO ADAPT TO THE EFFECTS OF CLIMATE CHANGE

As climate continues to change, millions of poor people globally; face increasing challenges in terms of extreme events, health effects, food, water, and livelihood security, migration and forced displacement, loss of cultural identity, and other related risks. Climate change mitigation refers to the actions and measures that are designed to reduce or prevent emissions of green-house gases in our environment (Salihu and Adamson, 2018). The SDGs unanimously adopted by all United Nations Member States signifying a commitment to addressing climate change has provided a collective platform for global action against discrepancies of climate change in order to promote environmental sustainability (Zhang and Ayyub, 2021) Being a global consensus, Costa et al., (2022) observed that the goals provide a comprehensive framework that recognizes the need to tackle climate change challenges through global community actions and empowerment. The interconnection between the various environmental issues including climate change, biodiversity loss, land degradation and marine conservation would therefore require an extensive awareness of the climate concerns. With a focus on climate change and environmental sustainability, Millard et al., (2016) emphasized that the economy; through its resource efficiency, the environment; through resource preservation and the society; through decision-making processes related to environmental issues are the three pillars of sustainable development (See Figure 3).

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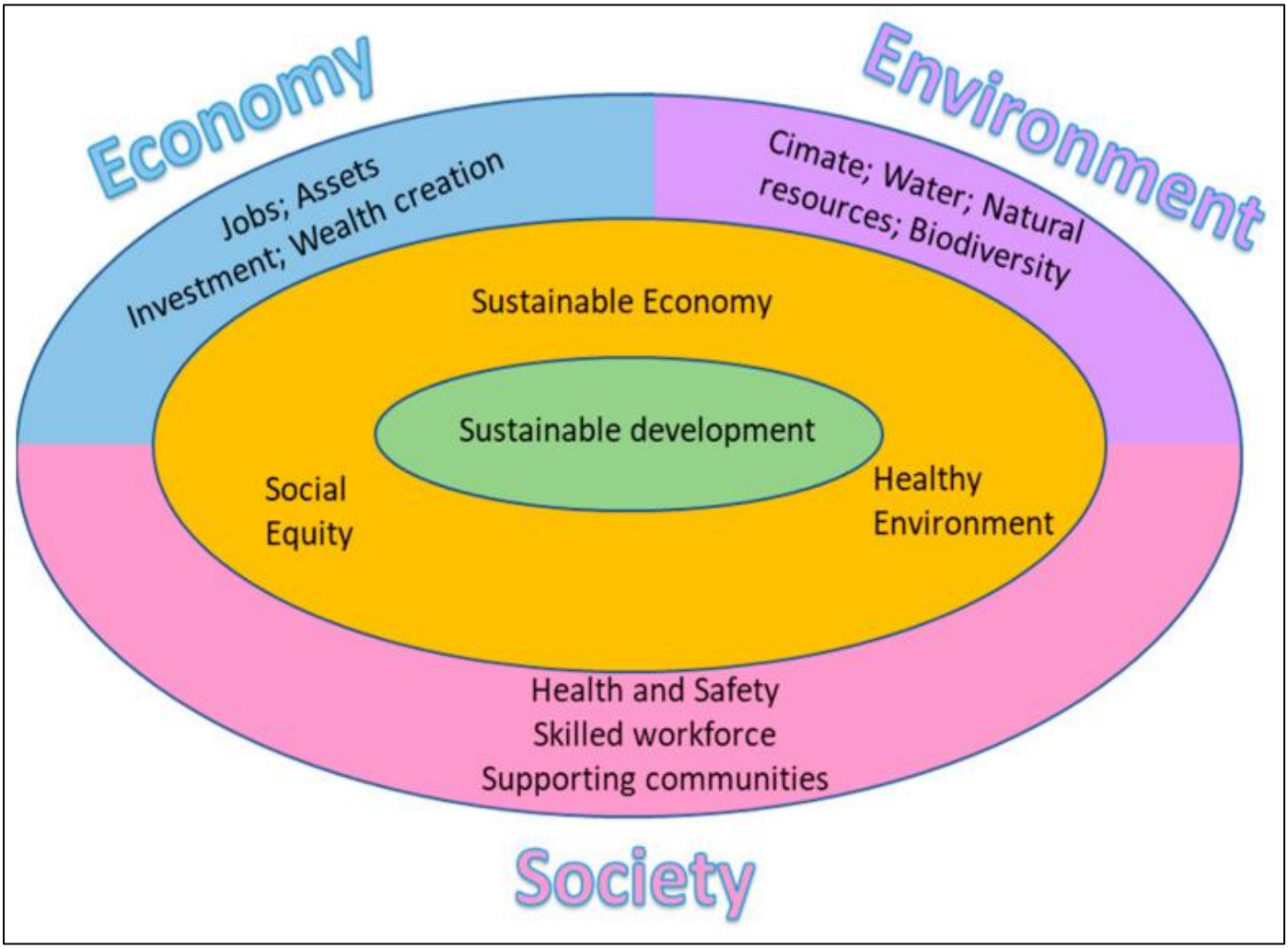

Fig 3 The Three Pillars of Sustainable Development by Millard et al. (2016).

