

Exploring the Potential of Data and Emerging Technologies in Enhancing Humanitarian Crisis Responses in Nigeria

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ABSTRACT

Humanitarian crisis responses remain crucial for supporting communities affected by natural disasters, armed conflicts, and other crises. However, the absence of appropriate technology and the continuous apparent lack of accurate and up-to-date information, especially in developing countries, often hinder the effectiveness of these operations. Data and technology can play a vital role in addressing this issue by providing real-time information and enabling more efficient decision-making. Humanitarian crises, such as natural disasters, armed conflicts, and forced displacement, significantly impact people's lives worldwide, especially in Nigeria. Using data and emerging technologies can potentially enhance the effectiveness of humanitarian response efforts in the continent. As the availability and accessibility of data increase and considerable advances in technology become prominent, new opportunities for humanitarian organisations will continue to emerge for improvement in response efforts. Emerging technologies have the potential to improve humanitarian operations in Nigeria by facilitating communication, coordination, and data collection and analysis, reducing congestion in the supply chain, decreasing lead times, increasing transparency and accountability of material and financial resources, and facilitating innovation and sustainable development. Despite the opportunities for improvement, several challenges associated with data and technology require attention. This research explores how humanitarian actors leverage data and emerging technologies to improve the response to humanitarian crises, focusing on Nigeria.

Keywords: Humanitarian Crisis, Emerging Technologies, Data-Driven Decision-Making, Nigeria, Transparency and Accountability

INTRODUCTION

Humanitarian assistance operations remain crucial for providing aid to communities affected by natural disasters, armed conflicts, and other crises. When these operations are not deployed in a rapid and coordinated manner, they exacerbate pre-existing social threats to vulnerable populations, their well-being, and the overarching social stability of the environment where the crises occurred.

According to the European Commission (2022), through its Civil Protection and Humanitarian Aid Operations, the humanitarian needs in Africa are high and recurrent due to conflict, climate change, natural hazards, and socioeconomic challenges. In 2022 alone, over 114 million people in 15 African countries, most affected by crises, required urgent assistance. There are about 30 million internally displaced people (IDPs), refugees, and asylum seekers in Africa, with over 10.4 million children under 15. Protracted and inter-communal conflicts continue contributing to and exacerbating growing displacements, food insecurity, and limited access to vital social services in various parts of Africa (African Union, 2022). Interestingly, all the ten most under-reported humanitarian crises recorded in 2022 were in Africa (CARE, 2022).

The ongoing fighting in north-east Nigeria has resulted in a massive humanitarian and protection crisis, pushing millions of people into survival mode. In 2022, an estimated 8.4 million women, men, and children would require

humanitarian assistance (UN OCHA, 2022). Northeast Nigeria has remained a large-scale humanitarian and protection crisis for more than 13 years, affecting the lives, livelihoods, and well-being of millions of people in the region and across the border (IOM, 2023). According to CARE International's Nigeria Conflict and Humanitarian Crisis, brief, Heavy rains and flooding have continued to exacerbate Nigeria's food crisis further, adding to the already dire humanitarian situation caused by the decade-long conflict.

In the past, humanitarian responses have relied heavily on manual processes and conventional strategies, most of which have been adjudged as slow, inefficient, and limited in scope and effectiveness. With the rapid advancement of data-driven technologies and their increasing availability, there is a growing recognition among humanitarian actors of their potential to revolutionize humanitarian crisis responses, particularly in the context of Africa. Data is becoming increasingly crucial in humanitarian response across the humanitarian industry. Humanitarian actors collect information about everything from the gender or age of individual recipients of assistance to sensitive data about those at risk of or who have been harmed by conflict actors, as well as situational data designed to manage the security risks they face in implementing these programs (Larissa Fast 2022).

The immersion of data and emerging technologies into humanitarian responses provides a tremendous opportunity to address the multifaceted challenges faced during humanitarian crises. Hence, it is easy to see why data and digital technologies have become central to humanitarian operations. Many United Nations agencies, as well as several International Non-governmental Organizations and UN agencies, have included innovation laboratories and data departments into their operations. By default, refugee registrations require biometric data, which is outsourced to commercial companies who are part of the multimillion-dollar, fast developing biometric business. Large datasets are being used to assess needs and coordinate relief. Simultaneously, artificial intelligence (AI) is being investigated as a means of tracking displaced individuals and forecasting population migrations and future crises (Madianou, 2019). Geographic Information Systems (GIS) have been used to design and plan humanitarian missions, especially for frontier areas, and provide rapid mobilization and implementation of field teams, including real-time monitoring and evaluating of actions and activities. Unmanned Aerial Vehicles (UAVs), or drones, have often been used to record visual data generated from mapping and have been deployed to transport sensitive relief items into areas with challenging access routes.

When humanitarian actors leverage these technologies, operations are then designed to generate more accurate needs assessments, enhance early warning systems, improve coordination among humanitarian actors and facilitate information sharing, optimize resource allocation, and empower affected communities to actively participate in the response and recovery of their own lives and communities.

Although several studies have explored the potential of data and emerging technologies in humanitarian contexts, there is a need for in-depth research with a specific focus on Africa, using Nigeria as an ideal case study. The cross-cutting challenges, which may not be unique, the opportunities, and contextual factors make the most populous country in Africa, Nigeria, an excellent case study for examining the sustainable approaches to the applicability of data and emerging technologies in humanitarian responses in Africa. This study identifies and analyses emerging technologies relevant to humanitarian operations and assesses their potential application in enhancing humanitarian response in Nigeria.

Nigeria is the most populous country in Africa, with a diverse and complex socio-cultural landscape. The population, estimated at 223.8 million people (UNFPA 2023), comprises over 250 ethnic groups, over 500 languages, various religions and diverse cultures, which creates a near-perfect context for a country with diverse humanitarian needs and vulnerabilities. This diversity presents distinctive challenges in understanding and addressing the potential specific needs of the various population segments during a humanitarian crisis.

Secondly, Nigeria has experienced and continues to experience persistent humanitarian crises, from conflicts to internal displacement, food insecurity, and the devastating effects of climate change, such as flooding et cetera. The country has faced protracted conflicts, especially in the Northeast, where the Boko Haram insurgency has resulted in widespread displacement and severe humanitarian needs. The violence in north-east Nigeria has been fueled by a decade-long insurgency by non-state armed groups (NSAGs), resulting in one of the world's most

severe humanitarian disasters. Millions of people have been uprooted because of the attacks and insecurity, which have wrecked agricultural productivity and other livelihoods, cut off basic services, and generated a protection crisis. There will be no quick resolution to the complicated issue (Reliefweb, 2022). These crises have put immense strain on existing response mechanisms and underscore the need for innovative approaches to enhance effectiveness, coordination, and scalability of humanitarian actions.

