IJCRT.ORG ISSN : 2320-2882

INTERNATIONAL JOURNAL OF CREATIVE RESEARCH THOUGHTS (IJCRT)

An International Open Access, Peer-reviewed, Refereed Journal

Flood Hazard Vulnerability Mapping Of Ernakulam District Using GIS And Remote Sensing

[1]Rose Mary Xavier, [2]Anto Paul, [3]Benila Raj, [4]Kevin Joseph, [5]Varsha Antony

[1]Associate Professor, [2 3 4 5]Students

[12345]Civil Engineering Department,

[12345]Viswajyothi College of Engineering and Technology, Vazhakulam, Ernakulam, India

Abstract: In the recent years society has come across different types of natural disasters, among which the most dangerous one is flood, that causes a great threat to both human and property. The objective of this study is to develop a flood vulnerability map of Ernakulam district for the year 2020 and also to find out the most flood prone area in the district. Ernakulam is rated as one of the flood prone districts in Kerala. Greater awareness about the risks of flooding can be analyzed by the development of this map. The flood inundation map can be developed in GIS platform by processing remotely sensed data. Land use, rainfall, slope and soil are the influential factors that are considered for the development of the map. These factors are evaluated and their corresponding maps are developed in GIS. The methodology adopted here is the weighted overlay. The study can be used by disaster management authorities and town planners for future projects and flood hazard management.

Index Terms **-Weighted overlay, GIS, Remote sensing, Flood hazard vulnerability.**

I. INTRODUCTION

Disasters are probably the occurrence of a potentially damaging environmental phenomena that often results in the loss of life and property. Any land which is usually above the water level is said to be flooded if it goes under water for a period arbitrarily for a particular duration of time. Usually it happens when the rainfall of an area exceeds the normal level and also when the draining is overbalanced beyond its capacity and thus it will be a catastrophic event. Land use pattern, land terrain, rainfall, soil type are the major causative factors of flood. Geographic Information System (GIS) is a computer-based system that provides the capabilities for input, data management, manipulation, analysis and output to handle spatial data.

In the field of science and technology, GIS and Remote Sensing will play a role in the management and data of spatial analysis in large numbers. The main advantage of GIS in flood management and planning is that it generates visualization of flood prone areas. Remotely sensed data mainly focus on collecting studies and experiences aimed at aiding and advancing flood monitoring and mapping. Preparation of a flood hazard map can help in the allocation of responsibilities to the departments of the government at the district level and the local authorities in the district, prompt response to disaster and relief thereof, procurement of essential resources, establishment of communication links and the dissemination of information to the public.

II. STUDY AREA

The study area selected is Ernakulam district which is located at the central part of Kerala, India. It is having a Northern Latitude10.00°N and Eastern Latitude 76.33°E. Ernakulam district covers an area of 3068 sq.km located on the western coastal plains of India. It is surrounded by Thrissur district to North, Idukki district to the East, Alappuzha and Kottayam districts to the South, and Lakshadweep sea to the West. The rivers that flow through the district are Periyar River, Muvattupuzha River and Chalakkudy River. Ernakulam is the most strategically connected district in the state. About 239 camps were opened, 11056 families had sought shelter and about 40000 persons were shifted to camps as an aftereffect of flood which occurred in the last two years in Ernakulam district. The aftermath of this flood encouraged us to select Ernakulam as the study area.

III. WORKING PLATFORM

Q-GIS (Quantum GIS) is a free and open source application software used for viewing, editing and analyzing geospatial data. It supports both raster and vector layers. Vector can be stored as either point, line or polygon features. It also supports shapefiles, personal geodatabases, MapInfo, PostGIS and other formats. It can display multiple layers containing different depictions of sources.

IV. METHODOLOGY

In this study, the causative factors such as land use land cover, land terrain, soil and rainfall were considered for mapping. Land use maps were obtained Bhuvan prepared by ISRO and land terrain as Digital Elevation Model (DEM)-SRTM data from Earth explorer. The respective maps of these factors were made for various years. These maps were overlaid using a weighted overlay method by providing weightage to each factor in a GIS platform. A comparative study is made with these maps and the most vulnerable area is predicted.

