Chapter 8
Evaluating Risk from Disasters to Improve Resilience: Lessons from Nigeria and South Africa

Yewande M. Orimoloye, Toju Babalola, Adeyemi Olusola, and Israel R. Orimoloye

Abstract Disaster risk is linked not only to the occurrence of severe hazards but also to the vulnerability factors that make disasters more likely when they do. Vulnerability is frequently associated with a set of fragilities, susceptibilities, and difficulties involving the lack of resilience of exposed human settlements in disaster-prone areas. It is also directly tied to social processes and governance deficits in disaster-prone areas. This study aimed at evaluating disaster risk over Nigeria and South Africa to improve resilience in the affected regions and to compare risk to assets in the two countries with the global average. This study reveals that Nigeria recorded losses to assets, economic resilience, and risk to well-being with about 0.12%, 48.3%, and 0.25% compared to the global average of about 0.63%, 61.12%, and 1.07%, respectively. More so, South Africa recorded losses to assets, economic resilience, and risk to well-being with about 0.24%, 55.13%, and 0.43% compared to the global average of about 0.63%, 61.12%, and 1.07%, respectively. Findings from both countries revealed that risks associated with disasters were high compared to the global average. This development requires urgent efforts to reduce risks in the two nations, as climate change continues to magnify natural hazards. Because protection infrastructure alone cannot eliminate risk, a more resilient strategy and

Y. M. Orimoloye
Disaster Management Training and Education Centre for Africa (DiMTEC),
University of the Free State, Bloemfontein, South Africa

T. Babalola
Water Resources Management and Agro-Meteorology, Federal University Oye-Ekiti,
Oye-Ekiti, Nigeria

A. Olusola
Faculty of Environmental and Urban Change, York University, Toronto, ON, Canada

I. R. Orimoloye (✉)
School of Social Science, The Independent Institute of Education,
Johannesburg, South Africa

inclusion of the outcomes in the planning and decision-making process are needed to critically break the cycle of disaster-induced poverty and vulnerability.

Keywords Asset losses · Disasters · Nigeria · South Africa · Socioeconomic resilience · Well-being

1   Introduction

As a result of rising losses from natural disasters, more proactive risk resilience and management strategies have to be developed (Bănică et al., 2020). As the population grows and settlements expand, more individuals and assets are exposed to danger, yet social and technological advancements do not succeed in diminishing countries', regions', or cities' vulnerabilities (Bănică et al., 2020). Between 1998 and 2017, about 1.3 million people died, and 4.4 billion were injured, displaced, or needed emergency aid due to climate or geophysical disasters (UNISDR and CRED, 2017). Earthquakes and their associated tsunamis accounted for more than half of these fatalities (UNISDR and CRED, 2015). Around 60 million people worldwide were affected by extreme weather events in 2018; thousands of people were killed by earthquakes, tsunamis, and volcanic eruptions, and millions displaced by storms, floods, and droughts.

According to the annual 2020 report released by AON, global direct economic losses and damage caused by natural disasters were estimated to be 268 billion dollars in 2020. Although the loss was significantly less than the losses of 2011 (557 billion dollars) and 2017 (485 billion dollars), it was still significantly more than the average (244 billion dollars) and median (246 billion dollars) loss of the twenty-first century (AON, 2020). Additionally, in the same year 2020, natural disasters claimed the lives of almost 8100 people. Disasters such as cyclones, hurricanes, floods, and other multi-hazard events contributed to these economic losses and fatalities (Nazif et al., 2021),. Furthermore, COVID-19 overtook the globe at the start of 2020, becoming the worst pandemic on the earth since the 1918 influenza epidemic. According to the World Health Organization, the novel coronavirus may have infected more than 10% of the world's population (AON, 2020). Despite advances in science and technology, it is still impossible to fully anticipate and avoid certain disasters (Barzinpour & Esmaeili, 2014).

