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FLOOD INUNDATION MAPPING OF MUNROE ISLAND –A GEOSPATIAL APPROACH

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ABSTRACT

Flood Inundation Mapping (FIM) is imperative, especially in the areas where the elevation is comparatively low. FIM helps to depict the spatial extent and depth of flood level of an area. Flood hazard map is developed using the terrain elevation data generated from DEM. The flood risk zones were identified and categorized into High, Medium and Low. In each zone the percentage of affected Land Use and Land Cover categories were delineated. This study can be used for planning flood preparedness in the worst affected areas. Appropriate management strategies can be adopted by the planners or the decision makers to curtail the impact of the disaster and also the fellow men could get the right knowledge of the area he belongs to.

KEYWORDS: *Land Use and Land Cover, Inundation, Hazard Map, High Resolution DEM and Risk Zones*

Article History

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1. INTRODUCTION

Inundation of land is considered as the covering of land area by water either due to the natural reasons like overflowing of rivers, heavy rainfall, tides or due to the man-made reasons like the construction of reservoirs, ponds, etc. The use of land for any other purpose is really a great hurdle if the inundation prolongs. The people living over here feel great difficulty due to its peculiar nature. The soil beneath the water gets deteriorated and the agriculture pattern of the region gets affected. Crops will also perish. The potable water becomes scarcer in this region. Ultimately the land becomes untenable for the people to survive.

The significant flood events in Europe during the period of 1985–2009 have led an incremental drift of occurred flooding, over topping the inundation severity and magnitude due to changing climate as well as changes in terrain surface [1]. Combining inundation maps and digital elevation models (DEMs),with GIS tool (Floodwater Depth Estimation Tool, FwDET), can generate flood water depth mapping [2].Remote sensing and GIS, along with geology, fuzzy theories, and statistical analysis of hydrological peak discharge and rain height in a GIS environment, can generate an accurate flood hazard map and could estimate the possible risk of every land use/land cover [3].The scientific interest regarding different sources of uncertainty concerning the hazard and the impact module of a probabilistic flood risk model in the area of Vorarlberg, Austria, was studied by Winter et al. [4]

This study solely revolves around Munroe Island - a union of eight small islands that are notorious for their inundation. It is considered as an archipelago in Kollam district in Kerala state and the land is situated at the confluence of

Ashtamudi Lake and the Kallada River. Being at the confluence of a river and lake made it a delta kind of formation, in which the agricultural production yielded results far higher than the area surrounding it. But in recent years, it is seen that many portions of this pristine land are greatly inundated. People living in this region are miserably affected due to the inundation of land. It is considered that this gradually sinking land may vanish into the waters within 15 to 20 years.

2. Why Munroe Island?

Munroe Island is the combination of eight small islands. It is a typical backwater island village of Kerala, India located at the confluence of Ashtamudi Lake and Kallada River. The geographical area of the island is 13.4 sq. km. The serene place is named in memory of Resident late Colonel John Munro of the erstwhile Princely state of Travancore. It is also known as Munroothuruthu, Manrothuruthu and Munroethruthu spelled in the regional dialect. The sediments in Munroe are of marine and fluvial origin and are mostly seen in the low lying are mostly by the side of Kallada River.

Since the Tsunami of 2004, this island, which has a population of around 10000 men and women, is facing subsidence leading to loss of shelter and occupation. In addition, there has been a reduction in the sediment load deposited by the Kallada River in the flood plains owing to the construction of the Thenmala dam.

