TIMBOU-AFRICA PUBLICATION INTERNATIONAL JOURNAL FEBRUARY, 2024 EDITIONS.

INTERNATIONAL JOURNAL OF BUILT ENVIRONMENT AND EARTH SCIENCE
VOL. 3 NO. 4 E-ISSN 3027-1606 P-ISSN 3027-0049

GEOGRAPHIC INFORMATION SYSTEM (GIS) FOR DISASTER MANAGEMENT

MURJANATU GARBA AYAWA; MOHAMMED BABA JIBRIL; ELIZABETH IWALAIYE; SHUAIBU DABO; AND HABIBAT SUBERU

Department of Geography, Federal College of Education, Kontagora.
murjanatuayawa@gmail.com

ABSTRACT

Natural disasters are the consequence of numerous complex geophysical characteristics and the connected social circumstances that are exposed to hazards. These hazards require the incorporation of information from various sources. Geographic Information System (GIS) is a unique technology often used to collect, store, analyze and display large amounts of

Introduction

Natural disasters are the consequence of numerous complex geophysical characteristics and the connected social circumstances that are exposed to a hazard. The hazards may be meteorological in a source such as severe storms, cyclones, droughts, and snowstorms, or maybe earth processes such as volcanic eruptions, earthquakes, tsunamis, etc., or a mixture of both as in the case of floods (Andrew, 2019).

All these events are location-dependent in the sense that a hazard is made more severe by the geological, topographical and land cover at the location of the hazard. Similarly, natural hazards turn into disasters when they affect societies. The amount of damage is dependent on the population concentration, infrastructure and available means for mitigation such as appropriate zoning and hazard mapping, flood control dams and evacuation facilities (Kirlin and Kirlin, 2020).

spatially dispersed information layers. This information can be useful for digital computer systems such as Geographic Information Systems (GIS). The study presented a discussion on the use of GIS for disaster management. Also, the study adopted an exploratory methodology broadly revising the available literature including research papers, policy documents and reports in relevant fields. This paper concluded that GIS is an important technology for all aspects of emergency management, mitigation, response and recovery. It recommended that the latest GIS technologies should be provided for collaboration, coordination and enhanced effectiveness of data synergy in managing disasters.

Keywords: Geographic Information Systems, Disaster and Management.

To comprehend the impact of diverse disasters, it is indispensable to understand the interactions and interrelationships among these varied and complex entities exposed to a given magnitude of the risky event (Peiris, 2020). This is made possible as a result of GIS deployment which aids and enhances hazard events mitigation.

The use of GIS become necessary and it spreads to the spatial analytical capabilities in locating affected areas. The strength of GIS (Joshi and Ashok, (2021) lies in the ability to represent real-world situations closely with layers of information (maps) that can be combined in a predetermined manner to identify the impacts of a natural hazard by the risk and disaster managers through the introduction of hazard dimension.

In addition, GIS has advanced significantly with the advent of voluminous data handling capabilities that facilitate synthesizing information from many different data sources. It has become an indispensable tool for managing complex information related to both societal and environmental functions (Kapucu, 2020). Brumarová (2021) reiterated that risk managers however require access to call support for GIS devices that allow them to understand the dreadful nature or hazard dimension.

In short, it is paramount that disaster and risk managers learn and comprehend the complex nature of information emanating from GIS databanks to enable them to relate it to a real situation on the ground. The study advanced by Jebur, (2021) emphatically declared that risk management requires the designed GIS databases to integrate and coordinate information/records for risk measure, analysis, model, planning, decisions and action. It is on this premise that this paper intends to highlight the use of GIS in disaster management discipline to showcase the enormous benefit of GIS technology developments in understanding risk efficiency, cost savings, improved analysis, effective planning and better decision making.

