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FLOOD RISK ASSESSMENT AND ZONATION OF NILAMBUR TALUK USING GEOSPATIAL ANALYSIS

Aswin Saji[1], Shaheer Akhthar C P[2], Shilpa B[3]

[1]*Department of Marine Geology, Mangalore University, Karnataka, India*
[2 3] *Department of Geography, Mangalore University, Karnataka, India*

Abstract - *The state of Kerala had witnessed massive floods during the years 2018 and 2019 which had affected the majority of its population. The scale of the damage was so vast that everyone suddenly started giving spatial planning the importance it always required. Geographical Information System (GIS) and other spatial tools can be used to generate flood maps which can help us in analyzing the trend thus reducing the damages to an extent. The findings can be utilized for strategizing the flood planning of a city.*

Key Words: GIS, flood, urban flood spatial planning, flood hazard

1. INTRODUCTION

Flooding is considered one of the most catastrophic disasters because of its magnitude of devastating impacts on overall human well-being [1]. Most of the floods occur throughout the monsoon and are sometimes related to tropical storms, depressions and active monsoon conditions. Because of these conditions, floods occur in the majority of water basins in India [2].

1.1 *Geographic Information System*

Chen (1998) [3] defined GIS as the software system for gathering, preparing and investigating spatial topographical data. It is a basic instrument for big business associations, private structures and government divisions to adopt proactive strategies and settle on significant choices broadly and universally. GIS has been providing for over 40 years. These product innovations are firmly identified with the advancement of geological science [4]. According to Lawal (2011), [5] GIS has grown to be interesting and outstanding software that controls flood threats along with risk zone estimations of geographical areas. This is the reason it is one of the most powerful tools to create a flood risk map.

2. STUDY AREA

Nilambur is a major town, a municipality and a taluk of the Malappuram district of Kerala. Nilambur Town situated towards the eastern boundary of Malappuram District, within $11°00' - 11°30'N$ latitudes and $76°10' - 76°30'E$ longitudes and, is bounded by Chaliyara and Chungathara panchayaths in the North and Karulai panchayath in the East, Amrambalam and Wandoor panchayats in the South, and Mampad Panchayat in the West. It is located on the banks of the Chaliyar River. This place is also known as "Teak Town" because of the abundance of Nilambur teaks in this area.

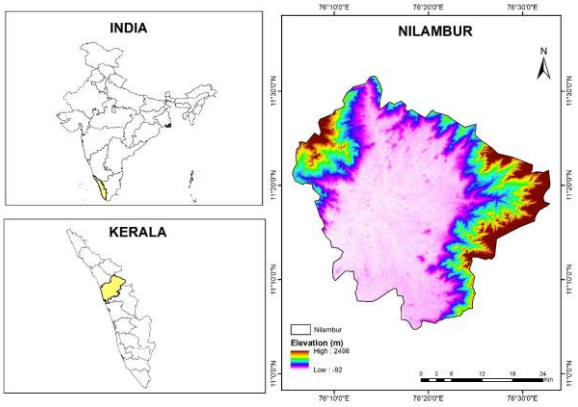

Figure -1: Map of Study Area

3. METHODOLOGY

The approach developed for this analysis has a simple structure and can be performed in a GIS environment. The weighted overlay method in the ArcGIS software was used to create a flood hazard vulnerability map. Maps of the relevant factors were created first. Then these maps were classed, followed by an overlay using a weighting factor [6]. The detailed methodology is shown in the flow chart.

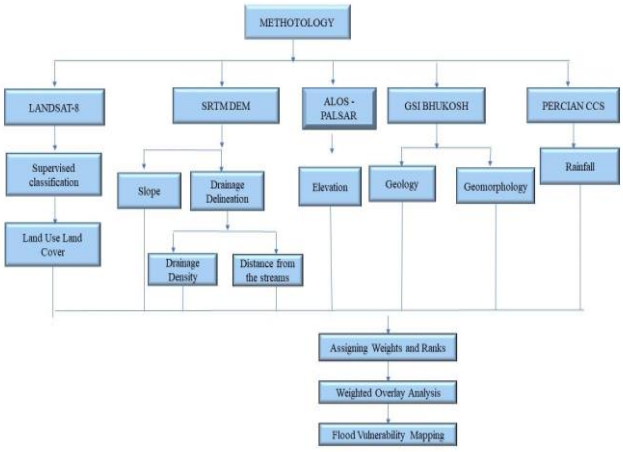

Figure -2: Proposed Methodology

Table -1: Contributing Factors and its Weightage

CONTRIBUTING FACTORS	WEIGHTS
Slope	1.6
Elevation	2.1
Rainfall	1.4
Drainage density	1.0
Euclidean distance	1.5
LULC	1.0
Geology	0.6
Geomorphology	0.8

Weighted overlay analysis is used to identify the places which are vulnerable to hazards. In this case, weighted overlay analysis is applied to identify and map the flood risk zones in Nilambur taluk, based on eight flood constructive variables. All parameters were generated in vector format and each parameter consists of a different range of values and classes which are assigned with the ranks.

