Application of Remote Sensing and GIS For Flood Vulnerability and Mitigation: A Case Study of Flood Affected Villages of Mahi River

Dhruvesh K Mathur[1*] and Praful M Udan[2]

[1*]*CU Shah University, Faculty of Sciences (Physics), Wadhwan, Gujarat, India*

[2]*Sardar Patel University, ISTAR-CVM, Vallabh Vidya Nagar, Gujarat, India*

[*]***Corresponding author:*** *Dhruvesh K Mathur, CU Shah University, Faculty of Sciences (Physics), Wadhwan, Gujarat, India, Tel: 9712703107; E-mail: dhruvesh_8mathur@yahoo.co.in*

ABSTRACT

Highly populated areas in India are affected by flood due to rivers passing from low elevation and highly populated areas. Flood comes with effects of loss of property and human lives. In this research paper, we are discussing flood evacuation planning for three villages situated at the bank of Mahi River in Gujarat. QGIS software is used for evacuation planning. Remote sensing and GIS are generally used during disaster for evacuation planning and decision making. Mahi is one of the longest river of Gujarat passing from highly populated density area this produces flood due to heavy rain during monsoon. In this research based on elevation, population density, and resources available for flood three villages are selected. Based on available road network rescue and evacuation planning is done. Flood evacuation plan is suggested based on available nearby resources and available high elevation road network.

Keywords: QGIS, Mahi River, Satellite maps, Remote sensing, Evacuation, Flood

INTRODUCTION

Flood is the most disturbing natural incident that affects and disrupts the safety of a society, especially people who are vulnerable to disaster due to geographic conditions and available poor resources. In natural disaster flood is produces maximum damage to property and lives comparisons to other disasters [1]. Remote sensing and GIS are tools to study and minimize the effect of flood. Pre-disaster and post disaster planning is done through these tools. Remote sensing is used to locate flood affected areas while GIS is helpful to evacuation planning during flood [2].

A mitigation activity aims to reduce the effect of disaster. This phase involves three kinds of studies:

1. Natural Hazard Assessments which give information on the probable location and cruelty of natural hazards and their probability of occurring within a specific time period in a given area.
2. Vulnerability Assessments estimate the degree of loss or damage.
3. Risk Assessments studies provide information about hazard and probable damage assessment from a hazardous event [3].

Evacuation is a risk management strategy that may be used to mitigate the effects of an emergency on a community. It involves the movement of people to a safer location and their return. For an evacuation to be effective it must be appropriately planned and implemented [4]. Evacuation Centers will be selected from available resources for shelter, medical facility and available road and rail network [5]. An Evacuation Center is established to provide shelter to people who are directly affected by an emergency situation and

for a people that do not have anywhere else to go to. Evacuation Centers are usually established in halls or school gymnasiums to provide basic shelter [6].

STUDY AREA

The State of Gujarat is situated on the north-western shores of India, lying between 20° 01' and 24° 07' North latitudes and 68° 10' and 74° 28' East longitudes. It covers a total geographical area of 1,95,984 sq. km [7]. Mahi, Narmada, Tapi rivers are passing from high population density areas. Due to heavy rains these rivers produces floods in nearby areas [8].

Present study is carried out in three flood affected villages of Anand district of Gujarat. Study area is bounded by 22° 27' 17.60" North 73° 03' 17.80" East latitude and22° 31' 2.57" North 73° 04' 11.6" east longitude. Mahi is one of the longest river passing from Gujarat. Mahi originates from Vindhyas mountain ranges in Madhya Pradesh and flowing west part of India it is draining in to Gulf of Khambhat. In Anand district three villages Rajupura, Vaherakhadi and Anklawadi is selected for present study. Satellite picture download from Bhuvan portal of study area is shown in Figure 1. It is clearly shown path of Mahi river in satellite picture. Villages under study are marked in Figure. Vasad is used as shelter location and providing health care facility for people under flood.
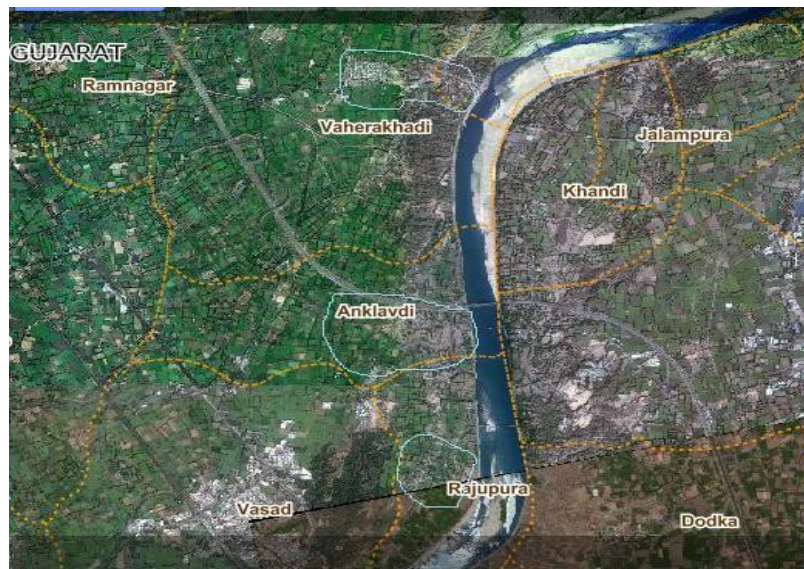