Apart from the COVID-19 pandemic, disasters caused by climate change dominated the year 2020, for instance, wildfire in the USA and Australia (Haque et al., 2021), tropical cyclone (Islam et al., 2021; Wang et al., 2021), and drought in South Africa (Orimoloye et al., 2021a). The pandemic intensifies the pressures placed on individuals affected by climate disasters, exacerbates their vulnerabilities, and hampers their recovery. With the COVID-19 pandemic, the global framework for sustainable development shifted dramatically. As a result, the world is confronted with

the most severe social, economic, and environmental risks (Ashraf, 2021). The devastating consequences of these disasters emphasize the critical importance of minimizing fatalities, injuries, damage to critical infrastructure, and economic loss (Gu, 2019). However, some countries are more prone to specific natural disasters than others due to their geographical locations. For example, China is frequently struck with frequent earthquakes and floods due to its enormous land area, diverse climatic zones, complex geographical environment, and precarious ecological conditions (Han et al., 2016). On the other hand, Indonesia is vulnerable to a wide range of hazards (flooding, droughts, volcano eruptions, tsunamis, earthquakes, epidemics, etc.) because of its geological conditions and geographic location at the confluence of four tectonic plates (Hansun, 2020). In the year 2018 alone, half of the total death in Indonesia were from natural disasters, according to the Centre for Research on the Epidemiology of Disasters (CRED) report.

Africa is one of the most vulnerable regions to natural disasters. The African continent has incredibly diverse climatic conditions ranging from equatorial to desert. Considering the number of individuals affected in the late 30 years, droughts and floods are the most common disaster having the most humanitarian impacts in Africa (Lumbroso et al., 2016). The primary causes of exposure and vulnerability in African countries include fast population growth, urbanization, informal land occupation, and poverty. Like other countries, sub-Saharan Africa, South Africa, and Nigeria are vulnerable to disasters. South Africa, for example, has always been a water-stressed region, with an average annual rainfall of 450 millimeters, far less than the global average of 860 millimeters (Goldblatt, 2011; Turpie & Visser, 2015). It has seen several climate-related disasters over the last few decades, the most recent being the 2014–2016 drought, during which the country received the lowest annual rainfall on record (Davis-Reddy & Hilgart, 2021). Increased variability in temperature and rainfall patterns are predicted to severely hit the country, affecting agriculture which plays a significant role in the nation's economy (Benhin, 2008; Goldblatt, 2011) and livelihoods (Orimoloye et al., 2021).

Flooding is Nigeria's most common natural disaster; it is a prevalent occurrence in many geopolitical zones. For instance, Ibadan in Oyo State and Lagos in Lagos State have recently been affected by flood events where numbers of properties were affected and destroyed due to the events. Because of rising precipitation due to climate change, most of Nigeria's states are progressively experiencing annual flooding during the rainy seasons, for example, Oyo and Lagos States (Echendu, 2020). On the other side of the climate spectrum, various records of droughts in Northern Nigeria have resulted in famines (Abaje et al., 2013; Shiru et al., 2018). Overcultivation, overgrazing, uncontrolled urbanization, rapid population growth, and a high poverty rate exacerbate the natural disaster problem in Nigeria. Disasters such as drought and flood in Nigeria result from insufficient environmental infrastructure, unethical behavior, poor urban planning practices, and increased vulnerability (Oyebode, 2021). Consequently, evaluating risk from disasters to improve resilience in South Africa and Nigeria is crucial considering the number of disasters occurring in both nations. In this light, this study attempts to evaluate disaster risk

over Nigeria and South Africa to improve resilience in the affected regions and compare risk to assets in the countries with the global average.

2   Study Area

The world including the African continent has been affected by disaster both human and natural disasters. Droughts, floods, landslides, and storms are common natural disasters, but climate change is increasing the frequency and severity of these weather-related risks in the Africa continent (Orimoloye et al., 2021a). South Africa covers about 1,218,000 square kilometers and has a coastline of nearly 3000 kilometers. South Africa share boundaries with Namibia, Botswana, Mozambique, Swaziland, and Lesotho. South Africa has a low precipitation rate, with an average annual rainfall of 497 mm which contributed to the persistent drought in the region (Orimoloye et al., 2021c). The climate is typically warm and dry, with winter temperatures rarely falling below 0 ° C and summer maxima frequently above 35 ° C (Schulze, 1997).

Nigeria is the world's 32nd largest country, with a total size of 923,768 km² (356,669 sq. mi) on the Gulf of Guinea in western Africa. Its borders stretch about 4047 kilometers (2515 miles), and it shares them with Benin (773 kilometers or 480 miles), Niger (1497 kilometers or 930 miles), Chad (87 kilometers or 54 miles), and Cameroon (1690 kilometers or 1050 miles). It has a coastline of at least 853 kilometers (530 mi). The incidence of disaster events such as drought and floods in Nigeria space has a long year of history of the devastation of lives and properties. Extensive flooding is a phenomenon of every rainy session in Lagos, Maiduguri, Aba, Warri, Benin, and Ibadan (Adedeji et al. 2020), and a good record of drought events is in the northern regions (Ekundayo et al. 2021).

