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# Application of GIS and RS for Flood Evacuation Planning: Olpad Taluka (Surat) Case Study

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***Abstract:*** *Flood is natural phenomenon which brings damage to properties, infrastructures, animals, plants and human lives. Issue of flood involves the emergency response of services related to evacuation relief center and health center facility.GIS and Remote sensing helps to identify suitable relief centers, road network availability and evacuation planning. (The Role of GIS in Emergency Planning, 2011).Evacuation planning is useful at time of disaster for movement of people to a safer location and their return. For evacuation planning shelters are identify from existing schools, colleges. Shelters are not located in normal flood area .Road network is available between relief center and flood area All this information and decision making is done with help of GIS (National Disaster Management Guidelines Management of Floods, January 2008).In this research paper as a case study evacuation planning for villages of Olpad Taluka of Surat are studied. These villages are highly vulnerable for flooding due to flood in Tapi river.Evacution of people from flooded area to high elevation safe location is necessary. In this research based on resources available, elevation of village area, population density of area are studied. Suitable available shelter is identified which contains necessary facility for hospital, food, rail and road network. These locations are identified and digitized in QGIS software complete evacuation plan is discuss in this paper.*
***Key Words:*** *Remote Sensing, GIS, Olpad, Risk Zone, Vulnerability, Evacuation planning etc.*

## I. Introduction

India is one in all the foremost flood prone countries within the world. The principal reasons for flood are prevailing natural ecological systems within the country and these are significant precipitation with temporal and spatial variation, extremely silted watercourse systems and inadequate capability to hold the high flood discharge, inadequate drain to hold away the fresh water quickly to streams / rivers. Repeatedly typhoons and cyclones conjointly cause floods. Flash floods are caused by steep and extremely erodible mountains, significantly in range ranges. The average precipitation in India is 1150 millimeter with important variation across the Country. The annual precipitation on the western coast and Western Ghats, Khasi hills and over most of the Brahmaputra River vale amounts to over 2500 millimeter. Most of the floods occur throughout the monsoon amount and are sometimes related to tropical storms, depressions and active monsoon conditions. Because of the mentioned conditions floods occur in the majority watercourse basins in India**.** (Mishra, Kumar, & Agarwal, 2011)

Vulnerability to floods and alternative natural disasters is caused by the high population density, widespread poorness, illiteracy, huge pressure on rural land, and agriculture dominated economy. Children, women, old age people are highly vulnerable during disaster.85% of the deaths throughout disasters are of ladies and kids. (Centre for analysis on the medicine of Disasters, CRED 2000). Presently protection within the country against floods is insufficient. Although non-structural measures improve the preparation to floods and scale back losses, the requirement of structural measures would perpetually stay for minimizing the extent of physical harm caused by floods. In future programs and development designing of the country, it's needed to integrate control and management designing alongside global climate change. In Gujarat, Tapi River mostly causes flood in Surat and its nearby areas of Olpad and Chaurasi Talukas (Udani & Mathur, 2016).This research is based on use of remote sensing and GIS in flood evacuation. Evacuation planning is most important during flood .Olpad Taluka of Surat is also coastal area and highly vulnerable for flood during cyclone and tsunami. Census based parameters like Population density, resources availability are used for evacuation planning using GIS.

## II. Study Area

Olpad taluka of Surat is chosen as a study space .The study space (Olpad Taluka) is confined by 20° 0' 0" to 21° 7' 48" north latitude & 72° 22' 48" to 74° 13' 48" east great circle region in south Gujarat(Surat District Panchayat Gujarat Government, 2017). Throughout the last decade most flood occurrences are discovered in Tapi

and also the chosen study area of Olpad taluka of Surat district. (Mahur, Udani, & Vora, 2016). Serious rains, abrupt discharge from Ukai reservoir, coinciding with high water in sea, voidance congestion and encroachments in geological formation space have seriously affected coastal taluks and specifically Surat town. The most important flooding has occurred in 1998, 2005, 2006 and 2007. (Gujarat State Disaster Management Plan Volume 1, 2014)

## III. Resaerch Methdology

For analysis purpose QGIS open source software is used. GIS data base is created based on different data collection, mapping of settlement locations, digitization in QGIS software .Major steps involve in data base creation are.