Another reason revolves around the advancements in information and communication technologies (ICTs) and their increasing accessibility within Nigeria. Nigeria has a growing mobile phone penetration rate, with over 85% of the population accessing mobile devices (GSMA Intelligence, 2021). This widespread mobile connectivity provides a unique opportunity for leveraging emerging technologies and data-driven solutions to enhance humanitarian crisis responses. It is, therefore, possible to illuminate the potential feasibility, challenges, and opportunities associated with the immersion of data and emerging technologies in humanitarian responses across Africa by simply studying the implementation of similar initiatives in Nigeria.

Additionally, Nigeria has a perfectly diverse development land space in terms of infrastructure, covering urban and semi-urban areas, rural communities, and remote areas. The diversity presents varying challenges regarding accessibility, communication, and resource allocation during humanitarian crises. Investigating the potential of data and emerging technologies in Nigeria can provide insights into addressing the specific challenges posed by diverse geographical contexts, such as improving remote data collection, optimizing resource distribution, and facilitating communication and coordination across regions.

The distinctive characteristics of Nigeria, some of which are mentioned above, make it an ideal case study to explore the potential of data and emerging technologies in enhancing humanitarian crisis responses in Africa. By investigating the Nigerian context, this research can contribute valuable insights into the applicability, effectiveness, and scalability of data-driven and technologically enhanced approaches while considering Nigeria's diverse socio-cultural, geographic, and technological landscape. This thesis's key findings and recommendations can inform policymakers and humanitarian organizations in Nigeria and other countries in Africa, thereby facilitating the development and implementation of contextually relevant solutions to address humanitarian crises effectively.

From the above problem the following research questions guided the study What are the emerging technologies around humanitarian operations and their application to the humanitarian response in Nigeria? To what extent has data and technology (a) improved understanding and (b) been effectively utilized in humanitarian assistance (especially aid delivery) in communities affected by the Crisis in Nigeria? What are the challenges of using data and technology in humanitarian crisis response in Nigeria? What are the sustainable approaches to the application of data and emerging technologies in humanitarian crises in Nigeria?

CONCEPTUAL REVIEW AND FRAMEWORK

Data

Numerous data definitions exist, reflecting the diverse perspectives of scholars and writers with a vested interest in the subject matter. Despite the lack of a universally accepted definition, certain shared perspectives among individuals regarding the term exist. Data is any piece, pieces or sets of facts, figures, or information existing in one or more forms, and stored in any format or place, that can be useful for a specific purpose, either in the form of an analysis or a survey.

Data, according to the American Society of Mechanical Engineers (2003), is information given in a format appropriate for communication, interpretation, or processing by humans or computers. According to this concept, when developing data, the components must be presentable in a way that is beneficial for computers or humans. Sabina Leonelli (2016), on the other hand, sees data as communication tools whose primary mission is to promote intellectual and material exchanges among individuals, collectives, cultures, governments, and other entities that find it helpful. The underlying assumption is that data are sources of knowledge rather than knowledge itself. Sabina went on to say that data do not have truth-value in and of themselves, nor can they be viewed as simple representations of any event; rather, they are basic outputs generated from study at precise

points in time to provide evidence for claims of knowledge in a researcher's field of interest. Sabina concludes, "data thus consist of a specific way of expressing and presenting information, which is produced or incorporated in research practices in order to be available as a source of evidence, and whose behaviour and scientific significance vary depending on the context in which it is used."

For Vangie Beal (1996), the basic consideration in the definition of data should be the forms in which they exist. Vangie Beal (1996) defines data as "numbers or text recorded on paper, bits or bytes stored in electronic memory, or facts living in a person's mind." From measurements and observations generated in research labs to information on weather, temperature, population densities and growth, behavioural patterns, economic and social indices, et cetera, humans generate and collect data every minute in various forms, shapes, and sizes.

As summarized by Boyd (2022) in the article on Data as assemblage, several other authors have identified data differently: "Data as gifts, mathematical premises, evidence, and digital bits are among the nine historical and contemporary meanings of data identified by Furner (2016)." Kitchin (2014) lists many types of data, such as quantitative and qualitative data, structured, semi-structured, and unstructured data, collected, exhausted, transient, and derived data, and primary, secondary, and tertiary data (pp. 4-8). Physical samples (Devaraju et al., 2017), capta (Drucker, 2011), documents, metadata, Big Data (Kitchin & McArdle, 2016), or information on features of units of analysis (Hjrlund, 2018) are all examples of data. Lenonelli (2015) defines research data as relational and portable; it may be aggregated into datasets or databases and shared in repositories. In the real world, data has an unstable relationship with information, knowledge, and wisdom (Buckland, 1991; Frické, 2008) and may be viewed as lacking regularity (Floridi, 2010, p. 23). Data can be viewed as a when rather than a what because it is neither impartial nor raw (Borgman, 2015, p. 26; Gitelman, 2013). Alternatively, it may act as a rhetorical gesture toward anything presented prior to an argument (Rosenburg, 2013, p. 36)."

Data usage and collection in various fields of human endeavours are not new, however, the way data is gathered or collected and deployed has evolved over time. According to Rudat (2020), tally or tick marks were the first forms of early data and were collected to help record or track food inventories for ancient civilizations, after which came the invention of the abacus to help with calculations. The need to tabulate census data motivated Herman Hollerith in the 1800s to develop the Hollerith Tabulating Machine. Hence, the evolution of data collection, analysis and storage was hugely informed by the discovery of new forms of data and their uses. However, Sarah El Shatby (2022) gives a different chronological description of events, stating that the first evidence of data collection is found in the Ishango bone from 19,000 BC, which is followed by John Graunt's introduction of the concept of data analysis in 1663, then came Herman Hollerith with the Hollerith Tabulating Machine used the US census of 1890, which is followed by Fritz Pfeumer 1900s' invention of the magnetic tape that brought about floppy disks and hard disk drives, before Sir Tim Berners Lee invented the World Wide Web (WWW) in 1989. For Sarah El Shatby (2022), the evolution of data collection was hugely influenced by storage needs. Today, data is collected with the aid of technology using surveys, interviews, observations, physiological evaluations, basic reviews of records already existing, social media and cognitive technologies, which are products of the field of artificial intelligence and linked to the concept of Big Data.

As defined by Botelho and Bigelow (2022), Big data is a collection of structured (transactions and financial records), semi-structured (text, documents, and multimedia files), and unstructured data collected by organizations that can be mined for information and used in machine learning projects, predictive modeling, and other advanced analytics applications. According to the Independent European Working Party on the Protection of Privacy and Personal Data, big data refers to the massive amounts of digital data controlled by companies, governments, and other large organizations that are subjected to extensive analysis based on the use of algorithms. Miguel Luengo-Oroz (2016), Chief Data Scientist at United Nations Global Pulse, defined big data as the staggering amount of information generated as a byproduct of our increasing digitization of our lives - our use of mobile phones, social networks, search engines, online payment methods, apps, and so on.

