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FLOOD HAZARD MAPPING IN RANNI TALUK, PATHANAMTHITTA

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Abstract - *The heavy rainfall that occurred in Kerala in the years 2018 & 2019 flooded the entire state as well as Ranni causing intense damage to our lives and properties. By providing flood inundation maps, can reduce impacts that occurred tremendously. Ranni is the area taken for mapping using ArcGIS & GIS methods. Ranni is the biggest block of Tiruvalla division with an area of 1004.6 sq.km. Inundation maps can show the susceptible area & the vulnerable zones.*

Key Words: Susceptibility, Vulnerability, Mapping, NDVI, TWI, ArcGIS, GIS

1.INTRODUCTION

Flooding is major natural disaster. Flood has tremendously put an impact on the study area, Ranni. By providing flood inundation maps we can find the low-lying areas with built up lands. Mapping gives management communication, Response, mitigation at the time of disaster. Billions of dollars in infrastructure, property and life damages and hundreds of human lives are lost each year. Thus, these can be prevented and reduced by providing reliable information to the public about the flood risk through inundation maps.

1.1 Software used

- ArcGIS
- QGIS
- Google Earth Pro
- GIS

ArcGIS(commercial/proprietary) and QGIS (open source) are the most popular GIS software programs. Their interfaces look very similar and many of the analysis tool can be found in each program.

1.2 Study Area

Ranni is a small village in Pathanamthitta district of Kerala, India. One of the largest taluks in Kerala. Ranni is known for its natural environment, forest, flora, fauna, rivers, hills and climate. It has a population of 1,98,194 as per the census in 2011. The total area is 1004.6 sq.km.

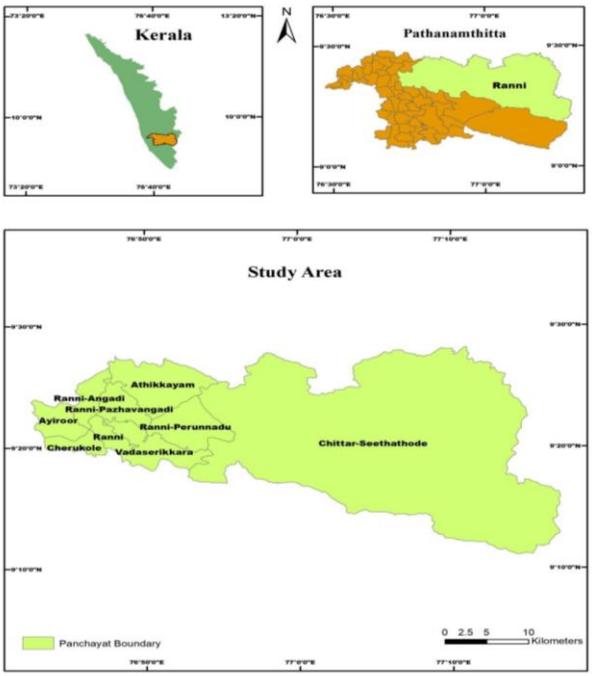

Fig -1: Study area

2. AIM AND OBJECTIVE

To collect data on the causative factors causing flood in the study area. The main aim of the study is flood risk mapping in Ranni area with respect to the physical, demo graphical and socio-economical vulnerability indicators. To identify the low-lying areas with built-up lands. Land use/land cover map. To analyze the flood risk factors and provide the structures which will help to minimize the flood risk.

3. BENEFITS OF FLOOD MAP

The study does effectively demonstrate the potential of combining GIS and community knowledge as an additional tool in regional and community-based disaster reduction planning.GIS maps have advantages over conventional maps.Flood plain maps provide valuable information towards flood risk preparedness, management, communication, response, and mitigation at the time of disaster.Flood plain maps indicate the geographical areas which could be covered by a flood.

