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The purpose of the *Kuveza neKuumba - Zimbabwe Ezekiel Guti University Journal of Design, Innovative Thinking and Practice is* to provide a forum for design and innovative solutions to daily challenges in communities.

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Planners, engineers, social scientists, business experts, scholars and practitioners from various fields.

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Climate Change in Africa: Vulnerabilities and Options for Building Resilience

INNOCENT CHIRISA[1]

Abstract

African countries and regions are experiencing extreme weather events and this contributes to socio-economic lagging. The aim of the article is to explore factors which contribute towards the vulnerability of the African region and examine the viable options which may be employed to reduce such vulnerability and thus promote climate change resilience. The motivation for this study is the heavy toll of climate change effects on the continent and thus the study is justified in that it may open some avenues among policy-makers and other stakeholders, which may reduce climate change-related carnage and destruction. As such, the study is desktop research which involving a review of relevant literature. As such, the study confirms that climate change is among the factors contributing towards a slow development pace in Africa. Furthermore, the effects of climate change were found to be fuelled by poor rural and urban planning and a lack of resources, particularly funding. As such, whereas the less economically developed countries of Africa are worse off in combating climate change, countries of the global North are less vulnerable to the climate change vagaries. It is, therefore, recommended that the more vulnerable African countries should partner with better-off countries to allow effective pooling of resources. Furthermore, resilience building against climate change is recommended to include participatory engagement with all stakeholders and a bottom-up decision-making strategy is seen to be effective.

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Keywords: extreme weather events, resilience, innovative thinking, proactive planning, partnership, early warning system

INTRODUCTION

Climate change is an extant global threat to human wellbeing and development. The threat becomes a reality to vulnerable households and communities. This implies that the risks associated with climate change are not uniformly distributed, but heterogeneous (Weber *et al.*, 2018). In other words, the differences to the impact of climate change are determined by various factors and thus the impact is a dynamic phenomenon. Nonetheless, scholars are agreed on the fact that the factors which promote climate change risks and thus vulnerability, may be grouped into two distinctive categories – physical and socio-economic factors (Doodman *et al.*, Guillaumont, 2015; 2009; IPCC, 2023). As such, whereas the social-economic factors may be changed through the alignment of policies to climate change vulnerabilities, the physical factors may not readily be changed as they are mostly exogenous in nature. For example, a locality may be susceptible to the influence of climate change vagaries owing to its location and thus the vulnerability is ever present and can be mitigated only through the implementation of eco-friendly policies. On the other hand, vulnerability, which originates from and is perpetuated by socio-economic factors, may be resolved through policies that promote the wellbeing of people (Tapsell *et al.*, 2010).

From this discourse, it is asserted that whereas climate change vulnerability distribution is not uniform, the vulnerability factor is recognised in various forms. Subsequently, with such vulnerability vicissitudes, building climate change resilience is a significant policy stance for communities at national and international levels. However, it is argued that less economically developed countries and island states are less resilient as their counterparts in the global North. Less resilience implies high

mortality rates for the people (Zhang *et al.*, 2019). For example, in the rural areas of sub-Saharan Africa, farmers who are not resilient to climate change, suffer from low agricultural productivity, tragic losses of crops and livestock, and worsened food insecurity and water scarcity (Ackerl *et al.*, 2023). As such, high vulnerability levels equate to low resilience and this is an apt description for less economically developed countries. However, whereas these countries are inherently prone to be affected by climate change, it does not necessarily signify that they need to be developed countries to be more resilient to climate change. Bikmann *et al.* (2022) argue that promoting progress towards climate resilient development requires not only visions and tools for future development, but also the consideration of pre-existing adaptation gaps revealed when looking through the lens of different levels of vulnerability. Thus, resilience building is a dynamic phenomenon which is of paramount importance for the alleviation of climate change and its effects. It is, therefore, the aim of the article to lay bare the options available for policy-makers in climate change high risk localities.

THEORETICAL FRAMEWORK

According to Scoones (2015:10), the Sustainable Livelihoods Framework (SLF) has gained popularity through its widespread use and application as it "seems livelihoods approaches are now applied to literally everything". In this context, the SLF is used to elaborate on the dynamics of climate change impact on the livelihoods of people. Chambers and Conway (1992:5) point out that a "livelihood in its simplest sense is a means of gaining a living" and a living is deemed sustainable when it can cope with and recover from stress and shocks. among them, climate shocks. These may be described to include extreme weather events such as heatwaves, droughts and floods. Therefore, a livelihood becomes resilient and thus less vulnerable, when people are endowed with capabilities and assets which make

them less vulnerable to the shocks. In this regard, Ye *et al.* (2022) reveal that the Intergovernmental Panel on Climate Change (IPCC) incorporated vulnerability as an essential concept into the SLF, defining it as the degree to which a system is susceptible to, or unable to cope with, adverse effects such as climate change variability and extremes.

