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Article

The Impact of Geographic Information Systems on Emergency Management and Disaster Response in Nigeria

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ABSTRACT

Emergency and disaster management in Nigeria has been marked by inadequate preparation, disorganized structures, reliance on donor-driven models, and a lack of accessible data. These issues pose significant challenges and uncertainties for the country's disaster management approach. This study, therefore, examines the impact of GIS on emergency management and disaster response in Nigeria. The study uses a cross-sectional design to assess the effect of Geographic Information Systems (GIS) on emergency management and disaster response in Nigeria. A quantitative approach was utilized, with data collected via a structured questionnaire from stakeholders involved in disaster management across Nigeria. A simple random sampling method was employed with a sample size of 124 respondents from all six geopolitical zones in Nigeria to ensure regional diversity. Data was analyzed with SPSS version 28. The study assessed the role of GIS technology in strengthening emergency management and disaster response in Nigeria. Results showed that respondents generally perceived GIS positively, with particular emphasis on the importance of data availability (6.39 ± 0.78) and system maintenance (6.51 ± 0.81). While satisfaction with existing emergency response was mostly neutral (means ranging from 3.81 ± 1.71 to 4.43 ± 1.85), there was strong agreement on the need for improvements (6.24 ± 1.14). Differences were observed across professions, with IT and Technology professionals recording the highest satisfaction (6.36 ± 0.46). Sociodemographic factors also influenced perceptions, as older respondents reported higher satisfaction (6.17 ± 0.51) than younger ones (5.38 ± 0.17), with statistical significance ($p < 0.05$). Although age and gender were not significant predictors, respondents outside Management and Consulting had higher odds (AOR=20.422, $p < 0.05$) of expressing satisfaction with the emergency response system. The study demonstrates that GIS is perceived as essential for strengthening emergency preparedness and response in Nigeria. Findings highlight critical gaps in data sharing, funding, and system coordination and provide evidence-based insights to improve GIS integration nationwide. The findings highlight the need for improvements in GIS technology applications and emergency response systems in Nigeria.



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KEYWORDS

Disaster management; emergency response; emergency management; geographic information systems; technology.

1. Introduction

Natural disasters result from a combination of complex geophysical characteristics and associated social conditions that are susceptible to hazards. These hazards can stem from meteorological sources, such as severe storms, cyclones, droughts, and snowstorms, or from geological processes, such as volcanic eruptions, earthquakes, and tsunamis. In some cases, they involve both, as with floods (Andrew, 2019). Both natural and human-induced hazards are part of the human-environmental interaction and cannot be entirely prevented. However, their disastrous effects on vulnerable populations and locations can be mitigated. Disaster preparedness, a crucial component of disaster management, requires extensive spatial information, including data that define exposure risks and population vulnerability, and is essential for developing early warning systems. Inadequate and unreliable information poses an obstacle to sustainable development, and the failure to integrate essential spatial datasets and other information for disaster management can have catastrophic consequences for a nation during emergencies (Fasona, Omojola, Soneye, et al., 2013).

Disaster management involves a range of activities, including disaster preparedness, risk assessment, preventive strategies, emergency response, and post-disaster recovery and reconstruction. Effective preparedness and thoughtful development practices can significantly reduce the impact of disasters, especially for vulnerable populations in high-risk areas (Alblooshi & Yahya, 2021). A disaster is typically seen as the result of the interaction between human systems and a natural or artificial hazard. According to the United Nations International Strategy for Disaster Reduction, a disaster is defined as a severe disruption in the functioning of a community or society, leading to extensive human, material, economic, or environmental losses that surpass the affected community's or society's capacity to manage with its own resources (Pirasteh & Li, 2017).

To fully grasp the impact of various disasters, it is essential to understand the interactions and inter-relationships among these diverse and complex entities exposed to a specific magnitude of a risky event (Peiris, 2020). This understanding is facilitated by the deployment of GIS, which aids in mitigating hazard events (Dabo, 2024). The necessity of GIS extends to its spatial analytical capabilities in identifying affected areas. Geographic data and information are critically important in disaster management and monitoring vulnerable hotspots (Fasona et al., 2013). GIS operations generally encompass tasks such as data acquisition, management, querying, vector and raster data analysis, and data visualization. GIS applications are essential in disaster mitigation efforts (Tomaszewski, 2014). Previous research has indicated that the effectiveness of disaster management is significantly influenced by the use of GIS (Hasan, 2013). As a form of geo-technology, GIS offers substantial capabilities in disaster management, including damage assessment, risk prediction, situational analysis, vulnerability and resilience assessments, and prioritizing mitigation strategies (Alblooshi & Yahya, 2021).