4. METHODOLOGY

This study carries out a Geoinformatics based Flood Vulnerability analysis of the Ranni Taluk using Analytic Hierarchy process (AHP). Initially for the analysis, the Past flood level data of the study area were collected. In order to achieve this, flood factors related to the causes of flood occurrence in the study area such as elevation, slope, rainfall, land use/land cover, NDVI, lithology, geomorphology, population density, road density, lineament density, stream density, soil texture, soil depth, and topographic wetness index layers were used. The mapping of flood Susceptibility includes, the preparation of various thematic layers from different data sources, such as Survey of India topographic sheets, Satellite data, Geological Survey of India maps, Google earth etc. Calculation based on the observed relationships between distribution of flood and each flood related factor, revealing the correlation between flood locations and the causative factors in the study area. The detailed methodology which was adopted for the present study for identification of flood vulnerable zonation mapping is given in the below flow chart

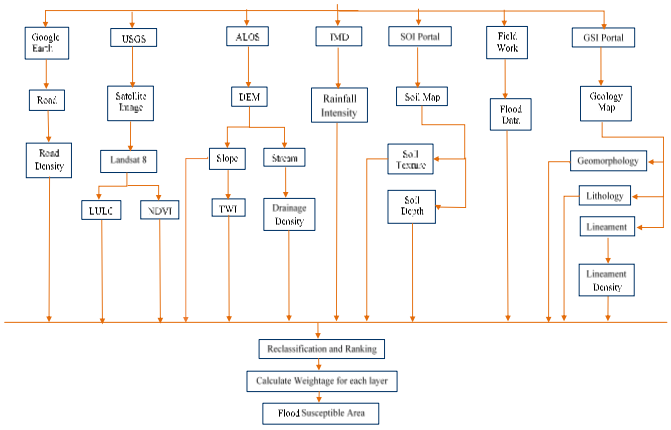

Fig -2 : Methodology Flow Chart

4.1 Analysis Performed

The present study for the processing of the flood vulnerability zones, past flood level data of the study area was collected. A total of 250 flood locations were recorded for flood level.

- Digital Elevation Model (DEM) of the study area was downloaded from the ALOS Research and Application Project of EROC JAXA Portal. A digital elevation model (DEM) is the digital representation of the land surface elevation with respect to a given reference datum.
- Slope was generated from the DEM prepared using the same extension of ArcGIS. It has a major role in the Flood occurrence.
- Stream were extracted from the DEM.
- Stream density found out by using line density tool.
- Road were digitized from Google Earth Pro.
- Lineament Density and Road Density also found out using line density tool.
- A lineament is a linear feature in a landscape which is an expression of an underlying geological structure such as a fault.
- Soil Texture and Soil Depth are obtained from Bench Mark Soils of Kerala (soil survey department, Govt. of Kerala).
- Land Use/ Land Cover pattern of the area was carried out using LANSAT-8 of 30m resolution, the land Use and Land Cover map is very useful to identifying landforms such as forest, water bodies, plantation, built up etc.
- Normalized Difference Vegetation Index (NDVI) has been used to describe vegetation dynamics. NDVI is computing using Near Infrared (NIR) band and red reflectance band.
- **NDVI = (NIR - RED)/ (NIR + RED)**

- Geomorphology is prepared on the basis of slope morphology. Geomorphology is the study of landforms, their processes, form and sediments at the surface of the Earth. Study includes looking at landscapes to work out how the earth surface processes, such as air, water and ice, can mound the landscape. It deals with the study of characteristics, origin and developments of the landforms. Geomorphologists map the distribution of these landforms so as to understand better their occurrence. The study area is classified into flood plain, plateau, middle plateau, denudational hills, reservoir islands, valley.
- Lithology of Each rock types have various compositions and showing different capacity to store water depending upon the porosity, permeability, packing, sorting, cementation and compactness of the grain. The rock types were delineated with the help of the geological map published by the GSI.
- Total Wetness index (TWI) describes the effect of topography on the location and size of saturated source areas of runoff generation. It can be calculated using formula:
- **TWI = ln (a / tan b)**

- In which a stand for catchment area and tan b for slope gradient.
- Precipitation data was collected as a satellite-based product (http://mirador.gsfc.nasa.gov). Annual average rainfall of 10 years (2011-2020) was calculated using raster calculator in Arc GIS.
- All the vector themes were converted to raster format with the same pixel size, processed and analyzed in Overlay.
- Rank was given for each category based on their influence on susceptibility of flood and weights

were also assigned according to the influence of different parameters

- Analysis was carried out using Weighted overlay tool for Flood vulnerability map of the study area using the equation (Eq.4.3).