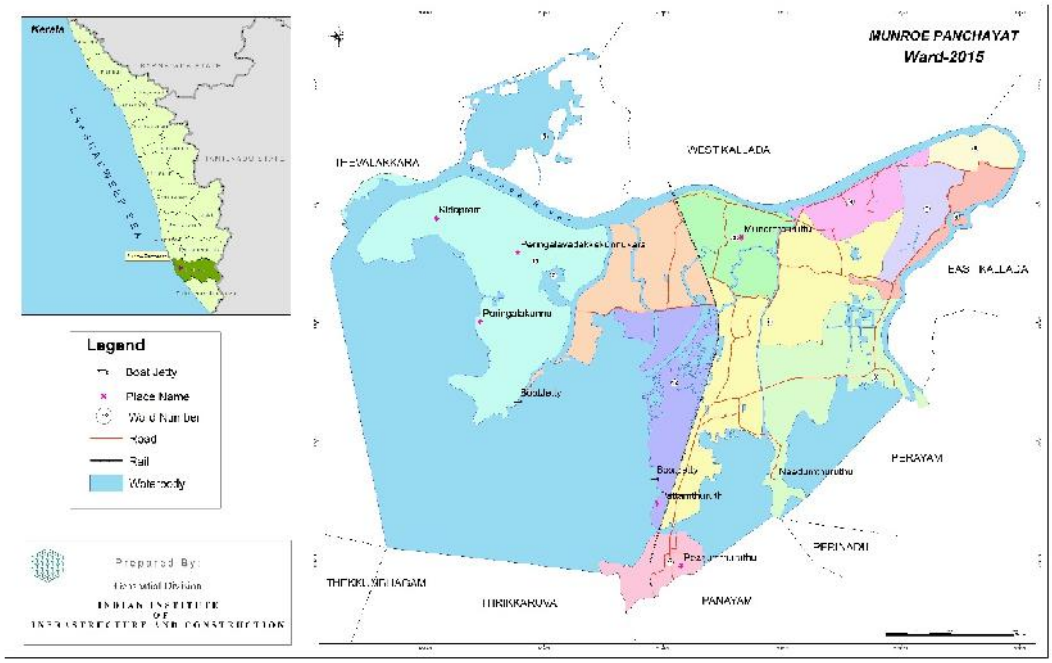


Figure 1: Base Map.

The regions that showed considerable settlement had submerged soil, saturated soil and highly moist topsoil. The topsoil is acidic saline and composed of organic clay matter. Sea and backwater tides make these soils saline. During monsoon season, when rainwater and fresh water from rivers enter the fields, salinity is partially washed off. 'Boiling' was observed during high tide. The Arabian Ocean is directly connected to the Ashtamudi Lake which is about 12 km away from Munroe Island. Near the waterfront areas, tidal ingress would generate seepage pressures in the sand. This results in settlement of structures near the backwaters.

Saline water intrusion causes reduced availability of drinking water. Reduced land availability for agriculture and allied activities cause decline in production and economy. Diminished space for house building and severe drainage problems including non-working of toilets are also problems faced by peoples of Munroe Island.

Over 300 families abandoned the place because their houses got flooded permanently. It is very important to assess the sinking rate of Munroe Island scientifically and to find out solutions to conserve this precious land. To ensure the livelihood of the local community adaptable methods of agriculture, aquaculture and allied activities have to be introduced

If tools like GIS are used to predict or understand the extent of such floods in the future, mitigation and rehabilitation measures can be undertaken. The aim of this study is to aid the administration in identifting key areas where flood mitigation and rehabilitation measures are needed. This approach can also be used in areas in the state of Kerala, which is prone to floods every monsoon in disaster preparedness, resettlement and also charting the course of development in the state.

3. MATERIALS AND METHODS

The study incorporates spatial and non-spatial data derived from different sources. The study area was delineated using the Survey of India Topomaps. Using the Google Earth data, the Land Use and Land Cover map was prepared. The Digital Elevation Model (DEM) data used for the study was downloaded from the US Geological Survey Earth Explorer website. Here the SRTM DEM data with a spatial resolution of 30m is used. The Inundation map was prepared using the ArcMap 10.7 software.