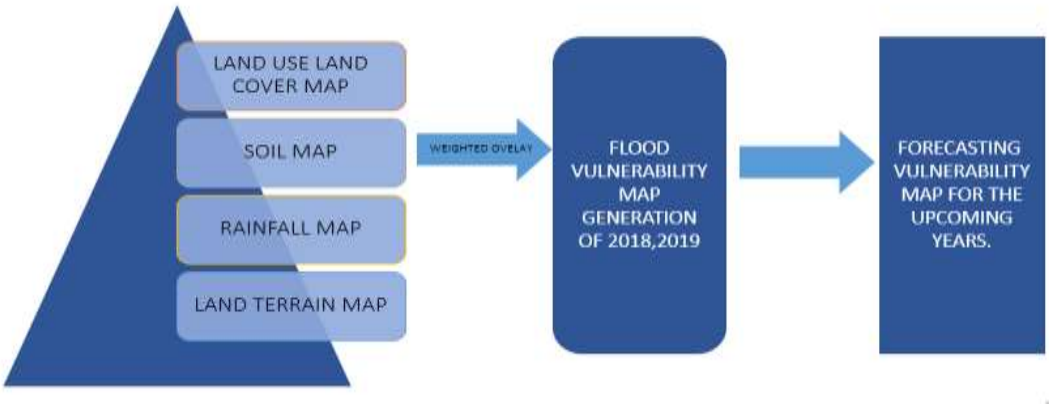

Fig.4.1 Flowchart showing methodology.

V. MATERIALS USED

1. Soil map: Soil map is a graphical representation of different soil types. It provides a tool for rapid, low-cost, delineation of flood prone area based on the difference in morphology between soils frequently flooded and soils free of flooding. Soil types in Ernakulam district can be classified as hill soil, sandstone and clay, coastal sand plain, laterite and hornblende gneiss with varying infiltration rates. The soil data was obtained from food and agricultural organization (FAO) soil portal at 5cm depth.

2. Land Terrain map: Flood susceptibility is greatly influenced by the slope of the area. Areas with greater slopes are less prone to flood and areas that have flat terrain are more prone to flood. We have exploited SRTM-DEM from Earth explorer with a resolution of 30meters. The topography of Ernakulam district can be divided in three categories- low land, midland, and highland region.

3. Rainfall map: A rainfall map shows the distribution of rainfall over an area. It is very essential to know the pre-existing scenarios of rainfall intensity in order to develop a flood inundation map and in forecasting flood. Tropical precipitation is a difficult parameter to measure, due to large spatial and temporal variations. The portion of our study area was clipped from Chelsa a high-resolution climate dataset of earth land surface areas at a resolution of 30 arc sec that is 1km. Even though the map clipped out from the whole world is of lower resolution and clarity, the accuracy of data was not compromised. The average rainfall of the Ernakulam district is found to be 362. 083mm.

4. Land use Land cover map (LULC): Land use land cover map shows the types of land and the intensity of different land use patterns in a particular area. Land use and land cover mapping will help to take up clear strategies for managing natural resources and monitoring the changes in environment. LULC map is directly acquired from Bhuvan prepared by Indian Space Research Organization with various classes.

VI. RESULTS AND DISCUSSIONS

6.1 Soil Map

Soil with low infiltration capacity causes increased surface runoff and thereby the chances of flood increases. The figure below shows the soil map of the study area.

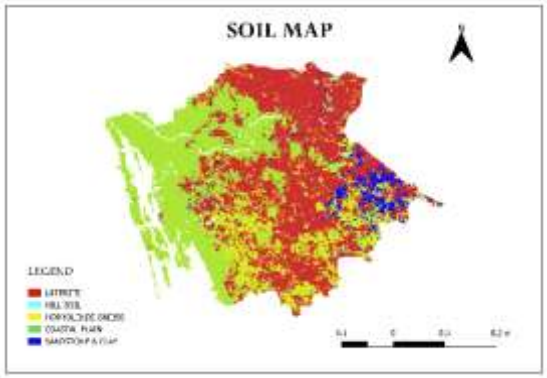

Fig.6.1 Soil map of Ernakulam District.

6.2 Land Terrain Map

Flood vulnerability is more for catchment areas with steeper terrain. For steeper terrains faster will be the runoff, thereby decreasing the chance of flood. The figure below shows the map obtained from SRTM-DEM data.

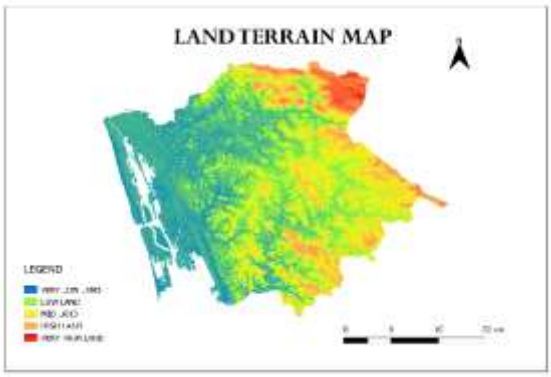

Fig.6.2 Land terrain map of Ernakulam District.

