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Flood Estimation Using GIS

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Abstract
The main necessity of flood estimation is for the requirement of more fast and detailed information about the location, area, and extent of the damage from a disaster to support response and recovery activities has led to a general usage of remote sensing and GIS, particularly in the disaster-related assessment The aim of work is to use GIS and remote sensing technology to map flood-prone areas in Chiplun, Maharashtra, is to provide planners and disaster management organizations with a practical and cost-effective way of identifying vulnerable areas.
Keywords:*, Geographic Information System, Remote Sensing, Chiplun, Vashisthi river,*

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I. INTRODUCTION

Geographic Information System, or in short GIS, is a computerized, knowledge-based system that allows one to store, retrieve and analyze geospatial data. It also allows one to make multi-criteria, logical and conditional queries to search, find and visualize a particular feature, or a set of features, pattern, attribute or changes of a geographic phenomenon that occurred over a time at any given location. The impact of GIS has been widely felt in all fields of studies that use geographic data (geospatial). A majority of large organizations are now using GIS and geospatial databases for planning, policy making and decision supports. A GIS stores information about the world as a collection of thematic layers that can be linked together by geography. This simple but extremely powerful and versatile concept has proven invaluable for solving many real-world problems from tracking delivery vehicles, to recording details of planning applications, to modeling global atmospheric circulation. These geographic references allow you to locate features, such as a business or forest stand, and events, such as an earthquake, on the earth's surface for analysis. Vector and Raster Models Geographic information systems work with two fundamentally different types of geographic models. . In the vector model, information about points, lines, and polygons is encoded and stored as a collection of x, y coordinates The vector model is extremely useful for describing discrete features, but less useful for describing continuously varying features such as soil type or accessibility costs for hospitals. The raster model has evolved to model such continuous features. Remote sensing and GIS technology has dramatically enhanced flood research, particularly in the all three phases of a flood. a) before floods (preparedness phase) b) during floods (monitoring phase), and c) after floods (damage assessment and mitigation phase). The study was carried out in the Basin of Vashisthi River, which is located in the Chiplun tehsil. Study area is located in the west side of India between latitudes 17°54'29.98"N to 17°23'0.01"N and Longitude 73°10'0.15"E to 73°45'0.00"E. Study area is located in the western coast of Maharashtra and east of Arabian Sea. Western Ghats of India receive highest annual rainfall in India. This hilly terrain acts as a hermetic to south west winds coming from AS leading to intensified downpour at the windward side of the mountains. This type of rainfall is known as ‗orographic rainfall'. , extra water from one of Maharashtra's largest dams, the Koyna Dam, which is located around 90 kilometers (56 miles) away, enters a reservoir near to Chiplun and mixes with the Vashishthi River. Therefore, if there is too much rain during the monsoons, the town becomes engulfedfrom all sides.

Necessity

The main necessity of flood estimation is to the requirement for more fast and detailed information about the location, area, and extent of the damage from a disaster to support response and recovery activities has led to a general usage of remote sensing and GIS, particularly in the disaster-related assessment. The flood region's features are extracted using remote sensing technology, which also provides information on potential disaster and event issues. For a wide range of civil engineering projects, including nearly all projects located near rivers, flood predictions are necessary in some capacity. Any structure will need an estimate of the risk that the river level will exceed and it will be helpful to design protection works.