Figure 1 Study area of villages (Source-BHUVAN Portal)

RESEARCH METHODOLOGY

QGIS source software is used for demonstrating flood evacuation planning.

1. Creation of GIS data base from available resources. Administrative boundaries, available road and rail network, drainage network, census data are used for data base creation.
2. Collect and analyze data for population, village area, road network available, elevation, resources available for flood in villages.
3. For higher vulnerability villages evacuation planning is done in QGIS software.

OBJECTIVES

Objectives of the study were to evaluate the use of GIS and remote sensing for the following;

1. To prepare flood vulnerability map of flood area
2. Based on available resources identify suitable locations for shelters
3. Identify best route for evacuation
4. Propose suitable flood mitigation/evacuation plan.

QGIS Analysis

As shown in Figure 2 highly vulnerable flooded area due to flood in Mahi river. It is clearly shown that Rajupura, Vaherakhadi and Anklawadi three villages are nearer to Mahi river and vulnerable for flooding. Different resource facility is identified in three villages and digitize in QGIS software.

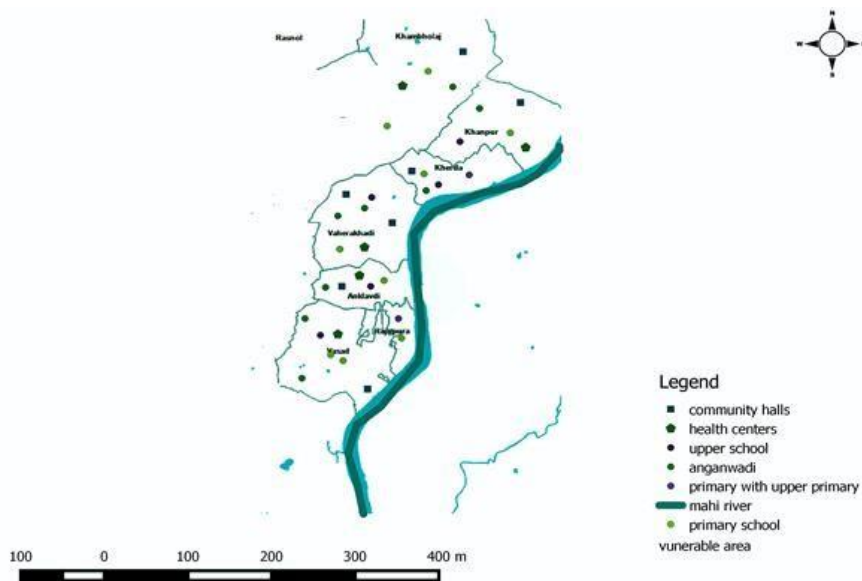**Figure 2 Vulnerable area of Mahi river**

Figure 3 Settlement locations of study are

Various parameters like population density, elevation and available resources are computed and summarize in below Table 1. Vasad is nearest village from these three villages so it is selected as shelter location. PHC center of Vasad is used as healthcare center for these villages during time of flood (Figures 3-5).