1. Collection of satellite data like land use, drainage system, district boundary, village boundary, rail and road network, digital elevation model.
2. Collect and analyze data for Elevation, Resources available for flood in villages, Population density of villageDisastnce of village from Tapi river.
3. Based on above available data analysis villages are classified in three different vulnerability zones.
4. For higher vulnerability evacuation planning is done in QGIS software.

Figure- 1 below shows different villages of Olpad taluka, Surat.
Figure-2 shows Cartosat satellite image of Olpad taluka taken from Bhuvan Portal


**Figure 1**-Villages of Olpad Taluka of Surat District


**Figure-2:** Satellite Image of Olpad Taluka (Source-Bhuvan Portal)

SRTM DEM of Olpad taluka is downloaded from and values for different regions are computed.study area is shown in figure 3.

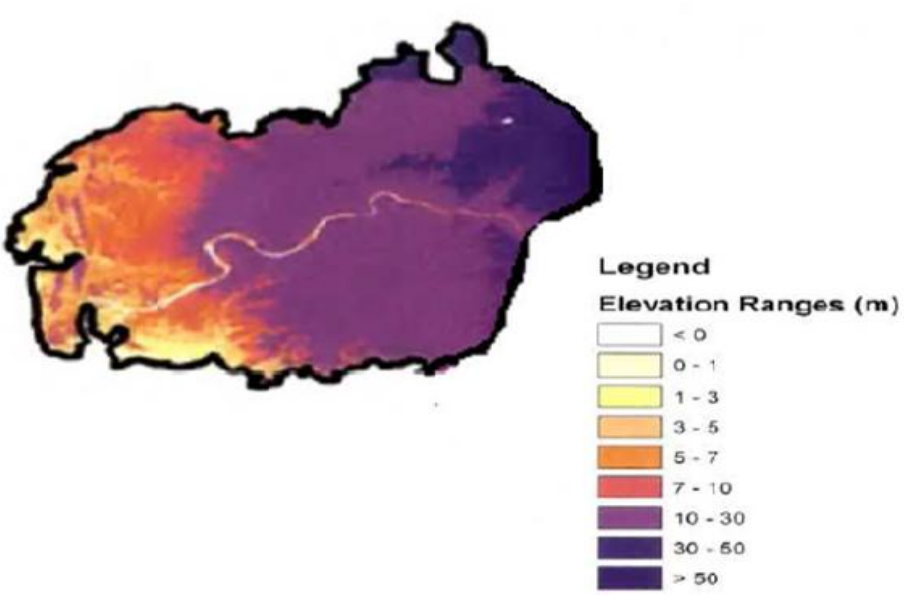


**Figure- 3:** Digital Elevation Model (Source-SRTM DEM)

## IV. QGIS Analysis

Most of the Villages of study area are well connected by roads .Major road network consist of National Highway, State Highway and District Roads. The road network map of Olpad taluka is shown in figure-4. Based on field observations for every village and available facilities data collected is shown in figure 5.