Scope of Study

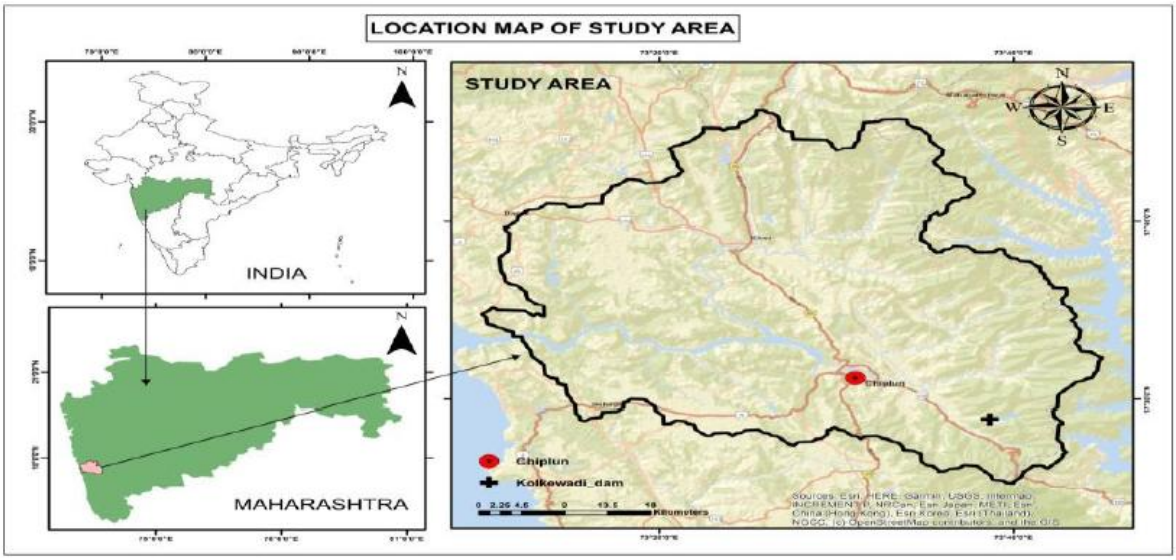
1. To Understand the Cause and Effect of the flash flood in Chiplun using GPM Analysis.
2. To use GIS and remote sensing technology to map flood-prone areas to provide planners and disaster management organizations with a practical and cost-effective way of identifying vulnerable areas.
3. Investigate the hydrological and physical parameter of flooding to prepare vulnerability map

II. Literature Review

Ajin. R. S.,et al.,(2013) In some areas, the Vamanapuram River Basin in Kerala State, India, provides a problem due to the risk of recurrent flash floods. The goal of the current study is to create a map of the flood hazard zones in the Vamanapuram River Basin based on the multi-criteria evaluation methodology. The weightage maps are produced by ranking and weighting various theme maps. In this study, the Flood Hazard Zone Map is prepared using the Weighted Overlay Analysis approach. The locations vulnerable to dangers will be displayed on the created hazard map as very low, low, moderate, high, and very high hazard zones. We can suggest actions to lower the danger of these risks in the Vamanapuram River Basin by creating the hazard zone map. **Karma tempa (2022)** Seven flood vulnerability (FV) indicators were taken into account in this study. The characteristics of historical floods can be broken down into five categories: number of flood events, number of fatalities, population affected, and infrastructure damages, including monetary losses. Two more variables that were taken into consideration were the maximum annual rainfall and the presence of a flood map. Flood danger and impact zonation were carried out using historical data. A multi-criteria decision model was developed using the analytical hierarchy process (AHP) methodology. **F. Dottori et al.,()** They offered a methodology for a thorough examination of flood susceptibility and vulnerability in this study. The approach is based on a mathematical index that replicates flooding processes by taking into account local topography and fundamental flood scenario details. The approach combines the geographic distribution of the map and curve index values that can be utilised to rank the susceptibility and carry out a vulnerability analysis in the relevant area. The findings demonstrate that the approach can offer a novel and useful understanding of flood susceptibility and vulnerability processes. In other words, the suggested methodology demonstrates that it is feasible to "compress" (i.e., cleverly synthesise) the information, delivering valuable information for susceptibility and risk assessment at a broad scale, with a decrease of the resources utilised.

Study Area

The study was carried out in the basin of Vashisthi river, which is located in the Chiplun tehsil. Study area is located in the west side of India between latitudes 17°54'29.98"N to 17°23'0.01"N and Longitude 73°10'0.15"E to 73°45'0.00"E (Fig -1). Study area is located in the western coast of Maharashtra and east of Arabian Sea. Western Ghats of India receive highest annual rainfall in India. This hilly terrain acts as a hermetic to south west winds coming from AS leading to intensified downpour at the windward side of the mountains. . The geography of the town is uneven and slopes toward the west. Chiplun's geography fluctuates from hilly to flat because it is situated near the Sahyadri mountain ranges' foothills. Lateritic and soft murrum soil types exist.



Global Precipitation Measurement (GPM) Analysis

GPM analysis outlines the Integrated Multi-satellite Retrievals for GPM's processing order and algorithm (IMERG). This algorithm aims to intercalibrate, merge, and interpolate "all" satellite microwave precipitation estimates, as well as microwave-calibrated IR satellite estimates, precipitation gauge analyses, and possibly other precipitation estimators at fine time and space scales for the TRMM and GPM eras over the entire planet. For each observation period, the algorithm is run multiple times; first offering a rough estimate and then progressively improving estimates as more data come in. The last step is producing research-level goods using monthly gauge data. To describe the context and the relationship to other missions with a similar mission, background information and references are given. A cloudburst was reported in Chiplun in the state Maharashtra, India on the late night of July 21, whichcaused flash flood in Chiplun.