Understanding geographic information system (GIS) and disaster management system

Geographic Information System

Although numerous Geographical Information Systems (GIS) definitions were advanced by different scientists and institutions. The study of Peiris (2020) echoed on process, functions, oriented and organization-based definition which defined GIS as a methodology used to capture, store, manipulate and display of geospatial information using computer hardware and software. In addition, the study by Peiris (2020) emphatically spelt out the known basic five geographical information system components as hardware, software, data, users, and methods. In furtherance of the GIS components description, the work of Peiris (2020) supported by that of Joshi and Ashok, (2021) elucidated as follows:

i. Hardware is the computer on which a GIS operates. Hardware in GIS Computers should essentially possess a central processing unit with high-speed data processing ability (CPU), high-capacity random access memory (RAM), and hard disk (HDD) with high storage capacity. According to Tomaszewski, (2020) input devices necessary to transform geographical data into digital data to feed them into the computer like magnetic disks, digitizing tablets/boards, scanners, on-screen digitizers as well as output devices such as monitors and printers should be adequately in place.

ii. Software in Geographical Information Systems should essentially be the unique type which provides the functions and tools needed to store, analyze and display geographical data and information. A database management system (DBMS), geographic query, analysis, and visualization tools, graphical user interface (GUI) for easy access to tools are some of these tools needed ((Jebur, 2021). A few such software types are ArcGIS, QGIS, MapInfo, Arc View GIS, Intergraph, Global

TIJBEES E-ISSN 3027-1606
P-ISSN 3027-0049

Mapper, GRASS, SAGA GIS, ILWIS, and IDRISI (Srikantha, 2020). Nonetheless, Arc GIS is the latest, sophisticated and complete software system for composing, serving and victimization geographic data. It is an integrated collection of GIS software products for desktops, servers or custom applications, and builds and deploys a whole GIS wherever needed on the web or within the field (Andrew, 2019). Various categories of Arc GIS are shown below for further understanding as advanced by the Environmental System Research Institute, Incorporation.

Desktop GIS	Mobile GIS	Server GIS	Online GIS	ESRI Data
ArcGIS Desktop **ArcGIS Engine** **ArcGIS Explorer**	ArcGIS Mobile Arc Pad	ArcGIS Server ArcGIS Image Server	ArcGIS Online	Community data Street Map premium ESRI data & maps

Environmental System Research Institute (ESRI), 2020.

iii. Data which is the most important component of a GIS should include Spatial Data relating to geographical features that can be presented by coordinates. (E.g. distribution of crops, location of a country, roads, rivers, cities) as well as Aspatial Data, that is, attribute data relating to spatial data. (E.g. Size of population, land extent under crops, length of a road). In addition, the study of Kapucu (2020) stressed that data in GIS are stored in Vector

Data format which all the geographical features are represented as points, lines and polygons. (E.g. Points:

Buildings, a well, Lines: Roads, Rivers or canals, Polygons: Reservoir, Cropped area that possesses an area) or Raster Data format which map area is transformed into columns and rows. The squares or pixels are given numerical values. (E.g. Satellite images, Aerial photographs).

iv. People/Users which consist of skilled personnel like operators, technicians, data analysts, systems engineers and management personnel are key GIS dependent. The efficiency of the Geographical Information System rests on the availability of the persons skilled in these fields.

E-ISSN 3027-1606
P-ISSN 3027-0049

v. Application of suitable GIS methods should be a priority as diverse methods are offered. A successful GIS operates according to a well-designed plan and business rules, which are the models and operating practices unique to each organization (Jebur, 2021).

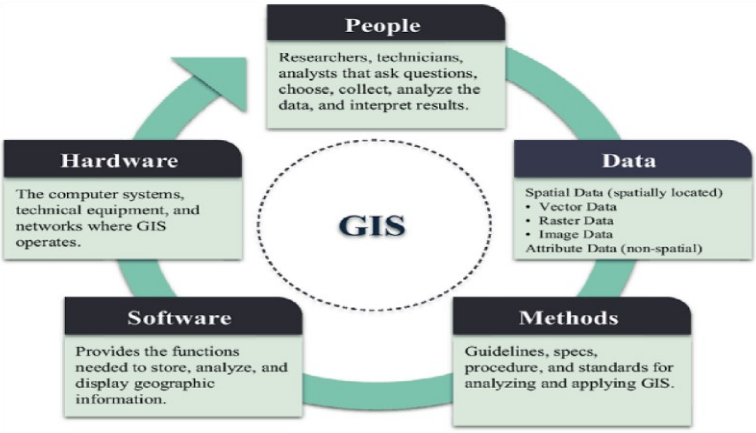

Figure 1: Components of GIS
Source: Peiris (2020)