Natarajan *et al.* (2022) underscore the practical significance of the SLF in promoting rural development, pointing out that it has: directed the development interventions of governmental, multi-lateral and non-governmental organisations; shaped how scholars and practitioners think about conditions in the rural South; and justified the allocation of billions of dollars of international assistance to livelihoods-focused programmes and projects. However, early proponents of the SLF do not emphasise on environmental sustainability, but are more inclined towards the socio-economic aspects. However, in the wake of climate change, the socio-economic sustainability is eroded in situations where the livelihoods of the people are vulnerable.

Whereas Conway and Chambers (1992) perceive that a resilient livelihood would have little stress on primary productivity and could create new economic and social development opportunities, their intuitive assessment of environmental shocks were superficial and, therefore, the envisaged resilience and sustainability would deteriorate when exposed to recurrent and intensive extreme weather events, for example. This perspective is supported by the IPCC (2018) which argues that increased incidences of extreme weather events have led to deteriorating agricultural productivity, rendering both rural and urban livelihoods unsustainable, as farmers are exposed to the vagaries of climate change. In this regard, Natarajan *et al.* (2022), using a case study of commercial farming in Zimbabwe,

demonstrate the shortcomings of the original SLF in explaining sustainable livelihoods and resilience in the 21st century.

A study carried out by Ackerl *et al.* (2023) in East Africa confirms that climate-induced risks are predicted to be worse in the future, affecting even more farm households and aggravating an already serious situation in terms of crop failures, food insecurity and vulnerability. This situation spells out the need for resilience building to sustain rural livelihoods. In this context, livelihood resilience can be defined as the capacity of livelihoods to protect against stresses and disturbances while maintaining or improving their essential properties and functions (Ye *et al.*, 2022). On the other hand, the International Monetary Fund (IMF) 2022) points out that resilience building requires an integration of measures which include reforms tailored to a country's specific climate change challenges; strong macroeconomic, institutional and structural policies; and measures to ensure food security. In this regard, Natarajan *et al.* (2022) offer a new version of the SLF which incorporates resilience building concepts through modifying the original assets pentagon through narrowing assets to financial and physical and adding two further pentagons: 'relational power' and 'climate and environment context/relations'.

The new SLF is depicted in Figure 1. Whereas the original SLF, whose proponents are Chambers and Conway (1992), assume that the major livelihood assets involve human capital, social capital, physical capital, natural capital and financial capital, the new SLF explicitly includes relational power and climate and environmental relations as factors which influence livelihood vulnerabilities and dynamics. In line with Olsson *et al.* (2014: 819), the 'climate and environmental context/relations' element recognises the need to both elucidate local-level climate and environmental contextual factors and also to do so in a relational sense, understanding how these are

shaped by broader forces and also how they shape rural livelihoods. As such, the new SLF resonates with climate change resilience building strategies at both local and national levels. In other words, the Framework is relevant to the study in that it represents a holistic approach in promoting climate change resilience by including all stakeholders and yet, at the same time, it does not discard the people-centred perspective of the original SLF.

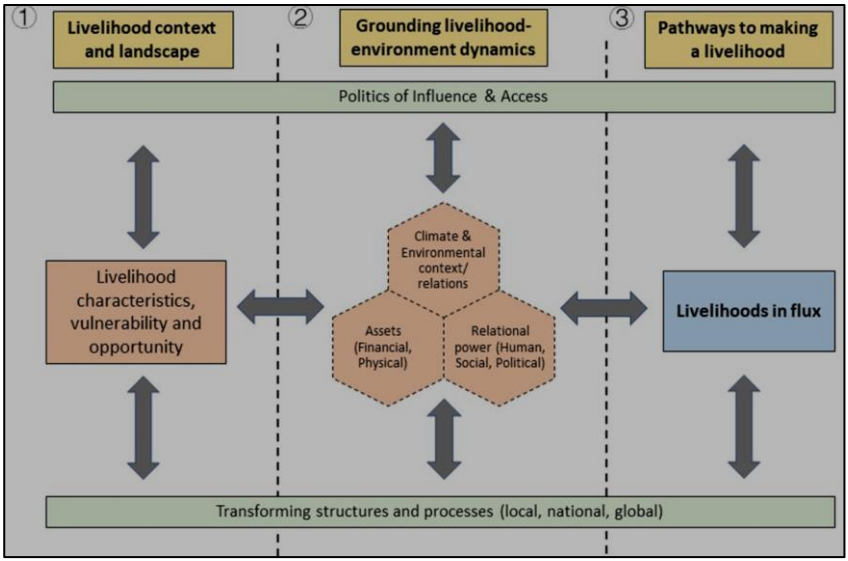

Figure 1: *A sustainable livelihoods framework for the 21st century* (Adopted from Natarajan *et al.*, 2022).