III. Methodology

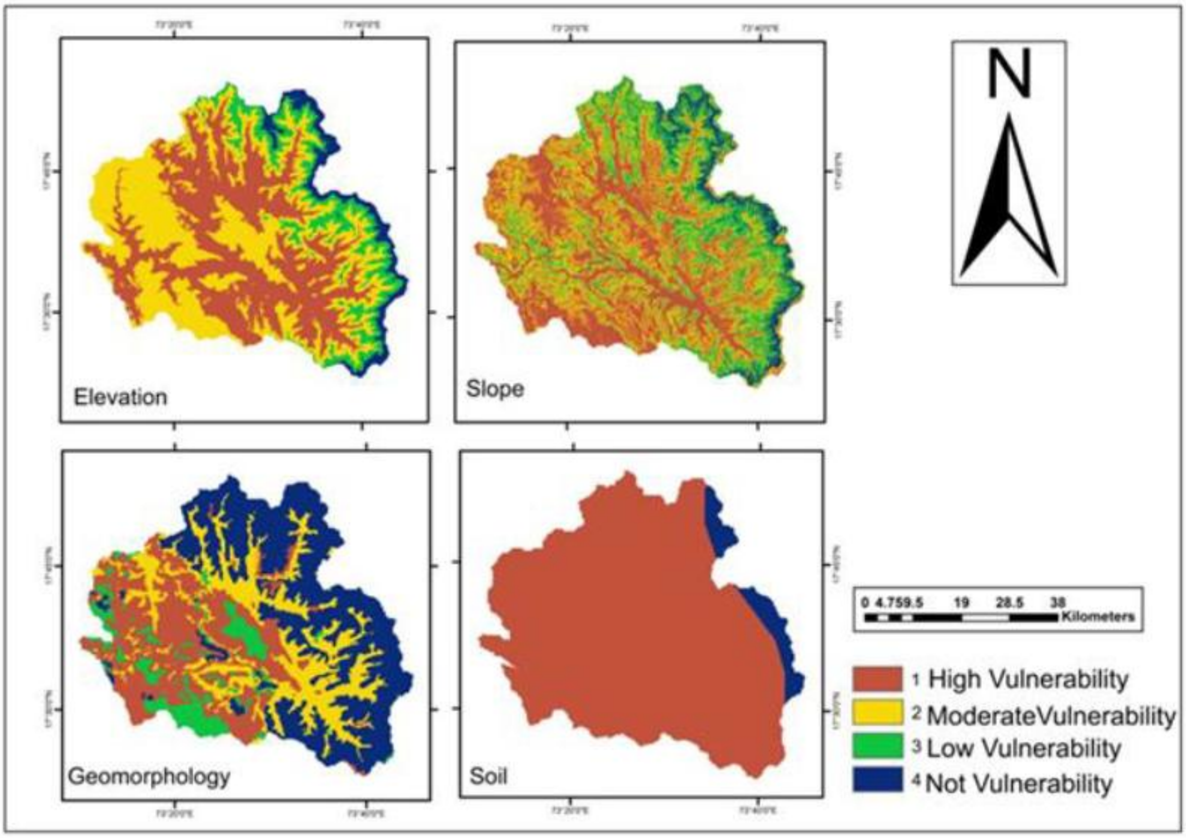
Methodology flow chart consist of following steps

2. To select and locate study map of Chiplun area using GIS.
3. To generate spatial thematic maps such as slope, Elevation, watershed, Drainage density, Geomorphology and Soil map of study area.
4. To analyze Landsat 8 imagery in order to create a map of the Vashishthi watershed's land use land cover (LULC).
5. Investigate the hydrological and physical parameter of flooding to prepare vulnerability map.
6. Weighted Overlay tool is used to integrate all the thematic layer to prepare final Flood vulnerability