For example, to reduce disaster losses, Kenya joined the global EW4All initiative, demonstrating its commitment to saving lives and to the country's hard-fought development gains. The launch of EW4All in Kenya underscores the urgent need to shift from reactive disaster response to proactive anticipatory action, while ensuring that no one is left behind when disasters strike. They collaborated, engaged, and built an Early Warning System in Kenya that will reduce loss of life and livelihoods, bolster food security, and build a more resilient Kenya for generations to come. (UNDRR, 2025). Also, **Ghana** has integrated GIS into flood mapping and urban risk assessment more systematically (Kwang & Matthew Osei, 2017). *Fusarium* and *Penicillium* are the most predominant species attacking maize seed and resulting in reduction in seed germination. The study was conducted at the Jimma University College of Agriculture and Veterinary Medicine in plant pathology laboratory. Three maize varieties and two levels of disinfection were used and arranged in complete block design with five replications. The highest frequency of *Aspregilus* spp. (40.4%

Inadequate preparation, disorganized structures, reliance on donor-driven models, and a lack of accessible data have marked emergency and disaster management in Nigeria. These issues pose significant challenges and uncertainties for the country's disaster management approach. Consequently, Nigeria's efforts in emergency and disaster management are hindered by insufficient information on disaster likelihood, the population in vulnerable areas, and accurate data on investments in disaster preparedness and response, which are crucial for disaster assessment and damage evaluation (Shatte, Holdsworth, & Lee, 2015). The increasing population puts more people at risk, making it essential to know their exact locations, social, demographic, and economic conditions, and how to disseminate relevant risk information to them for effective emergency and disaster management. Nigeria faces natural and human-made disaster risks that often overwhelm the current capacity of its emergency management services (Abdollahi Lorestani et al., 2024). Although prior studies acknowledge the importance of GIS in global disaster management, empirical evidence on how GIS is perceived, utilised, and linked to stakeholder satisfaction within Nigeria's emergency response system remains limited. Existing research focuses largely on conceptual discussions or small-scale case analyses, leaving gaps in understanding how socio-demographic characteristics and professional backgrounds shape GIS adoption and emergency response outcomes across the country. This study fills this gap by providing nationally representative quantitative evidence from emergency-management stakeholders across Nigeria's six geopolitical zones. This approach offers new insight into the factors influencing GIS effectiveness and emergency-response satisfaction in Nigeria, thereby advancing practical and policy-level understanding of how GIS can be better integrated into national disaster management frameworks.

Therefore, this study examines the impact of GIS on emergency management and disaster response in Nigeria.

2. Methodology

2.1. Research Design

The study utilizes a cross-sectional research design to evaluate the impact of geographic information systems on emergency management and disaster response in Nigeria. A quantitative research approach was chosen to gather numerical data that could be statistically analyzed to uncover patterns, relationships, and effects. A structured questionnaire was used to elicit responses from participants. This study utilized a simple random sampling method to select participants for the study.

2.2. Study Area

Nigeria, located on Africa's western coast, features a varied geography with climates ranging from arid to humid equatorial regions (Toyin Falola, 2024). The true essence of Nigeria's diversity is reflected in its people, who communicate in hundreds of languages, including Igbo, Fula, Yoruba, Hausa, Ibibio, Edo, Tiv, and English. Nigeria is abundant in natural resources, particularly petroleum and natural gas. The national capital, Abuja, in the Federal Capital Territory established in 1976, differs significantly from Lagos, the former capital, which continues to be the main commercial and industrial center. Nigeria shares its borders with Niger to the north, Chad and Cameroon to the east, the Gulf of Guinea to the south, and Benin to the west (Toyin Falola, 2024). Larger than Texas, Nigeria is the most populous nation in Africa, with a population exceeding 200 million and a land area of 923,768 square kilometers (Factbook, 2024). The country is home to more than 250 ethnic groups.

2.3. Study population

The target population for this study includes professionals actively involved in emergency management and disaster response within Nigeria. This population encompasses a diverse range of individuals working in various capacities, such as:

- **Government agencies** (e.g., National Emergency Management Agency (NEMA), State Emergency Management Agencies (SEMAs)).
- **Non-Governmental Organizations (NGOs)** involved in disaster relief and humanitarian efforts.
- **Private sector organizations** providing services related to disaster response (e.g., IT and GIS service providers).

2.4. Data Collection Instruments

A structured questionnaire was designed to gather data from agencies tasked with managing emergencies and disasters in Nigeria. The questionnaires were administered to emergency responders and relevant personnel to assess the perceived impact and challenges of GIS utilization in disaster management. The questionnaire consists of two parts:

Part A: Demographic Information: This section gathers demographic data such as age, gender, Profession category, and years of experience.

Part B: GIS Impact Assessment: This section includes Likert scale questions to measure the respondents' perceptions of the impact and satisfaction of GIS on various aspects of emergency management and disaster response. The 7-point Likert scale was used because it provides a wider response range than a 5-point scale, allowing respondents to express levels of intensity more precisely. This improves measurement sensitivity and enhances the reliability of perception-based constructs such as satisfaction and GIS usability.

2.5. Data Quality Assurance Measures

The following state how data quality was ensured, including:

- pre-testing the questionnaire with 10 respondents to refine wording and structure.
- logical consistency checks.
- removal of incomplete or duplicate survey entries.
- restricting each participant to a single survey submission; and
- cross-validating entries during data cleaning before analysis.

2.6. Sampling techniques and Size

A simple random sampling technique was employed to choose participants from the population, guaranteeing that every individual had an equal opportunity to be part of the sample. This method involves selecting a random subset of the population, where each member has an identical probability of being chosen (Thomas, 2020). It is the most basic of all probability sampling methods, as it only necessitates one random selection and minimal prior knowledge about the population (Thomas, 2020). This method was chosen to minimise selection bias and enhance representativeness across diverse professions involved in emergency and disaster management. The sample consists of a total of 124 respondents from the six geopolitical zones in Nigeria to ensure regional diversity.