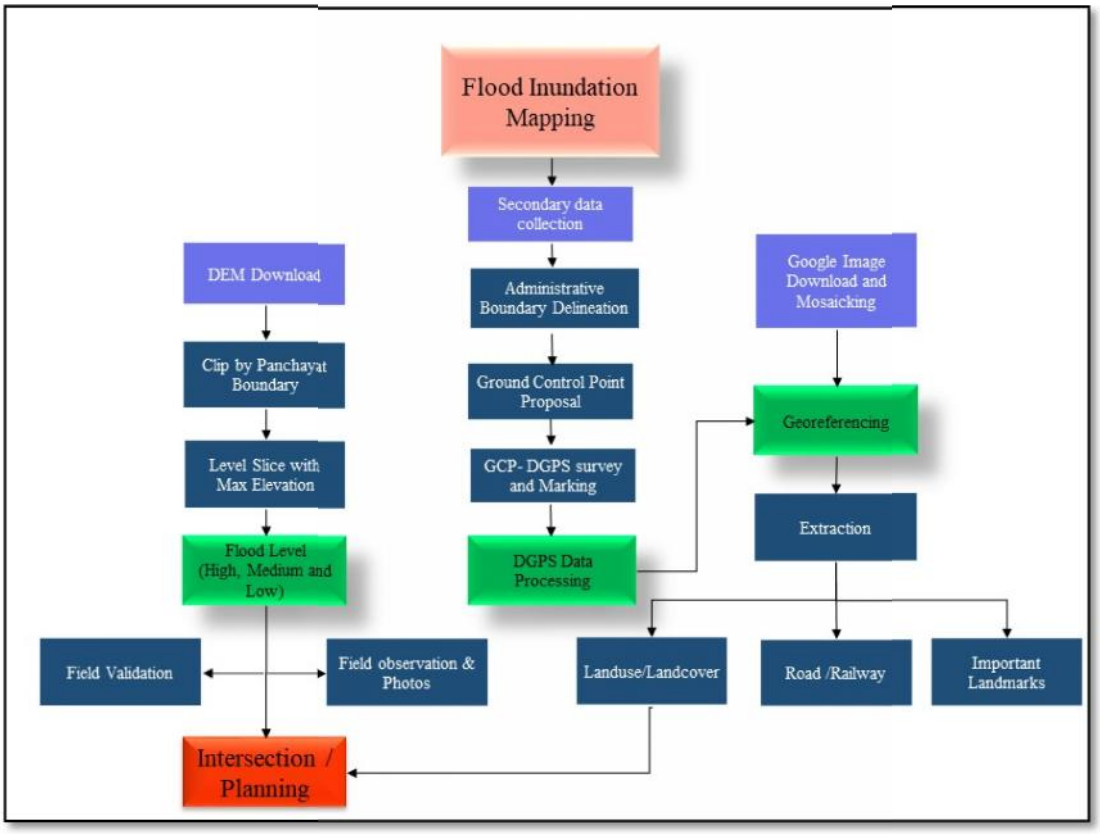


Figure 2: Methodology.

4. RESULT AND DISCUSSION

The LULC map prepared for the area gives an idea that the land marked waterlogged is already at high risk under the flood inundation mapping. These areas were already used for residential purposes as well as for cultivation. The increased risk of floods has forced the natives to move out or to seek the next available low risk area. On analysis of the high risk area the land use as mentioned earlier is predominantly waterlogged. The lack of a residential classification in the analysis is because of the fact that the majority of the landed properties are of mixed use type and cannot be distinguished through the analysis of satellite imagery. Without ground verification the land which is significantly covered in green cannot be determined whether it is residential or not.

The land on preliminary site visits correlated the findings of the flood inundation analysis using GIS. The native residents of the area are facing the ill effects of flood and daily tidal action. Their homes and spaces are destroyed by continuous influx of water. Access to clean drinking water and sanitation facilities are a distant dream in the minds of the people residing there. Many families in the area identified under the flood inundation mapping have already left their homes in search of safer spaces in the vicinity.

The geomorphological pattern of the flood or the causative factors are not being discussed due to the fact that the study goes beyond the initial scope of flood inundation mapping.

This identified flood inundated areas can be a useful tool in disaster mitigation, the areas marked high risk in the preliminary analysis can be taken as a point of immediate intervention and conversion of land use suited to the waterlogged condition of the area can be put forth. Tourism and fishing and similar activities if planned in conjunction with the land use can reap wonders for the local residents in terms of livelihood measures and improvement of quality of life.

The identified areas or the flood inundated areas under high risk can help the local administration body to thwart any disaster in making and will help them to take decisions pertaining to the area. Similarly, the identified medium risk and low risk areas can aid in the decision making process of the local administration agency.

