Flood Inundation Mapping of Puthenvelikkara Panchayat Based on 2018 Floods

Lakshmy Kakkanatt U
Assistant Professor,
Department of Civil Engineering,
SNMIMT Kerala, India

Sona Vincent
Department of Civil Engineering,
SNMIMT
Kerala, India

Sneha Sojan,
Department of Civil Engineering,
SNMIMT
Kerala, India

Nazrin Firoz
Department of Civil Engineering,
SNMIMT
Kerala, India

Sourav Raj
Department of Civil Engineering,
SNMIMT
Kerala, India

Abstract— **Flooding is one of the most frequent and devastating natural disasters and can often result in severe damage to agricultural products, commercial infrastructure, personal property and loss of human lives. Flood inundation mapping (FIM) is required to understand the effect of flooding in a particular area. Among the 17 wards in Puthenvelikkara Panchayath, 2 wards are severely affected by the flood. By taking wards 15 and 16, Ernakulam, Kerala as study area we designed a methodology for calculating the flood inundated area using QGIS software and Digital Elevation Model (DEM) of surveyed area from Earth Explorer. In this study it is aimed to develop the flood inundation maps of Puthenvelikara panchayat for 2018 flood. By mapping the areas affected by flood in Puthenvelikara, helps reducing the potential risk and evacuating the people of that area at the time of flood.**

Keywords—QGIS;DEM;Participatory GIS;Flood Inundation Mapping

I.   INTRODUCTION

During July-August 2018 resulting in heavy floods and natural catastrophe: The State of Kerala has its worst flood situation since 1924. Puthenvelikkara, Kunnukara and Chendamangalam are major flood-prone regions in Kerala. Puthenvelikkara and nearby areas in the district had borne the brunt of the devastation caused by the 2018 flood, the worst to hit the state in nearly a century. The panchayat has several low-lying areas and the roads are quite narrow. Ever since the reports of massive rains came in the panchayat made arrangements for boats privately. Paravur has a total 37 campus housing 9682 people. But reports regarding possible increase in water levels in Chalakudy river if there is release from Tamil Nadu has added to their anxiety.

Puthenvelikara still does not have an emergency action plan as mandated Kerala state disaster management authority. Only 147 of the 941 panchayats in the state have prepared emergency response plans to be executed in the event of a disaster. It is situated in the valley where the Chalakudy river meets the Periyar. The river is also narrow and hence a scientific approach is needed. The benchmark for our survey is the Ground Control Point marked at Cheraman Juma Masjid in 1887 by East India Company in its Great Trigonometrical Survey. The height marked in it is 4.40 metres above the sea level and flood inundation mapping is done based on that. flood mapping is done to identify up to which level the water will rise based on the amount of rain received.

Tidal flooding is also a problem that the people of Puthenvelikkkara panchayat have been facing for years. It occurred twice a day, so that their day-to-day life become intolerance. Flood inundation map will help to identify the vulnerable locations and the extend of their vulnerability during future floods. Besides, all the future constructions should also be undertaken accordingly.

II.   MATERIALS AND METHODS

A. Study Area

Puthenvelikara panchayat is the study area selected, which lies in the Ernakulam district, Kerala state. Total geographical area of Puthenvelikara panchayat is 19. 87km2. Population density is1420.58. Puthenvelikara shares its borders with Poyya and Methala villages in the North, Kurumalloor and Kunnukara villages in the South, Prakkadav, Kunnukara, and Kuzhur villages in the East, and Chendamangalam, Vadakkera and Methala villages in the West. The ancient belief is that, the formation of the village is a result of high-tide and this belief is proven by the existence of fossil of aquatic being found in the village.

Blessed with scenic splendor, Puthenvelikara is on the banks of the river Periyar and Chalakudy and Kottapuram kayal. Puthenvelikara is surrounded by water bodies such as rivers and lagoons. It resulted in the formation of fertile lands suited for cultivation. Puthenvelikara census town has total administration over8,379 houses to which it supplies basic amenities like water and sewerage. It is also authorized to build road with census town limit and impose taxes on properties coming under jurisdiction.

There are 17 wards in the panchayat. From the field survey of 15 and 16 wards, ward 16 was more affected than 15. The nearest town to this village is North Paravur, which is approximately 5km away and is connected to the village via a rail station named 'Kadavu'.

