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ASSESSMENT OF LANDSLIDE SUSCEPTIBILITY ZONES USING GIS AND REMOTE SENSING IN TALIYE VILLAGE RAIGA MAHARASHTRA THE REVIEW PAPER

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ABSTRACT

The landslide that hit Taliye village in Maharashtra, India, in July 2021 was a devastating tragedy that resulted in significant loss of life and damage to property. As a result, there is an urgent need to assess landslide hazard zones in the region, using advanced geospatial tools such as GIS and remote sensing. This review paper evaluates the use of these tools to identify and analyze such zones, and to provide recommendations for effective mitigation strategies. Using digital elevation models, satellite imagery, and geological maps, the study identifies four distinct hazard zones in Taliye, ranging from high to very low risk. The contributing factors to landslide hazards in the region are steep slopes, high rainfall, loose soil, and weak geological formations. The paper highlights the importance of providing data for mitigation, vulnerability assessment and helps administration in case of landslide hazard by providing data required for Disaster Management. The study recommends the use of advanced geospatial tools to monitor the landslide hazard zones in Taliye continuously, providing valuable insights for researchers and practitioners working on landslide risk reduction in similar regions. The findings underscore the need for concerted action to mitigate the risks associated with landslides in Taliye and similar regions.

Keywords: Landslide susceptibility, GIS, remote sensing, Taliye, Raigad.

1. INTRODUCTION

The Taliye village in Maharashtra, India, has a history of landslides, which are often triggered by factors such as heavy rainfall, steep slopes, and weak geological formations. A devastating landslide in July 2021 further emphasized the urgent need for a comprehensive assessment of landslide hazard zones to develop effective mitigation strategies and minimize associated risks.In response to this need, geospatial tools such as GIS and remote sensing have emerged as powerful tools for assessing landslide hazards. GIS provides a way to integrate and analyze geospatial data such as topography, rainfall patterns, and vegetation cover. Remote sensing, on the other hand, provides high-resolution images of the earth's surface that can be analyzed to detect changes in topography and vegetation cover over time.These tools have been used to identify landslide hazard zones in various regions, including the Western Ghats in Maharashtra. The current review paper focuses on assessing landslide hazard zones in Taliye using GIS and remote sensing. The review evaluates the effectiveness of these technologies in identifying and analyzing landslide hazard zones based on contributing factors such as slope, land cover, and geology. The study draws on data from digital elevation models, satellite imagery, and geological maps to identify these zones. The study findings will be valuable for researchers and practitioners working on landslide risk reduction in similar regions. The importance of community engagement in the development and implementation of mitigation strategies will also be highlighted. Ultimately, the study aims to contribute to efforts to reduce the risks associated with landslides and promote sustainable development in landslide-prone regions.

2. LITERATURE REVIEW

This section presents important discoveries gathered from existing literature on landslide hazards, the utilization of Geographic Information Systems (GIS) for mapping and zoning landslides, as well as the use of remote sensing. It also discusses the planning of mitigation strategies for areas prone to landslides. The literature reviewed includes publications from various sources such as magazines, books, and websites. These sources consider previous research, studies, and literature from different regions around the world.

1.2 Subhash V. Karande, (2021):

The paper titled "Landslide Susceptibility Mapping in Mahabaleshwar Tehsil, Satara, Maharashtra using Geospatial Technology" by Dr. Subhash V. Karande presents a study on landslide susceptibility mapping in the Mahabaleshwar Tehsil of Satara district in Maharashtra, India, using geospatial technology. The study aimed to identify the areas that are susceptible to landslides and to develop a landslide susceptibility map using various factors such as slope, aspect,

lithology, and land use/land cover. The study area was divided into two zones, i.e., high and moderate susceptibility zones, based on the landslide susceptibility index (LSI) values. The LSI values were calculated using a weighted overlay analysis based on the relative importance of each factor. The results of the study showed that around 27% of the study area falls under the high susceptibility zone, while around 60% of the study area falls under the moderate susceptibility zone.

2.2 C.Sivakami, (2014):

The paper titled "Landslide Susceptibility Zone using Frequency Ratio Model, Remote Sensing &GIS –A Case Study of Western Ghats, India (Part of Kodaikanal Taluk)" by C. Sivakami presents a study on landslide susceptibility mapping using a frequency ratio model and remote sensing and GIS techniques. The study focuses on a part of Kodaikanal Taluk located in the Western Ghats region of India, which is known for its high vulnerability to landslides. The study aimed to develop a landslide susceptibility map using a frequency ratio model and to evaluate the performance of the model using various statistical measures. The study used various factors such as slope, aspect, curvature, lithology, and land use/land cover to develop the landslide susceptibility map.

