

# Establishing Benchmark and Elevation Profile Mapping for Flood Modeling and Flood Inundation Studies

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**Abstract-**Establishing benchmark and elevation profile mapping for flood modeling and flood inundation study is targeting Puthenvelikara Gram panchayat. Since 2018, the flood in 2 ordered years the diversity and geographical conditions of the Puthenvelikara meets a forceful worst modification. Additionally, to the present situation it's one in every of the recurrent event flood prone space. By considering all this state of affairs, the aim of this study is to implement a disaster mitigation set up. This set up ought to facilitate the natives from the frequent global climate change affects like flood, drought and therefore the recurrent event flood problems and thereby give a far better survival for them. For additional development of this set up the mean water level ought to be determined. To knowing this level a field survey ought to be conducted. This paper includes the character and disaster history of the Puthenvelikara, bench mark and its restoration for shifting MSL, details regarding the field survey and profile mapping. There are many study area unit progressing related to this project and therefore the overall outcome ends up in the disaster mitigation set up together with the installation of river gauge at Puthenvelikara Gram panchayat.

**Keyword-** Benchmark; Kerala Flood; Total station; QGIS; Google Earth; Flood mapping

## INTRODUCTION

Puthenvelikara is village located at Parvoor taluk of Ernakulum district and it's encircled by the watercourse Periyar, Chalakudy and Kottapuram lagoon. It is one of the hotspot in Kerala throughout the flood of 2018 and 2019. Since 2018, the successive floods in the region bore the strength and plenty of were left homeless when they featured the furious waters from the Chalakudypuzha and Periyar. It's one in every of the recent witness of skyrocketing water level because of the frequent global climate change everywhere the globe. As a result of this, the impact making by the tidal flood in this area is increasing day by day and which leads the residents to an uncomfortable living condition. To reconstruction Puthenvelikara from this worse condition a disaster mitigation set up is implementing. As an initiative of this plan the mean sea level of the area should be determined. For this the nearest benchmark is shifted to station kadavu bridge at Puthenvelikara through the field survey. This should help to install the tidal gauge to follow the trends of tidal flood in the region.

## OBJECTIVE

The broad objectives of the projects are:

- Shifting of bench mark
- Profile elevation mapping

- Flood inundation studies
- Installation of tidal gauge

## STUDY AREA

The study area of the project is Puthenvelikara Gram panchayat which is located between latitude 10.1847° N and longitude 76.2421° E. The Chalakkudy River merges with the Periyar River at Elenthikara in the village of Puthenvelikara. Puthenvelikara is on the banks of the river Periyar, Chalakudy and Kottapuram lagoon. The Territory of Puthenvelikara covers an area of 19.87 square kilo meters. Puthenvelikara shares its boundary with Prakkadavu, Kunnukara and Kuzhar villages in the East, Chendamangalam, Vadakkekara and Methala villages in the West, Poyya and Methala villages in the North, Karumalloor and Kunnukara villages in the South. The field survey associated with project started from the Cheraman Juma Masjid at Kodungallur taluk of Thrissur district which is located at 10.2129° N to 76.2024° E and ended at the Station Kadavu bridge at Puthenvelikara Gram Panchayat of Ernakulum district located at 10.1786° N to 76.2431° E.

## METHODOLOGY

### 1. Reconnaissance survey

Reduced levels obtained from the study area is the major data required for the further developments associated with the project. The data available in the google earth can be utilised. But the advanced data from the google earth is not consistent. The data in the google earth is not completely meet with undulation of earth surface. When these data are directly used for the survey it may not be perfectly meet with the actual undulations of the study area. For getting perfect undulations of the study area field survey is the another better option. That is why the field survey is adopted for the further process.

The field survey is kick started from the ground control point marked at Cheraman Juma Masjid in 1887 in the Great Trigonometrical survey conducted under the auspices of the East India company to scientifically measure the Indian sub-continent. It denotes the height as 4.40 meters above the mean sea level been the nearest such benchmark to Puthenvelikara should be used as the base point for the disaster mitigation measures like flood inundation mapping. Also it helps to installing the tidal gauge because the panchayat is badly hit by saline water intrusions during tidal flooding. The route for the survey is selected with the help of google map. The determined route is from Cheraman Juma Masjid to Station kadavu bridge via Kottapuram and Thiruthupuram. It exactly covers 7.7 km which includes 2 bridges and 52 curves.



Fig.1. Bench mark at Cheraman Juma Masjid.

## 2. Field survey

For collecting the data required for the project a field survey is conducted in the study area. Bench mark at Cheraman Juma Masjid is taken as base point for the survey. With respect to this point the survey is started from the base station at Cheraman Juma Masjid. The instrument used for the survey is total station. For verifying the data taken with the total station, auto levels are also used along with the survey. The destination of the survey meets at station kadavu bridge through Kottapuram and Thiruthipuram which includes state highway 56. while conducting the survey instrument is shifted 51 times. During the survey the historical and religious spots are considered for marking level which may be useful for the future studies. Some of them are Thiruvanjikulam temple, Cheraman prambu, Thiruthipuram church, Puthenvelikara Police Station and VCHSS school Puthenvelikara. The two bridges which are covering during the survey are Kottabridge and Thiruthipuram bridge and also randomly covered 2018 flood levels near kottabridge and ST Thomas Shrine chapel. The survey is also extended to the Puthenvelikara Gram Panchayat for the future events conduct associating with this survey.