CONCEPTUAL FRAMEWORK

The vagaries of climate change are unpredictable. This implies that a bid to alleviate the effects of climate change is replete with uncertainties. Therefore, instead of a community solving climate change challenges through inflexible and reactive measures, it is more rational to be proactive and flexible. Flexibility in this case implies that community systems can meet service needs under a wide range of climate conditions

and key elements are spatially distributed and can substitute for each other but are functionally linked (Tyler and Moench, 2012). This defines resilience in the sense that policy-makers and all the involved stakeholders are geared to deal with climate change challenges, such as extreme weather events, even before they land within their localities. Such a stance in disaster risk management has its basis in innovative thinking. In this context, innovative thinking denotes thinking outside the box, a departure from conventional thinking, to solve complex issues related to climate change (Yang *et al.*, 2021). For example, the IPCC (2018) points out that achieving the transitions necessary to limit global warming depends on enhanced climate-driven innovation which includes both technological and social innovations. Technological innovation involves technologies such as remote sensing and early warning systems, and social innovation includes shifts in how economies and societies may be managed to reduce vulnerabilities (López-Gunn *et al.*, 2021). In line with innovative thinking, climate change resilience building involves the following aspects: responsiveness, capacity to learn and resourcefulness (Twigg, 2007).

Responsiveness in this case refers to the capacity to organise and reorganise in an opportune fashion; ability to identify climate change problems, anticipate, plan and prepare for a disruptive event such as an extreme weather event and to respond quickly in its aftermath (Tyler and Moench, 2012). From this analysis, the working definition of innovative thinking, within the context of climate change resilience building is: a mode of thinking that dares to break the conventional thinking, emancipate the mind, surpass the old conventions, adapt measures to the current conditions, keep pace with the times and open new situations of work with a new leap of thinking and understanding (Yang *et al.*, 2021:541). As such, in adopting innovative thinking, policy-makers ground their intervention measures on both adaptation and mitigation

measures through innovative strategies. However, for both adaptation and mitigation interventions to have an impact, an assessment of what is on the ground needs to be carried out. Wardekker (2018) argues that systematic resilience assessment is of paramount importance in resilience building.

Figure 2 depicts steps involved in the process resilience assessment. The steps involved underscore the need for making informed decisions and acting upon them systematically.

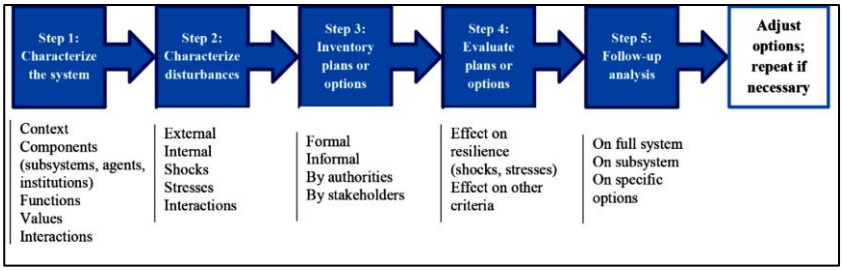

Figure 2: *Resilience assessment of options and plans* (Adopted from Wardekker, 2018)

LITERATURE REVIEW

The concept of climate change is marred by scientific controversy and contention. Todorov (1986:259) argues that the question of climatic change is complex and controversial in the sense that "No strict criteria exist on how many dry years should occur to justify the use of the words 'climatic change'" and this is a bone of contention. Nonetheless, climate change may be regarded as a long-term change in climatic patterns and is witnessed at both local and global levels. In other words, climate change focuses on long-term changes in dynamic meteorological variables such as the surface air temperature or surface pressure (Werndl, 2014). The IPCC (2018) defines climate change as any change in climate over time, whether due to natural variability and/or as a result of human activity. On the other hand, the United Nations Framework Convention on

Climate Change (UNFCCC, 2011) defines climate change as a change of climate which is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and which is in addition to natural climate variability observed over comparable time periods. In general, climate change is characterised based on the comprehensive long-haul temperature and precipitation trends and other components, such as pressure and humidity level in the surrounding environment (Abbass *et al.*, 2022).

As highlighted above, climate change is a result of both natural and anthropogenic factors. The natural causal factors for climate change are generally known to be related to changes in ocean currents, solar activity and volcanic eruptions. On the other hand, the human factors which promote climate change are centralised on such activities which promote global warming. The IPCC (2022) points out that\:

> "Human activities, principally through emissions of greenhouse gases, have unequivocally caused global warming, with global surface temperature reaching 1.1°C above 1850-1900 in 2011-2020".

The emissions are traced to emanate from

> "unsustainable energy use, land use and land-use change, lifestyles and patterns of consumption and production across regions, between and within countries and among individuals".

As such, human factors have led to the rapid and widespread climate change at global levels. This is confirmed by Yakovlev and Belyaev (2023) who submit that:

> "Since the beginning of the 21st century, [the greenhouse effect] impact on the planet has exceeded the influence of solar radiation by [eight] times in intensity".

They note that the greenhouse effect referred herein is because of human activities, such as the rampant use of fossil fuels.
Of concern is that the majority of the countries that are most prone to being affected by climate change have contributed little

to global greenhouse gas (GHG) emissions but still face the major burden of climate change (Birkmann *et al.*, 2022). According to Doodman *et al.* (2009), this reflects profound global inequalities as the countries that have profited from high levels of the emissions are the ones that are least affected by climate change, while countries that have made only minimal contributions to the problem are among the most affected.