Identification of inundated areas can curtail unwanted developments harming the delicate ecosystem around the area, which helps the administration in avoiding loss of life and livelihood due to the prolonged effects of the floods.

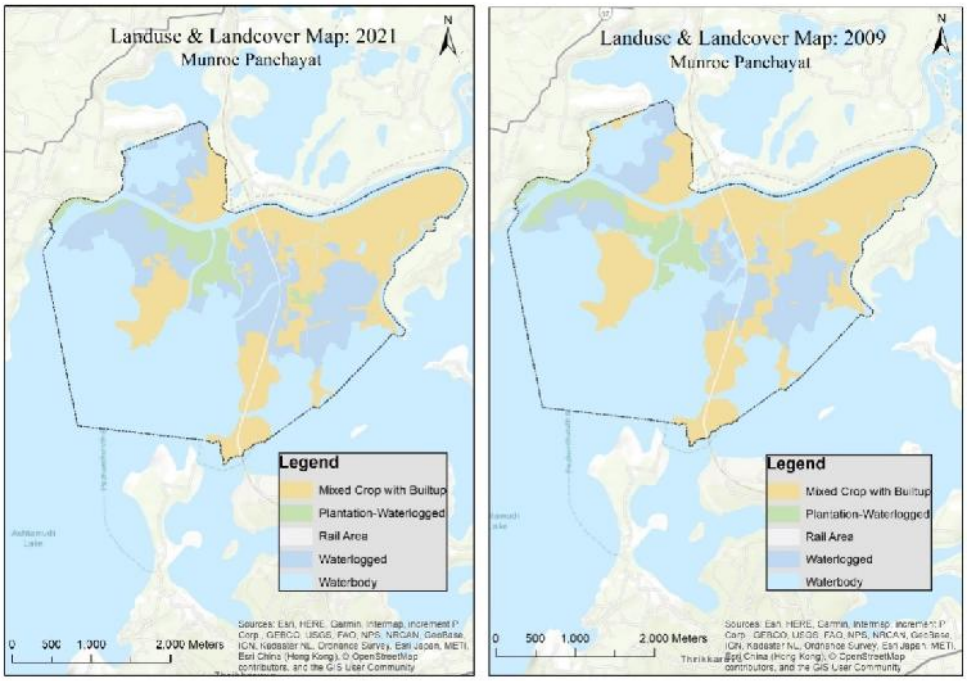


Figure 3: Land use and Land *Cover* Changes Map.

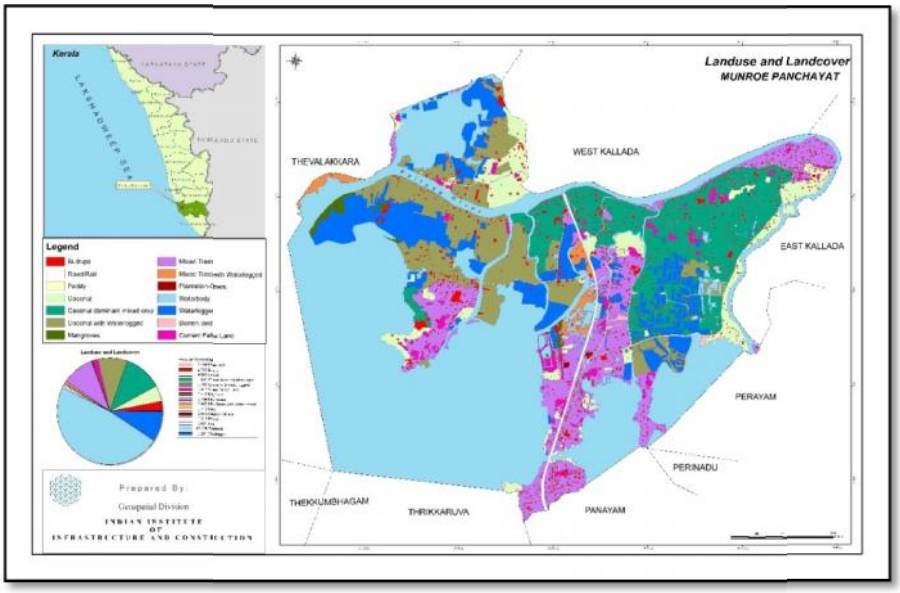


Figure 4: Detailed Land Use and Land Cover.