However, in the early 21st century, Laney (2001) described big data using three characteristics: large volumes, a wide variety of data types, and the velocity of generation, collection, and processing. These were collected, known as the three V's. Since then, the characterization of big data has expanded rapidly to the six V's, which

include volume, variety, veracity, value, and variability. Botelho and Bigelow (2022) summarized these as follows:

Volume is the amount of data collected from various sources. The variety of data kinds (structured, semi-structured, and unstructured); Velocity is the rate at which big data is generated. The degree to which large data can be relied on; Value - the monetary worth of the data collected; and Variability refers to the various ways in which big data can be used and structured.

Among researchers, it is widely acknowledged that big data has become a quintessential asset held by enterprises and that almost every large organization has made or is making investments in big data initiatives (Pratt, 2022). The question is, why? A 2021 survey developed and administered by New Vantage Partners shared valuable insights into the why. Findings from the survey (NVP 2021) revealed that of the 99% of the senior C-level executives at Fortune 1000 companies who confirmed that they were pursuing a big data program, 96% reported that they had had success with their companies' big data and artificial intelligence (AI) programs. A further 92% confirmed the accelerated pace of their investments, while 81% were super positive and optimistic about the future of their organization's big data and AI programs.

Emerging Technologies

Although the concept of emerging technology is still evolving, a couple of authors have explored the concept across several fields: from entrepreneurship to health and education to transportation and economics. According to the Emerging Information and Technology Association (EITA), Emerging Technologies are those technologies whose development or practical applications are largely unreached but are growing swiftly and coherently, having the potential to have a tremendous impact. While these technologies may be old or relatively new, they are generally seen as capable of altering the status quo (EITA 2023). Emerging technologies, as described by Cozzens et al. (2010), are early-stage technical advancements with tremendous potential that have yet to be demonstrated.

Stahl (2011) described emerging technologies in the European Commission-funded project Ethical Issues of Emerging ICT Applications (ETICA) as technologies that have the potential to gain social importance within the next 10 to 15 years. He opined that, by inference, these technologies are no longer in the early stages of development but have already progressed beyond the simply conceptual stage.

Previously, Boon and Moors (2008) defined emerging technologies as being in an early stage of development, implying that several aspects, such as the characteristics of the technology and its context of use, or the configuration of the actor-network and their related roles, are still uncertain and non-specific. According to Dolgui and Ivanov (2020), emerging technologies are a group of unproven or early-stage inventions with the potential for positive impact that can help redesign business and operations management dynamics.

Abdi et al. (2020), in the "Emerging Technologies with Potential Care and Support Applications for Older People, operationalized the concept of emerging technologies as technological developments that are novel and rapidly growing and have a potential socio-economic impact. According to Abdi et al. (2020), the ability of new technologies to provide investing entities with a shift in the status quo through exerting economic or social influence is a recurring feature among experts. Other criteria that academic academics generally agree on are growth or rise over time and freshness or newness. However, Daniele Rotolo et al. (2015) was the first to examine the latter, arguing that for a technology to be appropriately defined as emerging, it should include radical originality, relatively fast growth, coherence, and conspicuous influence.

Scholars such as Dubey et al. (2020), Ivanov (2021), and Queiroz & Fosso Wamba (2021) looked at emerging technologies in humanitarian responses from the lens of benefits. They opined those emerging technologies such as Big Data Analytics, Artificial Intelligence, Blockchain, Internet of Things (IoT), 3D printing, Virtual Reality and Digital Twins have the potential to reshape the relationships between operations and supply chain, minimizing costs while bringing more efficiency throughout the lifecycle of an operation. These scholars also agree that the interaction and integration between emerging technologies considerably improve response times and visibility in emergency situations, helping humanitarian organisations mitigate and help communities

recover from a crisis. However, based on COVID-19 experiences, Ivanov and Dolgui (2020a) stated that emerging technologies can play a critical role in the highly disruptive emergency presented by COVID-19, in which supply chains embrace new strategies for survivability and adaptability because they cannot survive using previous strategies. To gain insight into the food situation in the besieged city of Haditha, Saudi Arabia, for instance, the World Food Program (WFP) deployed mobile vulnerability analysis and mapping (mVAM). The information gathered indicated severe shortages and excessively high food prices in the city. Using this information, WFP was able to access the city and deliver enough food to sustain 15,000 people for a month (Morrow et al., 2016).

Humanitarian Crisis

A humanitarian Crisis refers to an event or series of events, natural or man-made, usually rapid and unique in nature, that causes great distress or puts the lives and well-being of several people or groups of people in danger, usually on an alarming scale. Several authors and organizations have attempted to discuss the concept of humanitarian crises in widely varied contexts. Jordan et al. (2021) described humanitarian crises as situations involving widespread human suffering resulting from complex political, economic, or social emergencies and natural hazards requiring large-scale aid provisions. Jordan et al. contextualized humanitarian crises under two types: complex emergencies and natural hazards, which are not comprehensive.

According to Malteser International, a humanitarian crisis typically refers to a situation in which one or more events threaten the population's long-term health and security by depriving it of access to necessities like water, food, shelter, medical care, and education (Malteser International, 2023b). Malteser International went further to operationalize the concept of humanitarian Crisis into three types: Man-made Crises, including armed conflicts, nuclear disasters, train or plane crashes, et cetera; Disasters associated with natural hazards such as earthquakes, floods, droughts, hurricanes, epidemics et, cetera; and Complex emergencies which covers oppressive political systems, extreme poverty issues, dilapidated economic and social systems, lack of access to food and water among others. This definition appears to encompass several sources of events that could evolve into a crisis. In terms of types, the Humanitarian Coalition (n.d.) defined a humanitarian crisis as "an event or series of events that represents a critical threat to the health, safety, security, or well-being of a community or other large group of people, usually over a wide area." In addition, Kohrt et al. (2019) defined humanitarian crises as man-made disasters such as armed conflict, forced displacement, and refugee crises; natural disasters such as floods, hurricanes, earthquakes, and droughts; and severe infectious disease epidemics.

In the context of emergencies, the International Committee of the Red Cross (ICRC 2020) defined humanitarian crises as "an event or series of events (arising from armed conflicts or natural disasters) that poses a critical threat to the health, safety, security, or well-being of a community or other large group of people, usually over a wide area" (ICRC 2020). This definition also aligns with Jordan et al. (2021) in the context of types. However, Josse and Dubois (2009) described humanitarian crises using a set of criteria, some of which several authors agree with by their individual definitions. For an event or series of events to be described as a humanitarian crisis, Josse and Dubois 2009 proposed the following criteria:

- The situation is rapid and seriously deteriorating; numerous victims or people are in danger.
- The unique nature and the extent of the Crisis plunge the population into a situation of great distress; there is substantial material destruction; and
- There is evidence that the existing Institutional management in place is undergoing great difficulty or is incapable of managing the situation.

According to Dijkzeul and Griesinger (2020), all definitions of "humanitarian crisis" eventually incorporate the following elements: (a) a population's immediate and unmet morbidity and mortality demands, as well as the pain connected with them; (b) an inability to totally or partially alleviate the suffering of those impacted, resulting in (c) an urgent need for external life-saving support.