Whereas climate change is a global threat, its impact on global development is not uniform, mirroring vulnerability and resilience inequalities. Dodman *et al.* (2009) argue that human-induced climate change is likely to have the heaviest impact on developing states and these countries form a group of 100 nations, with carbon dioxide emissions (excluding South Africa's) accounting for only 3.2%of the global total. Furthermore, long-term changes in climate have been observed and these include changes in arctic temperatures and ice, widespread changes in precipitation amounts, ocean salinity, wind patterns and aspects of extreme weather, including droughts, heavy precipitation, heat waves and the intensity of tropical cyclones (UNFCC, 2011). Owing to such increased climate change risks, the less economically developed countries are overburdened as they are inherently vulnerable. Furthermore, the World Meteorological Organisation (WMO, 2023) notes that many significant heatwaves occurred in various parts of the world during 2023, with some of the most significant witnessed in southern Europe and North Africa, especially in the second half of July where severe and exceptionally persistent heat occurred. Concerning food security, projections indicate that climate change could result in an 11% increase in the number of malnourished children by 2050 in low-income developing countries when compared to a scenario without climate change or perfect mitigation measures in place (Rahal and Elloumi, 2023). However, as noted above, both vulnerability to current climate extremes and historical

contribution to climate change are highly heterogeneous, with many of those who have least contributed to climate change to date being most vulnerable to its impacts (IPCC, 2023).

As aforementioned, climate change vulnerabilities are not uniform. According to the IPCC (2014), climate change vulnerability refers to the degree to which a system is susceptible to, or unable to cope with, adverse effects of climate change, including climate variability and extremes. In other words, such vulnerability is a measure of the extent to which a community is susceptible to be negatively affected by climate change. As such, climate vulnerabilities are context specific, varying by political, economic, demographic, social and environmental factors and these are unique to each population and place. Thomas *et al.* (2019) point out that vulnerability experiences differ across societies, varying by social, political, economic and historical factors operating at multiple scales. For example, Nightingale (2017) argues that climate change policies are implemented through the intervention of stakeholders who may be operating at national levels and the policies themselves may be more effective at such levels rather than at local levels. In other words, a gap in vulnerability policies may be widened owing to the incompatibility of such policies at different vulnerability levels. For example, inadequate legislative authority may hinder local authorities to reduce vulnerability at local levels (Mavhura and Mapuva, 2021). As such, Hunter *et al.* (2021) assert that there is need for policy-makers to devise climate change vulnerability frameworks which take cognisance of context-specific and multi-scalar processes that produce dynamics and differential outcomes of climate susceptibility and vulnerability across spatial and temporal scales. In this vein, it is argued that successful climate change adaptation is dependent upon the provision of high-quality information and authority at scales commensurate with the jurisdictions of

organisations responsible for adaptation policy (Smith *et al.*, 2016).

Recognising that climate change vulnerability and thus resilience, is dynamic and varies according to particular places and populations, the article adopts the hazard of place approach in assessing vulnerability scales (Cutter *et al.*, 2000; Schwerdtle *et al.*, 2020). Such vulnerability assessments at different levels are necessary for building climate change resilience through the implementation of suitable adaptation and mitigation measures. For example, at regional levels, Schneiderbauer *et al.* (2020) argue that there is necessity for the implementation of standardised vulnerability assessment approaches which allow comparability within and between countries to support adaptation planning and monitoring and evaluation of climate change vulnerability. However, Smith *et al.* (2016) point out that there is not yet a universally accepted approach for assessing socio-economic vulnerability to climate change impacts and environmental hazards that may be used to inform regional priorities and decision-making. Nonetheless, in building climate change resilience, multiple scales and hierarchies must be understood as vulnerability is a complex phenomenon. For example, Ahmed *et al.* (2023) reveal the interconnectedness of climate variables, pointing out that local air pollution adds to regional and global air pollution and global climate change may have local effects such as rising sea levels and extreme weather events like heatwaves. This justifies the initiative to look at vulnerability and resilience building holistically. For example, in assessing vulnerability in a built environment, it is rational to systematically assess the vulnerability from a micro level, which is the interior of a building in this case, to the macro-level, which is regionally. Figure 2 illustrates these vulnerability hierarchies and the arrows depict the interconnectedness of the levels. By and large, environmental issues, such as heatwaves, can manifest

differently at different spatial scales, and so to fully comprehend how the hazard promotes vulnerability, studying it from various spatial perspectives is essential (Ahmed *et al.*, 2023).

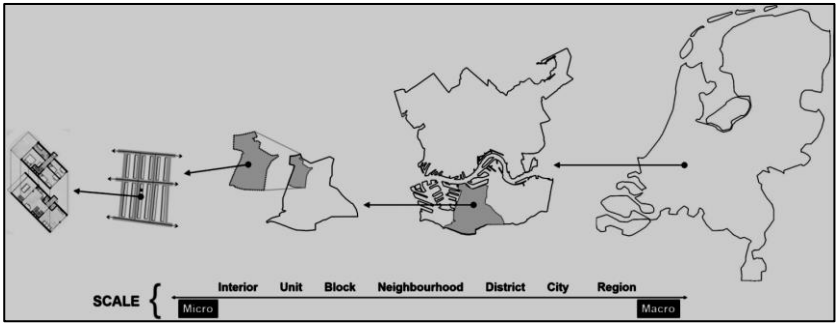

Figure 2: *The spatial distribution of vulnerability in built environment* (Adapted from Erickson and Lloyd-Jones, 2001).