IV. RESULT AND DISCUSSION

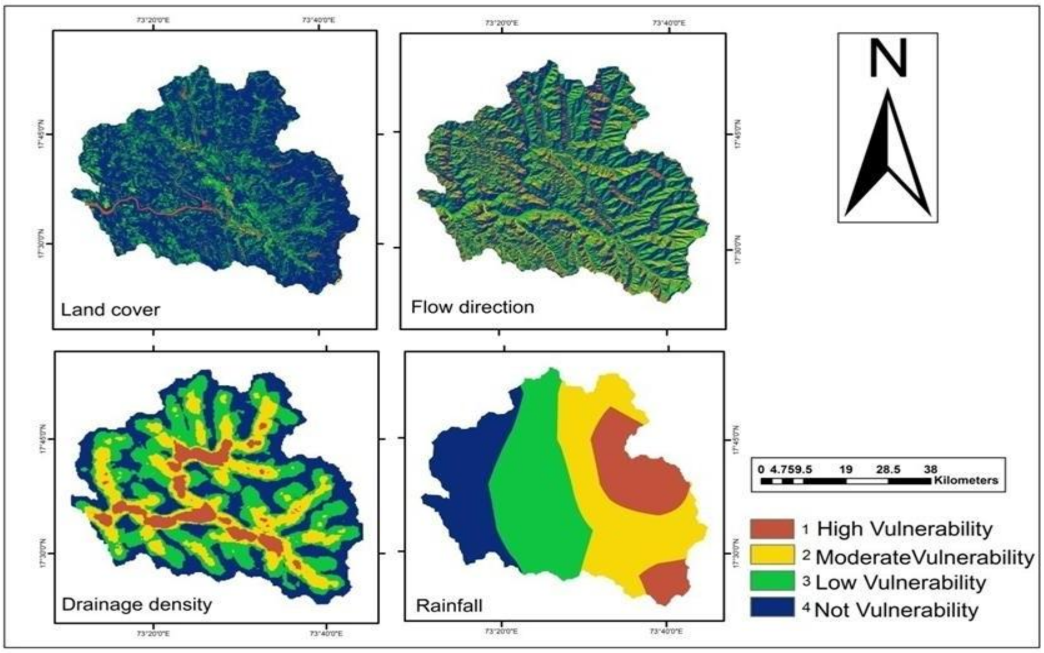
(a) Physical vulnerability

Composite vulnerable index is categorized into four vulnerable classes, e.g., ―high,‖ ―moderate,‖ ―low‖ and ―Not‖ corresponding to the numerical ranks 1, 2, 3 and 4, respectively. The vulnerability varied from lower in the east to higher in the west. Thus, the vulnerability to flooding decreases as the elevation increases. The east of the basin was the most vulnerable to flooding; this is due to the fact that it is characterized by low elevation and flat areas with slopes inferior to 0°. Low soil vulnerability had 5% (116.37 km2) in silty clay loam and high soil vulnerability had 95 % (7792.4 km2) in clay. High geomorphology vulnerability with29% (630.1 km2) was found in WatBod – Lake, StrOri - Moderately Dissected Lower Plateau, Mud Flat, WatBod – River, Creek Network, Dam and Reservoir, WatBod – Pond.