According to the United Nations Office for Disaster Risk Reduction (UNISDR), a humanitarian crisis is also described as a humanitarian emergency, which is any disaster, natural or human-made, that requires international

support (humanitarian assistance) to meet the basic needs of the affected population (UNISDR, 2009). For UNISDR (2009), disasters are common and have become part and parcel of the existence of humanity; but a disaster situation requires international support to meet the basic needs of a population, including food, water, shelter, protection, and other life-sustaining measures, it is a humanitarian emergency. The UNISDR defines disaster as a serious disruption in the functioning of a society, resulting in widespread human, material, or environmental losses that exceed the affected society's ability to cope using its own resources. The scale of impact of a humanitarian crisis, a disaster that requires international support, depends on the event's nature and how vulnerable and prepared the affected country is. When a country is prone to disasters, they are often highly vulnerable, which may be due to or exacerbated by a lack of resources, lack of preparedness, or both.

People's vulnerability to crises is determined not only by where they live (countries located on unstable tectonic plates are more likely to experience frequent earthquakes), but also by how they live; poverty, inequality, population growth, urbanization, and climate change can all reduce people's resilience and make them more vulnerable to shocks. Most humanitarian crises are caused by the interaction of natural disasters, armed conflict, and human vulnerability (Global Humanitarian Overview 2019 [EN/AR/ES/FR/ZH] - World, 2018). The UN Sendai Framework for catastrophe Risk Reduction (UNISDR, 2015b) encourages science and policy to produce rigorous knowledge of catastrophe risk and its consequences, as well as appropriate preventative actions. The INFORM Risk Index is a worldwide indicator-based disaster risk assessment tool that incorporates indications of hazards, exposure, vulnerability, and lack of coping capability (Marzi et al., 2021). The INFORM framework includes i) Hazards and Exposure - events that could occur and exposure to them; ii) Vulnerability - the susceptibility of communities to those hazards; and iii) Lack of Coping Capacity - a lack of resources available to alleviate their impact (Cardona and Carreo, 2011, Marin-Ferrer et al., 2017, Oppenheimer et al., 2014, Wisner et al.

Review of the Humanitarian Crisis in Nigeria

Scholarly work around the Humanitarian Crisis in Nigeria, as a holistic concept, is very limited. Authors have engaged the topic based on some of the events associated with the types of humanitarian Crisis described by Malteser International, 2023b; Humanitarian Coalition, n.d; Kohrt et al., 2019, et cetera. Nigeria, the most populated country in Africa, has experienced several humanitarian crises, such as prolonged armed conflicts, massive flooding, epidemics, extreme poverty issues, oppressive political systems, dilapidated economic and social systems, forced displacements, refugee crises, et cetera. The humanitarian Crisis in Nigeria has its roots in a combination of factors, including armed conflicts, socio-economic disparities, and environmental challenges.

The Nigerian Biafran War, also known as the Nigerian Civil War, lasted from July 6, 1967, to January 13, 1970, and was a political-ethnic military war precipitated by the attempted secession of the south-eastern Nigerian provinces, which were largely Igbo-populated (Unesco, n.d.). When photographs from the conflict were broadcast throughout the world, international public opinion was disturbed, and the critical need for humanitarian help was revealed. It is estimated that between 500,000 and 2,000,000 people died, the majority of whom died because of famine (Unesco, n.d.-b). Over three years, up to three million people were killed, with another three million displaced, a demographic shift that is still visible in Nigeria today; the war's scale and legacy would shape postcolonial conflicts in Africa for decades to come; it would set a precedent for international diplomacy and emerging independence movements.

The Boko Haram Insurgency in Northeast Nigeria, which began in 2009, has remained one of Nigeria's most devastating humanitarian crises in recent times. It remains a major catalyst for the violence and insecurity in Nigeria's northeastern states, resulting in large-scales displacement of communities, food and economic crises, destruction of infrastructure and fostering extreme poverty for millions of families. Human Rights Watch (2014) stated that between 2009 and 2014, the Boko Haram insurgency led to tremendous human casualties and thousands of deaths, which turned women and children into widows and orphans, respectively, mostly in the BAY (Borno, Yobe and Adamawa) states. Between 2013 and 2014, over 4000 human lives were lost to the crisis; before then, between 2009 to 2013, 64 terror attacks were recorded in Northeast Nigeria, ranging from armed attacks, bombing and explosions, mass murders, and abductions (Nigerian Security Tracker, 2014).

Almost a decade after the heinous kidnap of 276 girl students from a secondary school in Chibok by the Boko Haram terrorists, 98 of those girls are still being held captive by the group (Amnesty International, 2023).

This violent conflict has resulted in the proliferation of other violent groups, including the Islamic State - West Africa Province (ISWAP), and has taken a staggering toll on the civilian population in the northeast Nigerian states of Borno, Yobe, and Adamawa (International Crisis Group 2020). An estimated 27,000 people have been killed, with an additional 2 million internally displaced (International Crisis Group 2020b). The United Nations Office for the Coordination of Humanitarian Affairs (OCHA) estimates that over 8 million people in the region would require humanitarian assistance by 2020. However, while speaking in Geneva, the United Nations Humanitarian Coordinator in Nigeria, Matthias Schmale, revealed that the estimated number of people in need of humanitarian assistance increased by 500,000 to 6 million from 2021, and the number of people facing severe hunger increased to 4.3 million, with more than half a million on the verge of famine. He also noted that the number of children under the age of five (5) at danger of life-threatening severe acute malnutrition has quadrupled from 2021 to 700,000 in 2022 (Schlein, 2023).

Flooding is the outpouring or overflowing of water, usually through rainfall which covers dry space and causes devastations of the socioeconomic activities of the people; it is experienced every year in many areas across Nigeria. It occurs during periods of heavy rainfall and is caused, in part, by inadequate drainage systems. Flash floods, which are thought to be the deadliest weather-related hazards, are becoming more common in Nigeria (Ongoma & Dike, 2023). According to the Nigeria Hydrological Services Agency (2020), Nigeria has experienced two catastrophic flooding disasters over the last half century: the flooding of 2012 and 2018. Following several days of heavy rainfall across Nigeria, the Lagdo Dam, used for irrigation and electricity generation, released its excess water, causing Nigeria to experience its worst flooding in more than 40 years in 2012. The disaster affected 32 states across Nigeria, 24 of which were severely affected, and the floods occurred from July to October that year, affecting more than 7 million people and causing more than 2 million others to become internally displaced persons (IDPs). Over 5000 people and 5,900 houses were physically injured and destroyed, respectively (Umar & Gray, 2022). According to the National Emergency Management Agency, NEMA (2013), Nigeria incurred approximately N2.6 trillion in losses as a result of the 2012 flood disaster, which prompted the 2012 National Flood Recovery Action Plan as well as a National Disaster Recovery Strategy and Framework.

