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Disaster risk reduction through early warning systems

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Abstract

Disaster Risk Reduction (DRR) is critical to safeguarding the safety and well-being of communities in coastal regions and communities. An early warning system (EWS) is crucial for mitigating catastrophic risks associated with flooding because an effective EWS can allow communities to take the required steps to reduce the impacts of an impending hazard. It can therefore be implied that one of the reasons for the devastating effects of flooding in coastal communities, may be associated with the lack of EWS as witnessed in the October 2022 flooding in Nigeria. This paper advocates for more effective EWS and better technology integration into emergency operations in Nigeria's emergency services to minimise the impacts of flood risk amidst the cascading effects of climate emergency.

A combination of primary and secondary research methodologies was employed to conduct the study. This paper used the constructivist philosophical perspective to explain the snowball sampling method utilised for the research. The method also involves distributing open-ended questionnaires to Nigerian individuals in flood-prone regions, to obtain accurate information on flood occurrences. The selection criteria required individuals to have resided in Nigeria for at least five years. The survey involved 45 participants aged 20-60, with a majority being corporate workers (69.2%). Drawing from secondary data on the October 2022 flooding in Nigeria, and collated primary data, the result displayed a lack of effective Early Warning System (EWS)and limited response capabilities especially in coastal towns and cities. The findings from this evaluative process indicate the need to drastically improve EWS and capabilities for response in coastal communities in Nigeria.

This paper recommends incorporating disaster risk reduction (DRR) into development planning and policy to ensure the long-term viability of disaster risk reduction efforts. Beyond the policy implication of this paper, the impact on practice includes reviewing existing structural and non-structural measures to incorporate applicable and more effective EWS for coastal communities, and technology into regional emergency operations centres in the country.

Keywords: DRR; Early Warning System (EWS); Coastal Communities; Emergency Operations; Nigeria

1. Introduction

Disaster risk reduction has a long history dating back to ancient times when communities recognised and began to adapt to natural hazards (Wisner, Gaillard and Kelman, 2012). Over time, the field has evolved significantly due to technological advances, societal values, and shifts in global political priorities (International Telecommunication Union, 2019). During the Middle Ages, communities developed strategies to cope with natural hazards, such as using stone and brick to resist sea rise against cities and buildings near the ocean (Jacob, 2018). With the advent of the Industrial Revolution, natural hazards became more frequent and severe, marking a turning point in disaster risk reduction history (Wisner, Gaillard and Kelman, 2012). This enhanced the emergence of Early Warning Systems in the late 19th century, allowing communities to prepare for disasters and evacuate vulnerable areas before nature struck (IFRC and Red Crescent Societies, n.d.).

With the adoption of the Hyogo Framework for Action (HFA) in 2005, disaster risk reduction became a more prominent issue on the global agenda. By implementing the HFA and initiating advanced technologies, social media, and digital communication tools, disaster risk reduction became more effective. Disaster risks were reduced, and preparedness and response were improved (Rajabi et al., 2023). Despite these advances, disaster risk reduction remains challenging. Communities continue to face elevated levels of disaster risk, and climate change increasing natural hazards in large frequency and severity. Calling on research, education, and infrastructure, as essential to addressing these challenges (Weichselgartner and Pigeon, 2015) (United Nations Office for Disaster Risk Reduction, 2023).

According to the United Nations Office for Disaster Risk Reduction (DRR) Disaster risk reduction is a critical aspect of Sustainable Development mostly for countries prone to disasters (Seddiky, Giggins and Gajendran (2020). Leveraging strategies and measures to mitigate the impacts of disasters on individuals, communities, and societies. Focusing on preventing, reducing, and managing existing disaster risks to enhance resilience (United Nations Disaster Risk Reduction, 2015). Disaster Risk Reduction (DRR) emphasizes proactive measures at its core for managing disasters, shifting from reactive emergency response to proactive risk management strategies. It emphasises understanding risks, implementing preventive measures, and building resilience (Aitsi-Selmi et al., 2015). Highlighting community participation in disaster risk reduction (DRR) as rudimental and context-specific, culturally appropriate, and a sustainable strategy, as the communities possess valuable knowledge about local hazards and coping mechanisms (Zubir and Amirrol, 2011).

