DEVELOPMENT OF FLOOD HAZARD VULNERABILITY MAP FOR ALAPPUZHA DISTRICT

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Abstract

In the recent years the world has endured large number of natural disasters, among which one of the most disastrous is flood, that present a potential threat to both life and property. The aim of this study is to develop a flood hazard vulnerability map of Alappuzha district for year 2012 and to determine the most flood prone area in the same. Alappuzha is rated as the most flood prone district in Kerala. Development of these maps can be used to promote greater awareness about the risks of flooding. The flood hazard vulnerability map is developed by processing the remotely sensed data in GIS platform. The most influential factors that contribute to flood generation in Alappuzha district such as flow accumulation, land use, rainfall, slope and soil are considered for the development of the map. The flood causative factors are analysed and their respective maps are developed in GIS to derive the flood hazard vulnerability map using weighted overlay. The study can be utilized by decision makers and planners for future water projects and flood hazard management.

Index terms-Flood Hazard Vulnerability, DEM, Weighted Overlay, Reclassify

I.INTRODUCTION

Flood is an overflow of water that submerges the land. Its effects include structural damages, erosion, contamination of food and water, disruption of socioeconomic activity including transport and communication, as well as loss of life and property. Development of flood hazard maps can be used to promote greater awareness about the risks of flood and can help in flood hazard management. India is one of the worst flood affected countries, being second in the world after Bangladesh. Severe floods occur almost every year in at least one part of the country. Among the fourteen districts of Kerala, the most vulnerable to flood is Alappuzha. In the study flood hazard vulnerability map of Alappuzha district is developed using GIS and Remote Sensing.

Factors considered in the preparation of map include flow accumulation, land use, rainfall, slope and soil. GIS is a computer based system that provides the capabilities for input, data management, manipulation, analysis and output to handle spatial data. The main advantage of GIS in flood management and planning is that it generates visualization of flood prone areas. GIS has been extensively used to assemble information from different spatial data. The main focus in this field revolves around the preparation of flood hazard maps for the vulnerable areas and identification of the flood prone zones.

The main objective of flood hazard vulnerability mapping includes prevention of loss of life and property, smooth transfer of affected people from home to evacuation shelter as well as notifying the residents about potential flood damage and enhancing their awareness about the importance for flood disaster preparedness.

II. STUDY AREA

The study area selected is Alappuzha, one of the southern districts in Kerala, India having its North Latitudes – $9^0 05'$ and $9^0\ 54'$ and East Longitudes – $76^0 17'30''$ and $76^0\ 40'$. Alappuzha (formally known as Alleppey) is also known as "the Venice of the East". Alappuzha district has an area of 1414 km^2 . The district is bounded on the north by Ernakulum District, east by Kottayam and Pathanamthitta District, south by

Kollam district and west by Arabian Sea. The District lies in the midland and coastal areas. The major rivers flowing though the district are Manimala river, Pampa river and Achankovil river. All these rivers branch off in the low land and branches intermingle and they ultimately drain into the Vembanad Lake at different places. Alappuzha has been traditionally vulnerable to natural disasters on account of its unique geo-climatic conditions and vast coastline. The frequent flood in Alappuzha encouraged us to select this as the study area.

Fig. 2.1 Base Map of the Study Area

III. METHODOLOGY

The flood hazard vulnerability map was created by weighted overlay method in ArcGIS software. For this, first the flood causative factors were identified. In this study, the factors considered are flow accumulation, land use, rainfall, slope and soil and then maps of the respective factors were developed. Then these maps were reclassified followed by overlay by using weightage factor to create flood hazard vulnerability map. The detailed methodology is shown in the flow chart**.**

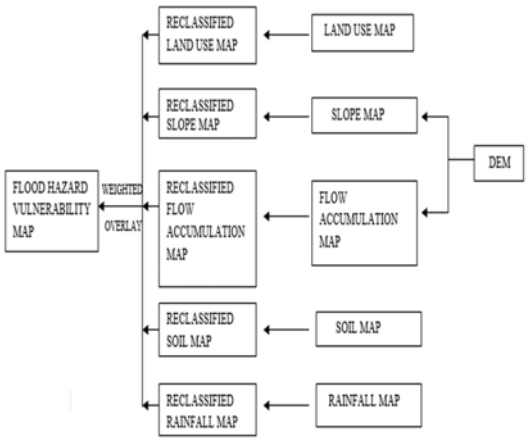

Fig. 3.1 Flow chart showing methodology

IV. WORK DONE

The work done for preparing flood hazard vulnerability map are given below:

A. Flow Accumulation Map: In hydrological modelling, flow accumulation shows water collection based on flow direction. If flow accumulation is high in an area, then the area is more prone to flood. Using DEM and hydrology tools of Arc GIS software flow accumulation map was developed. In Alappuzha flow accumulated area is less. The weighted flow accumulation map was created by assigning weights to each class as given in the table 3.1.