3   Data and Methods

The information used in this study was obtained from the Global Facility for Disaster Reduction and Recovery Unbreakable Web Platform (https://unbreakable.gfdrr.org/countrytool). This platform consists of the resilience indicator, which measures socioeconomic resilience in 117 countries including Nigeria and South Africa, and provides insights on what investments and policies drive resilience. It is based on a simple model that calculates asset and well-being losses for multiple hazards: river floods, coastal floods due to storm surge, windstorms, earthquakes, and tsunamis. Socioeconomic resilience is then estimated as the ratio (ranging from 0% to 100%) of expected asset losses to expected well-being losses. A larger socioeconomic resilience means that a country's population can experience larger asset losses while maintaining its well-being. A resilience level of 50% means that $1 in asset losses from a disaster results in a loss of well-being equivalent to a $2 drop-in

national income. The tool uses input data from the World Bank (World Development Indicators, ASPIRE, FINDEX) and the UN (Desai et al., 2015). Both nations considered in this study have several times been affected by drought and flood events which make some regions in the two countries vulnerable to disasters. Hence, disasters considered in this study are droughts and floods. The data is from 2015, the latest year the different data sources were all available. As stated in Hallegatte et al. (2016), socioeconomic resilience and risk to well-being are calculated as:

$$\text{socio-economic resilience} = \frac{\text{assest losses}}{\text{welfare losses}} \tag{8.1}$$

$$\begin{aligned} \text{risk to wellbeing} &= \frac{\text{expected assest losses}}{\text{socioeconomic resilience}} \\ &= \frac{\left(\text{Hazard}\right) \times \left(\text{Exposure}\right) \times \left(\text{Asset Vulnerability}\right)}{\text{socioeconomic resilience}} \end{aligned} \tag{8.2}$$

4   Result and Discussions

To achieve the aim of the study, clearly, evaluating disaster risk in Nigeria and South Africa toward improving resilience in the affected regions in comparison with the global average, the result reveals that various policies have influenced the reduction in asset and well-being losses in the two nations.