Disaster

A disaster is an event that has unfortunate consequences that society cannot handle. Disaster occurs when there is a serious disruption to the functioning of a community that exceeds its capacity to cope using its resources. Disasters can be caused by natural, man-made and technological hazards, as well as various factors that influence the exposure and vulnerability of the community (Andrea, Radovan, and Ágoston, 2018). It is worthwhile to conclude that disaster is a time when there are no predictions.

However, in recent decades there has been an unprecedented increase in the incidence of frequent human disasters (Andrew, 2019). The case of flood, landslide and wildfire disasters across the globe recently due to climate change is a result of many of man negative activities that affect the environment which those not exclude Africa and Nigeria respectively. Global warming experts issued impeccable warnings of such immense consequences.

For several years now nations, Nigeria inclusive have suffered from one or more of several natural disasters. Those are floods, landslides, droughts, lightning, coastal erosion, wildfire, earthquakes and tsunamis. This has also resulted in the loss of lives and properties. It was estimated that more than

TIJBEES E-ISSN 3027-1606
P-ISSN 3027-0049

64,000 individuals are killed by natural or human-caused disasters that have affected the economy, society and the surroundings. Over the past 10 years, several billions of US dollar has been lost as a result of 35 major catastrophic events in the world (ESRI, 2020).

These catastrophes happen in no time and most times without serious indication of it happening and are ultimately unstoppable. The crucial and foremost action left for concerned authorities is to manage its occurrence decisively, Federal Emergency Management Agency (FEMA, 2018). Conversely, failure to create and apply an action plan in the event of a disaster by stakeholders could lead to wanton damage to lives and properties.

Disaster Management System

Disaster management is the organization, planning and application of measures preparing for, responding to and recovering from disaster. Disaster management may not completely avert or eliminate the threats; it focuses on creating and implementing preparedness and other plans to decrease the impact of disasters and build back better (Adeniyi and Ifeoluwa, 2021). The eminent resultants of these disaster's effects are severe harm, injuries, loss of properties or deaths (Srikantha, 2020). It is on this evidence that disaster management discipline outlined or designed processes by applying science, technology, and management to address extreme events. This promoted authorities and concerned experts to promulgate a disaster management process which is majorly divided into mitigation, preparation, response and recovery pillars or stages since the goal of disaster management is to prevent or reduce loss. In furtherance of its propagation, National Geographic for Resource Educators (2018) supported by (ESRI (2020) elucidated the stages:

i. Disaster mitigation which is an effort to reduce the impact of hazards. It includes whole activities that eliminate the urgency, advancement of policies and laws, design of risky areas and implementation of the mandatory mechanisms to scale back impact.
ii. Preparedness which are actions that are taken before the disaster of plans as well as activities to handle things wherever mitigation is too little. Warning systems and repositioning, identification of emergency areas, coordinating departments, agencies, human resources, and

TIJBEES E-ISSN 3027-1606 P-ISSN 3027-0049

provision of shelters as well as security which answer when and where to base the emergency.

iii. Response which is an emergency or disaster following operations. These offer correct data on the exact location of the emergency on displacement, shelters and relief provisions.

iv. Recovery which is a phase that comes after a disaster. A systems model which all return to normal or better. These entail short or long-term rehabilitation, repatriation, retooling and reintegration (Tomaszewski, 2020), mapping the standing of the injury, data on broken basics, casualties or injuries, and impacts on the surroundings among others.