Disaster risk reduction is the systematic efforts to minimize vulnerabilities and enhance the resilience of individuals, communities, and nations to natural and human-induced hazards. It involves measures taken to prevent new risks, reduce existing risks, and manage residual risks. Hazards originate from increasingly integrated and interdependent social, technical, and biological systems, as well as complex risk environments (Kelman and Glantz, 2014). Therefore, DRR policy needs to incorporate both elements of development planning and policy that address the vulnerabilities of communities prone to flooding to address the underlying causes of disasters by considering social, economic, environmental, and institutional factors that contribute to disaster(Sanober and Naheed, 2021; Bosher, 2013). Mainstreaming DRR into development planning and budgeting though mainly a governance procedure, must guarantee that development is risk-informed to improve the safety of people and key infrastructure, safeguard the natural and built environment, and establish resilient lives and economic activity (UNDRR, 2019) (Benson, Twigg and Tiziana Rossetto (2008). Disaster risk reduction is a policy objective of Disaster Risk Management (DRM) (de Leon and Pittock, 2016). The agenda of DRM is to reduce disaster risk in every capacity and level and its goals and objectives are defined in the disaster risk reduction strategies and plans. All In line with the Sendai Framework for Disaster Risk Reduction 2015-2030 (United Nations Disaster Risk Reduction, 2015).

In recent years, there has been a growing recognition of the importance of DRR globally as societies have altered traditional planning practices, giving way to more effective procedures. This is due to risks and their determinants being increasingly complicated, intense, and frequent (Global Network of Civil Society Organisations for Disaster Reduction, 2022). The Sendai Framework for Disaster Risk Reduction 2015-2030, adopted by the United Nations member states in 2015, provides a comprehensive roadmap for DRR efforts. DRR is intricately linked to Sustainable Development and contributes to the achievement of the United Nations Sustainable Development Goals (SDGs). With the agenda to promote social, economic, and environmental resilience, ensuring that development gains are not lost due to disasters (United Nations, 2015). The Disaster Risk Reduction framework consists of interconnected components, including risk assessment, early warning systems, community involvement, infrastructure development, education, policy development, emergency readiness and response, monitoring and evaluation. These elements enhance resilience and reduce vulnerabilities in natural or human-induced hazards.

Therefore, this paper examines the Nigerian emergency services response to the flood risk of 2022 to determine whether measures reflect the application of DRR and EWS to minimise the impact of the flood in the communities.

2. DRR and EWS in Nigeria

The increasing frequency and severity of disasters have raised urgent concerns for immediate intervention. In 2021, 432 devastating flooding incidents occurred, a rise from 357 yearly events between 2001 and 2020, affecting 101.8 million people and causing 252.1 billion US dollars in economic losses (International Labour Organization, 2022). Early warning systems (EWS) are highly significant to the agenda of disaster risk reduction (DRR), potentially saving lives and mitigating 30% of damage if triggered 24 hours before a disaster (International Labour Organization, 2022). An Early Warning System (EWS) which has no universally accepted definition, as it is tailored according to the dynamics of a state, is defined by the United Nations International Strategy for Disaster Reduction, as the set of capacities needed to generate and disseminate timely and meaningful warning information to enable individuals, communities, and organisations threatened by a hazard to prepare and act appropriately and in sufficient time to reduce the possibility of harm and loss (UNISDR, 2012). Most disaster risk reduction (DRR) initiatives view Early Warning Systems (EWS) as a social process aimed at mitigating the impact of disasters and preventing harm (Kelman and Glantz, 2014).

According to certain hypotheses, this social process occurs across many geographical scales, including individuals in isolated villages lacking power over the global population (Kelman and Glantz, 2014). Immediate warnings about impending disasters, adequately distributed by telecommuting, especially broadcast services, are essential for enhancing the effectiveness of disaster prevention and preparedness (Golding, 2022). Building an effective early warning system (EWS) mitigates the consequences of natural hazards on communities, enhancing risk reduction strategies and the management of disaster risk reduction (DDR) initiatives (Baudoin et al., 2016). Sadly, around one-third of the global population, primarily in the least developed nations, is devoid of the effectiveness of these early warning systems (International Labour Organization, 2022). Despite the signing of the Sendai Framework for Disaster Risk Reduction 2015-2030 (SFDRR) by Nigeria and other African governments in 2016, disasters continually destroy homes and leave survivors miserable and homeless in Nigeria. This issue is exacerbated by the presence of substandard urbanisation and rural developments, which often lack risk-informed development (RID). According to the EM-DAT database, cities in Nigeria are experiencing an average annual economic loss of US$250 billion to US$300 billion due to climate change, imbalanced urbanisation, and inequality (EM-DAT, The International Disaster Database, 2020).

