URBAN FLOOD MANAGEMENT AT KOTTARACHOWKI, MANGALORE, KARNATAKA, INDIA. USING GIS AND REMOTE SENSING: A CASE STUDY

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ABSTRACT

Flood impact is one of the most considerable disasters in the world. Floods are caused due to natural factors such as heavy rainfall, high floods and high tides, etc., and human factors such as deforestation, improper land use, blocking of drainage channels etc. Floods result in damage properties and losses of life. Increase population results in more urbanization, more impervious area and less infiltration and greater flood peak and runoff. Flood loss prevention and mitigation includes structural flood control measures such as proper maintenance of the existing drainage system, construction of levees and non-structural measures such as flood hazard and risk management, flood forecasting and warning etc.

The study uses the Remote Sensing and GIS technique to assess the flood inundated places by flood hazard map in the study area, effect of flood on people, infrastructure and vegetation by flood vulnerability map and flood zones which shows hazards and classifying them as low, medium and high hazards by flood zoning map in the study area. The results of the above particulars are used to give early warnings of the flood and suggestion to flood control and mitigation measures for the flood prone study area that is Kottarachowki, Mangalore taluk, Dakshina Kannada district, Karnataka state, India.

Keywords: *GIS, Remote Sensing, DEM, Flood Hazard, Flood Vulnerability, Flood Zoning.*

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1. INTRODUCTION

Flood is defined as the overspill of areas that are normally submerged with water or a stream that has broken its normal confines or has accumulated due to lack of drainage. Floods are the most common and destructive natural hazards causing extensive damage to public and private services, economy, infrastructure and the Environment.

Floods caused by natural and man-made disasters are major environmental problems facing the world. In particular, areas adjacent to the coastal areas and inlands, wetlands, close to watercourses, low laying areas have seen a rise in flooding activities.

Many urban areas and cities are located in flood plains because land is flat and fertile which is suitable for agriculture and urban development. Rivers provide water supply for domestic, industrial and irrigation uses; they also provide convenient means for navigation, transportation and communication.

Cities which are in coastal areas are normally located in low lying areas where drainage is difficult without pumping. High tides or storm surges can impede flood drainage to the sea and cause continued flooding with polluted water. Climate change causes heavy rainfall, severe and frequent flooding which are more difficult to predict.

2. STUDY AREA

The study area of Kottarachowki is located at the coordinates of 12.9108°N, 74.8357°E of the Mangalore city, Karnataka. . It is situated on the west coast of India, and is bounded by the Arabian Sea to its west and the Western Ghats to its east. The study area that is Kottarachowki and its surrounding places spans an area of 28.7 km^2. It experiences moderate to gusty winds during day time and gentle winds at night. The topography of the city is plain up to 30 km (18.64 mi) inside the coast, and changes to undulating hilly terrain sharply towards the east in Western Ghats.

The geology of the area is characterized by hard laterite in hilly tracts and sandy soil along the seashore. The Geological Survey of India has identified Mangalore as a moderately earthquake-prone urban centre and categorized the city in the Seismic III Zone. The Gurupura River flows around the north of the study area and it form an estuary at the south-western region of the area and subsequently flow into the Arabian sea. Coconut trees, palm trees, and Ashoka trees comprise the primary vegetation of the area. It has a tropical monsoon climate and is under the direct influence of the Arabian Sea branch of the southwest monsoon.

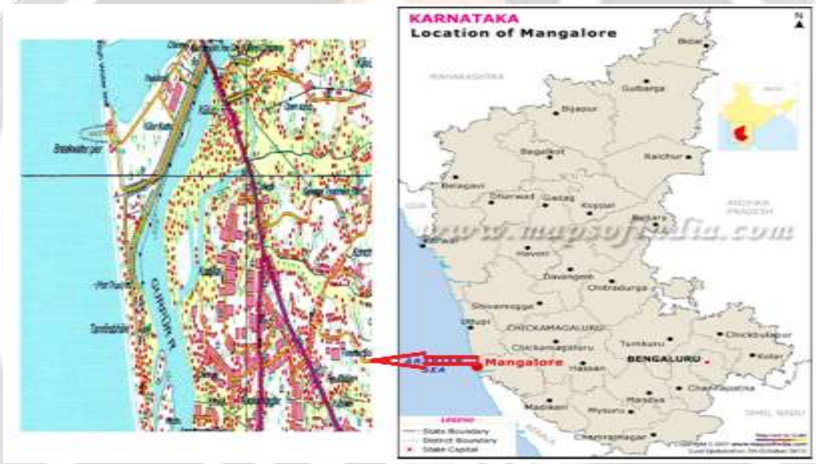

Fig -1 Study Area

It receives about 95 per cent of its total annual rainfall within a period of about six months from May to October, while remaining extremely dry from December to March. The average annual precipitation is 3,796.9 millimetres (149 in). Humidity is approximately 75 per cent on average, and peaks during May, June and July. The maximum average humidity is 93 per cent in July and average minimum humidity is 56 per cent in January.