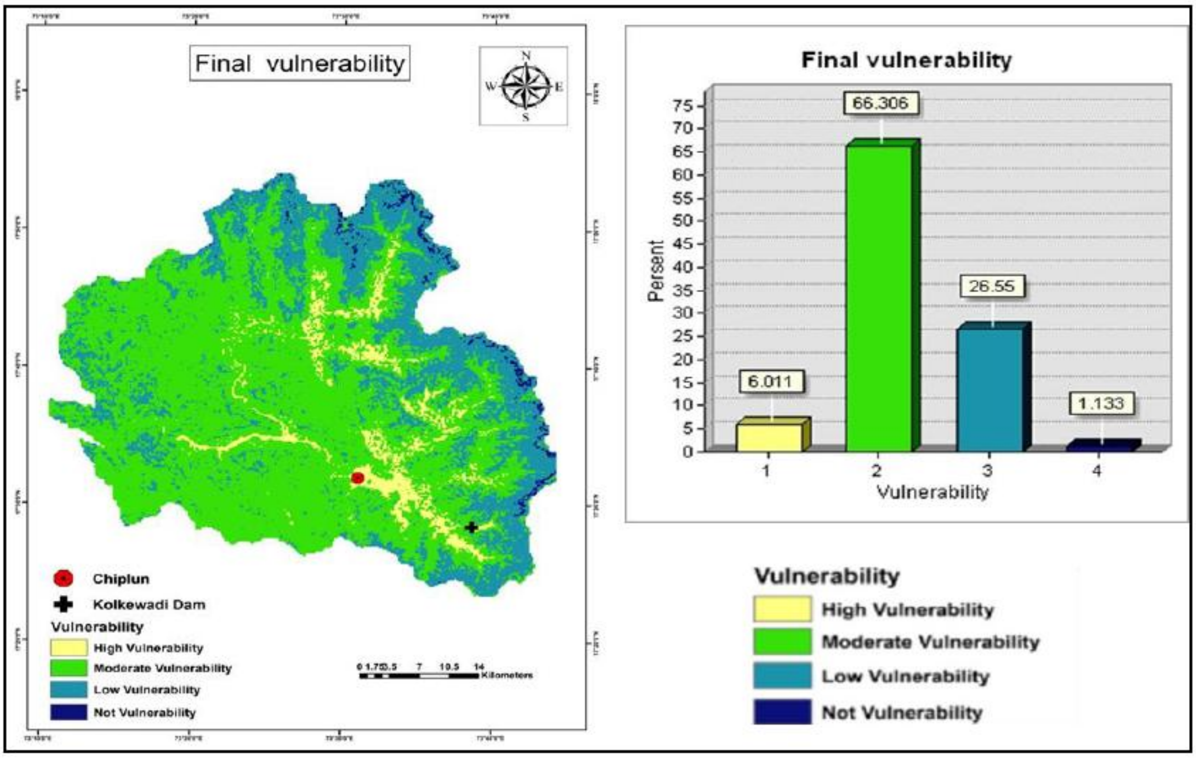


(b) Hydrological vulnerability

Nearly about 76% (1,665.39 km2) of Highly dense vegetation land cover had not vulnerability, while 20% (444.296 km2) had low vulnerability in barren land and 2% (40.018 and 50.9776 km2) only had moderate and high vulnerability in build areas and water body as seen in Fig. 11(e). Elevation vulnerability ranged from high (39% ~ 854 km2) in west to not (6% ~ 132.349 km2) in east. Rainfall had high vulnerability (18% ~ 394.47 km2) in the east and not in west (20% ~ 444.887 km2). Slope had high vulnerability (41% ~ 897.77 km2) in low areas with low elevation with about 854 km2.



VulnerabilityParameters	Vulnerability rank			
	Not	Low	Moderate	High
Land cover	vegetatio n	Barren land	Built up area	Water body
Elevation	Morethan 1200m	308 – 617m	132 – 307m	Less than -19 m
Slope	30 – 75°	18 – 29°	8.1 – 17°	0 – 8°
Geomorpholog y	EstuarineIsland, Scarp, Channel Island, Bench, Mesa, Hill, Butte, Plateau Remnant,StrOri - Highly DissectedUpper Plateau	ResidualCapping , Swamp,Pediplain	DenOri -Pediment - Pediplain Complex, Mangrov e swamp, Pediment	WatBod - LakeStrOri - ModeratelyDissected Lower Plateau,Mud Flat, WatBod – River, Creek Network, Dam and Reservoir, WatBod - Pond
Soil	-	Silty clay loam	-	Clay
Rainfall	58.2 - 83.2mm	83.3 – 106mm	107 – 129mm	130 – 170mm
Flow direction	West	North,south	northeast, south east	East
Drainage density	0.065 - 1.3	1.4 - 2.3	2.4 - 3.4	3.5 - 6.8



V. CONCLUSION

In this study, GPM daily Real Time Rainfall was analyzed to identify the heavy rainfall areas that resulted in flooding in Chiplun during 21 and 22 July 2021. The observations on rainfall and flood were observed to correlate spatially. Rainfall from GPM has been used as the input in the hydrological model. The results revealed that remote sensing data and their integration in a Geographic Information Systems contribute to a high advancement in flood studies and consequently, the damages and losses can be avoided. Furthermore, the multi-criteria and weighted overlay analysis presented the ability to distinguish areas with higher, medium and lower vulnerability to flash floods. The obtained final vulnerability map shows that Chiplun City has very high vulnerability to flash floods. The most prone areas cover residential areas in Chiplun City. Hence it is concluded that satellite-based rainfall and spatial flood have high potential for flood prediction, flood mapping and monitoring and flood mitigation. This information is very useful for the Central/State Governments to plan regional flood development measures.

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