4.1   Country Losses to Assets, Socioeconomic Resilience, and Well-being

Findings from this study revealed that losses to assets and well-being vary from one country to another especially with various policy priorities. This study shows that Nigeria recorded losses to assets, economic resilience, and risk to well-being with about 0.12%, 48.3%, and 0.24% compared to the global average of about 0.63%, 61.12%, and 1.07%, respectively (Fig. 8.2a). This connotes that losses to disaster events (flood and drought) in Nigeria are far beyond the global average. This necessitates a more reliable action and implementation toward disaster-resilient and mitigation strategy. Risk to asset (% of GDP) is the annual response or repair and replacement costs for assets affected by disaster, while socioeconomic resilience is the ability of the populace to cope with the recovery from disasters. It is calculated by the ratio of asset losses to well-being losses in a particular region. Risk to well-being (% GDP) measures the cumulative impacts of disasters on the resident's well-being, taking into account the lower capacity of poor people to cope with and recover from a shock due to disaster.
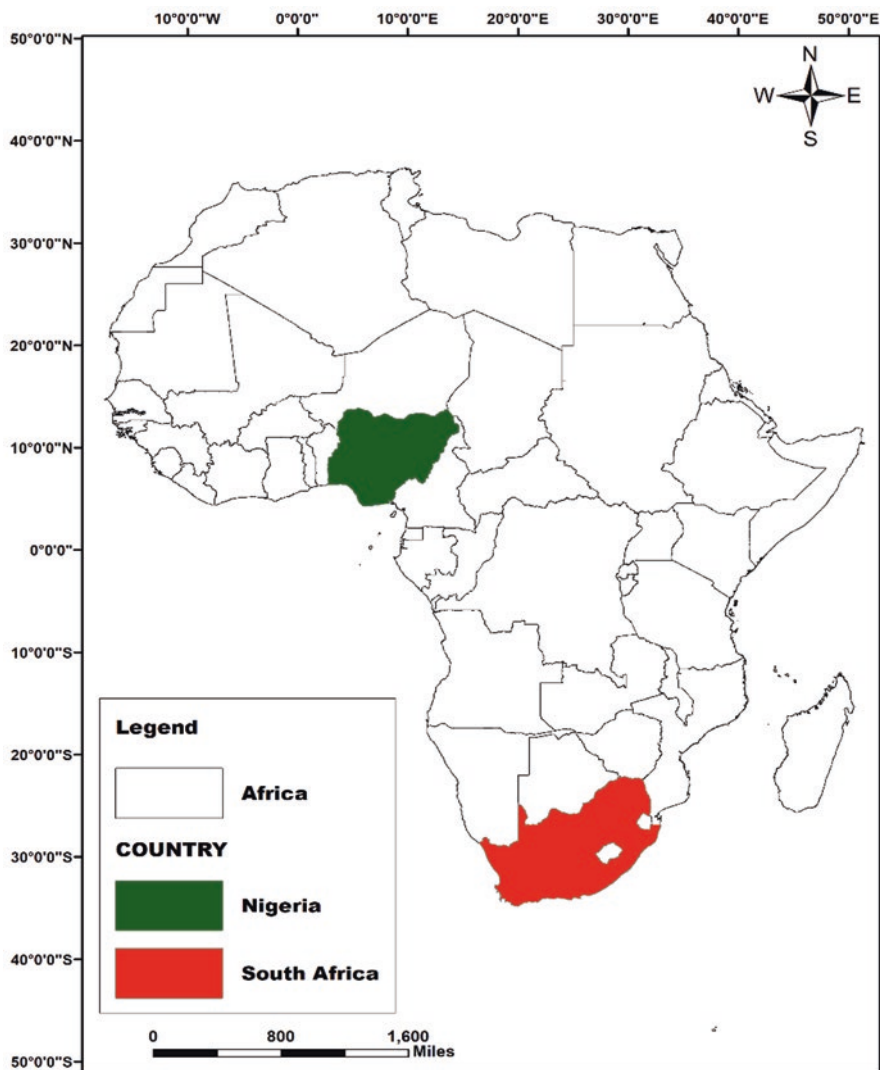
Fig. 8.1 Map showing the study area

More so, South Africa recorded losses to assets, economic resilience, and risk to well-being with about 0.24%, 55.13%, and 0.43% compared to the global average of about 0.63%, 61.12%, and 1.07%, respectively (Fig. 8.1b). This development might have affected various sectors including farmers, local communities, and water-reliant and vulnerability groups. Southern Africa, especially South Africa, has been found to be vulnerable to several natural and human-caused disasters that are becoming increasingly interrelated, according to studies (FAO, 2018; Aryal & Marenya, 2021; Branca et al., 2021). The growing frequency and intensity of
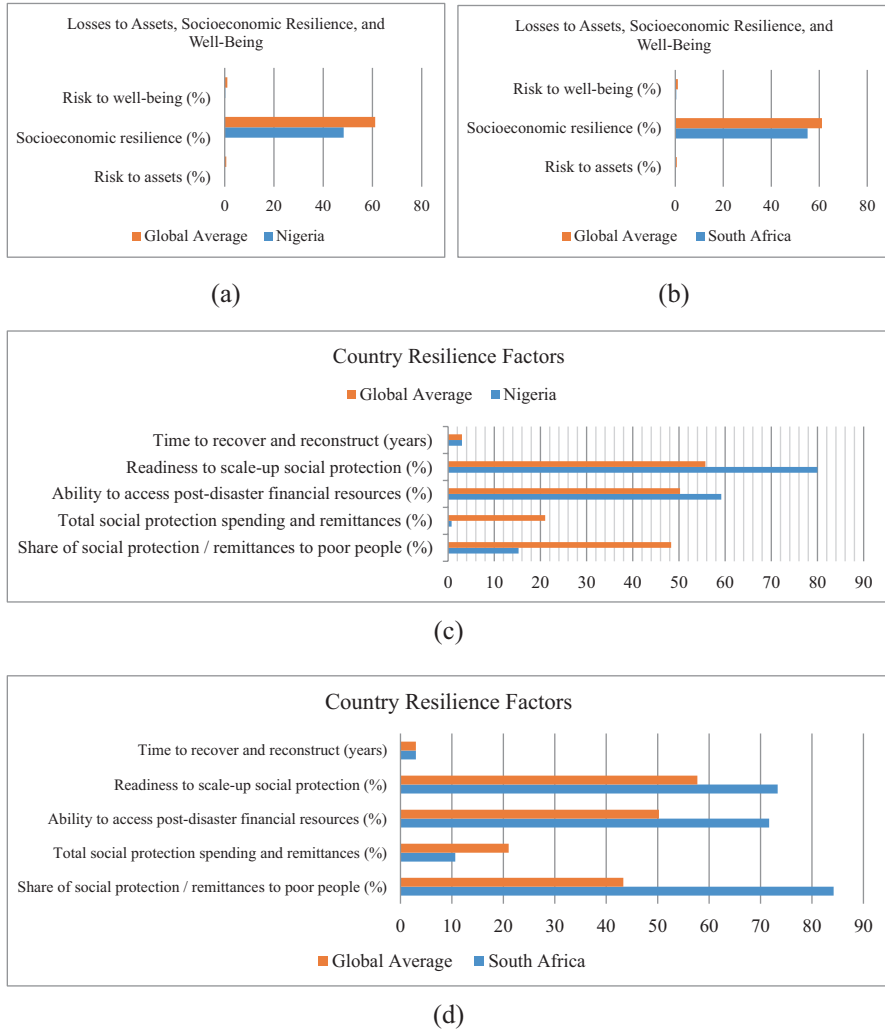
(a)