Sample Size

Since this is a cross-sectional study, the sample size was determined based on the estimated population of stakeholders utilizing GIS in disaster management and emergency response in Nigeria. Cochran's formula was used to ensure an appropriate representation of the population of the study.

The formula used is:

$$n = \frac{Z^2 \cdot p \cdot (1 - p)}{d^2}$$

Where:

- n is the required sample size,
 - Z is the Z-value (e.g., 1.96 for 95% confidence level),
 - p is the prevalence of the population,
 - d is the margin of error (precision).
- n = required sample size

Z = Z-value (the number of standard deviations corresponding to the desired confidence level, typically 1.96 for a 95% confidence level)

p = 20% = 0.20

d = margin of error 7.04% (0.0704),

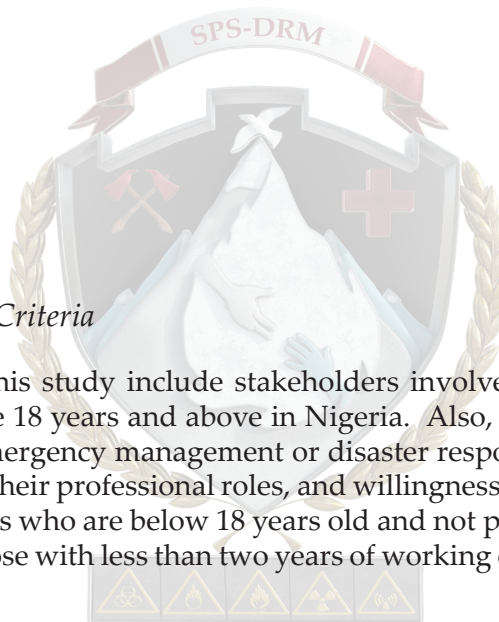
n=

n=

n=

n = 123.89

n=124



2.7. Inclusion and Exclusion Criteria

Participants recruited in this study include stakeholders involved in emergency preparedness and disaster response and are 18 years and above in Nigeria. Also, participants must have at least two years of experience in emergency management or disaster response, direct or indirect involvement with GIS technology in their professional roles, and willingness and ability to participate in the survey. However, respondents who are below 18 years old and not part of the disaster management team in Nigeria, including those with less than two years of working experience were excluded from the study.

2.8. Data analysis

After completing the data validation, all the data files were merged and imported into SPSS version 28. Data cleaning was then performed to prepare for analysis. Frequency tables on some key indicators were generated to check inconsistency and invalid entries if there were any. Descriptive statistics were used to outline the socio-demographic profiles of the participants. To examine the connections between demographic factors and the participant's perception and satisfaction with the implementation of GIS in emergency management, inferential statistical techniques, including chi-square tests and logistic regression, were applied. **binary logistic regression** was appropriate because the outcome variable (satisfaction with emergency response) was dichotomised into satisfactory vs. unsatisfactory. Logistic regression allowed the authors to estimate the influence of predictor variables while controlling for confounders. The original and the cleaned data were securely stored for future reference.

2.9. Ethical approval

Informed consent was secured from participants, who were briefed on the significance of their responses and asked for their cooperation. To ensure anonymity, no email addresses or other contact details were collected. Participation in the survey was voluntary, and respondents could only complete it once. Furthermore, responses were kept confidential and were not disclosed to any external parties.

2.10. Study Population

The study acknowledges that, although the sample was drawn from stakeholders across all six geopolitical zones, the use of self-reported questionnaire data may be subject to reporting bias or variations in individual interpretation. Additionally, the cross-sectional design limits the ability to draw causal conclusions about the relationship between GIS perceptions and satisfaction with emergency response. The study also recognises that certain professional groups—such as private-sector GIS specialists or remote communities with limited digital access—may be underrepresented despite the random sampling approach. Finally, the study did not incorporate qualitative interviews, which could have provided deeper insights into institutional constraints and operational challenges. These limitations have now been clearly noted to guide cautious interpretation and to highlight areas for future research.

3. Result

Socio-demographics

The sociodemographic of the respondents show a higher representation of males (53.2%) compared to females (46.8%). Most of the respondents are aged 45-54 (33.1%), followed by 35-44 (29.0%) and 25-34 (22.6%). Most study respondents' profession falls into the category of public and civil servants (42.7%), followed by the "other" category (24.2%), which includes retirees, students, self-employed, etc. The remaining occupations categorised in this study include health and medical practitioners (13.7%), finance and business (7.3%), IT and technology (7.3%) and management and consulting (4.8%).

Table 1. Sociodemographic of respondents

Variable	Frequency (n=124)	Percentage (%)
Gender		
Male	66	53.2
Female	58	46.8
Age		
18-24	6	4.8
25-34	28	22.6
35-44	36	29.0
45-54	41	33.1
55-65	13	10.5
Profession category		
Management and consulting	6	4.8
Finance and Business	9	7.3

Health and Medical	17	13.7
Public service and Civil Servant	53	42.7
IT and Technology	9	7.3
Others	30	24.2

APPLICATION OF GIS TECHNOLOGY

Table 2 presents the perceptions of respondents regarding the application of GIS technology in enhancing emergency management and disaster response in Nigeria. The table includes various statements (variables), and the respondent's level of agreement is quantified in percentages for each. The levels of agreement range from "Strongly Agree" (SA) to "Strongly Disagree" (SD). Additionally, the mean and standard deviation (SDev) for each statement is provided, along with a general decision regarding the perception (positive, neutral, or negative).