The Nigerian government recognises this fact and actively engages in many regional and International Disaster Risk Reduction (DRR) frameworks, including the Hyogo Framework of Action in 2005 and the more recent Sendai Framework for Disaster Risk Reduction. However, the government's achievements in this area have been unproductive. A plausible explanatory theory for this pattern is that the country's operational disaster risk reduction strategies prioritise disaster response (DR) above risk prevention and mitigation (RPM). The National Emergency Management Agency (NEMA), which is saddled with the organisation and coordination of disaster risk reduction (DRR) initiatives in the country, has been unable to execute its statutory duty. The agency's crisis management method primarily involves facilitating the evacuation of victims and promptly giving them essentials such as food, clothing, medication, and shelter. The agency's DRR policy has demonstrated an affinity for certain disaster preparedness initiatives, by being theoretical rather than pragmatic (Okunola, 2021).

Given Nigeria's obvious backwardness in disaster risk reduction (DRR), the National, State, and local governments should prioritise DRR laced with EWS in their daily operation. This method involves a comprehensive understanding of disaster risk reduction in alignment with the Sendai Framework (Okunola, 2021). In recent decades, the country has witnessed a surge in the recurrence of disasters. The most seen disasters are floods, landslides and lightning strikes, caused by intense rainfall, sea rise and storms (United Nations Office for Disaster Risk Reduction - Regional Office for Africa, 2018). Countries like Rwanda, owing to their limited resources in proportion to their size and natural resources, have experienced their share of frequent Natural Disasters. In 2002, an institutional framework was established in Rwanda to develop a national strategy for disaster risk reduction (DRR)and prevention. This policy was officially adopted by the Cabinet in July 2003. The policy established a National entity for Disaster Risk Management in July 2004, which operates as an independent authority under the Ministry of Local Government. The coordination of disaster reduction and preventive efforts in Rwanda is overseen by the National Service for Disaster Management (NSDM), which, as mandated by law, collaborates with all ministries in the country in other words cross-sectoral coordination (United Nations Office for Disaster Risk Reduction - Regional Office for Africa, 2023). Their selection of policies was characterised by precision. The coordination and effectiveness of the Strategic Plan of Action of the National Policy on Disaster Management was successfully demonstrated during the COVID-19 epidemic. The key lesson from studying Rwanda as a case study is the implementation of Disaster Risk Reduction (DRR) and prevention as a national strategy. And the agency in charge works arm-in-arm with all other ministries in the Nation because they have a sense of purpose, and that is to mitigate disaster and save lives.

3. Conceptual framework and research methods

Disaster Risk Reduction (DRR) Framework is a comprehensive approach to disaster risk management (DRM). It comprises four components which include disaster prevention and mitigation, disaster preparedness, disaster response, and rehabilitation and recovery. Disaster prevention and mitigation focus on reducing the likelihood and severity of disasters, while disaster preparedness involves immediate actions to save lives and meet the needs of survivors. Disaster response and rehabilitation and recovery aims to restore affected communities to their pre-disaster state or better, focusing on rebuilding infrastructure, and their livelihoods, while addressing the physical, social, economic, and psychological impacts of the disaster. The DRR framework acknowledges that disaster risk is not just about physical hazards but also about social, economic, and environmental factors that contribute to vulnerability (Twigg, 2005).

To effectively conduct a robust and significant study, a combination of primary and secondary research strategies was employed. The objective of this paper's technique was elucidated using a constructivist philosophical perspective. Within the framework of snowball sampling, constructivism emphasises the need to comprehend the mechanisms of referral and the social connections that play a role in recruiting participants, particularly when the researcher is unable to directly access the desired population. This philosophical perspective posits that individuals and collectives shape their comprehension of the world through their personal encounters, social exchanges, and mutually agreed-upon interpretations. Based on this, the snowball sampling approach is deemed more appropriate for this research.