(b)

(c)

(d)

Fig. 8.2 Losses to assets, socioeconomic resilience, and well-being: (**a**) Nigeria, (**b**) South Africa. Country resilience factors: (**c**) Nigeria, (d) South Africa

disasters are further weakening rural households' already low capacity to predict, cope with, and recover from shocks, especially those who rely on agriculture and are particularly vulnerable. Building stronger, more resilient livelihoods are crucial to achieving collective commitments under the United Nations 2030 Agenda for Sustainable Development. The information in Fig. 8.2c and d present country resilience factors for Nigeria and South Africa, respectively; these are the main drivers of well-being and asset losses to disasters (drought and flood). The ability to access post-disaster financial resources (%) in Nigeria is about 59% compared to South Africa with about 71%; both nations are higher than the global average of about

50%. More so, the share of social protection/remittances to poor people (%) for Nigeria is lower than that of South Africa with about 15% and 84%, respectively, compared to the global average of 45% during the same period. Total social protection spending and remittances (%) are also lower in Nigeria compared to South Africa counterpart with about 0.7% and 10.7%, respectively. Overall, South Africa's resilient capacity is more efficient compared to Nigeria's. Studies have shown that lack of proper spatial planning and land use management coupled with lack of resilient capacity with the incapacity of governments to ensure good urban governance exacerbates the cases of disaster in Nigeria (Adedeji et al., 2020; Adefisan et al., 2015). It was also revealed that drought's cumulative impacts in Nigeria have resulted in rising poverty and environmental deterioration, putting the country's capacity to meet the Sustainable Development Goals at risk (Leal Filho et al., 2019).

4.2 Policy Priority in Disaster Risk Reduction Toward Improving Resilience

The information in Table 8.1 reveals how Nigerian policies can influence or reduce asset and well-being losses. Positive and negative values connote cases where the policies decrease or increase losses. For instance, Nigerian policies increase losses by increasing the income of the poor by 10% which influenced the rate of losses while reducing the exposure of the non-poor by 5% of total exposure reducing the rate of well-being losses by about 194 million dollars.

Findings from this analysis revealed that South African policies played vital roles in reducing asset and well-being losses due to disaster events since 2015. More so, a study showed that disaster and natural hazard governance has become a significant policy and legislative focus in South Africa since the early 1990s especially after apartheid (van Niekerk et al., 2018). Information in Table 8.1 reveals various roles these policies have played in reducing asset and well-being losses due to disaster in the country, and these have influenced resilient strategies in combating disaster impacts (Orimoloye et al., 2021b). South Africa has led the way in natural hazard governance in sub-Saharan Africa and most of the developing world and is widely regarded as an international best practice in policy and legislation development. Various natural hazard governance practices in South Africa are commendable. The country's disaster risks, as well as the different natural hazards that drive this risk profile, are given special consideration (van Niekerk et al., 2018; Sutherland, 2019)."