The authors therefore raise a clarion call on countries to integrate climate measures into policies, strategies and plans that would foster an accelerating progress in climate change mitigation and sustainable environmental management.

Viewing the rapid growth of the population in developing countries coupled with their limited resources; it is only in a parochial sense that one conceptualizes that climate change will seize for decades to come. Therefore, drastic steps must be taken to address climate change and environmental sustainability management. Mitigating the effects of climate change and promoting sustainable environmental management have become key priorities for countries all over the world. Numerous global approaches have been implemented to address these challenges. For instance, in the words of Parmesan and Hanley (2018), the UNFCCC which was established in 1992 provides the foundation for international dialogue, knowledge sharing and coordination of actions to reduce greenhouse gas emissions and adapt to the impacts of climate change. Also, the Paris Agreement adopted in 2015 under the UNFCCC emphasizes determined contributions of countries to limit global warming to well below 2 degrees Celsius with efforts to limit temperature increase by 1.5 degrees Celsius. These measures are aimed at strengthening international collaborations to address global climate challenges effectively while supporting local communities to build their capacity for climate change adaptation. Hence, the approaches to mitigate the effects of climate change and promote environmental sustainability are viewed from the environmental, social and economic dimensions.

- *Environmental Policy Frameworks for Adapting to Climate Change for Sustainable Environment Management.*

Environmental policy frameworks which build resilience to the impacts of climate change serve as the backbone for guiding nations, organizations, and individuals in their efforts to mitigate and adapt to climate change. These frameworks provide a road map for integrating environmentally sustainable practices into various sectors, from energy and transportation to agriculture and urban planning. By establishing comprehensive policies and strategies, governments can lead the way in creating a future that balances economic growth with environmental preservation. Therefore, investing in renewable energy sources can contribute to carbon sequestration thereby encouraging the development of sustainable practices and technologies, creating a more sustainable future. It is in this context that Steffen, et al., (2015) recognize the transition from the use of fossil fuels like coal and natural gas to renewable energy sources such as solar, wind, hydro, and

ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/25apr2163

geothermal power as one of the approaches to reduce green-house gas emissions associated with energy generation. The authors affirm that this approach would enhance ecosystem resilience through conservation and restoration efforts aimed at reducing the overall amount of carbon dioxide released into the atmosphere.

A terse strategy given by IPPC (2012) coined as "low-regret measures" include biodiversity conservation, proper landfill management practices and community engagement which are risk management channels for sustainable land management. Hence, sustainable land use management practices such as afforestation, agroforestry, organic farming, reforestation, and forest conservation techniques can act as carbon sinks, mitigating atmospheric carbon dioxide levels. Therefore, effectively applying and combining the aforementioned approaches will enhance ecosystem management and restoration which in a broader sense promotes climate change adaptation paving ways for sustainable development.

Kershner, et al., (2020) suggest that policy makers integrate climate adaptation into development plans for sustainable environment management. From the authors' point of view, this would mean integrating climate considerations into infrastructure development, agriculture, water resource management, urban planning, and biodiversity conservation. This is in synergy with the report by the United Nations Department for Economic and Social Affairs (UNDESA, 2010) which noted that inclusive and participatory approaches that involve all stakeholders, including local communities, civil society organizations, and indigenous peoples, are essential for effective adaptation to global challenges accrued to climate change. and sustainable environment management.

Sustainable land management is another important environmental strategy used across Africa to tackle land degradation and promote climate resilient land use. For instance, Duarte, et al., (2013) opine that the initiatives by the African Union and the Nationally Appropriate Mitigation Action (NAMA) are environmental policies of climate change policies employed to integrate the management of land, water and other natural resources to meet long-term human needs. This approach complements the existing nature-based solutions to climate adaptation as it includes a wide array of interventions that can be applied across different ecosystems and scales ranging from natural to modified. Developing sustainable cities with efficient public transportation, green buildings, waste management systems, and urban greening initiatives can lessen the environmental impact of climate change and promote sustainable environmental management.

Additionally, while environmental policy frameworks for climate change adaptation provide a necessary foundation, their effectiveness depends on factors such as strong implementation mechanisms, adequate resources, stakeholder engagement, and continuous learning and improvement. To ensure sustainable environment management in the face of climate change, continued efforts to strengthen and refine these frameworks are essential in the aspect of engaging social policy and economic policy frameworks which forms the basis of the next piece.

- *Social Policy Frameworks for Adapting to Climate Change for Sustainable Environment Management.*

As the world confronts the realities of climate change, it becomes increasingly clear that addressing its impacts requires not only environmental measures but also comprehensive social policies. The implications of climate change extend far beyond the natural environment; they have profound social and economic consequences as well. In this context, social policy frameworks play a vital role in guiding societies towards sustainable development while simultaneously adapting to the challenges posed by a changing climate.