3. METHODOLOGY

- Digital Elevation Model (DEM's) are used to get terrain representation and information in terms of direction in which water that enters into an area will flow.
- Using ArcGIS, Raster analysis is done to generate data on flood inundation, flood vulnerability and flooded zones in the study area.
- Contour map and land use land cover maps are used for the preparation of flood hazard and flood vulnerability maps. Different contours are used for mapping of flood inundated areas at different levels. These contours are incorporated into the land use and land cover map to identify the damages caused by the flood at worst flood level.

3.1 FLOOD HAZARD MAP:

A flood hazard map graphically provides information on flood inundation (inundation depths, extent, flow velocity etc.) expected for an event of given probability or several probabilities. Flood hazard maps are important for assessment of flood risk, development of flood mitigation plans, preparing comprehensive flood risk management schemes, and in particular for local urban planning. Flood hazard maps form the basis for the flood risk maps, flood emergency maps and other related maps.

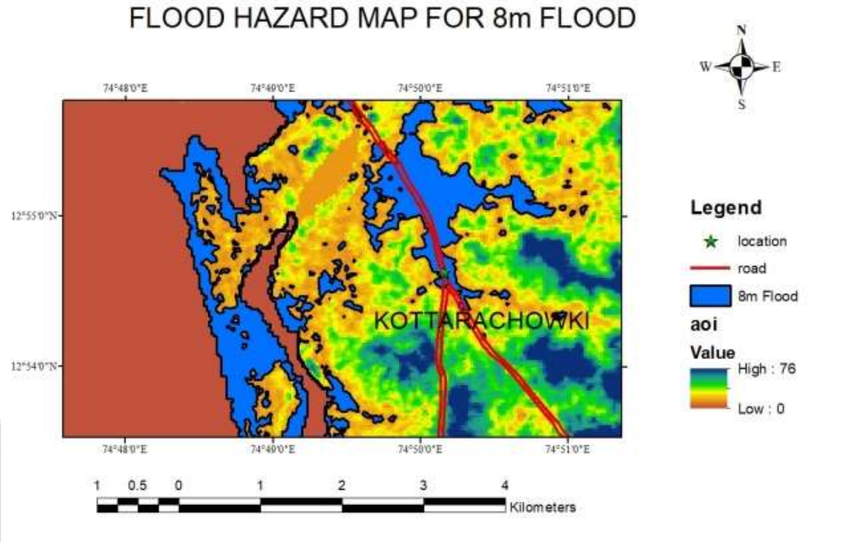

Fig -2 Flood Hazard map

3.2 FLOOD VULNERABILITY MAP:

A flood vulnerability map indicates the potential harm to people, assets, infrastructure and economic activities exposed to flooding either directly or indirectly. Vulnerability to flooding is dependent on the exposed people, assets, and infrastructure on the one hand and the magnitude of the hazard on the other. Vulnerability maps provide the basis for flood risk maps that support flood risk management decisions and are the necessary input for emergency planning. Vulnerability maps are a basis for planning of countermeasures but do not directly lead to action. They show the possible consequences of a flood event on human activity.

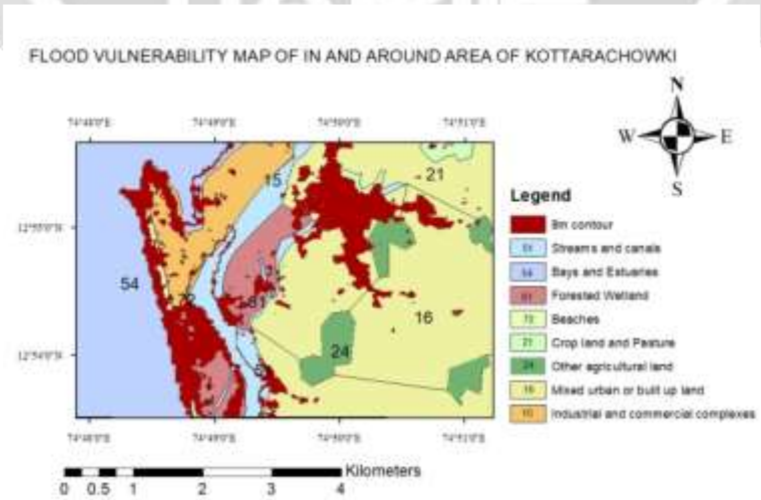

Fig -3 Flood Vulnerability map

3.3 FLOOD ZONING MAP:

Flood zoning map can be considered as 'adapted' flood hazard map for planning purposes. The zones show existing hazards, often classifying them as low, medium or high hazards. This map is based on a hazard map and makes provision for the land-use in a particular area. Planners are concerned with locating areas with limited exposure to hazards for various uses: human settlements, industries, infrastructure, and agriculture. Land use planning does not influence the existing risks, yet changes in land use can be induced. This is normally very difficult since existing rights must be compensated. However, it is the most effective measure to slow down the present continuous increase of risk and damage potential.