Results further show that the most efficient policies in South Africa in avoiding or reducing well-being losses due to disaster events are accelerated reconstruction and reducing exposure of the non-poor by 5% of total exposure with the worth of about 240 and 160 million dollars, respectively. The least effective is the policy on the increased social transfers to poor people to at least 33% in 2015; this connotes that this policy has nothing to contribute to resilient development. More so, in terms of asset loss avoidance, South Africa avoided asset losses worth about 99 million dollars with a policy on reduction of exposure of the non-poor by 5% of total

Table 8.1 Reducing asset and well-being losses through country policies (Nigeria and South Africa)

Absolute terms US$, millions per year	Avoided well-being losses (US$, millions per year)		Avoided asset losses (US$, millions per year)	
	Nigeria	South Africa	Nigeria	South Africa
Universal access to finance	25	61	0	0
Reduce exposure of the poor by 5% of total exposure	194	79	15	3
Reduce exposure of the non-poor by 5% of total exposure	95	160	65	99
Increase income of the poor 10%	17	10	−6	−1
Post-disaster support package	29	25	0	0
Develop market insurance (non-poor people)	60	103	0	0
Universal access to early warnings	110	141	51	75
Increase social transfers to poor people to at least 33%	129	0	0	0
Accelerate reconstruction (by 33%)	336	240	0	0
Reduce asset vulnerability (by 30%) of poor people (5% population)	61	26	4	1
Reduce asset vulnerability (by 30%) of non-poor people (5% population)	30	49	20	29

exposure followed by universal access to early warning policy with avoided asset losses of about 75 million dollars since 2015 as presented in Table 8.1. Studies have shown that natural disasters affect more than half a million people in South Africa each year, causing an average total economic damage of US$130 million per year (CRED, 2011; van Niekerk et al., 2018). Floods and storm events, droughts, and fires are the most common natural disasters (in order of frequency) in South Africa; this calls for more resilient strategies to combat disaster-related impacts especially drought and floods which are more frequent in the region.

4.3 Developing Socioeconomic Resilience to Natural Disasters

Space, where natural hazards occur, is a complex system. Natural hazards within this space act as shocks within the complex system. As shocks, natural hazards cause instability within the system. This instability could either be in the form of fatalities, casualties, or economic consequences which affect human well-being. Hence, the ability of the system to respond either in a positive or negative way determines its resiliency. Resiliency in simple terms is described as the ability of the system to withstand the existing shock and make a return to its initial state or a "near-state" with minimal damage. However, the capacity of the system to remain resilient has to do with a lot of factors. Furthermore, socioeconomic resilience, hereafter referred to as resilience, is the ability of an economy to minimize the impact of asset losses on well-being and is one part of the ability to resist, absorb, accommodate, and recover in a timely and efficient manner to asset losses (Hallegatte et al., 2016).

As identified by Hallegatte (2014), the behaviour of a system in responding to shocks is bifurcated. That is, there could be a situation of a small shock that necessitates a quick recovery to the initial state, or there could be a more intense shock which a bigger magnitude and recurrent frequency that significantly impairs the system. This type of shock(s) limits the ability of the system to recover and hence inhibits resilience. Systems here referred to as the natural environment, where living and non-living things interact, are largely impaired by the inability of the system to recover from the shock, in this case, a natural disaster. However, in the real-life scenario, a system is attacked by multi-hazards either at the same time or one after another. Therefore, there is the need for the system to be proactively resilient and prepared to resist the impending shocks. As observed in the case of Nigeria and South Africa, the resilience of the two countries differs due to several reasons ranging from factors such as but not limited to polity, governance, economy, climate/ location, and population. However, to build a strong and vibrant socioeconomic resilient system, there is the need to go beyond "paying lip" service to disaster risk reduction but creating a conscious and sustainable action plan that can proactively aid a sound-resilient system. Several frameworks are in existence such as the Hyogo gives way to the Sendai Framework. These frameworks are quite efficient in disaster risk reduction and building a resilience system. However, there is the need to

develop and couple site/region-specific frameworks that can cater for location differences and system instabilities. This in a way ensures a sustainable design that can adapt to the systemic changes.