5. DATASETS USED

Sl. No	Map	Sources	Sheet number/ place of the map	Scale
1	Soil map by Dept. Of Soil survey and soil conservation, Govt. of Kerala	Benchmark soils of Kerala	Pathanamthitta District	1:50,000
2	Geology map	Geologic survey of India		1:50,000

Table -1: Details of maps used

6. FLOOD DATA

Different inundation area was determined from newspaper articles and by conducting questionnaire with the public of the study area. Flood level values are recorded by visiting the study area. The one-and-a-half-kilometers stretch between Mamukku and Ittiyappara area is the worst affected area. From the collected flood level data St. Mary's central school has the highest flood level,8.99 meter.

6.1 FLOOD ANALYSIS PARAMETERS

- **Geomorphology**
- **Rainfall**
- **Drainage**
- **Demographics**
- **Soil types**
- **Roads**
- **Stream density**
- **Slope**

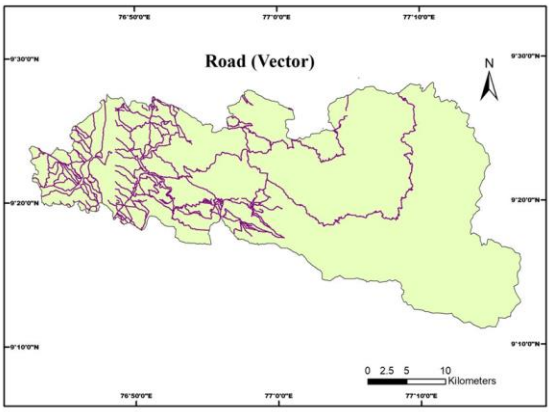

Fig-3: Map of roads

7. RAINFALL DATA

Rainfall data must be collected from IMD (Indian Meteorological Department) and is reclassified and ranked.

7.1 Ranking Method

Each parameter was assigned a value in a scale between 1 and 5 (rating score) and the classes as well as the weights were defined using the grading method of natural breaks and the literature, respectively. Also, the qualitative parameters were classified based on previous studies. In ranking method, every criterion under consideration is ranked in the order of the decision expert's consultation, knowledge, experience and subjectiveness. To make the various criterion maps comparable, a standardization procedure of the raw data was required through weighted-linear scale transformation. The normalized rate was calculated based on the sum of the rates assigned on each parameter (Lappas and Kallioras, 2019).

8. POPULATION DENSITY

The panchayt wise population density of study area was estimated for the year 2021 based on the 2011 population by using the equation is mentioned

Population density = Total population / Total area

Predicted total population in 2021 = 163956

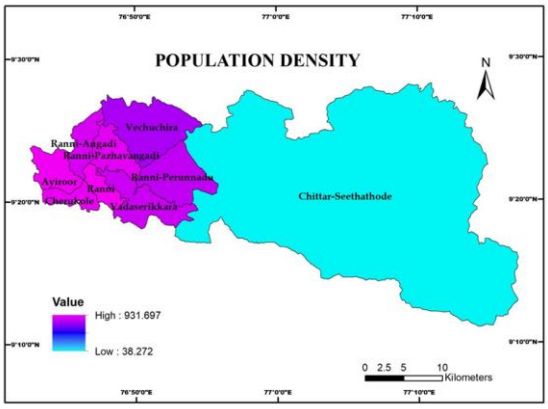

Fig-4: Map of population density

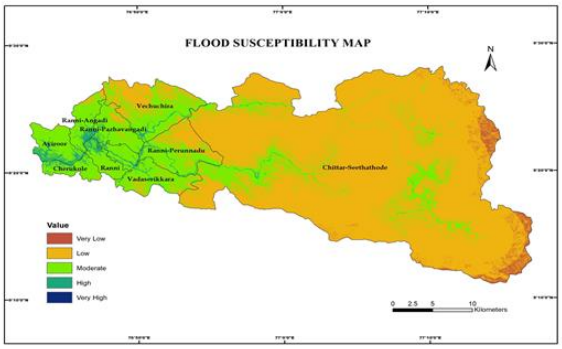

Fig-5 : Flood susceptibility map

9. CONCLUSION

Flood hazard mapping have become more efficient in recent years because of the availability of advanced computational facilities and use of Geographic Information Systems (GIS). In the present study, flood inundated areas were mapped using GIS for Ranni taluk in Pathanamthitta Dist, Kerala. For determining the flood susceptible areas in the study area two stages was undertook. First of all was determining the causative factors causing flood in the study area and secondly, reclassifying and giving rank to each layer and calculate weightage to each layer in finding the flood susceptible areas based on the flood related factors of the study area.

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