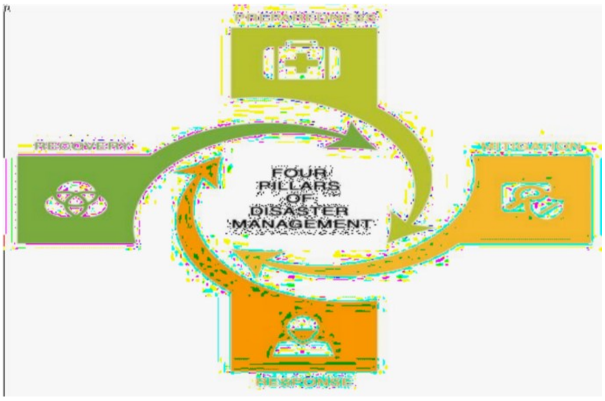

Figure 2: Disaster Management Phase
Source: ESRI (2020)

Geographic Information System (GIS) in Disaster Management

GIS is an advanced technology and plays a vital role in modern disaster management. This technology combines geospatial data with hardware and software that can analyze spatial, temporal and attribute data which is utilized to produce important disaster-related decision-making information (Sharma, Parkash and Joshi, 2018). The management's ultimate benefit from the use of GIS provides vital information for decision-making as regards disaster can't be over-emphasized. For its extent comprehension, disaster management is completed by following steps:

a. Planning and Analysis

GIS is the leading broad system for analyzing, modelling and demonstrating community vulnerability (Sharma, Parkash and Joshi, 2018). It provides a framework for planners and disaster managers to gain geospatial knowledge through computer-based maps through models. Models are processed to ascertain potential impacts and applicable mitigation needs as

E-ISSN 3027-1606
P-ISSN 3027-0049

they involve response, comprehensive preparation and mapping out infrastructure and disaster areas. In affirmation, Adeniyi and Ifeoluwa's (2021) study declared that the rudimentary for developing an associate degree emergency management program is to investigate the risks and risks required to cut back exposure, respond effectively, and recover quickly. The deployment of GIS tools in this area is of no doubt creating real situation awareness and accelerating the execution of emergency management programs.

b. Data Management

Emergency managers need to find sustainable and scalable ways to mitigate these increased risks and to minimize the loss of lives and livelihood when disaster hits. This is because natural disaster is complex events about which risks managers need accurate, reliable and timely data to respond effectively (Andrew, 2019). The data should cover needs in the area of crisis impact and the operational environment (Peiris, 2020). This is because a strong match between information needs and available data leads to enhanced situation awareness and enables adequate decision-making.

GIS provide a powerful data platform that allows information integration with alternative data systems needed by emergency managers. In addition, the correct classification of GIS data, knowledge and services, combined with your disaster management establishment's existing investments, provides a side of changing data into helpful data (Peiris, 2020). In general, the subsequent forms of knowledge or information required (ESRI, 2020) are data on devastating phenomena (e.g. landslides, floods, and earthquakes), their location, frequency, and magnitude; data on the surroundings during which harmful events might occur (i.e. topography, geology, geophysics, soil, hydrology, land use, vegetation); and data on the factors that may be destroyed within the event of an event (infrastructure, settlements, demographic and socio-economic knowledge). These are dire information desired by disaster managers for enhanced situation awareness and swift decision-making.

c. Situation Awareness

Situational awareness is the foundation of emergency and disaster management. Maintaining situation awareness is critical to response efforts. Manually collecting and sharing of data is slow, and the data is isolated and immediately out-of-date (ESRI, 2020). Using GIS helps to

E-ISSN 3027-1606
P-ISSN 3027-0049

provide powerful mapping and analytics capabilities that allow you to see what and where events are happening in real-time (prone areas, population density distribution within the disaster zone, villages with road property, hospitalization in disaster areas, and route map for disaster-prone areas) brief teams immediately, and make a better-informed decision.

d. Field Operations

Aside from the obvious office operations, the district's operations rely on information technology (IT) for data collection and analysis. This is ultimately achieved by using the power of location for data collection. GIS use the power of location to improve coordination and operational efficiency in field workforce activities (NGRE, 2018). ArcGIS field operation applications like Web Arc and Mobile Arc support the execution of the workforce to help users achieve success.