6.3 Rainfall map

Excess rainfall leads to severe surface runoff and the incapacity of natural watercourse which causes flooding; hence the map is made in accordance with the intensity of rainfall. Here the map acquired from Chelsa is having a low resolution of 1km so the clarity of the image was not maintained, but the accuracy of the data was not compromised and the map is shown in the figure below for the year 2018.

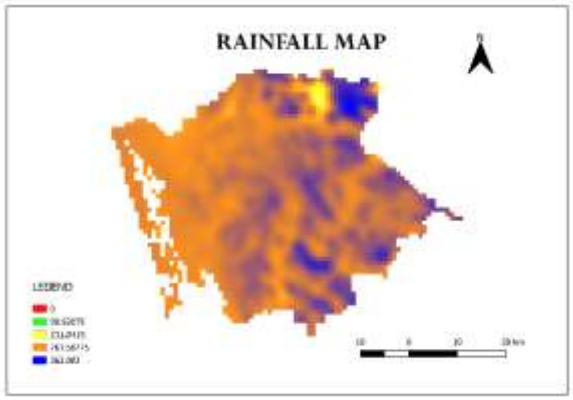

Fig.6.3 Rainfall map of Ernakulam District.

6.4 Land use & Land Cover Map

Varying Land use pattern greatly affects the runoff characteristics which thereby results in flooding the areas of greater impermeability, such as settlements, favour the runoff process and, hence, cause a substantial accumulation of rainwater in drainage channels, especially during periods of intense rainfall. The figure below shows the land use & land cover (LULC) pattern in the district for the year 2018.

Fig.6.4 Land use & Land cover map of Ernakulam district.

6.5 Flood Vulnerability Maps

The weightage for different factors, mainly depends on the extend of the significance of these factors in causing the flood. Considering the highland, midland & lowland regions of this district, land terrain is one most influential factor causing flood. Land use & land cover pattern has also more potential in causing the flood. Whereas the infiltration rate of the soil and intensity of rainfall is given less significance compared to other two factors, since a rise in water level in dams and rivers have more impact in causing flood in this district. Each input rasters were given a weightage based on their significance in causing floods and after normalizing the weightages, we get the percentage values with a total of 100 percentage.

Table 1 Vulnerability weightage for the corresponding factors.

Causative Factors	Vulnerability weightage
Soil Map	20
Land terrain map	35
Rainfall map	20
Land use & Land cover map	25

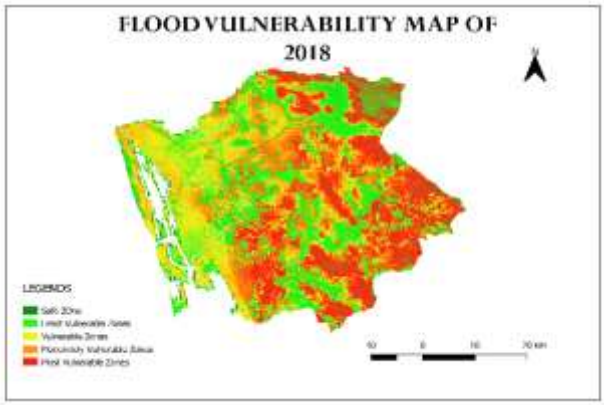

Fig. 6.5 Flood vulnerability map of 2018.

The impact of the 2018 flood was mostly felt in the eastern parts of the district. Flood water marooned many houses and commercial establishments in Aluva, Paravur and Perumbavoor. According to our study it was found that the most vulnerable areas include Kothamangalam, Muvattupuzha, Kunnathunad, Aluva taluks and a small portion of Kanayannur taluk based upon those factors considered.

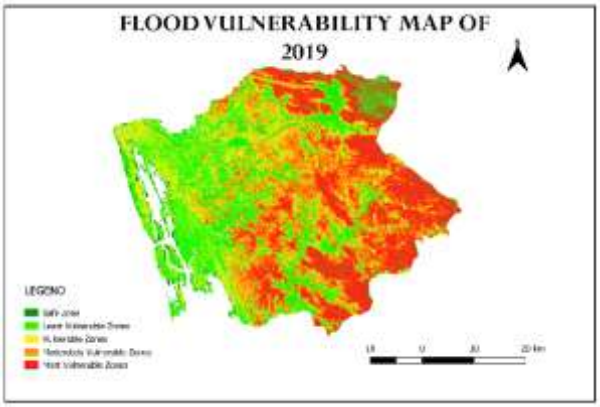

Fig.6.6 Flood vulnerability map of 2019.