In this study, the snowball sampling method was utilised to distribute open-ended questionnaires to Nigerian individuals residing in flood-prone regions in the country. This approach is especially valuable when investigating a situation where the principal researcher is geographically distant from the specific group being studied. The selection criteria require individuals who have primarily resided in Nigeria for a minimum of five years at the time of completing the questionnaire. The purpose of this selection approach was to obtain accurate and detailed information on occurrences of floods in Nigeria. The volunteers were recruited by distributing Google forms. A total of 45 individuals between the ages of 20 and 60 participated in the survey. Among them, 10 (22.7%) were male and 34 (77.3%) were female. The respondents came from various regions in Nigeria, including the south-south, south-west, north-central, and eastern parts. The majority of the participants consist of corporate workers, accounting for 31 individuals (69.2%). Additionally, 5 participants are craftsmen, representing 10.5% of the total, and 9 participants are students, making up 20.3% of the total.

4. DRR and flood EWS findings and discussion

Flooding has become a major hazard in Nigeria in recent years. It was estimated that Nigeria suffered combined losses of more than $16.9 billion in damaged properties, oil production, agricultural and other losses due to flood events in 2012 alone (Oladokun and Proverbs, 2016). In October 2022, Nigeria experienced severe flooding that caused considerable damage and affected numerous locations across the country. The flooding was a result of heavy rainfall and overflowing rivers, leading to widespread destruction and displacement of communities. Currently, about 178 local government areas (LGAs) in 32 of 36 states in Nigeria and the Federal Capital Territory fall within the highly probable flood risk areas, according to the Nigeria Hydrological Services Agency (NIHSA). Another 224 of the country's 744 LGAs fall within moderately probable flood-risk areas, and 372 fall within probable flood-risk areas (Usigbe, 2023). During the flooding, eight states across Nigeria were severely affected. Lagos, Ogun, Niger, Kogi, Delta, Anambra, Rivers, and Bayelsa states. These regions experienced extensive damage to infrastructure, including roads, bridges, buildings, and farmlands (ACAPS, 2022). The consequences of the flooding were devastating. communities in these states were submerged underwater for extended periods, leading to the displacement of thousands of people. Homes were destroyed or severely damaged, leaving individuals and families without shelter. Agricultural lands were flooded, resulting in crop loss, and affecting food security in the affected areas.

Table 1 The Economic, Social, Health and Environmental Impact of the 2022 Flood in Nigeria

Economic	Over 630,000 hectares of cropland across the country were destroyed. 100,000 hectares alone in Benue State.
	Inflation reached its highest 23% in this region as a result
Social	200,000 houses have either been partially or fully damaged
	Lack of access to essential, social services and other hygiene services
	3,174, people were injured as a result of the partial and full damage.
	Over 1.5 million children are at risk as a result of the 2022 devastating flooding.
	2.5 million people were displaced.
Health	7,485 Cholera outbreaks in Borno, Adamawa, and Yobe State and 319 associated deaths, including 662 deaths directly from the outbreaks.
	Contamination of water leading to other health-related illnesses.
Environmental	Landslide and environmental degradation.
	Destruction of farmland and further disruption to harvest season due to limited cultivatable land.

Adapted from Usigbe (2023), UNICEF (2022) and International Federation of Red Cross and Red Crescent Societies (2023)

The Nigerian government do not lack research institutions and agencies with the skills to adequately address Disaster and Risk reduction through EWS but lacks the willpower to make positive changes for the greater good. For instance, the National Emergency Management Agency (NEMA) has a department of planning and utilizing Geographical Information Systems (GIS) to work on flood data but there is no still no effective national EWS in place for floods at all levels of federal, state, and local governments, while the National Meteorological Agency (NIMET) provides seasonal rainfall predictions, but communication remains a problem (Echendu, 2020). And highlighted the absence of the use of state-of-the-art flood models integrating all hydrological processes for accurate prediction and mapping of flooding and its associated risks in Nigeria(Oladokun and Proverbs (2016). There has been insufficient progress in implementing large-scale integrated EWS (Golding 2022). To back up the above assertion that the government of Nigeria lack the willpower to effect adequate DRR, a snowball sampling technique was employed through a questionnaire. Forty-five people participated. The questionnaire was to inquire about the following: 1. whether they had ever received any advance notifications or alerts on probable disasters