Authorized managers in the field, then plan, navigate, understand, capture and share data in a different way from the traditional paper-based. However, getting correct data from field operations to the command centre could be an intimidating and challenging task (National Drought Mitigation Center, 2018). Mobile Arc for instance solve the misery of getting incorrect data by providing support to gather an understanding of ground condition, correct, and dynamic data for execution. In a nutshell, GIS (Mobile Arc) provides maps that establish specific areas of victim clusters and establish the distinctive desires of people in these clusters by the use of various satellite mental imagery (remote sensing data).

Figure 3: Disaster Management Phases in GIS
Source: ESRI (2020)

Applications of Geographic Information Systems in Disaster Management

GIS is a comprehensive computer-supported cartographic application and mapping tool for spatial analysis from the vast data acquired. The data

E-ISSN 3027-1606
P-ISSN 3027-0049

acquired through the GIS is utilized to represent different issues (Flood, drought, earthquakes, soil erosion and landslides) as illuminated:

i. Floods

The geographic information systems are used to map out areas exposed to floods (as shown in Figure 4). It can pinpoint potential areas of flood-hit and its analysis can accurately predict future flooding (GRE, 2018). GIS act to get special data for effective disaster management flooding of the affected areas.

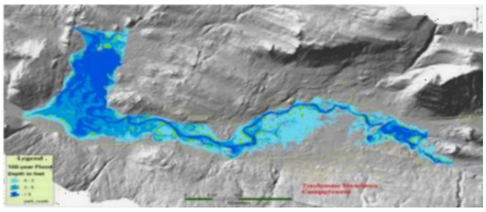

Figure: 4 Area Exposed to Flood

Source: Geography Resource for Educators (2018)

The GIS tool deployment aids in getting all relevant data within the event of a flood disaster and helps in designing flood disaster management demarcations: mitigation, preparedness, response, and recovery (ESRI, 2020). The activities which involve mapping flood-prone areas, flood detection, evacuation planning and damage assessment are undertaken under each aforementioned demarcation aided by GIS technology.

ii. Drought

The geographic information systems techniques have been widely recognized as a useful tool to map out drought risk areas developed by integrating climatic, water and physical drought maps using matrix overlay functions (as shown in Figure 5 below). This was done with the aid of ArcGIS which processed numerous raw satellite images for special analysis.

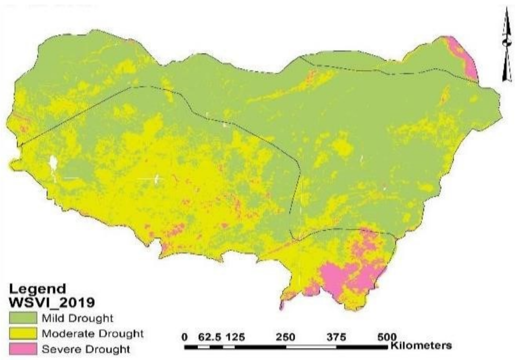

Figure 5: Drought Distribution Map in Northern Nigeria

Source: Adopted from Adeniyi and Ifeoluwa (2021)

E-ISSN 3027-1606
P-ISSN 3027-0049

Nonetheless, in the event of a drought disaster, GIS analysis helps in categorizing risk modelling, vulnerability analysis and weather forecasting, monitoring vegetation, and informing drought mitigation into mitigation, preparedness, response, and recovery disaster management demarcations (ESRI, 2020).

iii. Earthquake

Geographic information systems can be used to join the layers that are available for any area, to create an overlay that can be used and analyzed using the same system. Such overlays and their analysis and process of decisionmaking (Jebur, 2021) involve, among others, the selection of sites; make of simulation of environmental impacts such as creating a view of the perspective of the terrain; and planning of response emergency, such as link the network of the roads and information of earth science (as shown in figure 5) to explain the effects of a possible earthquake.

