

Flood Mapping of Aranmula Panchayat, Pathanamthitta using ArcGIS

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Abstract - Flooding is a transient condition where water overflows and accumulates from inland or tidal or rapid runoff due to rain. Kerala has witnessed a fatal flood during August 2018, after the dreadful flood that occurred a century ago. The river basins were overflowed due to the persisted rainfall and the low-lying areas turned submerged which caused damage to the lives and properties of many. As per IMD (Indian Meteorological Department) data, from 1st June 2018 to 19th August 2018, Kerala received a rainfall of about 2346.6mm which was 42% above the expected value. Aranmula Panchayat in Pathanamthitta district has been chosen as the study area as it was the most affected area in the year 2018, moreover, the area has only very few post flood studies. If proper planning had been taken prior to the flood, many lives could have been saved. Furthermore, a flood map would help to predict the impact of flood and take necessary actions accordingly. The present study used the Geographical Information System (GIS) in which a simple and cost-effective method has been deployed by incorporating Digital Elevation Model (DEM) and cumulative water levels. By examining the map generated, flood prone areas can be identified and proper planning and development works can be suggested to the authorities hence reduce the impacts of future flood.

Key Words: Kerala Flood, rainfall, Geographic Information system (GIS), Digital Elevation Model (DEM)

1. INTRODUCTION

Flood is a treacherous natural calamity that can desolate a region within a short period of time. Kerala witnessed a fatal flood which was considered to be bigger in terms of mortality rate due to the heavy rainfall that persisted for days. Almost all the dams were opened since the water level marked close to overflow level which affected the nearby areas drastically.

Aranmula, a place in Pathanamthitta district was chosen as the study area which experienced a catastrophic disaster during 2018 floods. The overflowing water from Pamba river submerged majority areas of Aranmula, Kidangannur, Thottapuzhasseri, Neervilakom, Arattupuzha etc. The government officials and volunteers had difficulties during these times but with coordination, over 3000 people were taken to the relief camps in the panchayat safely. A flood map would be highly beneficial to mitigate the difficulties in the future.

ArcGIS 10.4 is used to produce data visualizations in the form of a map with various disciplines and tools [1-4]. Flood map of Aranmula Panchayat has been obtained by using Digital Elevation Model (DEM) which is the primary input to the software. These maps could be used for emergency actions during flood as well as for future development of the community.

2. STUDY AREA

Aranmula Panchayat has been chosen as the study area, which lies in Pathanamthitta district, Kerala State and comes under Pandalam block. It is located on the banks of river Pamba with a population of 28,695 people according to 2009 census. The total area of the panchayat is 24 km², and spatial extent is from 9.3265°N 76.6840°E, with an average elevation of 7m [1]. During 15th August 2018 to 18th August 2018, severe floods affected the region due to unusual heavy rainfall and the peak flood height was 8.5m (approximate). Fig.1 shows the location map of the study area.

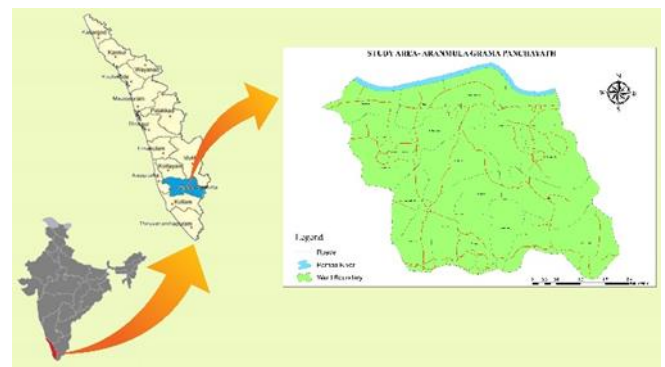


Fig -1: Location Map of Study Area

3. METHODOLOGY

In the mega flood 2018, the interior rustic reaches of Aranmula, Kurichimuttam, Nalkalickal, Malakkara, Edayaranmula and Neervilakom nestling in the Pamba river basin, were seriously affected in the deluge and were isolated. Therefore, a flood map is highly essential for this region. Primarily, a field survey has been executed for which survey forms were prepared which include location details (latitudes, longitudes), basic details (ward number, building number, and contact) and flood details (water level, sudden or gradual, flood duration, evacuation route, relief camps). Shape file is one of the most pervasive spatial data for storing geometric location and attribute information of geographic features and it is referred as the

base map. It has been created from the Bhuvan website using 2D drawing tool. Ward boundary details have been obtained from the delimitation website, which was helpful in drawing the boundaries.