Most respondents emphasized the importance of data availability on an appropriate scale, with 84.7% agreeing and a mean score of 6.09, indicating a strong consensus. Similarly, 90.3% highlighted the need for updated data, reflected in the highest mean score of 6.39, showing overwhelming agreement. Data compatibility was also widely recognized, with 89.5% in agreement and a mean of 6.29. Even stronger support was seen for proper data arrangement and system maintenance, as 95.2% of respondents agreed, with a mean of 6.51. Opinions on data sharing were more varied, as 67% supported it, but 22.4% disagreed, with a mean of 5.31 and a higher standard deviation, reflecting divergent views. The technical knowledge of decision-makers was acknowledged by 79% as crucial, though with some variability, indicated by a mean of 5.86. Staff training was another major factor, with 89.5% affirming its importance, giving a mean of 6.31. The influence of software, hardware, and equipment availability was recognized by 91.9%, reflected in a mean score of 6.37. Financial issues were identified as barriers, with 86.3% agreeing that funding affects training and research, while 67.4% noted financial constraints in acquiring geo-information technology, showing lower consensus with a mean of 5.19 and greater variability. Indigenous knowledge was considered valuable by 81.5% of respondents, with a mean of 6.15, underscoring its role in applying GIS in disaster management. Finally, societal perceptions of hazards were acknowledged by 71.7%, with a mean of 5.81, suggesting that while generally positive, opinions varied more in this area.

Overall, the respondents demonstrate a strong positive perception of the role of GIS technology in improving emergency management and disaster response in Nigeria, with particularly high consensus on the importance of updated data, data compatibility, data arrangement, and the availability of resources like software and hardware. Some variability in perceptions is noted in areas concerning the willingness to share data and funding constraints.

Table 2. Perception of Respondents about the Application of GIS Technology to Improve Emergency Management and Disaster Response in Nigeria

S/N	Variables	SA (%)	A (%)	SWA (%)	NA/D (%)	SWD (%)	D (%)	SD (%)	Mean±S-Dev	Decision
1	The availability of data at the right scale affects the use of geo-information and technology.	48 (38.7)	57 (46.0)	9 (7.3)	5 (4.0)	2 (1.6)	3 (2.4)	0 (0.0)	6.09±1.08	Positive perception
2	Having up-to-date data is crucial for effectively using geo-information and technology.	65 (52.4)	47 (37.9)	8 (6.5)	3 (2.4)	1 (0.8)	0 (0.0)	0 (0.0)	6.39±0.78	Positive perception
3	Data compatibility is important in geo-information utilisation.	54 (43.5)	57 (46.0)	9 (7.3)	3 (2.4)	1 (0.8)	0 (0.0)	0 (0.0)	6.29±0.77	Positive perception

4	Data arrangement and maintenance of systems like databases are important.	75 (60.5)	43 (34.7)	4 (3.2)	0 (0.0)	1 (0.8)	0 (0.0)	1 (0.8)	6.51±0.81	Positive perception
5	The extent to which people are willing to share data influences the use of geographic information in disaster management.	41 (33.1)	42 (33.9)	7 (5.6)	6 (4.8)	9 (7.3)	15 (12.1)	4 (3.2)	5.31±1.88	Positive perception
6	Decision makers' technical knowledge at the geo-information implementation stage affects usage.	45 (36.3)	53 (42.7)	12 (9.7)	3 (2.4)	2 (1.6)	7 (5.6)	2 (1.6)	5.86±1.42	Positive perception
7	Timely and sufficiently trained staff are influencing factors in GIS application.	60 (48.4)	51 (41.1)	9 (7.3)	2 (1.6)	0 (0.0)	2 (1.6)	0 (0.0)	6.31±0.88	Positive perception
8	Availability of software hardware and equipment influences geo-information and technology usage	61 (49.2)	53 (42.7)	5 (4.0)	5 (4.0)	0 (0.0)	0 (0.0)	0 (0.0)	6.37±0.75	Positive perception
9	Financial considerations impact training and research programs.	61 (49.2)	46 (37.1)	13 (10.5)	3 (2.4)	0 (0.0)	1 (0.8)	0 (0.0)	6.31±0.86	Positive perception
10	Funding resources impose limitations on obtaining geo-information, GIS, and geo-information technology.	35 (28.2)	48 (38.7)	8 (6.5)	4 (3.2)	6 (4.8)	14 (11.3)	9 (7.3)	5.19±1.98	Positive perception
11	Gaining indigenous knowledge through public involvement is crucial for effectively utilizing GIS in disaster management.	45 (36.3)	56 (45.2)	20 (16.1)	2 (1.6)	1 (0.8)	0 (0.0)	0 (0.0)	6.15±0.80	Positive perception
12	Society's perception on risks affect how geo-information and technology are utilized.	35 (28.2)	54 (43.5)	21 (16.9)	8 (6.5)	2 (1.6)	4 (3.2)	0 (0.0)	5.81±1.16	Positive perception