Table 3.1 Table showing flow accumulation weightage

Sl No.	Flow Accumulation	Weightage
1	0-590	2
2	590-2,507	4
3	2,507-5,458	6
4	5,458-9,957	8
5	9,957-18,807	10

B. Land Use Map: Land use map shows the types and intensities of different land uses in a particular area. Land uses influences infiltration rate. The land use layer of the study area was prepared by digitizing the land use map. In this study area, the land use classes identified are agricultural area, built-up area, water bodies and waste lands. Agricultural area favours medium infiltration whereas built-up area supports overflow of water which ultimately leads to flood. Alappuzha is mainly covered by agricultural land and built-up area is less. The weighted land use map was created by assigning weights to each land use as given in the table 3.2.

Table 3.2 Table showing land use weightage

Sl No.	Land Use Type	Weightage
1	Waste Land	2
2	Built up	5
3	Agriculture	6
4	Water Body	8

C. Rainfall Map: Rainfall map is a map showing the distribution of rainfall over an area**.** Heavy rainfall reaches land within a short period of time and incapacity of natural watercourse to convey excess water during heavy rainfall causes flood. The rainfall distribution map for year 2012 was prepared by kriging method using Arc GIS and spatial analyst tool. Rainfall mostly occurs

during the south west monsoon period (June to September) and North-east monsoon period (October to November). The weighted rainfall map was created by assigning weights to each class as given in the Table 3.3.

Table 3.3 Table showing rainfall weightage

Sl No.	Weighted Rainfall (mm)	Weightage
1	3.80-5.95	2
2	5.95-7.63	4
3	7.63-9.21	6
4	9.21-10.52	8
5	10.52-12.37	10

D. Slope Map: Flood hazard susceptibility is greatly influenced by slope of the area. Areas in higher elevation with steeper slope are less vulnerable to flood while areas in lower elevation with flat terrain are more vulnerable. Using DEM and slope generation tools of Arc GIS software slope map was developed. Alappuzha has almost a flat terrain and the slope ranges from 2^0 to 12^0. The weighted slope map was created by assigning weights to each class as given in the table 3.4.

Table 3.4 Table showing slope weightage

Sl No.	Slope (Degree)	Weightage
1	2	10
2	2-4	8
3	4-6	6
4	6-8	4
5	8-12	2

E. Soil Map: Soil map is a geographical representation showing diversity of soil types. Soil type is an important factor in determining the water holding and infiltration characteristics of an area and it consequently affect flood of that area. With the decrease in soil infiltration capacity, surface runoff increases and thereby the chances of flood hazard increases. The soil layer of the study area was prepared by digitizing the soil map. Based on soil's runoff potential and infiltration rate, soil are classified as group A, group B, group C and group D and they are known as hydrologic soil groups. In Alappuzha, the types of soil found are group A, group B and group D which are highly infiltrated, moderately infiltrated and less infiltrated respectively. The weighted soil map was created by assigning weights to each soil group as given in the table3. 5.

Table 3.5 Table showing soil weightage

Sl No.	Soil Group	Weightage
1	A	4
2	B	6
3	D	8

F. Flood Hazard Vulnerability Map: The net probability of occurrence of flood in the study area is estimated by contributing weightage to map of each factor and by overlaying them. Overlaying was done by weighted overlaying tool in Arc GIS. The study area is divided into high risk zone, moderate risk zone and low risk zone. The factors contributing to flood and their percentage weightage are given in the table 3.6.

Table 3.6 Table showing contribution factors percentage weightage

Sl No.	Contributing Factors	Percentage Weightage
1	Flow Accumulation	10 %
2	Land use	20 %
3	Rainfall	15 %
4	Slope	35 %
5	Soil	20 %

V. RESULTS AND DISCUSSIONS

A. Flow Accumulation Map

Flow accumulation map of the study area is shown in the Fig.4.1. Flow accumulation map is classified into very low, low, medium, high and very high flow accumulated areas.

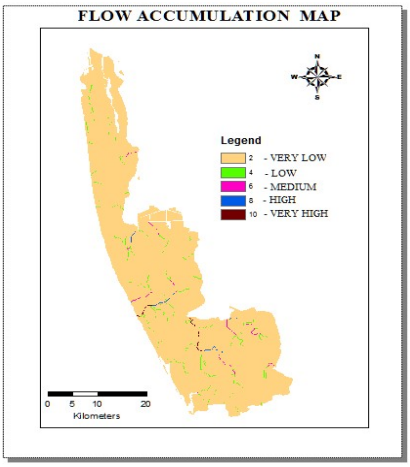

Fig.4.1 Flow Accumulation Map

B. Land Use Map

Land use map of the study area is shown in the Fig. 4.2 The different land uses identified in the study area are agriculture, built up, waste land and water body.