Following the review conducted on the works of several scholars including Edwards et al. (2023), Dennehy et al. (2021), Martin and Painho (2019), Eghe-Ikhuhe and Bonsu-Assibey (2022), Yoo et al. (2016), McCosker et al. (2020), Talabi et al. (2022), Fayehun et al. (2023), and Ashiru et al. (2022), it can be observed that the study conducted by Edwards et al. (2023) examined the use of delivery drones for humanitarian operations, by analysing adoption barriers among logistics service providers using a model based on a perspective of technology acceptance, but with focus on China. The study conducted by Dennehy et al. (2021) explored the role of big data analytics on supply chain resilience in mindful humanitarian aid organizations and found that organizational mindfulness was critical to enabling resilient humanitarian relief supply chains. According to the study by Martin and Painho (2019), humanitarian organizations, through their information management officers, adapted their working practices and used alternative data sources, online mapping, and remote sensing to influence decision-making in the early stages of a humanitarian crisis.

METHODOLOGY

This research adopts a qualitative methodology to explore the potential of data and emerging technologies in enhancing humanitarian crisis responses in Nigeria. Qualitative research, as defined by Tenny et al. (2022), seeks to provide an in-depth understanding of participants' experiences, perceptions, and behaviours, focusing on the "hows" and "whys" rather than quantifiable measures. This approach is particularly suited for examining the nuanced dynamics between potential of data and emerging technologies in enhancing humanitarian crisis responses in Nigeria.

A purposive sampling technique was used to select participants based on their expertise and involvement in the potential of data and emerging technologies in enhancing humanitarian crisis responses. The sample size was

determined by data saturation, ensuring comprehensive insights without redundancy. Data was analysed using thematic analysis, as outlined by Grey et al. (2022). Transcripts from interviews will be manually coded to identify recurring themes such as transparency, accountability, and collaboration, which will then be linked to broader theoretical frameworks on governance and security.

Ethical considerations are central to this study. Informed consent was obtained from all participants, ensuring they understand the purpose and scope of the research. Confidentiality will be maintained, and data will be anonymized during reporting. Additionally, care will be taken to avoid biases in interpreting findings, ensuring that the study provides credible and actionable insights into fostering effective civil-military partnerships in addressing climate justice.

RESULTS

In this section, the researcher analysed some of the questions that were fundamental to the achievement of the objectives of this study. The analysis was based on the respondents' responses to each of these questions as provided for the key informant interviews conducted.

Table 1: Distribution of Respondents by Cadre

Occupation	Frequency	Percentage (%)
Project Manager/Coordinator Cadre	10	66.6
Project Officer Cadre	5	33.3
Total	15	100

Source: Key Informant Interview July 2023

Table 1 reveals the respondents' cadre in their organizations; 10 respondents, representing 66.6%, were in the project manager or coordinator cadre, while the project officers' cadre was 5, representing 33.3%. This shows that the study approached very key informants in the areas related to this study, and the majority being at the project manager/coordinator cadre shows how in-depth their response provided was, as they are the key component in the delivery of humanitarian aid during crises.

Table 2: Distribution of Respondents by Highest Level of Educational Qualifications

Educational Qualifications	Frequency	Percentage (%)
NCE	0	0.0
Bachelor's degree	3	20.0
Master's degree	8	53.3
Doctorate Degree	4	26.7
Total	15	100

Source: Key Informant Interview July 2023.

Table 2 Shows responses derived from the level of educational qualification of the respondents. Therefore, three respondents, representing 20.0%, had a Nigerian Certificate of Education (NCE), eight respondents, representing 53.3%, had a bachelor's degree, while 4 respondents, representing 26.7%, had a doctorate. Therefore, with most of the respondents at the level of master's and doctorate, this measure the nature of the in-depth responses that

were provided. In that these respondents have high educational levels; they were able to provide intellectual and in-depth reviews as they related to the objectives of the study. They were also able to properly understand the nature and the use of data and technology as it relates to humanitarian crises in Nigeria.

Description of organization's activities regarding crises in Nigeria and humanitarian crises actively engaged in by Organizations.

Several respondents opined that the activities of UN agencies in Nigeria whose mandate aligns with humanitarian issues are coordinated by the UN Resident Coordinator Office (RCO), with several on-ground engagements being led by the United Nations Office for the Coordination of Humanitarian Affairs (UNOCHA). UNOCHA has been actively involved in coordinating and facilitating humanitarian activities to address the crises associated with the activities of Boko haram insurgency in Northeast Nigeria, particularly in the states of Borno, Adamawa, and Yobe (collectively known as the BAY states). This crisis, whose repercussions have been far-reaching, impacting millions and extending their suffering, has wrought havoc upon the region's civilian infrastructure and livelihoods, leaving a considerable segment of the population reliant on humanitarian aid and in dire need to access essential services.

The international humanitarian response in the BAY states, initiated in 2014 at the request of the Nigerian government in response to a non-international armed conflict, has sought to mitigate these profound challenges. The ongoing turmoil has compounded the vulnerabilities of at-risk individuals, exacerbating their plight due to the dual challenges posed by climate change-induced food security disruptions, malnutrition, and disease outbreaks. The activities of UNOCHA in the northeast include the following:

- **Coordination and Leadership:** UNOCHA is central in coordinating and facilitating the humanitarian response efforts of various UN agencies, international organizations, non-governmental organizations (NGOs), and government entities. It ensures that humanitarian assistance is well-coordinated, avoiding duplication of efforts and maximizing the impact of interventions.
- **Needs Assessment and Analysis:** UNOCHA supports collecting, analysing, and disseminating data related to the region's humanitarian needs. Through assessments and analysis, it helps identify priority areas for assistance, including food, health, water, shelter, and protection.
- **Humanitarian Response Planning:** UNOCHA assists in developing comprehensive humanitarian response plans that outline the strategies and activities required to address the needs of affected populations. These plans guide the allocation of resources and inform the actions of various humanitarian actors.
- **Advocacy and Resource Mobilization:** UNOCHA advocates for increased international attention and support for the crises in Northeast Nigeria. It engages with governments, meet the urgent needs of affected populations.
- **Information Management:** UNOCHA provides platforms and tools for information sharing among humanitarian actors, including maintaining databases, maps, and other resources that facilitate decision-making and coordination.
- **Logistics and Access Support:** UNOCHA helps address logistical challenges and access constraints that often arise in crises. It works to ensure that humanitarian organizations have the necessary access to affected areas to deliver assistance.
- **Protection and Advocacy for Vulnerable Groups:** UNOCHA places a strong emphasis on protecting the rights and well-being of vulnerable populations, including women, children, internally displaced persons (IDPs), and refugees. It advocates for their needs and ensures that protection concerns are integrated into humanitarian activities.
- **Supporting Local Capacities:** UNOCHA works to strengthen the capacity of local governments, NGOs, and community-based organizations to lead and coordinate humanitarian response efforts.

For some respondents, humanitarian actions around pandemics, such as Ebola, COVID-19, yellow fever, et cetera, have been tackled through public-private partnership (PPP) arrangements, which would describe the engagement of their institutions or organizations in humanitarian crises. While these humanitarian actions are medium to longer term and funded by multilateral institutions like the world bank, others have a shorter period and were funded by either ((i) private donors such as the Private Sector Coalition Against COVID-19, mostly called CACOVID; (ii) federal government institutions like the Central Bank of Nigeria (CBN); or (iii) a combination of both.