(Key: SA- Strongly Agree, A – Agree, SWA- Somewhat Agree, NA/D- Neither Agree or Disagree, SWD- Somewhat disagree, D- Disagree, SD- strongly Disagree, SDev –standard deviation, Negative perception: 1- 3.57, Neutral perception: 3.57-4.43, Positive perception: 4.43- 7.00

EMERGENCY RESPONSE



Table 3 provides insights into the levels of satisfaction with emergency response in Nigeria, as perceived by the respondents. The table covers various aspects of emergency and disaster management, with responses ranging from “Strongly Agree” to “Strongly Disagree”. Additionally, each statement is accompanied by a mean score and standard deviation, as well as an overall decision categorising satisfaction levels as low, neutral, or high. The findings reveal that only 37.1% of respondents reported satisfaction with current emergency and disaster management arrangements, while 32.3% expressed dissatisfaction. The mean score of 4.43 with a relatively high standard deviation of 1.85 points to a generally neutral perception, though responses varied widely. Public communication during disasters attracted lower satisfaction, with only 18.5% expressing approval compared to 34.6% who were dissatisfied. The mean score of 3.98, below the neutral threshold, suggests an overall perception that leans negative. Communication with emergency responders and health sector workers was viewed more neutrally, with 25.8% satisfied and 29% dissatisfied, reflected in a mean of 4.41 and standard deviation of 1.53.

Perceptions of the government's attitude toward man-made disasters were also relatively poor, with only 18.5% satisfied and 37.1% dissatisfied, producing a mean score of 3.94 and standard deviation of 1.60, which reflects neutrality but with a tilt toward the negative. Regarding the effectiveness of the emergency response system in reducing disaster impacts, 15.3% expressed satisfaction while 35.5% reported dissatisfaction. The mean score of 4.02, coupled with a standard deviation

of 1.42, suggests a neutral perception with moderate variation. In terms of personal experiences, 27.4% indicated that natural disasters had affected them, while 30% stated otherwise. The mean score of 3.81 and standard deviation of 1.71 again suggest neutrality, but with a tendency toward negative perceptions. Despite these variations, there was strong agreement on the need for systemic improvements: 84.7% of respondents agreed or strongly agreed that the emergency response system in Nigeria requires significant enhancement. This was supported by a high mean score of 6.24 and a standard deviation of 1.14, reflecting a clear consensus on the necessity for reform.

Table 3. Levels of Satisfaction with Emergency Response in Nigeria

S/N	Variables	SA (%)	A (%)	SWA (%)	NA/D (%)	SWD (%)	D (%)	SD (%)	Mean±S-Dev	Decision
1	Do you agree that emergency and disaster management arrangements are satisfactory during emergencies and disasters?	14 (11.3)	32 (25.8)	23 (18.5)	15 (12.1)	13 (10.5)	18 (14.5)	9 (7.3)	4.43±1.85	Neutral
2	How satisfied are you with the way information is conveyed to the public in times of disasters and major incidents?	5 (4.0)	18 (14.5)	37 (29.8)	13 (10.5)	20 (16.1)	23 (18.5)	8 (6.5)	3.98±1.66	Neutral
3	How satisfied are you with the way information is relayed to emergency responders and healthcare workers during disasters and significant incidents?	3 (2.4)	29 (23.4)	45 (36.3)	11 (8.9)	15 (12.1)	17 (13.7)	4 (3.2)	4.41±1.53	Neutral
4	How would you rate your satisfaction with the government's understanding of man-made disasters and its approach to handling emergency response?	4 (3.2)	19 (15.3)	31 (25.0)	18 (14.5)	22 (17.7)	24 (19.4)	6 (4.8)	3.94±1.60	Neutral
5	How well does Nigeria's emergency response system mitigate the effects of disasters?	3 (2.4)	16 (12.9)	32 (25.8)	29 (23.4)	17 (13.7)	27 (21.8)	0 (0.0)	4.02±1.42	Neutral satisfaction
6	How would you rate the following statements in relation to the impact of the natural disaster? Has a natural disaster impacted you?	6 (4.8)	28 (22.6)	25 (20.2)	28 (22.6)	9 (7.3)	18 (14.5)	10 (8.1)	3.81±1.71	Neutral satisfaction
7	The emergency response system in Nigeria requires significant improvement.	72 (58.1)	33 (26.6)	0 (0.0)	15 (12.1)	4 (3.2)	0 (0.0)	0 (0.0)	6.24±1.14	High Satisfaction

(Key: SA- Strongly Agree, A – Agree, SWA- Somewhat Agree, NA/D- Neither Agree or Disagree, SWD- Somewhat disagree, D- Disagree, SD- strongly Disagree, SDev– standard deviation, Low satisfaction: 1-3.57, Neutral satisfaction: 3.57-4.43, High satisfaction: 4.43-7.00).