RESEARCH METHODOLOGY

The study is qualitative research which employs a desktop study approach. In this vein, various secondary data sources were collated and reviewed. Specifically, journal papers from various search engines were accessed and were systematically reviewed to come up with some case studies which reinforce the objectives of this study. Subsequently, some case studies from sub-Saharan Africa were thematically analysed to come up with reliable results. In this regard, the research findings reveal the impact of climate change in sub-Saharan Africa and how these may be reduced.

FINDINGS

Africa is among the most climate change vulnerable regions in the world (Coovadia *et al.*, 2022). Studies that assess the future development direction of climatic hazards in different regions show, for example, that there is a high probability that droughts and flash floods, will increase, with Northeastern and Southeastern African areas ranking among the most vulnerable

regions globally (Birkmann *et al.*, 2022). Furthermore, Medinilla *et al.* (2023) point out that Africa is on the front line of climate change, justifying this assertion by revealing that in the African region, there is evidence of low agricultural productivity, increased water insecurity, coastal erosion, flooding, desertification and frequency of extreme weather events. Of concern is that various scholars like Scholes and Biggs (2004) refer to sub-Saharan Africa as the food crisis epicentre of the world and conclude that projected climate change during the first half of the 21st century will make this situation worse (Scholes and Biggs, 2004; Kristjanson *et al.*, 2008) and this projection remains relevant and true today. Torsu and Krönke (2023) point out that the African continent is responsible for less than 3% of global GHG emissions, yet is one of the most vulnerable regions to climate change and is projected to experience some of its most severe impacts. The African Union (2023:03) submits an explanation for such vulnerability as follows:

> "This is due to the continent's biophysical makeup and numerous socio-economic vulnerabilities – including a high dependence on rain-fed agriculture (and natural resource-based sectors broadly), a lack of alternative livelihood support, widespread poverty and inequality, weak adaptive capacity, low levels of education and inequitable access to financial resources, credit, markets and climate information services.

In a bid to explain the differentiated aspects of climate change vulnerability within countries in Africa, it is pointed out that for Zimbabwe, rural vulnerabilities differ in terms of the following reasons: agro-ecological regions where the impact of climate change requires variegated farming systems; political factors in moderating resource access; and the political economy of how different spaces were economically and socially shaped over time (Newsham *et al.*, 2021). Nonetheless, at household levels, a study carried out by the Afrobarometer reveals the gender aspect of climate change vulnerability, pointing out that while African women are, on average, less aware of climate change

than men, researchers have found that they are more likely to adopt climate-resilient crops when they are climate-change aware and know about relevant adaptation options (Torsu and Krönke, 2023). By and large, these factors explain both social and environmental factors in propagating climate change vulnerabilities within the African region. Tapsell *et al.* (2010) points out that identifying such vulnerabilities is the first step towards improving risk reduction and disaster preparedness to natural hazards.

Nonetheless, there are increasing incidences of extreme climate and weather events recorded in Africa. The IMF (2022) points out that:

> "In recent years, the frequency and intensity of droughts, floods and storms - such as cyclones Idai and Kenneth and droughts caused by the El Niño-Southern Oscillation (ENSO) - have grown."

In line with this observation, Mamman *et al.* (2023) observe a rising trend in climate change estimates in Africa, particularly in the inland subtropics and this includes the frequent occurrence of extreme heat events, increasing aridity and changes in rainfall, especially the apparent decrease in Southern Africa and an increase in East Africa. Additionally, Birkmann *et al.* (2022) argue how Northeastern and South Eastern Africa are areas that rank among the most vulnerable regions globally, qualifying that the region of Eastern Africa was exposed to over 200 hazard events (droughts, floods and storms) and faced more than 100 fatalities per event between 2010 and 2019. On the other hand, the most devastating cyclone was recorded in southern Africa in March 2019. Charrua *et al.* (2019) reveal that in Mozambique, Cyclone Idai brought torrential rain (more than 200 mm in 24- hours) and strong winds (up to 220 km/h), causing severe widespread flooding (flood waters rose more than 10m) and affected more than 1.5 million people in Mozambique, resulting in more than 600 deaths while over 1 600 persons were injured.

Furthermore, Serdeczny *et al.* (2017) assert that the continent is experiencing a 4°C warming scenario and this may lead to a one-metre sea-level increase by the end of this century. Han and Kirabaeva (2024) confirm this scenario, revealing that temperatures may rise by 3-6 °C by the end of the 21st century, and sea levels projected to increase by 0.26-0.55 metres even under low-emission scenario. In this regard, addressing climate change in this region is costly and few sub-Saharan African countries have the resources or fiscal space to tackle this challenge without assistance from the international community (IMF, 2023).