Meanwhile, raster data has been obtained from USGS Earth Explorer —official website which is the Digital Elevation Model (DEM). It is the 3D representation of surface terrain which has been a major input for the creation of slope map, contour map, and finally the flood map. Subsequent to the collection, all the data has been exported to GIS platform.

The base map of the study area has been created by incorporating the collected GPS coordinates [1] and the shapefile in ArcGIS hence used for boundary validation in the initial stage. Then, slope map and contour map have been created by incorporating DEM in ArcGIS [8]. These maps have helped in identifying the nature of the terrain and consequently used for the validation.

4. RESULT AND DISCUSSIONS

From the social surveys conducted and discussions with the authorities in the district, it has been summarized that the flood depth varies from 2m to 8m in the panchayat. In concern with the flood depth values, flood inundated maps of cumulative water levels from 1m to 10m were generated using the Digital Elevation Model in ArcGIS 10.4. By using “Math Function” and “Conversion Tools (Raster to Polygon)” in ArcGIS, the maps are generated for the flood levels 1m to 10m. Fig.2 shows the flooded areas in the panchayat for a water level of 10m from the ground.

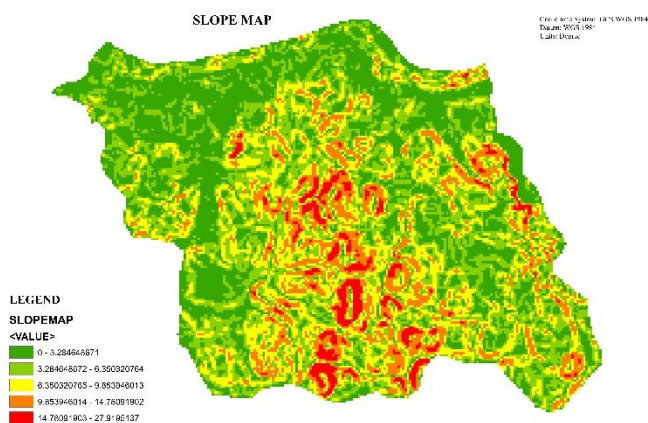


Fig -2: Slope Map of Aranmula Panchayat

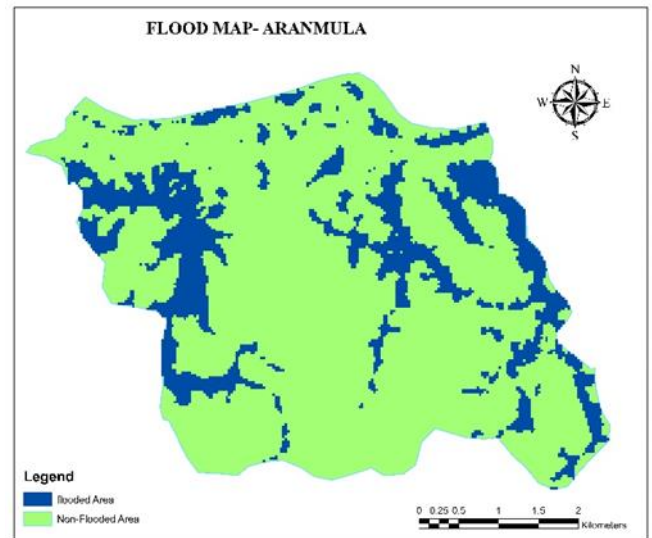


Fig -3: Flood Map of Aranmula Panchayat (water level-10m)

5. CONCLUSIONS

From our research flood inundated areas of Aranmula Panchayat which is crucial in the present scenario has been located. The generated map smoothens future disaster preparedness and land use planning effectively. Communities could use the map and thus obtain data to determine high risk areas and safe evacuation routes. Hence this study proved to be successful. By looking into the flood map, we could suggest various mitigation measures in the risk zones like elevating the upcoming or existing structures, floating buildings, plan for a new city centre in the flood free zone so that the cultural heritage of Aranmula could be protected, insuring private properties in the flood zone etc. As the flood assessment studies of the study area has been less this would be highly beneficial for the front liners to work with. Even though natural hazards cannot be eradicated we could carry out action plans and preventive measures through various studies. As a result, creating a flood inundation map using ArcGIS has been an attempt to reduce the impending quiver of flood.

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