Puthenvelikara was one of the first spot in Ernakulam district to bear the burst of the flood in August 2018.

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B. Methodology

Data collection

Data collection is the primary stage of the project includes collecting location details, basic details and flood levels from ground level. It is done through field survey using ZOHO FORMS application with the help of local people. Zoho Forms is an online form builder that backs up data on the cloud. With a drag and drop form builder that is responsive on all mobile devices. All data will be stored in the cloud, and you can access them any time, from anywhere.

Questions for data collection are Location details, Basic details and Flood details.

Location details include latitude and longitude of each house is collected using mobile phone GPS. A GPS provides latitude-longitude coordinates gathered by the hardware on a device which communicates with a satellite such as a car navigating system, a mobile phone or a fitness tracker. The latitude/longitude coordinates generated by the GPS are considered the standard for location data. Device receives signals from the satellites and it can calculate where it is by measuring the time it takes for the signal to arrive.

Basic details include the data regarding name, ward number, building number and contact number of the residents of the area.

Flood details include flood level from ground level, may include an increase in ground and underground water due to the high level of surface water. Flood associated with flooding of water in an area due to an increase of water level above ground level. Flood depth varies according to ground characteristics. Flood depth from ground level is greater in low lying areas than high lying areas.
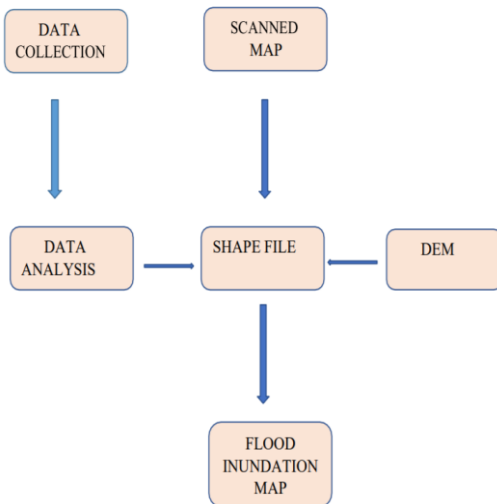

Fig. 1. Flowchart of Methadology

Working Platform

Mapping is done with the help of QGIS software. QGIS (Quantum GIS) is a free and open-source application software used for viewing, editing ana analysing geospatial data. It supports both raster and vector layers.

C. Flood Mapping

From the field survey of 15 and 16 wards, ward 16 was more affected than ward 15. "Cheerupalam,Vellottumpuram " were the places bear the worst of 2018 flooding. From wards 15 and 16, total number of houses surveyed is 293. By analysing surveyed data, we can find out that in Puthenvelikara Panchayath, among wards 15 and 16 most of the houses were affected by 2018 flood.

Highest flood level from ground level - 290 cm
Latitude - 10.199950000
Longitude - 76.2259710000
Lowest flood level from ground level - 54 cm
Latitude - 10.1965
Longitude - 76.2233

Reduced level of Thuruthipuram in puthenvelikara panchayath is about 1.290 m. Relative level in surveying refers to equating elevations of survey points with reference to a common assumed datum. It is a vertical distance between survey point and mean sea level. So, it is considered as the base elevation which is used as reference to reckon heights or depths of other important places.

TABLE I. FLOOD DEPTH

Sl No	Flood Depth(cm)	No of Houses
1	0	2
2	1-100	6
3	101-200	184
4	201-300	101

FLOOD DEPTH RANGE (cm)

- 0
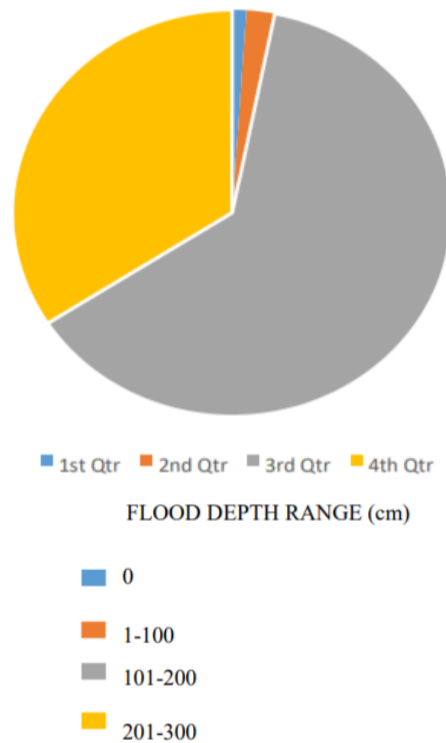- 1-100
- 101-200
- 201-300

Fig. 2. Pie diagram for flood depth range

The surveyed data will be saved in excel format. The table will contain the Latitude(Y) and Longitude (X) collected using mobile GPS. Then the table will be added to the GIS software. In order to use those types of data in GIS it is necessary to align it with existing geographically referenced data, this process is also called geo referencing. Geo referencing is also a necessary step in the digitizing process.