Furthermore, climate change has contributed towards increased rural to urban migration in sub-Saharan Africa. With reference to East Africa, a study carried out by Ackerl *et al.* (2023) confirms that climate change risks and vulnerability are complex, interconnected and integrated, and thus decreased crop yields and livestock may cause food insecurity, which may then trigger migration or armed conflict. This confirms a study carried out in South Africa which reveals that homicide was about 22% more likely when temperatures were above 35°C, compared to when temperatures were below 20°C, and the most vulnerable population groups being children (Coovadia *et al.*, 2022). This is in line with the observations by the International Organisation for Migration (IOM, 2019) which reveals that in West and Central African countries, climate change has exacerbated conflict over natural resources threatening peace and security.

PLAAS (2022) explains that in southern Africa, as climate change progresses, it will have a negative impact on rural livelihoods as more poor people could be concentrated in less favourable agricultural lands and areas and inequality and poverty are sharpened, leading to rapid rural-urban migration. Examples of climate-induced rural to urban migration include

migration of fisherfolks from coastal villages in West Africa to cities because of the depletion of fish resources linked to ocean acidification, and nomadic populations in East Africa altering their traditional migration patterns to cope with the impacts of desertification (IOM, 2019). However, such migrations are contributing towards disarticulated development as the urban economies have largely morphed into informality (Ayanlade *et al.*, 2022).

Urban informality further increases climate change vulnerabilities among the poor and this is owed to increased pressure on urban infrastructure, the environment and employment opportunities. This was illustrated in the April 2022 floods in Durban, South Africa, where over informally settled 300 people lost their lives, exposing poor resilience building on the part of the responsible authorities (PLAAS, 2022). Nonetheless, the United Nations (UN) 2022) submits that without concrete climate and development action, up to 32 million people in West Africa could be compelled to move within their countries by 2050, in response to water scarcity, decline in crop and ecosystem productivity and sea level rise, augmented by storm surge. However, at the 2022 United Nations 27th Conference of the Parties (COP27) in Sharmel-Sheikh, Egypt, the UN Secretary-General posited that humanity, without decisive corrective measures, is facing imminent catastrophic consequences of climate change (United Nations Economic Commission for Africa, 2022). Such decisive and collaborative actions are exemplified by the Intra African, Caribbean and Pacific (ACP) Global Climate Change Alliance Plus (GCCA+) programme which was launched in 2019 by the Southern African Development Community (SADC) Secretariat and the European Union (EU) to strengthen the capacity of regional countries to undertake climate change adaptation and mitigation interventions. In this regard, urban resilience building in Africa needs to include the following strategic

elements: a multidimensional approach to risks and contexts; the connection of various systems in policy design and implementation; the inclusion of multiple stakeholders; and the development of resilience capacities (United Nations Development Programme (UNDP) (2023).

Most African urban areas are vulnerable to climate change vagaries. Such vulnerability may be traced back to poor urban planning. For example, a study carried out in the city of Kigali, Rwanda by Mwenje and Kumar (2024) reveals that the city is susceptible to serious climate risks including intensified flooding and public health risks owing to a lack of explicit consideration of climate risks in national and local plans and policies. This has a result of weakening resilience building through a reduction of adaptative capacities of socio-ecological systems. This view is further stressed by the Lagos city, Nigeria, study. The city is affected by recurrent flooding, with the most devastating ones experienced in 2012 and 2020 and rising sea-levels, as the effects of climate change (Schraven *et al.*, 2019; Rigaud *et al.*, 2021). However, the most compelling argument for the recurrence of these incidences is poor reactive urban planning as the city's urban development involved the transformation of biophysically vulnerable spaces to accommodate rapid urbanisation (Kasim *et al.*, 2021).

As such, a study carried out by Ekoh and Teron (2023) concludes that flood risk in Lagos is because of and exacerbated by state actions and inactions related to the provision of necessary urban amenities, infrastructure and enactment of policies that curb flooding, and the urban poor are mostly affected. Such inequalities experienced in urban setups are illustrated by the urban poor in Harare, Zimbabwe, resorting to wetland farming in the Monavale wetlands as a livelihood strategy to cope with climate change effects (Matenga, 2019). However, transformative initiatives may be an

effective panacea to the impasse caused by poor urban planning in the urban cities of Africa. For example, in realising the limited state-led planning initiatives towards addressing climate change, the leadership in the Old Fadama informal settlement in Ghana mobilised the residents to construct gutters to improve drainage networks to reduce flood events in the area (Cobbinah and Finn, 2022). As such, the IPCC (2023) offers that inclusive, integrated and long-term planning at local, municipal, sub-national and national scales, together with effective regulation and monitoring systems and financial and technological resources and capabilities foster urban and rural system transition, necessary for resilience building. Resilience is made on the call that countries in Africa ought to have their resilience strengthened, empowered and enabled if they are to cope with climatic impact (Marion, 2023).