From 2019 flood reports it was found that the most affected regions in Ernakulam include Aluva, Kothamangalam, Kunnathunad, Muvattupuzha and Northern Paravur. Moreover, many houses were inundated near the Periyar river. From our study it was observed that the areas like Aluva, Kothamangalam, Muvattupuzha taluks are more likely to get affected. Moreover, a small portion of Kunnathunad and Kanayannur taluks are also vulnerable to flooding.

The change in soil type due to 2018 flood and the difference in land use and land cover pattern led to the difference in 2018 and 2019 flood hazard vulnerability maps. Substantial changes are not visible on both maps, since Kerala has witnessed a severe rainfall during those two years. The flood vulnerability map for the upcoming years were developed by overlaying the above maps.

VII.CONCLUSION

Floods are natural disasters that cannot be prevented, but its impact can be controlled by appropriate planning. The flood inundation map is forecasted for the upcoming years using corresponding factors, by weighted overlay method in the QGIS platform.

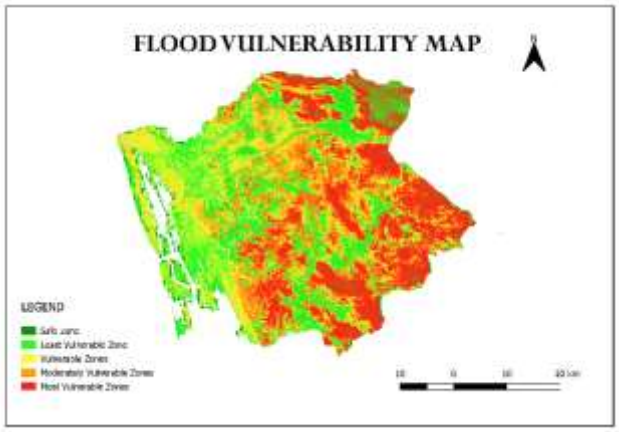

Fig.6.7 Flood vulnerability map for the upcoming years.

It was concluded that the worst affected areas include Perumbavoor, Karukutty, Eloor, Angamaly, Kalady, Malayattoor, Kothamangalam, Muvattupuzha, Piravam, Koothattukulam. This predicted map can be utilized for proper planning and for taking precautions in the vulnerable areas during heavy flood. The rise in water level in Periyar Valley, Bhoothathankettu barrage, and Malankara Dam are also responsible for flood in this district. Inclusion of such factors can help in better and accurate prediction of flood in this area.

Better ways to solve this hazard would be decreasing the amount of runoff by upstream interventions such as reforestation, protection of vegetation, clearing of obstructions from streams, regular de-silting of major reservoirs and water holding structures, conservation of ponds and lakes etc. Construction of levees, embankments, dams and channel improvement which are also useful for flood diversion in some flood prone areas. Reduction of population density in flood prone areas is also a suggestive measure to prevent the aftermath of flood.

REFERENCES

[1] Ciya Maria Roy, Elsa Manoj, Harsha Joy, Sarin Ravi, Abhinanda Roy, "Development of flood hazard vulnerability map for Alappuzha District" ISSN:23938374, vol. 5, issue. 3, 2018.

[2] Thakuriya Gitika and Saikia Ranjan, "GIS based flood hazard mapping: A case study in Krishnai river basin, India," vol. 5, 2016, pp.50-59.

[3] Surajitt Bera and Akash Bindari. Hirano, "Assessment of flood hazard zone using remote sensing and GIS: A case study of Subarnarekha river basin," International journal of science and research (IJSR), ISSN:2319-7064, vol. 5, issue .9, September 2016.

[4] Ismail Elkhrachy, "Flash flood hazard mapping using satellite images and GIS tools: A case study of Najran City, Kingdom of Saudi Arabia (KSA)," The Egyptian journal of remote sensing and space science, vol.18, issue. 2. 2015, pp 261-278.

[5] Tian. Q, Brown. D, Bao. S, Qi.S," Assessing and mapping human wellbeing for sustainable development amid flood hazards: Poyang lake region of China" ELSEVIER, Applied geography 63,2015,pp.66- 76.

[6] Mateeul Haq Akther, Sher Muhammed, Siddiqi Paras and Jillani Rahmatullah, "Techniques of remote sensing and GIS for flood monitoring and damage assessment: A case study of Sindh province, Pakistan," 2012.

[7] T Subramani and V.Vishnumanoj, "Land use and land cover change detection and urban sprawl analysis of Panamarathupatti lake, Salem," International journal of engineering research and applications ,ISSN:2248-9622,vol.4,issue6.