The SDG (Goal 13) policy initiated by the United Nations, provides an overarching framework that call for action on climate change while addressing poverty eradication, education, health, and gender equality. As emphasized by Raworth (2017), the SDGs recognize a close link between social and environmental issues and advocate for a holistic approach to sustainable development. This stimulated the Just Transition Framework proposed by the International Trade Union Confederation (ITUC, 2021), which focuses on the social aspects of transitioning to a low-carbon economy. It emphasizes the need for social dialogue, decent work, and social protection in the context of climate action. Boyd (2019) report that these two policies have over the years advocated for the implementation of social protection floors as a means to address climate change vulnerabilities; contributing to poverty reduction and social inclusion, thereby strengthening societies against climate impacts and moving societies closer to sustainable environmental management.

Gough (2013) in a study of global governance via the implementation of social policies in climate change mitigation argued that while social policies are distilled as meeting basic needs, protecting against risks, developing human capacities and promoting human well-being in an equitable way, their frameworks should prioritize education and awareness campaigns to promote climate literacy, behavior change, and sustainable practices. These initiatives can include public awareness campaigns, educational programs in schools, and capacity-building activities at various levels. By enhancing knowledge and understanding of climate change, individuals and communities can make informed decisions and contribute to sustainable environment management. Strong partnerships and collaboration between diverse stakeholders, including governments, civil society organizations, businesses, and academia, are essential for implementing effective social policy frameworks to address climate change challenges and promote sustainable environment management.

- *Economic Policy Frameworks for Adapting to Climate Change for Sustainable Environment Management.*

Economic policy frameworks for adapting to climate change and promoting sustainable environment management

ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/25apr2163

are crucial for addressing the economic implications associated with climate change. For instance, Parkash (2017) observes that implementing effective carbon pricing policies, such as carbon taxes or cap-and-trade systems for industries can reduce greenhouse gas emissions. By attaching a price to carbon, these policies encourage the transition to low-carbon technologies and promote sustainable practices. However, Anderson et al., (2021) noted that careful design and consideration must be given to industries to ensure adequate revenue allocation for sustainable initiatives. Such approaches could include providing financial incentives, establishing green banks, and promoting sustainable investment standards.

Nathan et al., (2016) persuasively argued that differences in natural endowments prevent rates of adaptation to climate changes from equalizing across locations with the implication that there is need to address climate change through global cooperation and trade policies that support sustainable practices. This could be in the aspect of encouraging international partnerships, reducing trade barriers for clean technologies, and incorporating sustainability criteria into trade agreements that can foster the collaboration between nations to implement climate change mitigation and adaptation strategies, for sustainable innovations globally. Individuals, communities, and businesses are therefore encouraged to adopt sustainable practices such as energy conservation, waste reduction, and responsible consumption while the government is encouraged to integrate climate change considerations into all relevant policies and sectors to ensure a holistic approach to sustainable environmental management.

V. CONCLUSION

The main aim of this paper is to examine climate change and environmental sustainability management which are critical issues that require our immediate attention. This study used a qualitative methodology to gather the necessary information on climate change and environmental sustainability. It reviews literature and presents its findings in a narrative form focusing on the key themes of the research. The reports are made in a logical order, emphasizing more frequently the crucial place of environmental, social and economic approaches to mitigate the impacts of climate change and promote a sustainable future. The evidence from the research overwhelmingly suggests that human activities have contributed to the acceleration of climate change, leading to adverse impacts on ecosystems, weather patterns, and human livelihoods. Considering the role that environment, society and economy play in the process of integrating climate change with sustainable environmental management; development policies alongside these three cohorts cannot be overemphasized. It is crucial for us to take proactive measures to mitigate the effects of climate change and ensure a sustainable future for generations yet unborn. There is therefore a dare need to encourage new technologies, involve the general population in prioritizing environmental sustainability in their everyday actions and advocate for policy measures that are based on achieving a greener and more resilient planet.

RECOMMENDATIONS

- Policies and regulations that aim to reduce carbon emissions from major sources such as greenhouse technologies in transportation, industry, and energy production should be implemented to promote energy efficiency and reduce greenhouse gas emissions.
- Sustainable agricultural practices should be implemented to conserve land, minimize deforestation and soil degradation while ensuring food security.
- International agreements and partnerships that aim to reduce greenhouse gas emissions and support developing countries in adapting to the impacts of climate change should be encouraged.
- Climate change resilience and adaptation measures should be strengthened at local, regional, and national levels so as to withstand climate-related hazards.

By implementing these recommendations, we can work towards mitigating the effects of climate change and fostering sustainable environmental management. It is therefore a collective effort that requires the commitment and collaboration of individuals, governments, businesses, and organizations worldwide. Together, we can create a more sustainable and resilient future for our planet.

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