To carefully design frameworks that are site/region-specific, there is the need for the government to do the following:

(i) Adequately plan for resilience.
(ii) Provide a careful laid-out design to finance resilience.
(iii) Be ready to partner with relevant stakeholders
(iv) Ensure viable monitoring of results.
(v) Plan for resilience

The Nigerian and South African governments are confronted with challenges that are hydra-headed and complex as a result of the impact of natural hazards. To ensure that they navigate through these complexities and present a strong and sustainable system requires efficient planning that can limit the loss and damage to lives and assets. As mentioned earlier, to adequately plan for resilience is to be ready to integrate disaster risk reduction into planning process at all stages of economic planning. These ensure that across all levels, national, state, provincial, and community, there is a resilient approach to natural hazards (Desai et al., 2015). A plan that adequately cater for those at the community level invariably covers the poor in society. The poor people are most often than not exposed to these shocks more than any other person. In Nigeria, for example, poor people are 50% more likely to be flooded; 130% more likely to be affected by drought; and 80% more likely to be affected by extreme heat. In short, in either Nigeria or South Africa, poor people are losing more, and they receive less support aftershocks and disasters (Hallegatte, 2014).

4.3.1 Finance Resilience

There is the need to consciously put a concerted effort into resilience finance. Governments in Nigeria and South Africa will have to do more in providing funds for resilient programs and projects across all scales. The state of global infrastructure deficit is acute in tropical environments, especially in Africa and Asia (GFDRR, 2015). Hence, it is a known fact that government alone might not be able to act as the sole financier in programs or projects to finance resilience. Hence, there might be the need for relevant stakeholders in the private sector to partner by helping to deliver, maintain, and fund part of these projects or programs. The government can design some sort of financing plots by creating:

(a) Upstream general legal and capacity analysis related to project financing in a specific city and strategic guidance to project teams on potential areas for expanded financing for resilience projects in the city.
(b) Financial and regulatory analysis related to a specific project concept.
(c) Specific transaction advisory and financing services (GFDRR, 2015).

4.3.2 Be Ready to Partner with Relevant Stakeholders

As specified in financing resilience, the government will have to design a solid blueprint to allow relevant stakeholders to be interested in partnering with the government. Since government alone cannot fund these projects or programs, there is the need to attract external partnerships especially with the private and multinational organizations dealing with resilience in all forms. These provide a more robust approach to achieving a lot using different opportunities and key players in addressing various issues within the system as regards resilience.

4.3.3 Ensure Viable Monitoring of Results

For a viable resilient program and design, there is a need for partnership with stakeholders. However, this can only be possible if there is an avenue for monitoring and evaluation of results. Government and various stakeholders should be ready to monitor the results of interventions put in place to build a resilience system either at the national, regional, state, provincial, or community level. These provide feedback for the design and help in understanding the behavior of the system or intervention. Without proper monitoring, there can be a viable resilient design to withstand shocks from natural hazards.

5 Conclusions

The findings from this study show that disasters such as floods and droughts can have a negative impact on development in terms of asset and well-being losses, necessitating the development of people's capacity to prepare for, manage, mitigate, and cope with disaster threats. Both countries' findings found that disaster risks were high when compared to the worldwide average. This development necessitates immediate efforts in both countries to avoid vulnerabilities. As natural hazards become more severe as a result of climate change, and because protection infrastructure alone cannot eliminate risk, a more resilient strategy and the inclusion of outcomes in the planning and decision-making process are required to address the problem of disaster-induced poverty and vulnerability. Strengthening national capacity in the government, public and private sector, and NGOs to mitigate the consequences of disasters such as floods and drought is one of the techniques for promoting long-term disaster resilience. It is important to remember that disaster prevention, mitigation, and planning are preferable to disaster relief and response. In Nigeria and South Africa, effective and timely spatial information on flood and drought monitoring is required, as well as their impact on flood and drought prevention programs. One of the benefits of promoting or improving resilience is that it will help advance solutions and efforts on quantifying risks and potential losses due to disasters in Nigeria and South Africa. Consequently, relevant authorities in these

countries should develop policies for various types of disaster risk management. Disaster risk reduction must be mainstreamed into urban and regional planning at all levels of decision-making; governments and key collaborators should address prudent budget allocation, planning, and response mechanisms to manage disasters, resilience activities, response programs, and activities related to flood and drought hazards impacting humans, animals, and the environment. This is anticipated to preserve residents and infrastructure, particularly where development occurs in disaster-prone areas.

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