in their vicinity. Out of the respondents, twenty individuals (44.4%) responded affirmatively, while the majority, 26 individuals (57.8%), responded negatively.
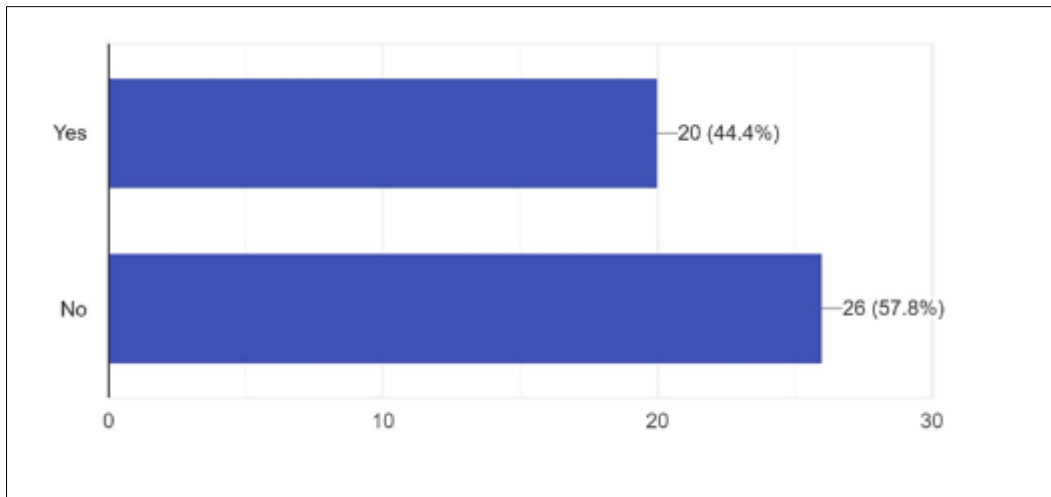
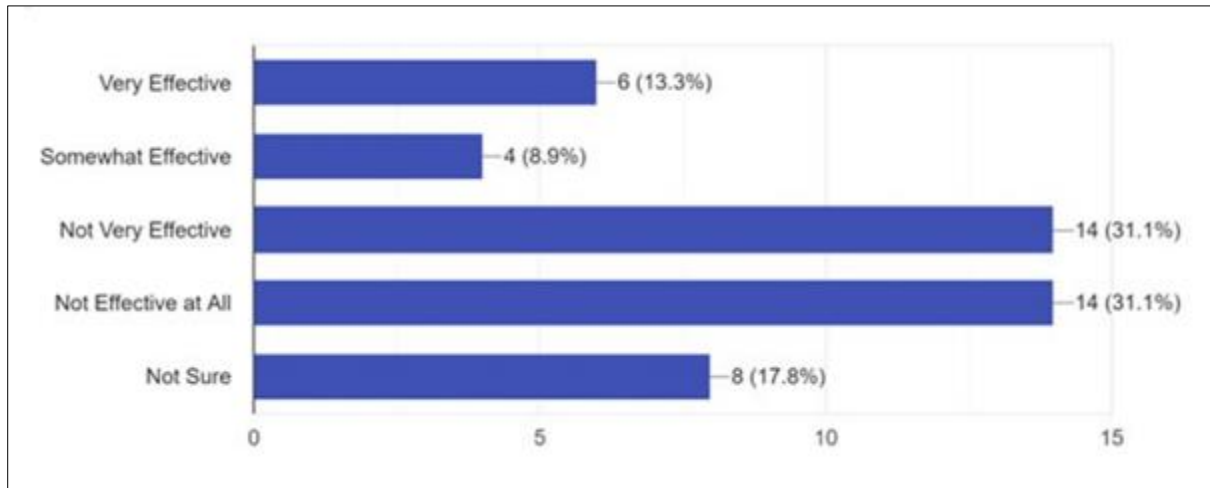Source: Author