40% of the respondents described the engagement of their organizations as focusing on addressing complex emergencies such as extreme poverty issues, economic and social systems challenges, access to food and water, flooding and climate change challenges, preservation of human dignity, et cetera. The multifaceted engagements of several international and national non-governmental organizations also fit into the description of actions addressing complex emergencies. Some of the programmes mentioned revolve around health, WASH (water, sanitation, and hygiene), Food security and livelihoods (FSL), protection and shelter, especially for Internally Displaced Persons (IDPs).

Two respondents described their operations as support of humanitarian operations via data and technology. These engagements have prioritized data collection using mobile technological tools such as Kobo Toolbox, MagPi, Survey CTO, Fulcrum, ArcGIS, et cetera, and data analytics to inform the humanitarian projects of multilateral institutions like the African Development Bank (AFDB), the World Bank among others, on flooding, extreme poverty alleviation and livelihoods.

Data and emerging technologies are being adopted by organizations during humanitarian operations.

According to feedback from several respondents, some of the data collection and emerging technology tools that their organizations have employed to enhance their humanitarian operations are Geographic Information Systems (GIS), Remote Sensing and Satellite Imagery, Big Data and Analytics, and Artificial Intelligence (AI). Others are Data collection tools such as Kobo Toolbox, MagPi, Survey CTO, Fulcrum, ArcGIS, INFORM and COSPAS-SARSAT. Some of the Data visualization tools mentioned are Microsoft Power BI, Tableau, Google Charts, Microsoft Excel, and Visually. Others are mobile phone technologies, chatbots, Interactive Voice Response (IVR) and dedicated SMS emergency lines, usually in partnership with mobile network service providers.

Two respondents, majorly afflicted with public-private-partnership (PPP) engagements, mentioned the use of Unmanned Aerial vehicles to deliver vaccines in the aftermath of the COVID-19 pandemic. However, they cited limited operations. Some respondents mentioned that their engagements have involved the use of digital cash transfers, biometrics, social media, mobile technologies and chatbots.

Application of data and technological tools by organizations in humanitarian crises.

One hundred per cent of the respondents stated that their humanitarian organization utilize data analytics and visualization tools to make informed decisions. By analysing the vast amounts of data from various sources, including satellite imagery, displacement needs assessments, response and deep field inputs, humanitarian actors have been able to identify trends, predict needs, and allocate resources more effectively, thereby resulting in better preparedness and response.

Respondents also stated that the use of the Geographic Information Systems (GIS) technology has critically optimized disaster response and recovery. Several organizations use GIS to map affected areas, assess risks, and plan evacuation routes. The GIS tool has also been adopted for spatial analysis, hence helping humanitarian actors understand the geographic distribution of affected populations, infrastructure, and resources.

To ensure that the affected populations participate actively in their own recovery, respondents stated that data collection tools have been used to support and empower them. Tools such as Kobo Toolbox and MagPi, among others, have provided a platform for individuals, especially those in dire need of humanitarian assistance, to report their needs, share information, and communicate with aid providers. The developed interactive dashboards

and maps have been used to visually represent complex data, hence making it easier for decision-makers to understand and communicate information. They have also supported facilitating coordination among humanitarian agencies, government bodies, and other stakeholders, thereby strengthening advocacy and donor strategies.

Some respondents mentioned the importance of the COSPAS-SARSAT (Search and Rescue Satellite-aided Tracking) system during major disasters associated with flooding. Social media was also used to fast-track information dissemination during the COVID-19 pandemic and also during major flooding, where it is utilized for search and rescue operations. Drones, also known as Unmanned Aerial Vehicles, have been used to deliver vaccines and other essential medical products to several communities that are difficult to access, especially in Kaduna. Drones have also been used to map communities in need, specifically the Makoko community, which was described as one of the largest slums in Africa, in dire need of shelter, water, sanitation and hygiene (WASH), and nutrition.

A few Respondents stated Biometrics have also been utilized, although sparingly, in the management of Internally Displaced Persons (IDPs) and the programmes targeted them. It has also been used in the northeast by several humanitarian organizations to facilitate cash transfer programs. Respondents also stated that, increasingly, they have used digital cash transfer systems to implement poverty alleviation interventions across communities in the northeast, although it is still not widely utilized in some communities in need. According to them, digital cash transfer systems removed the burden of travelling to communities to distribute cash monthly and provided the opportunity to remotely reload payment cards and monitor transactions, especially during the COVID-19 pandemic restrictions.

20% of the respondents stated that chatbots, Interactive Voice Response (IVR) and dedicated SMS emergency lines in collaboration with mobile service providers were very instruments for the gathering and dissemination of information, risk assessments and tracking of victims during the COVID-19 pandemic, and the 2022 flooding disaster.

Implementation of data and technology tools improved the understanding of humanitarian crises in affected communities.

All respondents, 100%, affirmed that the mainstreaming and implementation of data and emerging technologies tools drastically improved the understanding of humanitarian crises in affected communities. They also share that aside from the affected communities, the infusion of the data and emerging technologies positively influenced their work and the social impact of the initiatives and programs deployed by their humanitarian organizations.

Challenges encountered with the usage data and technology in humanitarian crisis response.

Several respondents stated that the core challenge revolved around accessing data from various stakeholders, often due to bureaucratic challenges that can impede the timely and effective delivery of assistance. They mentioned that the challenges arise due to varying organizational structures, data-sharing agreements, and legitimate concerns over data privacy, protection, and security. The absence of an up-to-date central database of all of Nigeria was also flagged as one of the impeding challenges to the immersion of data and emerging technologies into humanitarian operations in Nigeria.

Other respondents stated the absence of a lack of favourable regulatory frameworks to assist the rapid deployment of some emerging technologies such as unmanned aerial vehicles (UAVs) and artificial intelligence (AI). In particular, the cumbersome regulatory and licensing process associated with the quality of drone operations for any endeavour in Nigeria, as provided by the Nigerian Civil Aviation Regulations (NCARs), was flagged as one of the biggest challenges with the deployment of drones for humanitarian operations.

The seeming lack of political will among government officials, especially on the complete utilization of technological tools such as digital cash transfer systems like mobile money, et cetera, has facilitated corruption and lack of accountability across some government-led humanitarian programs. Hence, even where emerging

technological solutions exist, immersion has been very slow. However, some respondents also mentioned that since some of the programs target the poorest of the poor, in several communities without financial inclusion systems and the internet, it has become difficult to infuse technology into interventions, especially those led by the government.

Several respondents also mentioned the expensive nature of some emerging technological innovations and big data storage tools as some of the challenges encountered. As global funding for humanitarian operations continues to trail the required amount needed to address the increasingly complex humanitarian emergencies, several organizations are prioritizing the cheapest technological solutions, thereby abandoning critical but expensive technologically dependent programs.