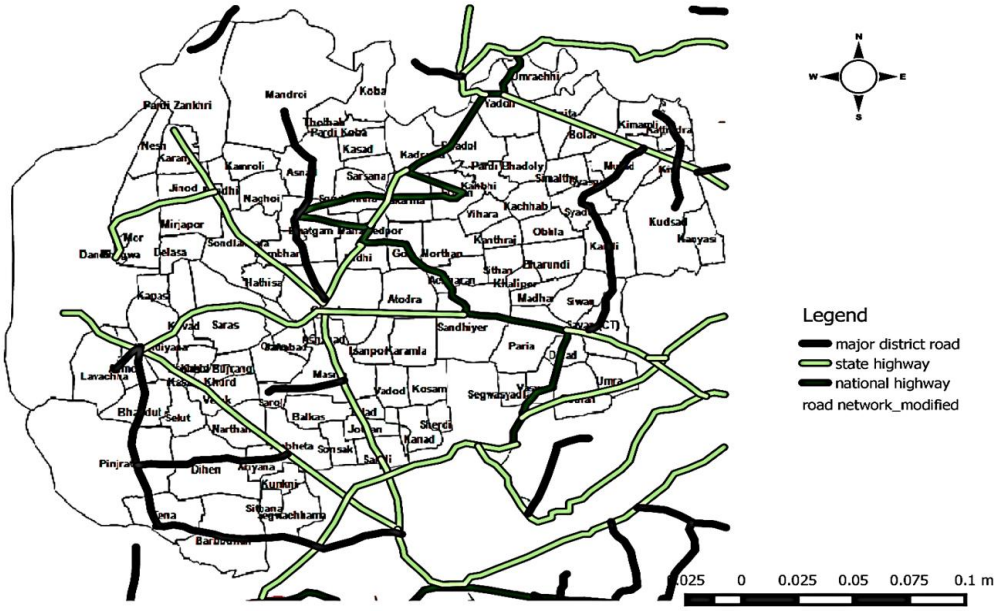


**Figure -4:** Road Network(QGIS Map)

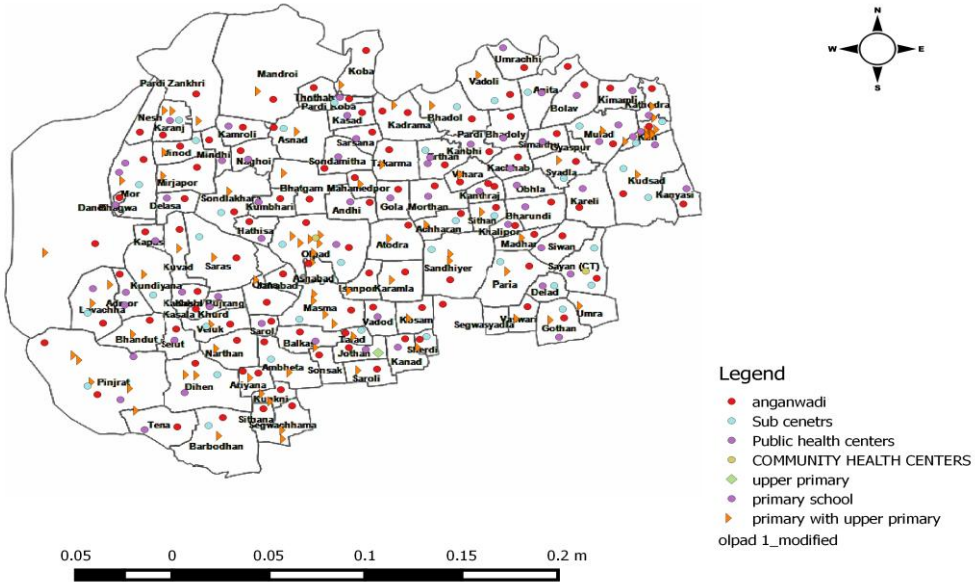


**Figure -5**: Facilities Data for Study Area (QGIS Map)

Based on QGIS analysis data for elevation, resources available like sheletrs,road network ,population density of villages are computed in software and following classification is done for villages.