4. RESULTS

4.1 *Slope Map*

Flood hazard susceptibility is greatly influenced by the slope of the area. Areas in higher elevations with steeper slopes are less vulnerable to flooding while areas in lower elevations with flat terrain are more vulnerable. Using DEM and slope generation tools of ArcGIS software slope map was developed. Nilambur taluk has almost a flat terrain and the slope ranges approximately between 18^0 and 82^0.

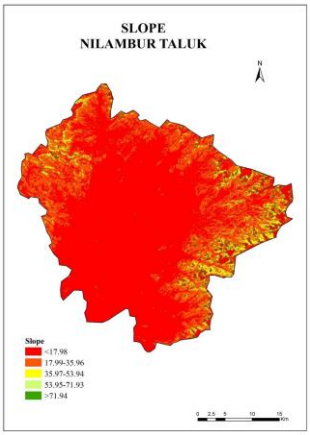

Figure – 3: Slope Map

4.2 *Elevation Map*

Elevation of the area can influence its flood hazard susceptibility. The chance of flooding increases with a decrease in elevation. The layer has been assigned with the weights and risk rates, in flood risk zonation point of view low elevated areas are more vulnerable, and high elevated areas are at low risk. The major part of the study area lies in very high flood-risk zones in terms of elevation

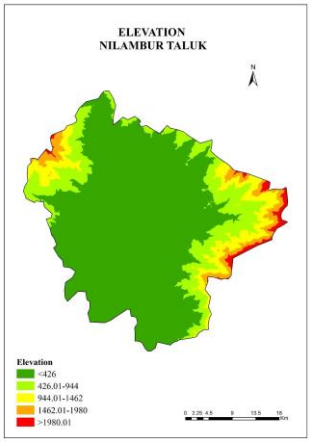

Figure – 4: *Elevation Map*

4.3 *Rainfall Map*

The rainfall map shows the distribution of rainfall over the study area. Heavy rainfall reaches land within a short period and the incapacity of the natural watercourse to convey excess water during heavy rainfall causes floods. The rainfall distribution map was prepared by the IDW interpolation method using ArcGIS and the spatial analyst tool. In Nilambur taluk the actual rainfall was more than the average rainfall during the years 2018 & 2019. Rainfall has a significant relationship with the river discharge and it directly controls the occurrence of floods [7].

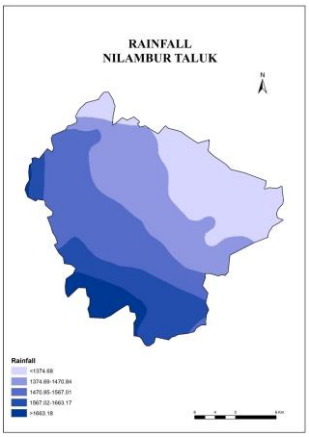

Figure – 5: Rainfall Map

4.4 *Drainage Density Map*

The drainage density map represents the closeness of the spacing of stream channels. It is a measure of the total length of the stream segment of all orders per unit area [8]. Since

flow velocity is higher in river drainage density significantly affects the concentration time and therefore the peak flow magnitude. It follows that increasing drainage density implies increasing flood peaks.

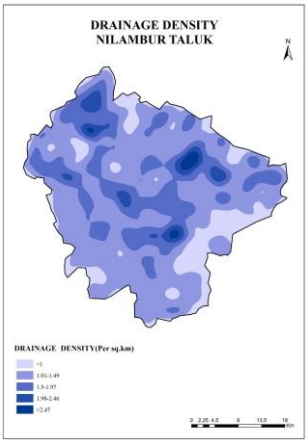

Figure – 6: *Drainage Density Map*

4.5 *Euclidean Distance Map*

The distance from the mainstream is one of the important factors to be considered during flood zonation mapping. The distance from the mainstream is classified into 5 classes <200, 201- 400, 401-600, 601-800, >801. The area which comes within <200 of main streams is at higher risk and the places which lie more than 800 meters away from the mainstream are at very low risk in terms of distance from the mainstream.

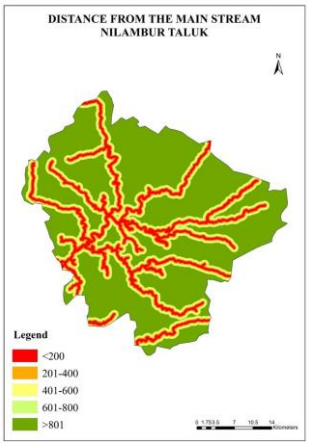

Figure – 7: *Euclidean Distance Map*

4.6 *LULC Map*

A land use map shows the various types and intensities of different land uses in a particular area. Land use influence infiltration rate. In this study area, the land use classes identified were vegetation, built-up area, water body, cultivation and open land. Agricultural area favors medium infiltration whereas built-up area supports overflow of water which ultimately leads to flood. Nilambur taluk is mainly covered by vegetation and cultivation areas.