Figure 1 Early Warning System Awareness

The diagram below illustrates how early warning systems were received by respondents who responded positively to question 1. Majority of the participants reported receiving the Early Warning System (EWS) through radio broadcasts and announcements, constituting 40% of the respondents. Another 15% mentioned receiving the EWS through an unidentified broadcast. The remaining 5% each reported receiving the EWS through TV/social media, word of mouth, flood alerts, or not receiving any alerts at all. Revealing a high level of inconsistency on the part of the government and its agency responsible for managing disaster.
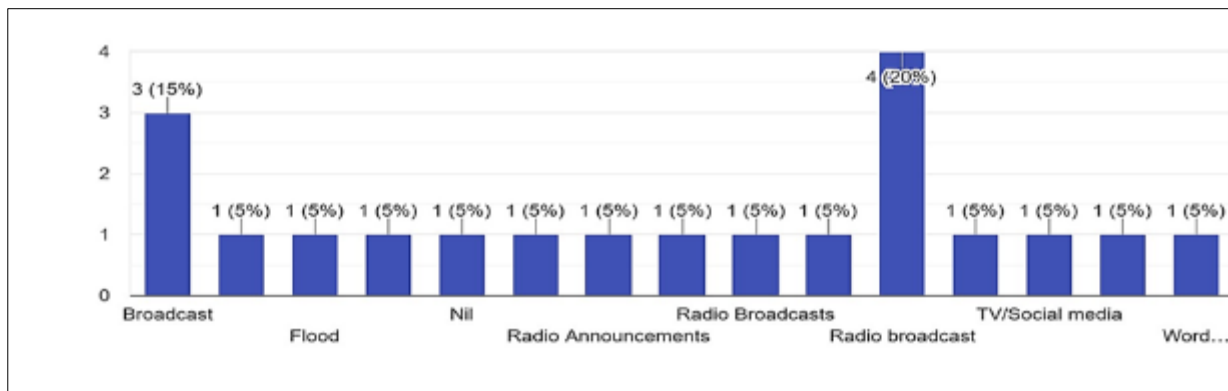
Source: Author

Figure 2 Mediums of EWS

The following chart displays the respondents' assessments of the efficacy of the existing Early Warning Systems (EWS) in their respective regions or communities in Nigeria, in terms of delivering prompt and precise information regarding impending disasters. Out of the respondents, 6 (13.3%) said that the Early Warning System (EWS) in their region is highly effective. 4 (8.9%) indicated that it is moderately successful. 8 (17.8%) expressed uncertainty about its effectiveness. Meanwhile, 14 (31.1%) and another 14 (31.1%) of the respondents answered that the EWS is not very effective and not effective at all, respectively.

Source: Author

Figure 3 The Effectiveness of EWS

Participants were also asked whether they had ever observed or been informed about a disaster incident, particularly floods, in their locality or community when the absence of a proficient Early Warning System (EWS) led to severe consequences. 80% of respondents reported being aware of and having personally experienced a disaster event. They believed that the absence of efficient Early Warning Systems had a significant role in exacerbating the extent of the disaster. In contrast, 20% of respondents claimed that they had not encountered any such events.
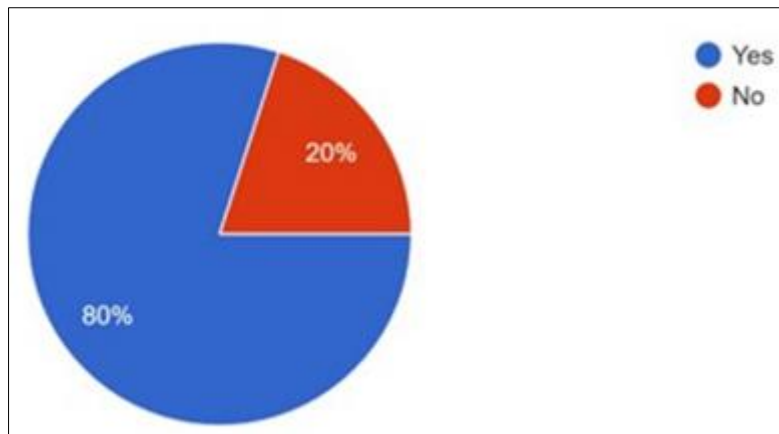
Source: Author

Figure 4 The Contribution of EWS to Disaster Management

According to the collected data and statistics, it is evident that Nigeria has an idea of EWS, however, its effectiveness falls short of expectations. Respondents were questioned about the primary challenges or constraints impeding the efficacy of EWS in Nigeria, and their responses were as follows:

- *Lack of effective communication and efficient information systems*
- *Insufficient scientific, and socio-economic investigation into the causes of the disaster, and governmental incompetence and lackadaisical attitude demonstrate a lack of urgency in taking measures to avoid, mitigate, and address these disasters.*
- *Insufficient documentation of disaster events and failure to follow up. The government's failure to act in addressing Disaster challenges has led to citizens developing indifference towards innovative ideas to enhance disaster management in the country.*
- *Lack of knowledge and Awareness.*
- *Absence of consciousness*
- *Absence of established framework*
- *Minimal or negligible government interference*
- *The government perpetually displays a lack of concern.*

Respondents were questioned about their knowledge and experiences to ascertain their opinion on the integration of Disaster Risk Reduction (DRR) into development planning and policies in all areas, mostly coastal areas. 25 individuals, accounting for 55.6% of the respondents, expressed a strong agreement about the integration of DDR into development planning and policies. 19 individuals, representing 42.2% of the total, agreed, while only 2 individuals, accounting for 2.2%, remained neutral.
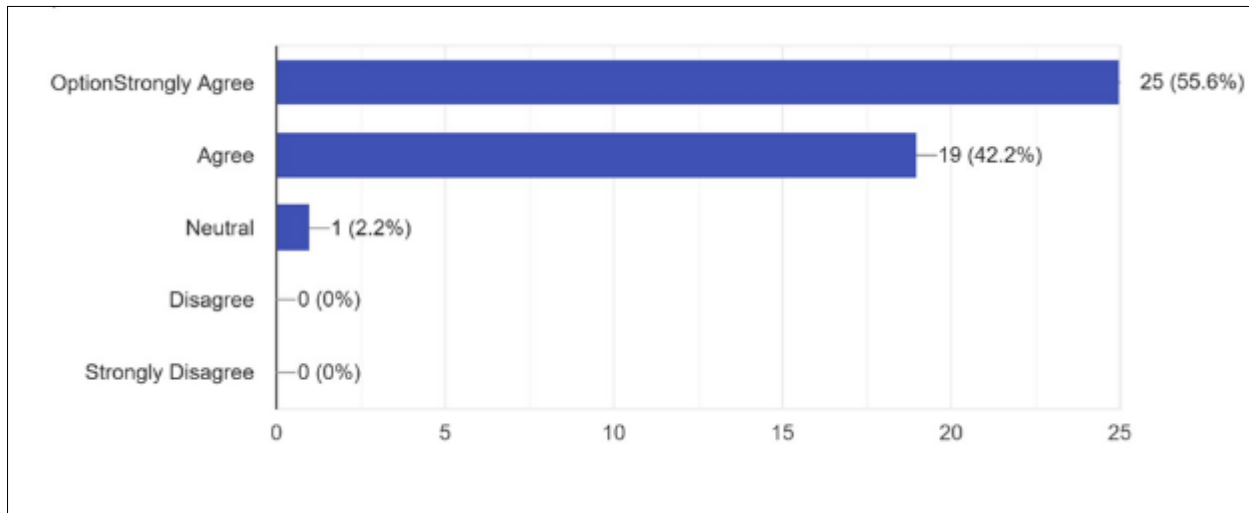

Figure 5 Integration of Disaster Risk Reduction (DRR)in Development Planning and Policy

Participants were questioned on the precise policies or strategies they believe should be enacted to enhance EWS, mostly coastal towns. A total of 29 individuals responded to:

- *Educate individuals on disaster events.*
- *Enhance scientific research and effectively implement and monitor improved government policies.*
- *Monitor Initial measures and strategies that were implemented to tackle the cause and consequences of disasters and improve government preparedness and mitigation levels.*
- *Ensure sufficient time is allocated in the case of evacuation. There should be no spontaneous or unplanned warnings. Additionally, it is crucial to develop alternatives in situations where certain individuals are unable to purchase evacuation services, such as the evacuation of those residing along coastal areas.*
- *Promoting awareness by facilitating community dialogue.*
- *Offer telephone networks in every region.*
- *Focus on proactive measures rather than waiting for the occurrence of a disaster before seeking solutions.*

Respondents were also questioned about the optimal methods for integrating technology into regional emergency operations centres to bolster disaster planning and response in coastal regions. Among the 27 replies are:

- *Using appropriate media broadcasts and other social media channels.*
- *Establish stations and offices in all locations, constructed within the local vicinity.*