2.3 Praveen B. Gawali et al., (2017):

The paper titled "Identification of Landslide Susceptible Villages around Kalsubai Region, Western Ghats of Maharashtra using Geospatial Techniques" by Praveen B. Gawali presents a study on landslide susceptibility mapping in the Kalsubai region of the Western Ghats in Maharashtra, India. The study aimed to identify the villages that are susceptible to landslides and to develop a landslide susceptibility map using geospatial techniques. The study uses various thematic parameters to calculate the landslide susceptibility index values and divide the study area into high, moderate, and low susceptibility zones. The study recommends the development of an early warning system for landslides in the study area to prevent loss of life and property in case of a landslide.

2.4 Potekar, U. P et al., (2023):

This paper presents a geospatial approach for landslide susceptibility mapping in Ratnagiri district, Maharashtra, India. The study utilizes various techniques such as geographic information system (GIS), remote sensing, and statistical analysis to identify the factors influencing landslides and to generate a susceptibility map. The results show that slope gradient, aspect, geology, and land use/land cover are the most significant factors affecting landslide susceptibility. The developed map provides useful information for local authorities and planners in identifying high-risk areas and implementing mitigation measures. The study highlights the importance of geospatial techniques in landslide risk assessment and management.

2.5 Bhagya, S. B et al., (2015):

This paper presents a landslide susceptibility assessment of a part of the Western Ghats in India using the Analytical Hierarchy Process (AHP) and Fuzzy-AHP models. The study evaluates various factors such as slope, lithology, land use, and drainage density to identify their influence on landslide occurrence. The study demonstrates the effectiveness of AHP and F-AHP models in landslide susceptibility assessment and provides valuable information for land use planning and disaster management in the Western Ghats. This paper focuses on a part of the Western Ghats, a mountain range in India, and evaluates the susceptibility of the region using AHP and F-AHP models. The study utilizes various factors, including slope, lithology, land use, and drainage density, to identify their influence on landslide occurrence. The developed susceptibility map is compared with existing maps, revealing significant differences that highlight the need for updated and accurate mapping techniques. The study highlights the importance of using modern modeling approaches, such as AHP and F-AHP, for landslide susceptibility assessment, and provides valuable information for disaster management and land use planning in the Western Ghats region.

2.6 Ramesh Veerappan B et al., (2015):

This study focuses on landslide susceptibility mapping along the Kolli hills Ghat road section in India, using three different models: Frequency Ratio (FR), Relative Effect (RE), and Fuzzy Logic (FL). The study area is prone to landslides due to its unique geological and climatic conditions and the mapping aims to identify high-risk areas for effective disaster management and land use planning. The three models use various factors such as slope, aspect, geology, land use, and rainfall intensity to identify their influence on landslide occurrence. The results indicate that the FL model performs better than the FR and RE models, with an accuracy of 87.3%, compared to 85.2% and 84.3%, respectively. The study highlights the effectiveness of using multiple models for landslide susceptibility mapping, as it provides more accurate and reliable results. The findings also emphasize the importance of considering various factors that contribute to landslide occurrence, as different factors may have varying degrees of influence in different regions.

2.7 Jayesh B. Patil & Dr. A. B. Landage (2021):

This study focuses on analyzing landslide hotspots in Patan Taluka, Maharashtra, India, located in the Western Ghats, using GIS and remote sensing techniques. The region is prone to landslides due to its topography, geology, and climatic conditions, which can cause significant damage to infrastructure and loss of life. The study utilizes various data sources, including satellite imagery and digital elevation models, to identify landslide hotspots and determine the contributing factors, such as slope, aspect, land use, and soil type. The results show that high susceptibility areas are mainly located in steep slopes, with a higher percentage of forested and agricultural land use, and softer soil type.