Perception of Sociodemographic Variations in the Application of GIS Technology for Emergency Management and Disaster Response in Nigeria

The mean perception scores of males and females regarding the application of GIS technology are very similar, with males scoring slightly higher (6.06 ± 0.63) compared to females (6.02 ± 0.58). Younger respondents (18-24 years) have a lower mean perception score (5.38 ± 0.17) compared to other age groups. The highest mean perception is among those aged 45-54 (6.17 ± 0.51) with the p-value of 0.048 indicating a statistically significant difference between perception and age groups. Lastly, respondents in IT and Technology have the highest mean perception score (6.36 ± 0.46), indicating they are the most optimistic about the application of GIS technology in emergency management. Conversely, respondents in Finance and Business have the lowest mean perception score (5.95 ± 0.43).

Table 4. Sociodemographic Variations in Perceptions of GIS Technology’s Application in Emergency Management and Disaster Response in Nigeria

Variable	Mean SD	Lower-upper bounds at 95% CI	T/F Value	P-value
Gender				
Male	6.06 ±0.63	-0.177 - 0.25901	0.371	0.711
Female	6.02 ±0.58	-0.17617- 0.257		
Age				
18-24	5.38±0.17	5.208-5.56	2.481	0.048*
25-34	5.97±0.76	5.67-6.27		
35-44	6.09±0.53	5.91-6.27		
45-54	6.17±0.51	6.01-6.33		
55-65	6.00±0.69	5.57-6.42		
Profession category				
Management and consulting	6.26±0.45	5.79-6.73	1.173	0.327
Finance and Business	5.95±0.43	5.62-6.28		
Health and Medical	6.17±0.80	5.75-6.58		
Public service and Civil Servant	5.93±0.58	5.77-6.09		
IT and Technology	6.36±0.46	6.00-6.71		
Others	6.06±0.61	5.83-6.29		

* Statistically significant p=0.05

Relationship Between Sociodemographic Characteristics and Satisfaction with Emergency Response in Nigeria

The relationship between the satisfaction levels regarding emergency response, categorised as satisfactory and unsatisfactory, and the sociodemographic characteristics of the respondents was assessed using logistic regression. The professional category of the respondents reveals that those in IT and technology (COR 17.500, 95% CI: 1.233-250.357, p = 0.035) and the ‘others’ category (COR 20.000, 95% CI: 1.954-204.728, p = 0.012) were more satisfied compared to those in management and consulting, based on the unadjusted odds ratio. Similarly, in the adjusted odds ratio analysis, respondents in IT and technology (AOR 14.371, 95% CI: 0.974-212.112, p = 0.052) and the ‘others’

category (AOR 20.422, 95% CI: 1.902-219.322, $p = 0.013$) also showed greater satisfaction compared to those in management and consulting, indicating a significant relationship.

Table 5 Relationship Between Sociodemographic Characteristics and Satisfaction with Emergency Response in Nigeria.

Variable	Satisfaction category n(%)		COR	P-value	AOR	P-value
	Unsatisfactory	Satisfactory				
Gender						
Male	23 (34.8)	43 (65.2)	1.229 (0.592-2.550)	0.581	1.213 (0.548-2.687)	0.634
Female	23 (39.7)	35 (60.3)	ref	-	ref	-
Age						
18-24	1 (16.7)	5 (83.3)	ref	-	ref	-
25-34	10 (35.7)	18 (64.3)	0.360 (0.037-3.526)	0.380	0.310 (0.30-3.246)	0.329
35-44	11 (30.6)	25 (69.4)	0.455 (0.047-4.361)	0.494	0.402 (0.38-4.254)	0.449
45-54	16 (39.0)	25 (61.0)	0.313 (0.033-2.926)	0.308	0.346 (0.35-3.448)	0.366
55-65	8 (61.5)	5 (38.5)	0.125 (0.011-1.406)	0.092	0.119 (0.10-1.479)	0.098
Profession category						
Management and consulting	5 (83.3)	1 (16.7)	ref	-	ref	-
Finance and Business	4 (44.4)	5 (55.6)	6.250 (0.504-77.494)	0.154	5.523 (0.436-69.928)	0.187
Health and Medical	7 (41.2)	10 (58.8)	7.143 (0.678-75.219)	0.102	7.608 (0.668-86.590)	0.102
Public service and Civil Servant	22 (41.5)	31 (58.5)	7.045 (0.769-64.578)	0.084	6.402 (0.676-60.622)	0.105
IT and Technology	2 (22.2)	7 (77.8)	17.500 (1.233-250.357)	0.035*	14.371 (0.974-212.112)	0.052*
Others	6 (20.0)	24 (80.0)	20.00 (1.954-204.728)	0.012*	20.422 (1.902-219.322)	0.013*

* Statistically significant $p=0.05$

4. Discussion

A disaster happens when a significant disruption in a community's operations overwhelms its ability to manage using its own resources (Sharma, Parkash, & Joshi, 2016). As cities grow and become increasingly interconnected, natural and human-caused disasters present a clear threat to the functionality of infrastructure systems that support the physical and economic well-being of communities throughout the world. Protecting these systems is vital for ensuring that the populations that depend on them can survive even in the face of significant disruptions (Deelstra & Bristow, 2023) such as natural disasters, threaten to disrupt service to these systems and the communities they support. Strategies designed to reduce the impacts from disasters and other events are therefore an important consideration for community planning. At a regional level, coordination between communities supports the efficient use of resources for implementing disaster risk reduction (DRR). The

eminent resultants of these disaster's effects are severe harm, injuries, loss of properties or deaths (Srikantha, 2020). As a result, the use of GIS is essential in disaster management, as it represents an advanced technology that plays a crucial role in contemporary disaster management efforts. GIS integrates geospatial data with hardware and software capable of analyzing spatial, temporal, and attribute data, which is then used to generate critical information for disaster-related decision-making (Sharma et al., 2016). This study explores the influence of GIS on emergency response and disaster management in Nigeria.