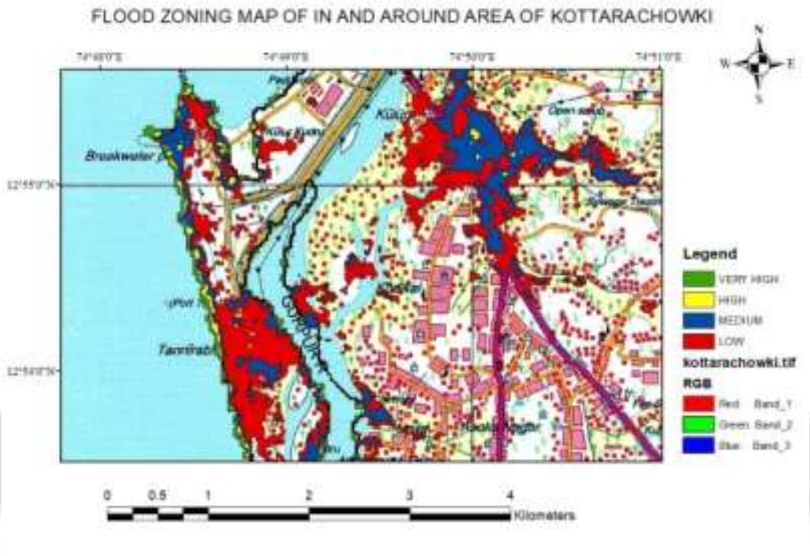

Fig -4 Flood Zoning map

4. RESULTS AND DISCUSSION

4.1 FLOOD HAZARD MAP:

The map shows that the total area of 3.72 km^2 is going to inundate which includes beaches, crops and pasture land, industrial and commercial places, agricultural land and most of the urban built up areas in the worst flood condition.

4.2 FLOOD VULNERABILITY MAP:

The map shows that the total area of 0.29 km^2 of beaches, 0.54 km^2 of industrial and commercial places, 0.85 km^2 of forested wetland, 0.015 km^2 of agricultural land, 0.29 km^2 of crop and pasture land and 1.49 km^2 of urban built up land are going to affect in the worst flood condition.

4.3 FLOOD ZONING MAP:

In Flood zoning map the inundated areas are zoned into 4 categories. The zones and their color in the flood zoning map are discussed below.

1. Very high flood zones ---- Green
2. High flood zones ---- Yellow
3. Medium flood zones ---- Blue
4. Low flood zones ---- Red

The different zones shows different degree of danger and the building restrictions for different zones are discussed below.

- The very high flood zones are in elevated danger and are prohibited for building construction.
- The high flood zones are in less danger when compared to very high flood zones but high danger when compared to medium flood zone and the buildings are constructed with restrictions and conditions.
- The medium flood zones are also called as awareness zones which are in medium danger and the buildings are allowed with restrictions.

- The low flood zones are less danger when compared to all other zones and the buildings are allowed to construct in the urban areas with less or no restrictions.

4.4 FLOOD CONTROL AND MITIGATION MEASURES:

- Proper utilization and maintenance of present drainage system in order to prevent the new flood hazards in the low lying areas by constructing new drainage systems in the upstream side of the area.
- Reduce surface runoff by increasing infiltration by preserving unsealed and greened spaces in the city.
- Since the availability of space is highly limited in cities, the infiltration trenches and soakaways are effective in town infiltration.
- Parking surfaces shall be made of permeable materials can also contribute significantly to the reduction of runoff in the city areas.
- Levees are constructed in the flood predicted areas to regulate the water levels.

5. CONCLUSION

Kottarachowki is one of the low lying area of the city and the use of GIS and Remote Sensing data are very useful to locate the inundated places of the study area at different flood levels and identification of effects on the different systems of the study area like built up areas, agricultural land etc. The return period of the flood is expected to be in next 6 years and is very useful for giving early warnings of the flood to the people who are residing in this area to prevent loss of life and to save the property in the flood event. Proper utilization and maintenance of the present drainage system, increase of infiltration rate and construction of levees at high flood regions of the area are effective in controlling the flood in this area. This study is very useful to the Mangalore Urban Development Authority (MUDA) for the extension of the city and other planning process in future.

6. REFERENCES

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