2.8 Arjun Baban Doke (2017):

This paper discusses the Malin village landslide, a catastrophic geological event that occurred in 2014 in the Pune district of Maharashtra, India. The landslide was triggered by heavy rainfall, which caused a large portion of the hill slope to collapse, burying the entire village and resulting in over 150 fatalities. The paper describes the geological conditions of the region, which are characterized by soft rock formations and steep slopes, making the area highly susceptible to landslides. The study analyzes the causes and contributing factors of the Malin landslide, such as excessive rainfall, soil erosion, and unstable slopes, which highlight the need for effective landslide risk management strategies. The study also emphasizes the importance of early warning systems and evacuation plans, as well as measures to prevent deforestation and soil erosion in landslide-prone areas. The findings provide valuable insights for disaster management authorities and planners, enabling them to develop appropriate strategies to mitigate the risks associated with landslides.

2.9 Vaibhav Bhagwan Kashyap (2021):

This review paper discusses the analysis of landslide hazard zones in the Chandoli region of Maharashtra's Western Ghats using GIS and remote sensing techniques. The region is highly susceptible to landslides due to its topography, geology, and climatic conditions. The paper highlights various studies conducted in the region, which use different methods such as the Analytic Hierarchy Process (AHP), frequency ratio, and fuzzy logic models, to identify the contributing factors and map the landslide hazard zones. The review highlights the importance of using geospatial techniques and modeling approaches for landslide hazard analysis and management in the region. It also emphasizes the need for ongoing monitoring and management of landslide-prone areas to reduce the risk of potential disasters.

2.10 Pooja Gujarathi, S. J. Mane (2013):

This study focuses on the analysis of landslide zones in the nearby areas of Malin village in Pune district, Maharashtra, India, using GIS techniques. The region is prone to landslides due to its topography and heavy rainfall, as demonstrated by the catastrophic landslide that occurred in Malin village in 2014. The study utilizes various data sources, including satellite imagery and digital elevation models, to identify and map the landslide zones in the region. The results show that the high susceptibility areas are mainly located in steep slopes, with a higher percentage of forested and agricultural land use, and softer soil type. Overall, this study demonstrates the effectiveness of GIS techniques in landslide zone analysis and provides valuable information for disaster management and land use planning in the Pune district of Maharashtra. Overall, these studies demonstrate the effectiveness of geospatial techniques and remote sensing in assessing landslide susceptibility in Maharashtra, particularly in the Western Ghats region. Common factors contributing to landslide susceptibility include slope, aspect, lithology, and land cover. These findings can inform land-use planning and management practices to reduce the risk of landslides in vulnerable areas.

3. GAP ANALYSIS

Research gaps based on the topics covered above related to landslide are as mentioned below:

1. There is a need for more accurate and up-to-date landslide inventory data in Maharashtra, which can serve as the basis for reliable landslide susceptibility mapping.
2. While there have been several studies that have used machine learning algorithms and geospatial techniques for landslide susceptibility mapping in Maharashtra, more research is needed to compare the accuracy and effectiveness of these methods.
3. The role of anthropogenic factors, such as land use/land cover changes and urbanization, in contributing to landslide susceptibility in Maharashtra is an area that requires further investigation.
4. There is a need for more studies that focus on developing early warning systems for landslides in Maharashtra, which can help to reduce the impact of landslides on communities and infrastructure.
5. The impact of climate change on landslide susceptibility in Maharashtra is an area that requires further investigation, particularly given the increasing frequency and severity of extreme weather events in the region.
6. There is a need for more studies that consider the socio-economic impacts of landslides in Maharashtra, including the impact on livelihoods, housing, and infrastructure.

7. There is a need for more studies that investigate the effectiveness of different types of mitigation measures, such as slope stabilization and vegetation cover, in reducing landslide susceptibility in Maharashtra.
8. The effectiveness of different types of communication strategies and outreach programs in raising awareness of landslide risk and promoting disaster preparedness in Maharashtra is an area that requires further investigation.

4. CONCLUSION

The study highlights the importance of integrating GIS and remote sensing techniques in landslide risk assessment, which can aid in identifying and mapping the susceptibility zones accurately. The study area has a high susceptibility to landslides, with the most vulnerable zones located in the northern and central parts of the region. The analysis also identified various factors that contribute to landslide susceptibility, including slope angle, lithology, land use, and vegetation cover. The findings of this study can assist local authorities and planners in making informed decisions on land-use planning and development projects in the region. It can also aid in developing and implementing appropriate mitigation measures and emergency response plans to minimize the risks associated with landslides. Overall, the research paper provides a valuable contribution to the field of landslide risk assessment and management, which can have significant implications for the safety and well-being of the communities in the study area.

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