This study findings indicate a generally positive perception of the application of GIS technology to improve emergency management and disaster response in Nigeria. Variables such as the availability of updated data, data compatibility, and data arrangement were rated highly, suggesting that respondents believe these factors are crucial for effective GIS application in disaster management. Specifically, the high mean scores for data availability (6.39 ± 0.78) and data arrangement (6.51 ± 0.81) reflect a strong agreement on the importance of these aspects. These findings align with a study by Goodchild & Glennon (2010) emphasizing the critical role of updated and compatible data in enhancing GIS efficiency in disaster management. The possible reason for this could be because GIS provides detailed and accurate maps that help visualize disaster-prone areas, plan emergency routes, and manage resources effectively. This capability enhances situational awareness and aids in better decision-making during crises (Alblooshi & Yahya, 2021). Also, GIS integrates various types of data, including satellite imagery, demographic information, and infrastructure details. This comprehensive view allows for more informed planning and response strategies (Dabo, 2024). GIS tools help in assessing risks and vulnerabilities by analyzing historical data and predicting potential impacts of disasters. This proactive approach aids in preparedness and mitigation strategies (Srikantha, 2020).

This study findings reveals a generally neutral satisfaction among participants with various aspects of emergency response in Nigeria. The mean scores for questions about satisfaction with emergency management arrangements (4.43 ± 1.85) and communication during disasters (3.98 ± 1.66) falls within the neutral satisfaction range. This indicates that while there are areas of concern, respondents do not overwhelmingly perceive these aspects as either satisfactory or unsatisfactory. The possible reason for this may be due to the fact that emergency response times differ widely, giving people different experiences. Some individuals may have received prompt assistance, while others encountered delays, leading to a generally neutral overall perception (Lim, Li, & Fang, 2020). Also, limited resources, including personnel, equipment, and funding, can affect the efficiency and effectiveness of emergency responses (Lim et al., 2020). This can lead to a perception of mediocrity in the service provided. It is recommended to improve response times by investing in resources and training, address infrastructure challenges, and strengthen public awareness and engagement. Also, Nigeria's chronic emergency-management challenges, including fragmented coordination, inconsistent response times, and limited investment are factors that may generate mixed user experiences. Additionally, Institutional constraints limiting GIS adoption such as inadequate technical capacity, outdated infrastructure, weak inter-agency data-sharing systems) and **financial barriers** (high cost of geospatial equipment, insufficient government funding) may hinder. This may cause respondents to have mixed feeling towards emergency response satisfaction in Nigeria. Countries such as Japan—where real-time geospatial dashboards support earthquake and tsunami response—and the United States, where GIS platforms such as FEMA's HAZUS have strengthened decision-making during hurricanes and wildfires. These international countries

Implementing effective feedback mechanisms can also help tailor services to better meet the needs of the community. Notably, there is a high level of agreement that the emergency response system needs substantial improvement (6.24 ± 1.14), reflecting a critical view of the current state of emergency management. The need for substantial improvement in the emergency response system aligns with recommendations for increased investment in disaster preparedness and response infrastructure (United Nations, 2015).

This study analysis of socio-demographic variations in the perception of GIS technology application in emergency management varies significantly with age but not with gender or profession. While gender differences were not statistically significant ($p=0.711$), age shows some significant

variation ($p=0.048^*$), with younger respondents (18-24 years) showing lower positive perception (5.38 ± 0.17) compared to older age groups (6.17 ± 0.51). This could be due to varying levels of exposure and familiarity with GIS technology across different age groups. Older professionals may have greater exposure and experience with GIS technology. Younger individuals may have higher expectations for technology or be more critical due to their familiarity with advanced technology. In order to address the variation in perception based on age, consider offering targeted educational programs about GIS technology to younger age groups. This could help them better understand the value and application of GIS in emergency management, potentially improving their perception and engagement with the technology. (Marin et al., 2019).

Lastly, this study examines the relationship between sociodemographic characteristics and satisfaction with emergency response. The results indicate no significant difference in satisfaction between gender and age. However, respondents in the professional category, notably those in other professional categories had significantly higher odds of reporting satisfaction with the emergency response system (AOR = 20.422, $P = (< 0.05)$ compared to those in Management and Consulting.

5. Conclusion

The study reveals a generally positive perception of the application of GIS technology in emergency management and disaster response in Nigeria. Key factors such as data availability, compatibility, and the maintenance of systems were highly valued by respondents. However, challenges related to data sharing, funding, and inter-agency cooperation persist. The neutral satisfaction with the current emergency response system, coupled with the recognition of the need for substantial improvements, highlights critical areas that require attention. Sociodemographic variations in perception and satisfaction underscore the necessity for tailored strategies to address the diverse needs of different groups.