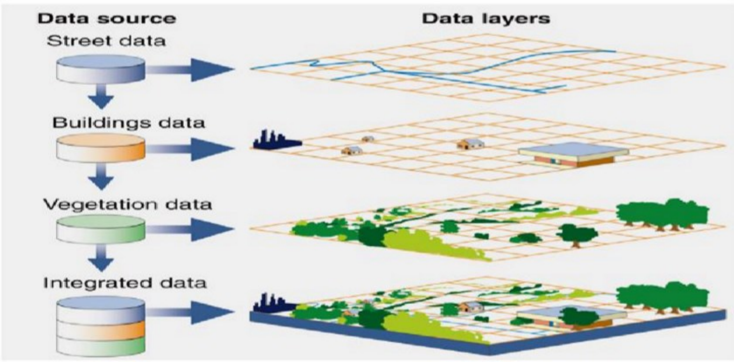

Figure 5: Data Layers

Source: Geography Resource for Educators (2018)

iv. Soil Erosion

GIS tools are increasingly being used in disaster Management, including erosion disaster management. GIS technology provides a platform for the collection, storage, analysis, and visualization of data related to soil erosion and other natural disasters. These tools can also be used to create maps that show the location of erosion-prone areas and the extent of damage caused by erosion. These maps can be used to develop effective erosion management strategies and to guide emergency response efforts. This information can be used to develop policies and regulations that help prevent erosion and protect vulnerable areas. For instance, the study of Iko-Ojo1, Joshua and Akoji, 2020 which aimed to perform geomorphological and GIS analysis to map gully erosion susceptibility in Taraba State is depicted below:

E-ISSN 3027-1606
P-ISSN 3027-0049

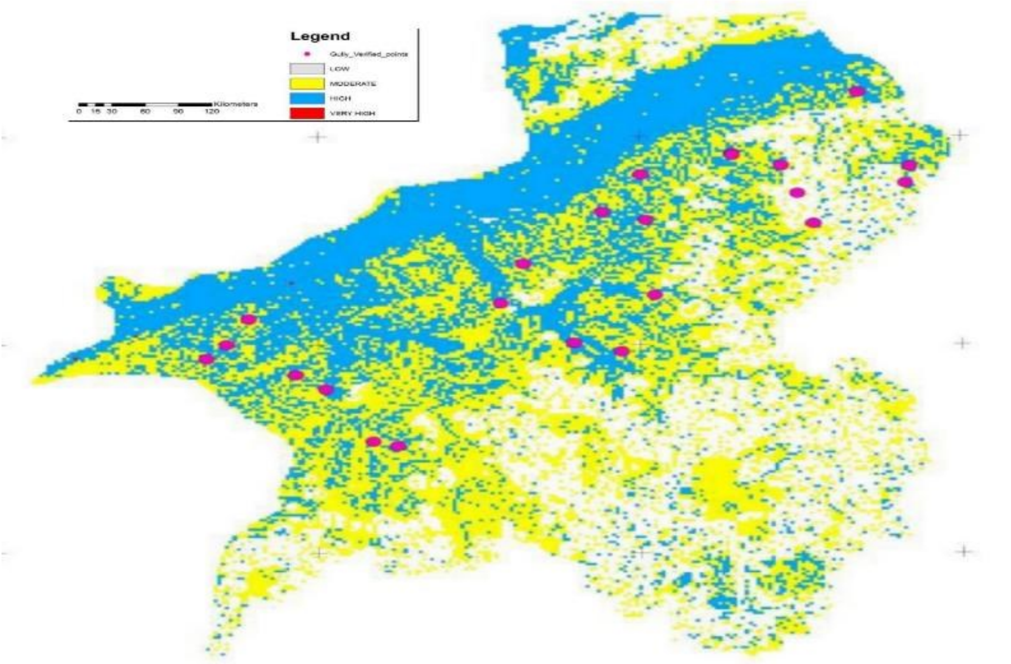

Figure 6: Erosion Susceptibility Map

Source: Iko-Ojo1, Joshua and Akoji (2020)