Digitizing in GIS is the process of "tracing", in a geographically correct way, information from images/maps.

The process of geo referencing relies on the coordination of points on the scanned image (data to be geo referenced) with points on a geographically referenced data (data to which the image will be geo referenced). By "linking" points on the image with those same locations in the geographically referenced data you will create a polynomial transformation that converts the location of the entire image to the correct geographic location.

Fig. 3. Shape file of Puthenvelikkara Panchayat

Digital Elevation Model (DEM) as an indicator of the earth's surface contains information about the elevation of the earth. The DEM elevation and Flood depth values will be added to get the Flood level above sea level. These flood level points are interpolated to get the flood map. Different colour can be used to show the non-flooded area and the flooded area.

Digital Elevation Model is frequently used to refer to any digital representation of a topographic surface. It is the simplest form of digital representation of topography. By extracting required region from USGS Earth Explorer, we get depth from mean sea level to ground level of each required point in the DEM. When digital elevation model is clipped with shape file get the depth of specified shape file region. This help to identify whether the surveyed houses belong to low lying or high lying. By importing flood depth, latitude and longitude collected from field surveyed data get the height from mean sea level to flood level at the time of 2018 flood.
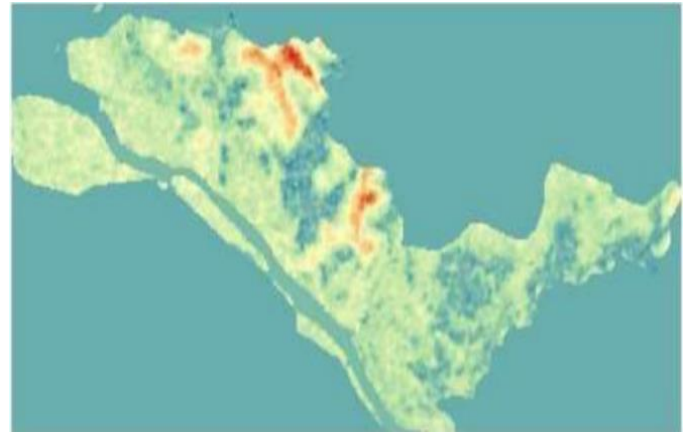

Fig. 4. Clipped DEM and Shape file of Puthenvelikkara Panchayat

III. RESULTS AND DISCUSSION

The method used was very effective in mapping the flood inundated areas. Flood map of the study area was created in the software which shows flood level ranges of 2018 flood. The method used was very effective in mapping the flood inundated area. The map in fig 5 shows the variation of flood height on ward 15 & 16 of the puthenvelikara panchayath. Highest flood level is 290 cm and highest range of flood level (201 – 300 centimetre) is depicted in blue colours dots. The medium range of flood level (101 -200 centimetre) is in green colours and lowest range of flood level (0 – 100 centimetre) is in orange colour.
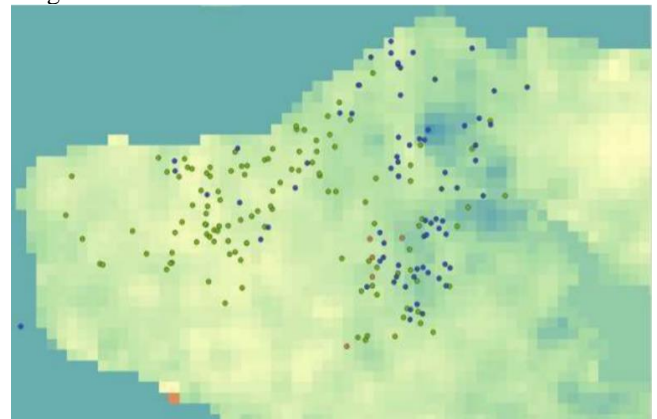