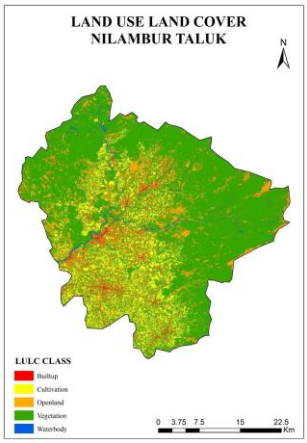

Figure – 8: *LULC Map*

4.7 *Geology Map*

Geology is taken as an influencing factor for this study as the capacity of the ground to absorb water is directly related to the underlying geology. The geology of Nilambur taluk was extracted from the Geographical Survey of India. Such geological terrains will thus be susceptible to rapid run-off, enhancing the potential for serious flooding downstream during high rainfall events.

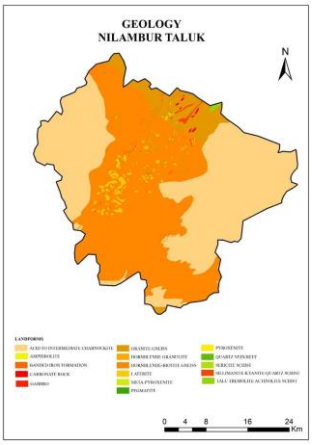

Figure – 9: *Geology Map*

4.8 *Geomorphology Map*

Geomorphology is the scientific study of nature, the history of landforms on the surface of the earth, and the processes of their creation. It focuses on the compositions, shape, and topography of the materials and the geologic processes that give rise to and modify them. It can help in determining the physical characteristics of various landforms by which areas prone to floods can be identified.

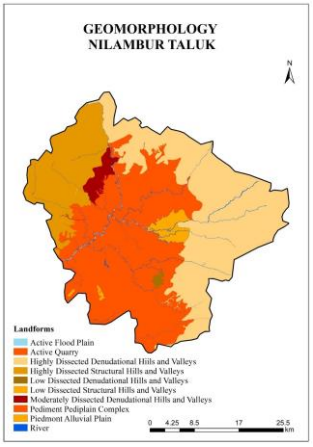

Figure – 10: *Geomorphology Map*

4.1 *Flood Vulnerability Map*

The hazards that occurred due to flood in the study area are estimated by contributing weightage to the map of each factors and overlaying them. Overlaying was done by the weighted overlaying tool in ArcGIS. The study area is categorised into different zones depending on the risk factor as very high risk, high risk, moderate risk, low risk and very low risk zones.

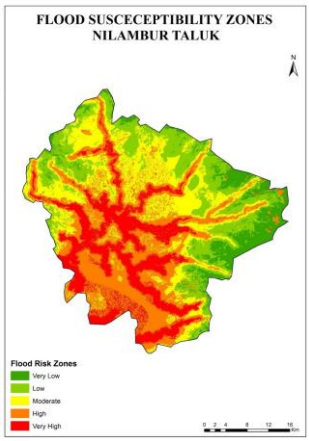

Figure – 11: *Flood Vulnerability Map*

Table -2: Area in different Risk Zones

AREA IN SQ. KM	RISK CATEGORY
240.92	Very High
389.36	High
335.91	Moderate
285.88	Low
121.8	Very Low

5. CONCLUSIONS

The study was an attempt to prepare a spatial plan to minimize the risk and damage caused due to the incidence of floods in Nilambur municipality. The study formulated strategies and proposals to minimize the risk due to floods [9].

As can be observed in the map the very high-risk zones are near to main river channel of the Chaliyar River, which has most settlements, and agricultural land, with low elevation and slope and moderate rainfall and drainage density. Vegetation plays a crucial role as the areas categorised under vegetation are found to be within low to very low-risk zones.

Nilambur was one of the most impacted areas after the flood in Kerala. The entire area is considered to be vulnerable to floods. The consecutive floods have destabilized many areas. The geological survey of India emphasizes land use planning and zoning regulations to reduce flood disasters and strengthen disaster preparedness.

Geospatial techniques are very useful in identifying the areas that are risk at of flooding hazards. The risk zone maps are useful for the steps of authorities to reduce damages due to floods and help in reducing the loss of life and property. This study emphasizes the need for spatial planning and non-structural measures which help to make interventions at the planning level to ensure sustainable development with concern to the environment in the study area and also to reduce its frequencies

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