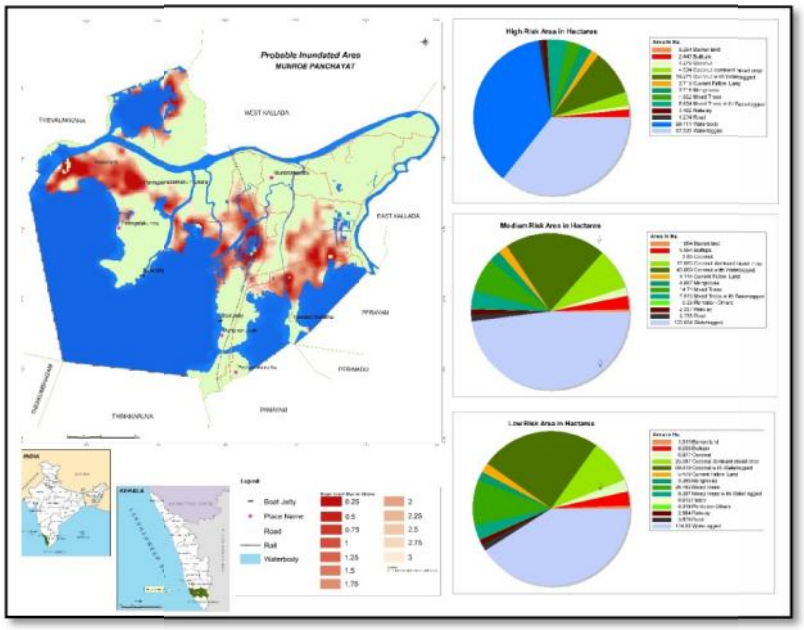
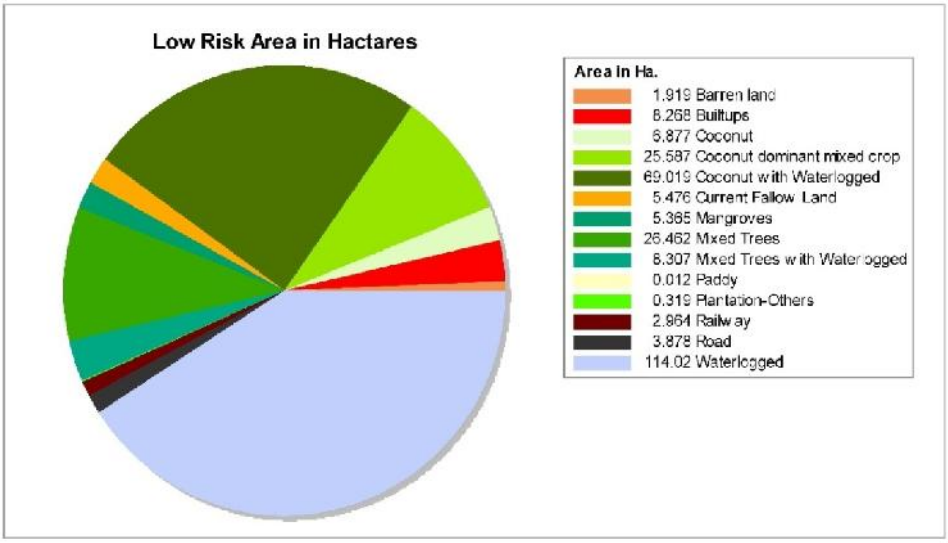


Figure 5: Inundation Map.