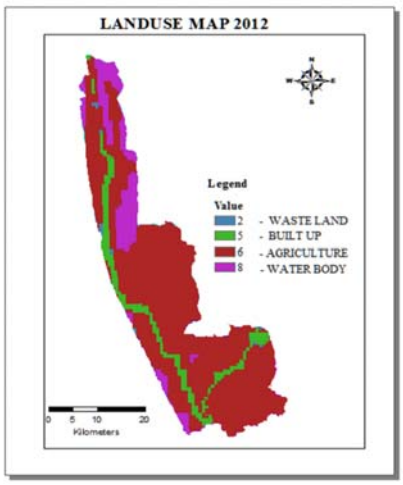

Fig.4.2 Land Use Map of 2012

C. Rainfall Map

Rainfall map of the study area is shown in the Fig.4.3. Rainfall map is classified into different zones according to intensity of rainfall.

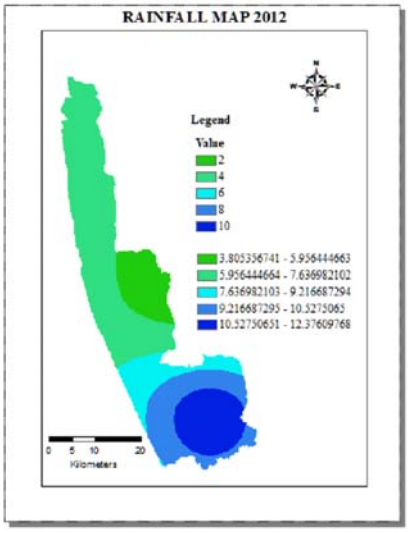

Fig.4.3 Rainfall Map of 2012

D. Slope Map

Slope map of the study area is shown in the Fig.4.4. Slope map is classified into very high, high, medium, low and very low sloped areas.

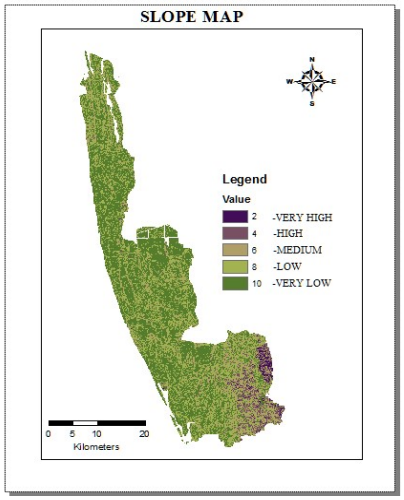

Fig.4.4 Slope Map

E. Soil Map

Soil map of the study area is shown in the Fig.4.5. The various soil groups found in the study area are A, B and D is shown separately in the soil map.

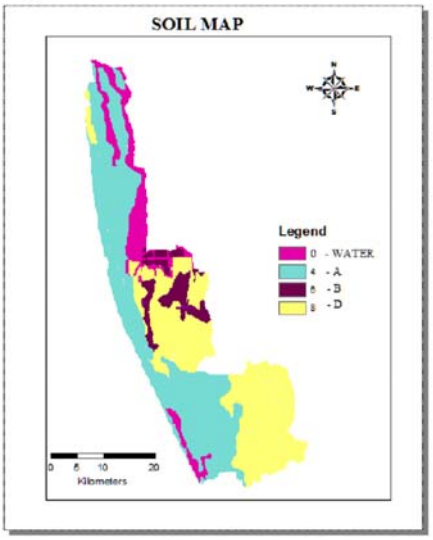

Fig.4.5 Soil Map

F. Flood Hazard Vulnerability Map Flood hazard vulnerability map of the Alappuzha district for the year 2012 which was developed by weighted overlay after reclassifying all the maps of the causative factors is shown in the Fig.4.6. The high risk zone, moderate risk zone and low risk zone can be clearly identified from the flood hazard vulnerability map**.**

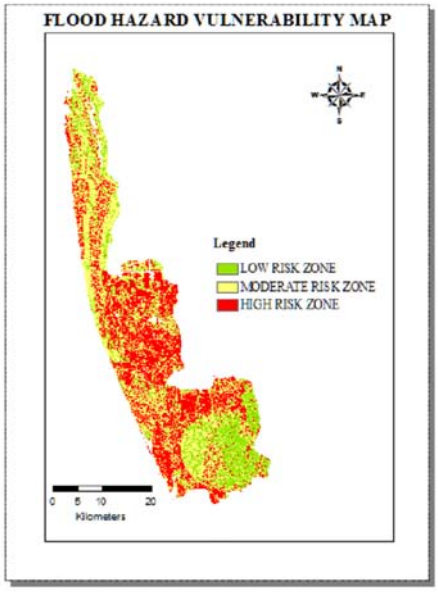

Fig.4.6 Flood Hazard Vulnerability Map of the year 2012

VI. CONCLUSION

The flood hazard vulnerability map of Alappuzha district for the year 2012 was developed. It can be concluded that floods are natural disasters that cannot be prevented but its impacts can be controlled by appropriate planning. Proper planning can be done by revealing the hazard areas to flood. The aim of flood hazard vulnerability mapping is to evacuate the flood prone areas. But evacuation is not practically possible due to high cost and social problems. However the functional characteristics of area can be changed according to its vulnerability towards flood. The flood hazard vulnerability mapping done in this study using GIS and remote sensing is simple and cost effective.

VII. REFERENCES

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