However, for 30% of the respondents, the challenges encountered with using data and technology in humanitarian crisis response revolved around the risks associated with these technological innovations. Challenges associated with data protection and privacy were stated, especially in relation to sharing information with multiple actors working in the field, thereby encouraging non-compliance with the principles of humanitarian assistance. A respondent stated that during the COVID-19 pandemic, remote management of operations aided by technology was very high, which in turn encouraged the transfer of risks to the local actors and even victims, and in some cases, led to reduced quality of the programs implemented. This challenge resonates with the research of Joe Belliveau (2016) on opportunities and applications associated with Humanitarian access and technology. Another respondent from a local organization stated that these challenges associated with risks were anchored on government policies, specifically around national security. According to the respondent, the potential of terrorist organizations like the Islamic State's West Africa Province (ISWAP) to acquire and deploy UAVs for whatever reason has made getting government approvals for the utilization of UAVs more difficult.

Sustainable approaches to the application of data and emerging technologies in humanitarian crises

For 90% of the respondents, embracing and integrating sustainable approaches into the application of data and emerging technologies in humanitarian crises is essential to ensure long-term effectiveness, minimize negative impacts, and promote responsible innovation. Some of the sustainable approaches proposed are:

- **Local Capacity Building:** Some respondents encouraged a greater focus on building local capacity and expertise in utilizing data and emerging technologies. There was a call for the training of local communities, organizations, and governments to collect, analyse, and leverage data effectively for disaster preparedness, response, and recovery. There was also a suggestion for the increased empowerment of local actors, ensuring that sustainable solutions are tailored to the specific context and needs of each region.
- **Ethical Data Use:** Respondents also suggested a prioritization of ethical data collection, storage, and sharing practices, ensuring that data is collected with consent, anonymized when necessary, and protected to respect privacy rights. Transparent data-sharing agreements and mechanisms should be established to maintain accountability and prevent misuse of sensitive information.
- **Open-Source Solutions:** Respondents suggested the promotion of the use of open-source technologies and tools. Open-source platforms foster collaboration, innovation, and knowledge sharing. They allow different stakeholders to contribute, customize, and improve solutions, reducing dependence on proprietary systems and enhancing sustainability.
- **Community Engagement:** There was also a recurring call to involve affected communities in decision-making processes related to data and technology interventions. Respondents suggested a robust engagement of local knowledge, and they emphasized that collaborative approaches help ensure that solutions are contextually relevant, with a higher likelihood of being sustained over time.
- **Partnerships and Collaboration:** Some respondents suggested a stronger drive towards fostering partnerships between humanitarian organizations, governments, academia, the private sector, and local

communities. These collaborative efforts would help to harness diverse expertise, resources, and perspectives, leading to more comprehensive and sustainable solutions.

- **Resilience and Adaptation:** As flexibility and resilience remain crucial in ensuring that solutions remain effective even as crises and environments shift over time, respondents suggested the design of technologies and interventions that are adaptable to changing conditions and evolving needs.
- **Education and Digital Literacy:** Respondents suggested huge investments in education and digital literacy programs to ensure that communities can effectively use and benefit from data and technology tools. Empowering individuals with the skills to navigate digital platforms and interpret information helps create a sustainable user base.
- **Feedback Mechanisms:** Respondents also suggested the establishment of mechanisms for continuous feedback and evaluation from beneficiaries and stakeholders. Regular assessments provide insights into the effectiveness and impact of data and technology interventions, enabling adjustments and improvements.

DISCUSSION OF FINDINGS

According to the research findings, the operations of humanitarian organizations in Nigeria fit perfectly into the operationalization of the types of humanitarian crises that Malteser International (2023) talked about. The humanitarian crisis in northeast, which is a consequence of the over-a-decade-long Boko haram armed conflict, fits perfectly in the description of man-made crises and has evolved into a complex humanitarian emergency. The humanitarian crisis associated with the 2012 and 2022 major flooding, the human sufferings of Ebola and the impact of the COVID-19 pandemic align with the description of disasters associated with natural hazards on one hand but also complex emergencies on another, depending on the lens they are viewed from. The humanitarian operations around health, WASH (water, sanitation, and hygiene), Food security and livelihoods (FSL), protection and shelter, especially for Internally Displaced Persons (IDPs), are perfect examples of humanitarian actions addressing complex emergencies. Hence, the engagements of humanitarian organizations in Nigeria are addressing all types of humanitarian crises as described by several authors including Malteser International (2023), Kohrt et al. (2019) et cetera.

The research findings also showed that data and emerging technologies are adopted by humanitarian organizations in Nigeria, for numerous humanitarian crisis responses. Some of the data emerging technologies adopted are big data, Geographic Information Systems (GIS), Remote Sensing, Digital Cash Transfers, Biometrics and Digital Identity, Mobile technologies and chatbots, Drones or Unmanned Aerial Vehicles (UAVs), mobile technology, social media, and Interactive Voice Response (IVR). Data collection tools tools such as Kobo Toolbox, MagPi, Survey CTO, Fulcrum, ArcGIS among others were also utilized for humanitarian crisis responses in Nigeria.

This discovery is consistent with the findings of other scholarly studies, including Dubey et al. (2020), Ivanov (2021), Queiroz & Fosso Wamba (2021), Ivanov and Dolgui (2020a), and others. Indeed, as stated by the European Parliamentary Research Service (EPRS), the accessibility and use of mobile phones and social media platforms by those affected by to detect crises, biometric identification to facilitate support, and a shift to digital payments as relief provisions with e-vouchers and mobile money are fundamentally changing humanitarian actions. The findings of the study also show that data are an important part of humanitarian crisis responses and can be used in a variety of ways, such as acquiring real-time information about people's needs, interacting with communities, and developing situational awareness through mapping (AIDF, 2016). This discovery is not novel; for example, the World Food Programme (WFP) used mobile Vulnerability Analysis and Mapping (mVAM) to acquire a better knowledge of the food situation in Haditha, which is under siege. The information gathered suggested that food costs in the city were unusually high and that there were food shortages. WFP was able to use this data to contact and enter the city, feeding 15,000 people for a month (Morrow et al., 2016).

Research findings also revealed that the mainstreaming, utilization or implementation of data and emerging technology initiatives or tools, improved the work of humanitarian organizations, by enhancing their

understanding of the humanitarian crises across several communities in need in Nigeria. Hence, among humanitarian organizations, technology is seen as both a tool for the existing humanitarian environment and a revolutionary tool to change the underlying principles of humanitarian action (Sandvik, Jumbert, Karlsrud and Kaufmann, 2014). While there are numerous potentials and positive impacts of the use of data and emerging technologies in humanitarian crises responses in Nigeria, several challenges continue to impede its usage. There are challenges associated with government regulatory frameworks and national security implications especially around the deployment of AI and drones, access to data and sharing of data, between government parastatals and humanitarian organizations.