v. Landslide

GIS maps are used to identify high landslide hazard areas and hazard frequencies. GIS is one of the most effective tools in such a situation to get results with good accuracy (Kapucu, 2020). The use of GIS software like ILWIS helps in landslide hazard zone zoning mapping assessment. It is a useful tool for landslide risk analysis and a very fast and accurate tool for processing, analyzing and representing spatial data (Kirlin and Kirlin, 2020). Also, it is used to estimate the landslide risk of an area: past landslides and their distribution, bedrock properties, area slope, area hydrology, and human factors. In another development, the utilization of this software in risk zoning helps determine the land use potential of the area, show the risk for current land use development, show the area at risk of landslides, and help predict future landslides based on surveys. This is done by importing the base map into ILWIS software, and then, converting it to ILWIS data format. In a nutshell, GIS software is used to interconnect satellite data and infrastructure making risk zonation maps possible. Nonetheless, landslides can be managed by identifying and avoiding unstable slopes, moving out people or buildings, and improving drainage and artificial channels to redirect debris flow (Srikantha, 2020). This analysis is finally represented as the GIS model shown below depicting landslide susceptibility Buruku area of Jos South, Northern Nigeria.

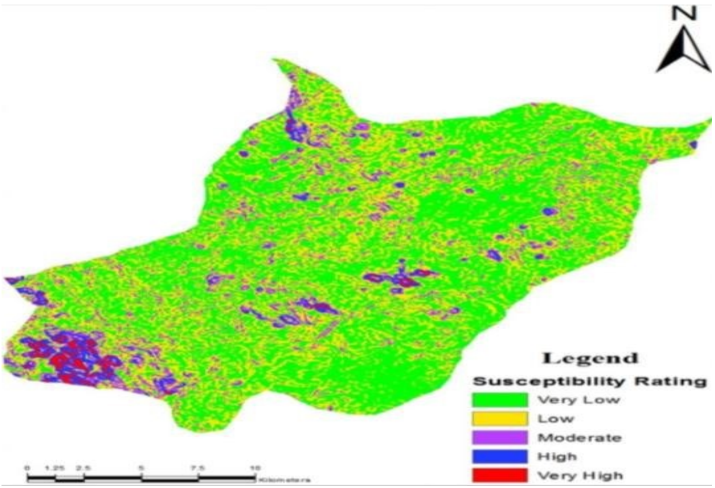

Figure 7: Landslide Susceptibility Map
Source: Akinwumiju (2018).

Methodology

This study was accomplished by reviewing the available published works of literature, case studies, and different governmental and non-governmental organizations' information from reports and official websites. Scientific literature was collected through electronic means from the database of Environmental System Research Institute
(ESRI) Science Direct, Springer, Academia, Mdpi Web of Knowledge, Geographic Book, Research Gate, and Google Scholar in a systematic manner. From a large number of studies, this study compiles and presents the data and information which are relevant to the discussions on the use and understanding of Geographic Information Systems and meets the study goals.

Conclusion and Recommendations

The importance of GIS for natural disaster management is relevant in two major aspects; the analytical ability for decision making and the data combination capacity. The pair aspects allow the unified analysis of large quantities of different data in each disaster stage. The use of GIS for natural disaster management involves numerous uses of software in solving several disaster issues like flood, drought, earthquake, landslides, wildfire etc. on widely recognised phases. Considering these aforementioned disasters and

E-ISSN 3027-1606
P-ISSN 3027-0049

their phases, new applications of GIS for natural disaster management have surfaced in recent years due to a determined attempt to decrease disaster losses. However, many of these applications are only utilized with one sort of disaster at one level and for one or two stages of disaster management. Moreover, some GIS uses aim to conclude by generating susceptibility, hazard, vulnerability or risk maps instead of incorporating these maps with all other data for genuine disaster management. Due to the outcome of these problems, emergency managers do not usually use hazard and risk maps and a lot of determined attempt at disaster mitigation and prevention is certainly lost. Therefore, it is concluded that:

1. the use of GIS is an important technology for all aspects of emergency management, mitigation, response and recovery.
2. the concerned authorities are at the helm of affairs to create an enabling atmosphere for real decision-making mechanisms for disaster managers to achieve the ultimate goal of managing disaster events.
3. GIS is the central platform for the information for the functionality of a GIS-based system in each disaster management phase.