Table 1 Flood vulnerability parameters

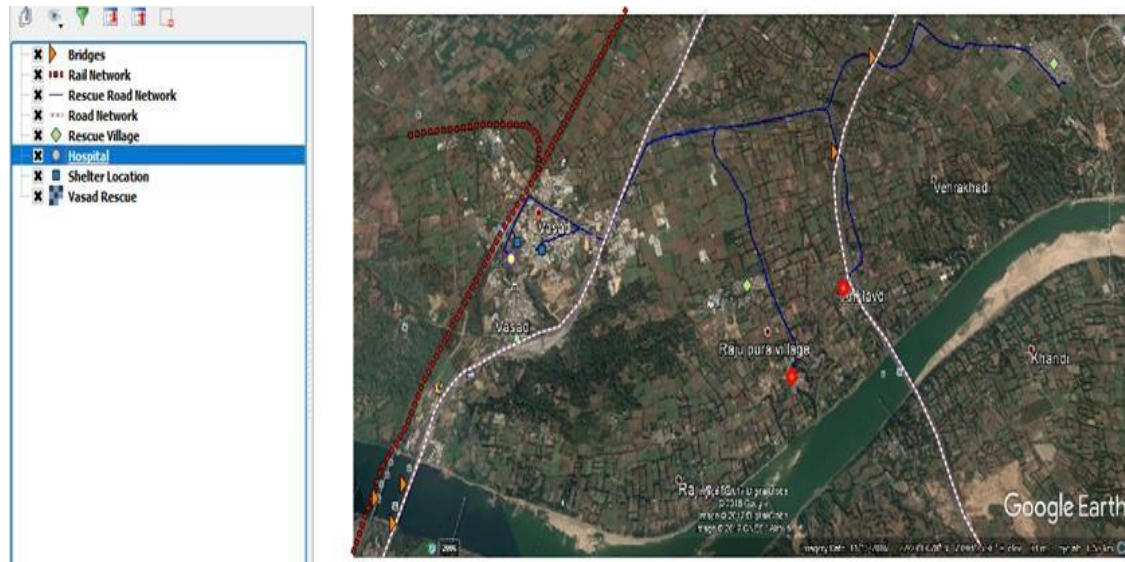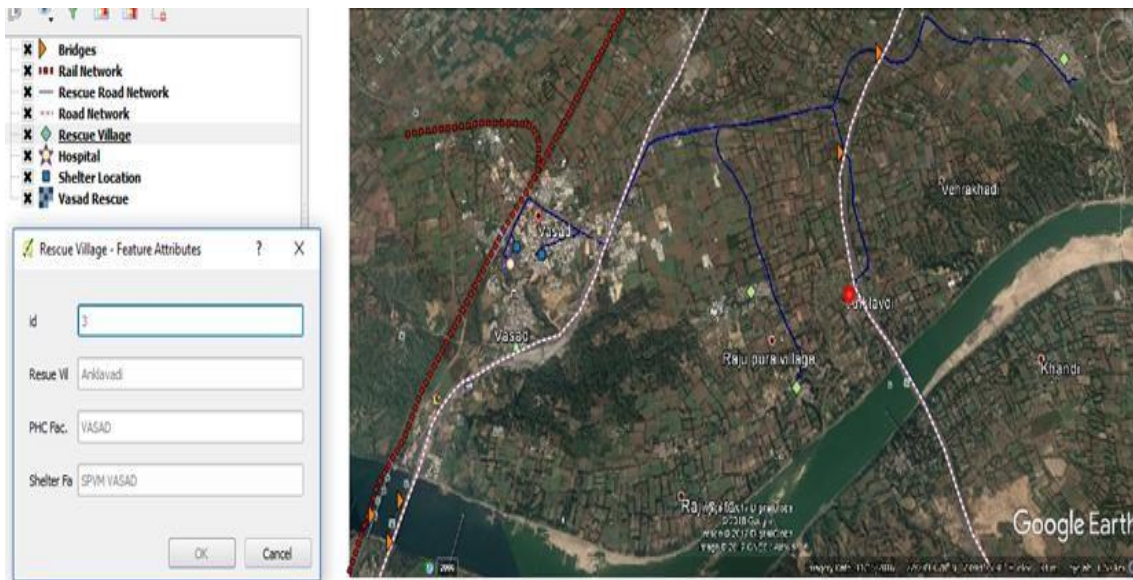| Sr. No	Name of Village	Total Area (Sq Km)	Total Population	Population Density	Elevation in ft	Available resources for flood evacuation
1	Rajupura	3.3763	4165	1233.59	34.13	Poor
2	Vaherakhadi	12.38	8282	642.77	34.13	Poor
3	Anklawadi	6.10	3046	498.72	39.62	Poor

Figure 4 QGIS analysis

Figure 5 QGIS query analysis for decision making

RESULTS AND DISCUSSIONS

Using GIS software study area is digitized. Various locations like shelter, hospitals, road network are identified and digitize in QGIS. Google earth map is used as base map for showing flood evacuation plan. For these three villages nearest village Vasad is used as Shelter location PHC hospital available at Vasad is equipped with modern facilities for emergency services. Vasad is at High elevation compare to these three villages well defined road network is shown in QGIS. This road network is at high elevation and used for evacuation path during flooding. For QGIS query analysis and decision support is done at time of disaster shown in Figure 5. Vasad is also connected with well-defined rail network it may be helpful during disaster.

CONCLUSION

This research paper provides used of remote sensing data and GIS during flood for evacuation planning. This study is carried out in three villages. This study is helpful during disaster for decision making and movement of people from one place to other Administration gets help for planning for providing shelter and medical facility as per probable vulnerable area. This study helpful for informing people about flood occurrence and also making evacuation planning based on available resources.

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