The research of Haruna (2022) and Dass (2023) supports the research finding on the national security implications of drone usage in humanitarian crises responses within active war situations, as they both presented evidence of the development and utilization of drones by ISWAP in Gubio town, northwest of Maiduguri, Borno state, which led to huge casualties on the side of the government anti-terrorist forces. There are also challenges that arises from the frequent disconnection between available data, the decisions made from them, and the responses they inform. If the right data is not readily collected, analysed, and made available, the evidence needed for calculated and informed decisions as well as the accompanying humanitarian crises responses, will not be available rapidly enough to generate intended positive outcome. Raymond and AI Achkar (2016) also agree with the above opinion.

The possibility of risk transfer to local actors and contractors and the outcome of programs with reduced quality is also a valid challenge and resonates with the research of Joe Belliveau (2016) on opportunities and applications associated with Humanitarian access and technology. Another challenge is the huge divide around internet penetration, and poor digital literacy and technological knowledge within communities in need. If victims are unable to use digital tools, it could hinder the effectiveness of their participation and buy-in into humanitarian operations that are completed dependent on emerging technologies, hence potentially abusing their right to human dignity. Without internet access, there is a greater chance that vulnerable groups will lag in the digital society (UN, 2018), thus disrespecting the principle of Do No Harm, and Leave No One Behind. One of the most important challenges is the genuine concerns around data privacy and protection, as well as informed consent.

The International Committee of the Red Cross (ICRC, 2020) captures this concern succinctly by saying that “humanitarian effectiveness through new technology requires standards of control over data, data integrity and data availability”. Human Rights Watch's report on UNHCR's gathering of biometric data on Rohingya refugees is an example of where this concern played out (Human Rights Watch, 2021). UNHCR acquired biometric data from Rohingya refugees in Bangladesh, advising them that this was a need for receiving aid. The UNHCR provided the biometric data with the host government of Bangladesh, who then shared it with the government of Myanmar - the same government from which the refugees were fleeing. This endangers the lives of refugees and their families who may still be in the nation (Rahman, 2017, 2021; Hodal, 2021). Even if UNHCR did everything correctly, they ended up betraying the victims' confidence and possibly putting them in danger.

Indeed, the immersion of data and emerging technologies into humanitarian crises responses are essential for effective long-term strategies, and the sustainability of the positive impacts of aid delivery. According to UNOCHA (2019) and EPRS (2019), the major forces pushing innovation in humanitarian aid include technical advancements, the demand for new economic models, private sector engagement, and partnerships. Therefore, to ensure sustainability, humanitarian organization needs to build the capacities of local communities and actors, foster the engagement of communities in need, encourage and actively promote collaboration and partnership, but equivocally ensure the ethical use, storage and handling of data generated during the humanitarian crisis's responses in Nigeria.

CONCLUSION AND RECOMMENDATIONS

This research aimed to explore the potential of data and emerging technologies when immersed into responses of humanitarian crises, by humanitarian organizations in Nigeria. The central questions for this research were: to identify and analyse emerging technologies relevant to humanitarian operations and assess their potential

application in enhancing humanitarian response in Nigeria; to assess the impact of objective data and technology on (a) improving understanding and (b) effective utilization of humanitarian assistance, particularly aid delivery, in communities affected by crises in Nigeria; to highlight, examine and explore the challenges associated with the use of data and technology in humanitarian crisis response in Nigeria; and to identify and propose sustainable approaches for the application of objective data and emerging technologies in humanitarian crisis response in Nigeria. These questions have been comprehensively answered by this study.

Based on the research findings, it was concluded that data and emerging technologies are important factors to consider when designing humanitarian actions for the complex emergencies that communities are facing in Nigeria. The results indicate that humanitarian organizations see a huge potential for the immersion of data and emerging technologies in the responses to humanitarian crises in Nigeria. The methodology of using key informants within humanitarian organizations, and the qualitative analysis of the feedback, provided incredible information as the past and present utilization of data and emerging technologies in humanitarian actions in Nigeria, but it also showed that the potential of emerging technologies like drones, telemedicine and 3D printing was greatly under-utilized or untested.

As the availability and accessibility of data increase and considerable advances in technology become prominent, new opportunities for humanitarian organizations will continue to emerge for improvement in response efforts. This research clearly illustrates that emerging technologies have the potential to improve humanitarian actions in Nigeria by facilitating communication, coordination, and data collection and analysis, reducing congestion in the supply chain, decreasing lead times, increasing transparency and accountability of material and financial resources, and facilitating innovation and sustainable development.

However, it also raises questions of the several challenges associated with data and emerging technology which require attention. Inadequate data security can cause harm, worsen insecurity, and impede the principled delivery of humanitarian help. Inequality in connectivity, access to technology, and digital literacy can exacerbate underlying vulnerabilities and reinforce gender biases. Digital discrimination can occur when datasets on impacted individuals are incomplete. Technologies can fail, break down, and spread mistrust; and technology's potential is limited by its underlying data set, decision-making process, user dispersion, and political buy-in (UNOCHA 2021). To further understand the implications of these results, future studies could address data privacy issues, data protection and equity; ethical questions around emerging technologies especially with artificial intelligence; the non-inclusive and dismissive strategy to the development of some of these technologies; and an apparent lack of evaluation of the technologies.

Based on these conclusions, humanitarian actors should consider deploying data and emerging technologies across humanitarian crisis responses in Nigeria, but in a responsible and thoughtful manner that fosters inclusion and a continuous evaluation of technologies with adequate safeguards in place.

- Increased government investment in digital infrastructure, data management systems, and technological innovation for humanitarian crisis response in Nigeria.
- Capacity-building programs should be organized to train humanitarian workers, security agencies, and local communities on the use of emerging technologies in disaster preparedness and response.
- Strong partnerships between government institutions, international organizations, universities, and private technology companies should be encouraged to enhance knowledge sharing and technical support.
- The establishment of comprehensive legal and ethical frameworks to regulate data protection, cybersecurity, and the responsible use of artificial intelligence in humanitarian operations.
- The impacts of unmanned aerial vehicles, Telemedicine and 3D printing in humanitarian actions across the world, cannot be overemphasized. Hence, humanitarian actors should find sustainable way to immerse these technologies into humanitarian operations in Nigeria, and government should create a collaborative atmosphere especially with policy framing, for that immersion to take place.

- Control over data, data protection, data integrity, data availability and ethical oversight should become the responsibility of collaboration and partnerships that exists among humanitarian organizations; data collected and analysed should be used only for purposes of humanitarian operations; and humanitarian actors in Nigeria should ensure a responsibly balance the opportunities for immersion of emerging technologies into humanitarian operations and the potential risks associated with them.
- Future scholars should consider carrying out research that address data privacy issues, data protection and equity; ethical questions around emerging technologies especially with artificial intelligence; the non-inclusive and dismissive strategy to the development of some of these technologies; and an apparent lack of evaluation of the technologies.
- The application of data and emerging technologies in humanitarian crises responses continue to evolve, all relevant stakeholders especially government institutions and technology developers should ensure the protection of the digital humanitarian space, to preserve the principles of humanity, neutrality, impartiality and independence among humanitarian organizations.

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