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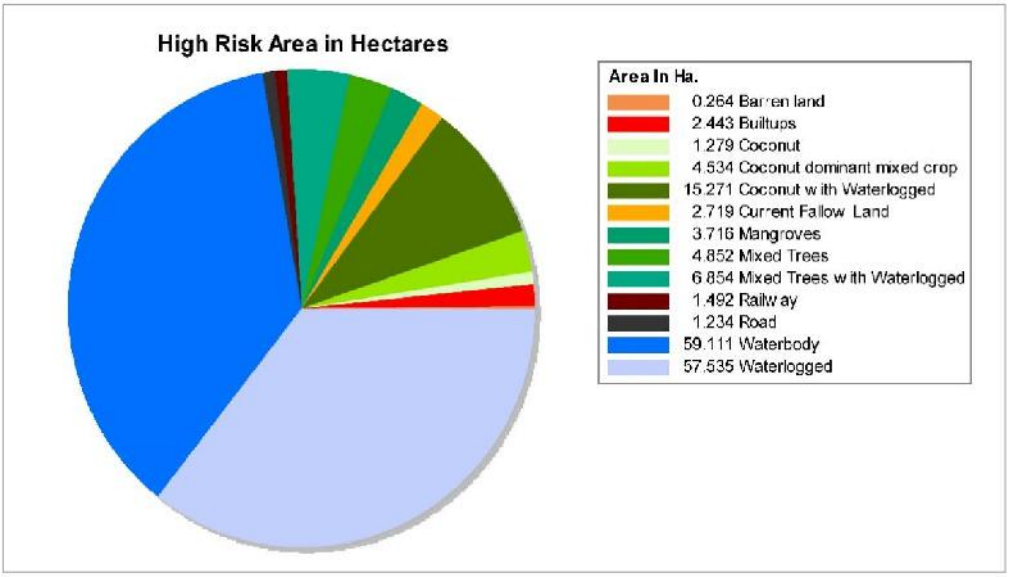

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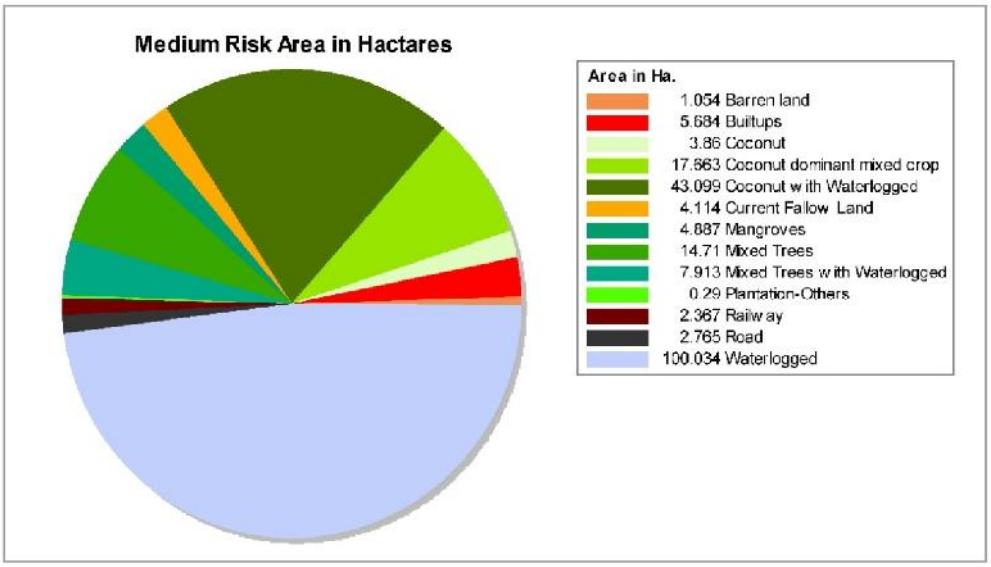

Figure: 8.

2. CONCLUSION

This analysis points out the immediate areas that need intervention, in terms of conservation and rehabilitation, and such analysis of similar areas can help in mitigating flood or related disasters. Similar approaches are required in preparation of land use plans and development plans, especially in an ecologically sensitive state like Kerala. This approach of identifying potential areas can save the administrative departments millions from being spent on post disaster rehabilitation and resettlement. The study can be developed into an approach of finding the suitable development of the area and will provide results much more accurate than traditional development plan preparation as it is more realistic and uses the scientific tools of geospatial analysis

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