   The study, therefore, recommended that:

   1. The latest GIS technologies should be provided for collaboration, coordination and enhanced effectiveness of data synergy in managing disasters.
   2. The authorities' concerned research should concentrate on the ideal ways of producing susceptibility, vulnerability, hazard and risk maps considering that they need to be more understandable and transparent for decision-makers.
   3. Unrelenting efforts should be made to integrate these maps with land use, cadastral, and social-economic information for the functionality of a GIS-based system in each disaster management phase in which GIS is the central platform.

References

Adeniyi, I.H. and Ifeoluwa. B. (2021). An Assessment of Drought in Northern Nigeria using Spatiotemporal Remote Sensing Data. Proceedings of the 70th International Astronautical Congress (IAC), Washington D.C., United States, 21-25 October 2019. : https://www.researchgate.net/publication/338543045

Andrea, M., Radovan, H. & Ágoston, R. (2018). GIS Applications in the Disaster Management – an Overview *Fire Protection & Safety Scientific Journal*, 12(1), 44 – 81. https://doi:10.17423/delta.18.12.1.37.

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/10.1177/1078087408323941.

Brumarová, L. (2021). Use of Geographic Information Systems in Crisis Management. *Earth and Environmental Science*, 900 (21), 012004. https://doi:10.1088/1755-1315/900/1/012004.

ESRI (2020). Emergency Management Respond: Situation Awareness. Emergency Management. https://www.esri.com/en-us/industries/emergency-management/solutions/situation-awareness.

Federal Emergency Management Agency (FEMA). Natural Disaster Management. Trends in Disaster Mitigation in Contemporary World. http://www.fema.gov/.Ingleton,J.Ed2018.

Iko-Ojo1, I. V., Joshua, M. M. & Akoji, I. F. (2020). Geomorphology and GIS Analysis for Mapping Gully Erosion Susceptibility in Taraba State, Nigeria. *International Journal of Trend in Scientific Research and Development*, 4 (5), 2456 – 6470. www.ijtsrd.com e-ISSN: 2456 – 6470.

Jebur, A. K. (2021). Uses and Applications of Geographic Information Systems. *Saudi Journal of Civil Engineering*, 5(2), 18-25 https://doi:10.36348/sjce.2021.v05i02.001.

Joshi, V., & Ashok, K. S. (2021). Geographical Information Systems for Disaster Response and Management. National Institute of Disaster Management. https://wwwacademia.edu/20081132.

Kapucu, N. (2020). Disaster and Emergency Management Systems in Urban Areas. *Network Governance Review*, 2 (9), 41-49. https://doi/10.1016/j.cities.2011.11.009.

Kirlin, J. J. & Kirlin, M. K. (2020). Strengthening Effective Government-citizen Connections through Greater
Civic Engagement. *Journal of Public Administration Review*, 62(7), 80–85. https://www.jstor.org/stable/3110175.

National Drought Mitigation Center, (NDMC) (2018). What is Drought? Understanding and Defining Drought. http://drought.unl.edu/whatis/concept/

National Geographic for Resource Educators (NGRE) (2018). Geographic Information System. Technology and Innovation Resource Article. http://education.nationalgeographic.org/resources/geographic-information-systemgis.

Oluwafemi,O. A., Yakubu, T.A., Muhammad, M.U., Shitta, N. & Akinwumiju, A. S. (2018). Mapping Landslides Susceptibility in a Traditional Northern Nigerian. Proceedings of International Cartographic Association, 4(6), 185. https://doi.org/10.519/ica-proc-1-85-2017.

Peiris, S. (2020). Geographical Information System (GIS) for Disaster Management. International *Network Review Research*. 4(9), 70- 90. https://www.researchgate.net/publication/345179571.

Sharma, A. K., Parkash, S. & Joshi, V. (2018). An Evaluation of Geographical Information Systems for Disaster Response and Management. National Disaster Management Centre. http://www.academia.edu.com.

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.

Tomaszewski, B. (2020). Geographical Information System (GIS) for Disaster Management. *Geography politics and International relations Research,* 46 (12), 43- 56. https://doi.org/10.4324/9781351034869.