Fig. 5. Zoomed Image of FIM

The problem faced by officials was the unavailability of flood prone area maps for reference. Because of that they faced difficulties in evacuation and selecting camp locations, two relief camp locations selected were flooded during the peak flood hours and people were stranded there. This makes the necessity of a Flood map for future reference. When considering the previous major flood in Kerala which is around 100 years back, shows the importance to map the current flood events for the future generation. Otherwise, the same disaster will be repeated.
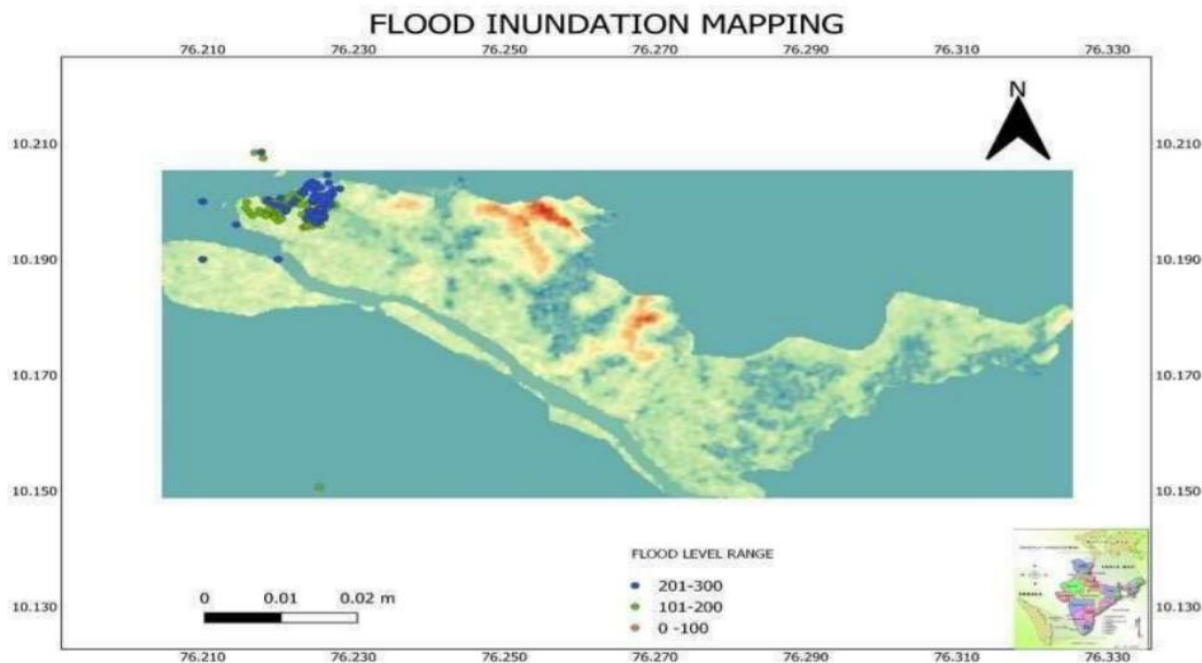
Fig. 6. Flood Inundation Map

IV. CONCLUSION

The impacts of flooding are devastating in terms of human displacements, loss of life and damage in infrastructure and property. One of the efforts to minimize losses is providing early information to the community about risks through flood inundation maps. These maps do not only identify future flood prone areas, but also provide useful information for rescue and relief agency, land planners and local authority.

This study paved the way to find the flood inundated area and the preparation of flood inundation map. Flood inundation map helps to understand the effect of flooding in a particular area. This map will facilitate future uses disaster awareness, land use planning, to reduce potential risk and helps in evacuating people of the area at the time of flood. Puthenvelikara is a place surrounded by water bodies such as rivers and lagoons. It is a low-lying area with narrow roads and paddy fields. Wards 15 and 16 was one of the first spot in Ernakulam district to bear the worst of 2018 flood. The reduced level of Thurithipuram is about 1.290 m above mean sea level. Thus, the need of a flood inundation map initiated. The map shows highest, medium and lowest flood affected areas. The problem faced by officials was the unavailability of flood prone area maps for reference. Because of that they faced difficulties in evacuation and selecting camp locations, relief camp locations. This makes the necessity of a Flood map for future reference. When considering the previous major flood in Kerala was on 1924, which is around 100 years back, shows the importance to map the current flood events for the future generation. Otherwise, the same disaster will be repeated.

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