| Higher Risk Zone Villages | | Medium Risk Zone Villages | | Lower Risk Zone Villages | |
|---|---|---|---|---|---|
| Admor,<br>Ariyana,<br>Asnabad,<br>Balkas,<br>Bhagwa,<br>Delad,<br>Gothan,<br>Hathisa,<br>Jafrabad,<br>Kadrama,<br>KaslaBujrang,<br>Kathodra,<br>Kim,<br>Kudsad,<br>Masma, | Mirjapor,<br>Mulad,<br>Narthan,<br>Olpad,<br>Orma,<br>PardiKoba,<br>Sarol,<br>Saroli,<br>Sarsana,<br>Selut,<br>Sherdi,<br>Sonsak,<br>Umra,<br>Umrachhi, | Ambheta,<br>Barbodhan,<br>Bhadol,<br>Bhandut,<br>Dandi,<br>Delasa,<br>Erthan,<br>Isanpur,<br>Jinod,<br>Kachhol,<br>Kamroli,<br>Kanyasi,<br>Karanj, | KasalaKhurd,<br>Kosam,<br>Kunkni,<br>Kuvad,<br>Lavachha,<br>Mahamedpor,<br>Mor,<br>Naghoi,<br>Nesh,<br>Saras,<br>Sayan,<br>Segwasyadla, | Kanad,<br>Karamla,<br>Kachhab,<br>Kareli,<br>PardiZankhri,<br>Khalipor,<br>Kimamli,<br>Vaswari,<br>Veluk,<br>Vihara,<br>Thothab,<br>Vadoli,<br>Talad, | Paria,<br>Mandroi,<br>Sandhiyer,<br>Andhi,<br>Kanad,<br>Sondlakhara,<br>Sithana,<br>Obhla,<br>Sithan,<br>Syadla,<br>Takarma,<br>Tena, |

## V. Evacuation Planning

For evacuation planning of highly vulnerable villages based on available road network and resources available villages are divided in 5 zones .For each zone shelter and health care facility centre which are well connected through road network are identified. In following screen shot for QGIS evacuation planning different road network like national highway, state highway, and village roads are digitized in QGIS software (Pawar Amol D, 2014).In Left portion of map clearly indicate different zones prepared for evacuation planning.diffrent road network, rail network, rescue and health care centre digitize in QGIS.Decision making and query analysis is shown for particular village in form of query is shown.

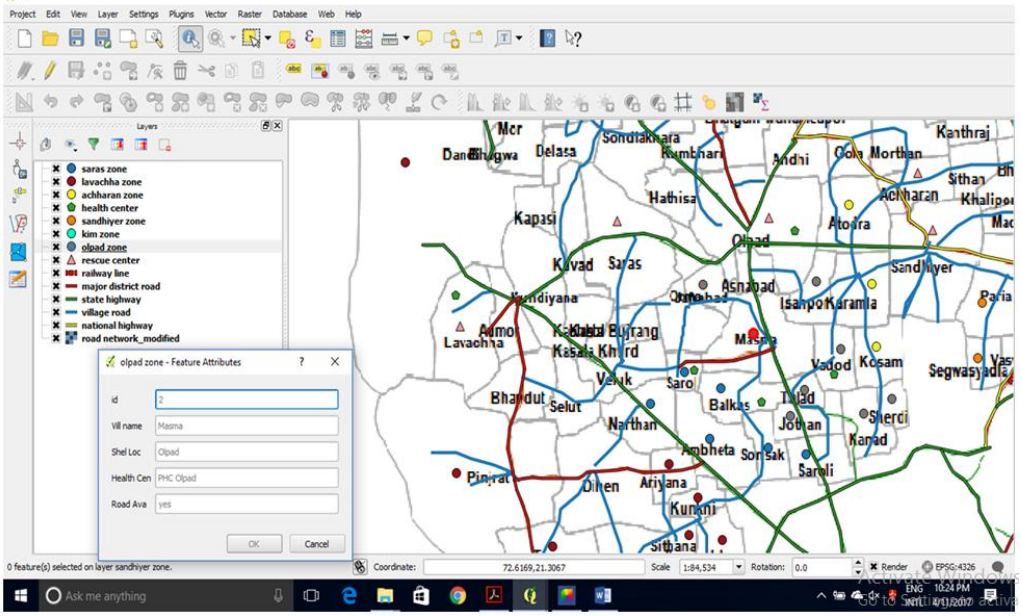


**Figure 6**: QGIS decision making for evacuation planning.

## VI. Conclusion

Remote sensing and GIS are basically used for disaster management and analysis and decision making purpose.Evacution planning for flood for this study are is demonstrated here.Same methodology also used for other natural and manmade disasters. Census data analysis is very useful with integrate with QGIS for decision making during disaster phase.

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