4.1. Policy Implication and Practice

Policy implication and practice of DRR in Nigeria are nowhere close the benchmark of progress. There is no identifiable incorporation of DRR in existing development planning and policy which is crucial to guaranteeing DRR's long-term success. Governments, organisations, and communities could successfully decrease disaster impacts, increase resilience, and promote sustainable development by incorporating disaster risk reduction into development processes through policy (Seddiky, Giggins and Gajendran, 2020). The integration of DDR into development process or planning must come from within the key development sectors for specific sectoral vulnerabilities to be assessed and risk management to be institutionalised in policymaking, planning, project cycle, and investment planning (United Nations Disaster Risk Reduction, 2014). These policy implications have an impact on practice when communities severely at risk and those around them use this method, they may make educated decisions to achieve their ambitions as a community and save their environment. The implications of these practices also involve evaluating current structural and non-structural measures to integrate suitable and more efficient Early Warning Systems (EWS) for coastal communities (Hatami, Neisi and Kooti, 2016), as well as incorporating technology into regional emergency operations centres in Nigeria. These measures are crucial for improving disaster preparedness, response, and resilience.

Therefore, the importance of incorporating DRR in policymaking, which has the potential to drive risk-informed development planning cannot be overemphasised, as it addresses difficulties and impediments to progress and growth, particularly risk from risk drivers and hazards (Weichselgartner and Pigeon, 2015). A long-term process should be developed to integrate DRR into development planning. That is a detailed and comprehensive risk analysis which includes risk-informed development, sustainable development and long-term resilience.

The findings of this study on flood response in Nigeria have policy and practice implications that require immediate attention. This enables further on-site examination into the implementation of preventative measures during the 2022 floods, the development of mitigation strategies for affected regions, and the evaluation of the abilities of the individuals deployed in each location. There is minimal evidence of a well-established and successful flood prevention cycle and little mention of disaster risk reduction (DRR) efforts. Nigeria lacks sufficient capacity to effectively respond to disasters and implement risk reduction measures. That is because of the country's unchanging attitude toward development and institutional progress which has grossly affected the country to effectively mitigate the impact of floods and other disasters. In addition, the designated agencies tend to wait for tragedy to strike before responding in panic, therefore limiting the effectiveness of any interventive measures employed and, there is no current cross-sectoral partnership in the country for DRR mitigation.

5. Implications and conclusion

Disasters have had an increasing human and financial impact in Nigeria. Disasters pose a rising threat to sustainable development, poverty reduction efforts, and the achievement of the United Nations Sustainable Development Goals. As a result, the government and designated disaster management parastatals should prioritise disaster risk reduction (DRR) to safeguard the environment from potential hazards and loss of life. Through this study, it was discovered that there is a scarcity of publicly available studies and research on the successful approaches used in Nigeria's 2022 flood incident, indicating a lack of flood mitigation efforts as well as the deployment of preventative measures. Tragically, the websites of the National Emergency Management Agency (NEMA) and the National Hydrological Agency (NHA) provided no useful information but pictures of flood incidents, award ceremonies, programmes, workshops, and conferences.

Early Warning Systems are very important in every spectrum, mostly in the context of Nigeria's coastal villages. Nigerian coastal communities are vulnerable to several natural disasters, including floods, storm surges, and increasing sea levels. In most coastal communities, there are no structural measures in place that are effective, such as dikes, seawalls, and breakwaters. Making the communities particularly susceptible to these risks, which have repeatedly had catastrophic effects on infrastructure, human life, and the environment. It is therefore imperative to develop and implement effective measures to mitigate the risks associated with these hazards. These systems would provide timely warnings of impending floods, storms, and other hazards, allowing communities to take adequate precautions to safeguard themselves and their property. EWS should be created and integrated into communities, rather than being a far-fetched concept and external technological impositions that are separated from a community's day-to-day activities and needs. EWS should be made relevant to everyday lifestyles and needs, while also acknowledging how different sectors within a community interact and trust specific information.

Protecting coastal towns from the effects of storm surges and sea level rise is the aim of these precautions. However, given the increasing intensity of meteorological occurrences and the rising levels of seas, these remedies might become insufficient and ineffective. Disaster Risk Reduction also heavily relies on non-structural solutions. These consist of public awareness campaigns, early warning systems simulations, community-based preparedness initiatives, and land-use planning rules. This can be accomplished by incorporating education, awareness, and continuous data collection into an EWS to ensure its contents become familiar, inscribed, and accepted by the communities.

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