Another direct impact of climate change on the African region is food insecurity and health problems. For example, in 2021, 2.2 billion people were facing moderate or severe food insecurity in the world and of those, 743.5 million were in Africa, with 322 million severely food insecure (UNECA, 2023). Rahal and Elloumi (2023) explain that the African region has faced significant challenges, including severe flooding in West Africa, prolonged and intensified droughts in East Africa, the depletion of equatorial rainforests in the equatorial parts of the continent and issues related to ocean acidification, and these extreme events pose substantial threats to agricultural production, food security and health. On the other hand, Newsham *et al.* (2021) reveal that climate change and variability are already causing problems for tobacco production in Zimbabwe and have, in the past 20 years already been, at times, catastrophic for Zimbabwean agriculture and this is attributed to a drier climate regime since the 1980s. In this regard, Manatsa *et al.* (2020: 03) argue that:

> "The current revision of the [Agricultural Economic Zones] AEZ map acknowledges that while the overall pattern of AEZs in Zimbabwe is

> stable…climate change has led to significant shifts in agricultural practice within the AEZ."

Therefore, it is argued that climate change both directly and indirectly leads to food insecurity, health problems and low agricultural productivity in less economically developed countries.

Additionally, within the African context, climate change results in health problems. For example, owing to climate-related challenges such as excessive rainfall, drought, temperature extremes and humidity fluctuations, and transportation problems, both pre-harvest and post-harvest, food losses in Africa saw 239.1 million individuals grappling with undernourishment in 2018 (World Health Organisation, 2019). In this regard, Coovadia *et al.* (2022:157) point out that:

> "Due to the large subsistence farming dependency in sub-Saharan Africa, children in this region are particularly at risk of undernutrition from increasing temperatures and rainfall variability."

Referring to Eastern and Southern Africa, Musuka and Dzinamarira (2023) submit that communities are more susceptible to a variety of illnesses because of natural catastrophes and extreme weather events brought on by climate change, including raising barriers to access clean water, sanitation and health care facilities. These challenges increase the probabilities of infectious, respiratory and cardiovascular diseases, heat-related morbidity and mortality, malnutrition due to food insecurity, and mental health disorders (Rocque *et al.*, 2021). The study depicts the health challenges, and these are particularly evident in the urban areas of the region. For example, a study carried out in the Johannesburg city of South Africa reveals that high temperatures in early pregnancy increased the risk of severe hypertensive disorders and evidence indicated that there is an

association between heat and increased rates of pre-term birth, low birthweight and stillbirths (Coovadia *et al.*, 2022). As such, climate change as a health threat in sub-Saharan Africa is a reality which cannot be disputed.

Owing to climate change, African countries are obliged to protect the environment among their primary goals towards development. Unlike developing countries in the global North, the industrialisation thrust of less economically developed countries in Africa is now constrained by the urgent need to reduce GHG emissions (African Development Bank, 2023). As such,

> "African countries today must pursue a dual goal of accelerating growth while protecting the environment - or more precisely, accelerating growth while minimising the adverse impact of economic activity on the environment" (UNECA, 2023: 13).

Invariably, less developed countries bear the brunt of global climate change. For example, a report by the IMF (2023) reveals that there is a significant negative impact of climate-related disasters on medium-term growth, especially for sub-Saharan Africa, and this was confirmed by the point that the impact of a drought is about three times larger in this region than in other emerging and developing economies.

Therefore, the developed countries have a moral debt to those who suffer from the debilitating effects of climate change and this justifies the initiatives for climate change vulnerability funding to assist the less developed countries to mitigate the effects and allow them to transition to net-zero economies (Guillaumont, 2015). However, Torsu and Krönke (2023) argue that the global North is yet to mobilise sufficient funding for climate change action in Africa, and thus coordinated interventions from African governments, business, civil society and ordinary citizens are a necessity. Nonetheless, an effective international collaboration to combat climate change effects in

Africa is the Africa Climate-Smart Agriculture Alliance which was launched in to increase the uptake of climate-smart agricultural practices in the most vulnerable rural communities of Africa (United Nations Framework Convention on Climate Change (UNFCCC) (2020). Such measures promote climate resilience through encouraging effective adaptation measures in the agricultural sector.

Awareness campaigns and innovative technological interventions are other initiatives which promote resilience building against climate change effects in Africa (Torsu and Krönke, 2023). Nonetheless, across39 countries across sub-Saharan Africa, an Afrobarometer survey reveals that the awareness of climate change ranges from 22% in Tunisia to 80% in the Seychelles, and is particularly low among economically disadvantaged and less educated citizens, rural residents and women (Torsu and Krönke, 2023). On the other hand, a study carried out by Okunola *et al.* (2022) in Port Harcourt, Nigeria, reveals that socio-economic factors which influenced climate change resilience include the following: education, average monthly income, house type, house ownership and age, with age contributing towards innovative thinking in resilience building. Concerning innovative thinking in the rural areas, a case at hand is the Zimbabwean small-scale farmers who adopted digitalisation in the agriculture sector through partnership with Econet, a mobile network operator in Zimbabwe, and the Zimbabwe Farmers' Union, to access agricultural extension services via unstructured supplementary service data (USSD) and short message service (SMS) and the services accessed promote resilience building (FAO, 2018).