To enhance the effectiveness of emergency management in Nigeria, it is essential to focus on improving data-sharing mechanisms, securing adequate funding, and fostering better communication and coordination among stakeholders. Addressing these challenges can lead to a more robust and responsive emergency management system, ultimately reducing the impact of disasters on communities. Also, this study emphasises the need for a coordinated national GIS data-sharing framework to reduce duplication and fragmentation across agencies, improved and continuous capacity-building programmes for emergency responders and GIS practitioners, and the integration of GIS tools into national early-warning systems to enhance real-time monitoring and community preparedness. This helps reinforce the policy relevance and long-term value of the research.

Future research should continue to explore these areas, providing deeper insights and practical solutions to optimize emergency management practices in Nigeria and similar contexts.

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6. References

1. Alblooshi, S. A., & Yahya, M. Y. Bin. (2021). Influence of geographic information system on natural disaster management in the united Arab Emirate. *Proceedings of the International Conference on Industrial Engineering and Operations Management*, (2016), 1713–1720. <https://doi.org/10.46254/an11.20210329>
2. Andrew, S. A. (2019). Regional Integration through Contracting Networks: An Empirical Analysis of Institutional Collection Action Framework. *Urban Affairs Review*, 44(3), 378–402. <https://doi.org/10.1177/1078087408323941>.
3. Dabo, S. (2024). *Geographic Information System (GIS) For Disaster Management* Geographic Information System (GIS) For Disaster Management BY Murjanatu Garba Ayawa , Mohammed Baba Jibril , Elizabeth Iwalaiye , Shuaibu Dabo and Habibat Suberu Department of Geography Fede. (May), 0–17.
4. Deelstra, A., & Bristow, D. N. (2023). Assessing the effectiveness of disaster risk reduction strategies on the regional recovery of critical infrastructure systems. *Resilient Cities and Structures*, 2(3), 41–52. <https://doi.org/10.1016/J.RCNS.2023.05.001>
5. Factbook, T. W. (2024). Nigeria. Retrieved from <https://www.cia.gov/the-world-factbook/countries/nigeria/>
6. Fasona, M., Omojola, A., Soneye, A., & ... (2013). Geographic Information for Disaster Management in Nigeria: Case Study of the Mud-beach Coast of Southwestern Nigeria. *Unilag Journal of ...* Retrieved from <http://eureka.unilag.edu.ng/index.php/ujh/article/view/241>
7. Goodchild, M. F., & Glennon, J. A. (2010). Crowdsourcing geographic information for disaster response: A research frontier. *International Journal of Digital Earth*, 3(3), 231–241. <https://doi.org/10.1080/17538941003759255>
8. Hasan, S. (2013). *Sound practices in space technology applications for disaster risk reduction and inclusive and sustainable development*. 1–23.
9. Kwang, C., & Matthew Osei, E. (2017). Accra Flood Modelling through Application of Geographic Information Systems (GIS), Remote Sensing Techniques and Analytical Hierarchy Process. *Journal of Remote Sensing & GIS*, 06(01). <https://doi.org/10.4172/2469-4134.1000191>
10. Lim, H. W., Li, Z., & Fang, D. (2020). Impact of management, leadership, and group integration on the hospital response readiness for earthquakes. *International Journal of Disaster Risk Reduction*, 48(March), 101586. <https://doi.org/10.1016/j.ijdr.2020.101586>
11. Peiris, S. (2020). Geographical Information System (GIS) for Disaster Management. *International Network Review Research*. 4(9), 70- 90. Retrieved from <https://www.researchgate.net/publication/345179571>.
12. Pirasteh, S., & Li, J. (2017). Global changes and natural disaster management: Geo-information technologies. *Global Changes and Natural Disaster Management: Geo-Information Technologies*, 1–228. <https://doi.org/10.1007/978-3-319-51844-2>
13. Sharma, A. K., Parkash, S., & Joshi, V. (2016). Geographical Information Systems for Disaster Response and Management. *National Institute of Disaster ...* Retrieved from <https://www.aca->

- demia.edu/download/40996026/Geographical_Information_Systems_for_Disaster_Response_and_Management.pdf
14. Shatte, A., Holdsworth, J., & Lee, I. (2015). Multi-synchronous collaboration between desktop and mobile users: A case study of report writing for emergency management.
 15. Srikantha, H. (2020). Geographical Information Systems in Disaster Reduction. *Journal of Institute of Industrial Science*, 6 (10), 158-8505. <https://www.researchgate.net/publication/974179526>.
 16. Thomas, L. (2020). Simple Random Sampling | Definition, Steps & Examples. Retrieved from <https://www.scribbr.com/methodology/simple-random-sampling/>
 17. Tomaszewski, B. (2014). Geographic information systems (GIS) for disaster management. *Geographic Information Systems (GIS) for Disaster Management*, 1–283. <https://doi.org/10.1201/b17851>
 18. Toyin Falola. (2024). Nigeria. Retrieved from <https://www.britannica.com/place/Nigeria>
 19. UNDRR. (2025). Kenya launches “Early Warnings for All” initiative to enhance disaster preparedness. Retrieved from <https://www.undrr.org/news/kenya-launches-early-warnings-all-initiative-enhance-disaster-preparedness>
 20. United Nations. (2015). Sendai framework for disaster risk reduction 2015-2030. *Australian Journal of Emergency Management*, 30(3), 9–10.