Regarding early warning mechanisms in Africa, there is need to make full use of innovation such as big data technologies which have the potential to improve early warning systems and

identify areas where natural disasters will likely occur (UNDP, 2023). One of the critical components of a resilient society is the existence of efficient early warning systems that ensure timely warnings which can be acted upon by stakeholders as early action initiatives (African Union, 2022). In response to the weak state of multi-hazard early warning and early action in Africa, the AU developed the Africa Multi-Hazard Early Warning and Early Action System Programme (AMHEWAS) and the programme is based on the following four pillars: risk knowledge; observations, monitoring and forecasting; communication and dissemination; and preparedness to respond to warnings (WMO *et al.*, 2023). A study carried out by Maripe *et al.* (2022) reveals that while some form of early warning systems exists in all SADC member states, they are not fully developed, of low quality and are under-resourced to enable them to play a significant role in providing a timely warning. This poses a threat in the southern African region as early action initiatives in the wake of extreme weather events, for example, are disrupted and thus, ineffective.

DISCUSSION

Climate change is a grim reality. As evidenced above, the occurrence and intensity of extreme weather events and incidences is increasing across the African continent. Furthermore, such climate change vagaries are fuelling conflicts, food insecurity and rapid rural-urban migration. Considering these factors, it is argued that climate change is a ubiquitous threat to development in Africa. Nonetheless, whereas climate change affects all nations in the world, the risks associated with it are high in developing countries, particularly in Africa. Nonetheless, the stark reality is that climate change is every nation's responsibility. The actions taken today by one nation will always have a rebound effect into the future. In this regard, recognising that both rural and urban areas of Africa are affected by climate change, becomes a

resilience building strategy to device ways to reduce its effect. Of significance is that resilience-building is an integrative exercise which involves various stakeholders and thus the input of all stakeholders is of great importance towards the successful implementation of effective measures to combat climate change. In some cases, grass-root initiatives and bottom-up decision-making strategies are significant steps towards resilience building as they reduce resilience policy gaps. As an innovative step, proactive rural-urban planning initiatives are necessary for climate change resilience building.

Africais among the most vulnerable regions with regards to the negative impacts of climate change. Although African countries may opt to justify their continued GHG emissions into the atmosphere for economic growth purposes, this will have the direct effect of fuelling the climate change threat. Particularly, since it is unequivocal that the use of fossil fuels during the global North industrialisation era immensely contributed to rapid global warming, and hence climate change, the most suitable resilience pathway the African states can take to mitigate climate change is a just transition of energy use. However, the challenge is that these countries are inherently vulnerable as they do not have the financial capacity to mitigate climate change in such a manner. For example, it is estimated that developing regions, including Africa, would need $1.4 trillion to $2.8 trillion per year up until 2030 just to finance investments in mitigation, compared to developed countries, which need $0.9 trillion to $1.7 trillion per year (Boehm *et al.*, 2023). Therefore, the 'causal responsibility' for climate change financing rests on the global North to bankroll both mitigation and adaptation strategies on climate change in Africa. However, since the developed countries may be reluctant to partner with African countries, it is the responsibility of regional blocs like the AU and SADC to promote resilience building against climate change.

Nonetheless, resilience building is not an overnight strategy which can be employed without systematic planning. It has been noted that climate change effects in Africa, and the world at large, are not uniform. The effects differ among countries and within a particular country. The factors which differentiate the effects are both geographic and socio-economic. However, this comes down to the fact that the less economically endowed locality, or individual, is the most vulnerable. In other words, vulnerability is fuelled by a lack of resources. This is the reason most African countries are vulnerable to climate change as compared to developed countries; and the urban poor are likewise more vulnerable than the urban affluent. Subsequently, resilience building involves taking a resilience assessment and then act proactively and make informed decisions. In this regard, the use of early warning systems for early action initiatives are a necessity in African as they are a form of resilience assessment. In other words, resilience building in climate prompts innovative thinking in the sense that a successful resilience strategy implemented to counter climate change involves assessing the situation, evaluating the best options and then timely implementing them. As such, early time action interventions, as either mitigation or adaptation measures, are necessary to reduce the negative impact of the climate change. Noteworthy is that technological innovations in resilience building Africa are less efficient owing to limited resources and this disrupts early time action initiatives against climate change.

CONCLUSION, OPTIONS AND PRACTICAL RECOMMENDATIONS

Climate change is a global threat which cannot be wished away. Pragmatic measures are needed to be assessed and implemented to resolve the negative effects of climate change. As such, the adage that 'necessity is the mother of invention' becomes a reality in resilience building against climate change. All stakeholders need to explore the most viable options to

counter this global threat to development. As it is a universal phenomenon, it is only prudent for nations to team up and pool resources to fight climate change. As the impact of climate change is heterogenous among nations, an effective climate change funding mechanism needs to be effected at global levels. Developed countries obliged to contribute towards this cause must have the assurance that the allocated funds are used efficiently, with no incidences of fungibility, towards resilience building against climate change. At local levels, responsible authorities need to involve all stakeholders in making decisions which promote resilience building, and proactive rural and urban planning constitutes innovative measures which build up resilience. As such, pathways towards resilience building need to be participatory in nature and must be flexible enough to transform both mitigation and adaptation measures into holistic and integrated pathways of promoting sustainability in the face of climate change. Furthermore, early warning systems are a necessary resilience assessment initiative which contribute towards development by promoting early action against hazards.

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