## DOCUMENTATION

The data obtained from the field survey is exported in to excel sheets and analyzed. The reduced levels respective to each data are calculated by using HI method. The resultant data thus obtained is compare with the advanced data taken from google earth. This comparison is done mainly for verifying the accuracy of the field data. Through this comparison a huge variation is discovered among these data. For cross checking the consistency of both data and to prove which is more accurate and also to counteract the errors an alternate method is used.

The alternate method used is collecting the reduced levels of various railway station from Ernakulum to Alappuzha district. The actual reduced levels of these railway stations are collected from the stations records and then which is compared with the respective levels available from the google earth. The comparison between the actual reduced

levels of the considered railway stations and their respective level from the google earth as shown in table 1.

TABLE 1

RAILWAY STATION	RL FROM GOOGLE EARTH	ACTUAL RL
Kayankulam	7	8.63
Ambalapuzha	2	2.84
Alapuzha	4	3.04
Cherthala	5	3.75
Ernakulam jn	4	1.22
Kalamassery	8	6.641
Aluva	12	11.28

RL of various Railway station from google map and field survey

By analyzing the table, we came to a conclusion that there always occurs a variation in the data obtained from the google earth with the actual data. For example, consider the railway station at Ernakulam district, the actual RL of the station in records is the 1.22 meters and the RL from google earth is 4.00 meters. so there occurs a variation of 2.780 meters. This is due to the undulation of the earth surface and this variation is sometimes greater than the actual value and vice versa which is clearly depending on the topography of the considering region. As per the result of this analyses we conclude that the data obtained through field survey is more accurate than the advanced data from the google earth. So the further study is continuing by considering the field data. From the field survey, the resulted RL meets with many undulations in many regions and somewhere it shows a consistent nature also. In some places it shows steep rise and somewhere it shows a decreasing nature. The intermediate stations included in the survey shows different nature in RL. This survey covers the most sensitive regions in the time of flood in previous years this sensitivity to flooding is a result of the undulation in the region.

The levels of the major staff stations including the intermediate stations are shown on the table 2.

TABLE 2

Major Staff stations	RL from field survey in meters
Cheraman juma masjid	4.40
Thiruvanjikulam temple	5.085
Cheraman paramb	5.070
2018 flood level at kotta bridge	2.160
Thiruthipuram bridge	6.025
Thiruthipuram church	1.290
Japamala ranchi church	1.665
Water level at st. Thomas shrine	2.000
Puthenvelikara grama panchayath	2,470
Police station	3.375
VCSHSS	3.115
Station kadavu bridge pier	2.405

RL of major stations in the field survey

### MAPPING

The resultant data acquired from the field survey is again exported into excel sheets. The excel sheet contain reduced level of the staff stations and their respective locations i.e. latitude and longitude. These excel sheets are converted into .csv file for the mapping purposes. These .csv files are imported into. kml file. After importing these data into. kml file, a map is generated with reduced levels respective to each point and its locations in the .csv file. The Fig 2 shows the map plotted in the. kml file.

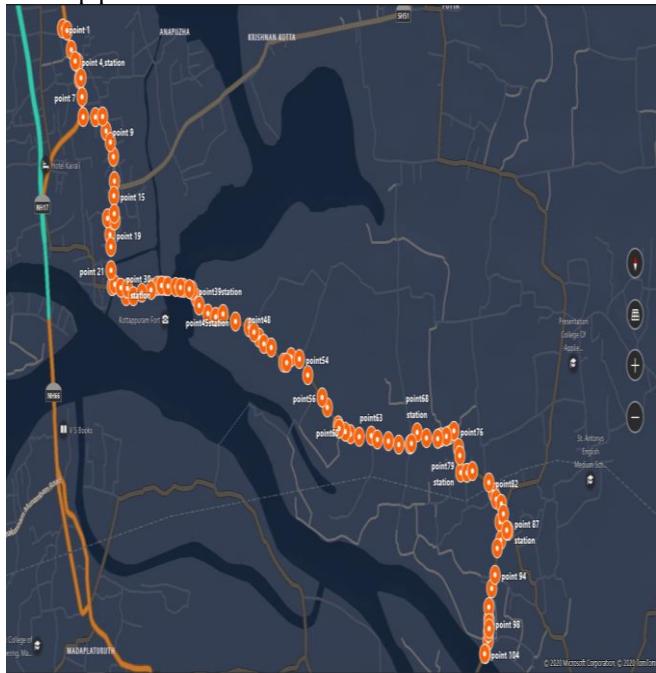


Fig.2.Map in. kml file.

The further mapping process including profile mapping are carried out in QGIS software. The .kml file is then open in QGIS software, then the map with reduced levels of each stations are generated as per Fig 3

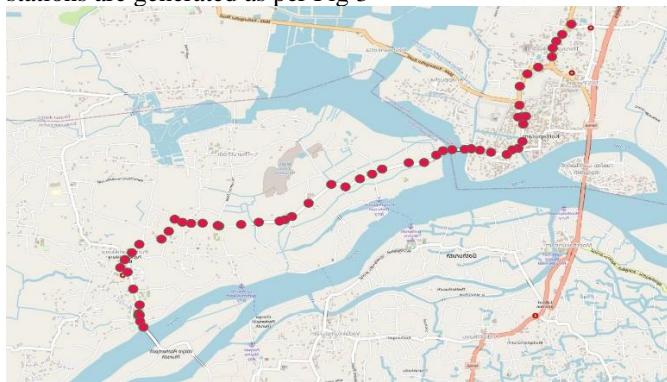


Fig.3. Map in QGIS software with reduced level.

Then these files are again interpolated with these marked points in the map with the help of profile tool in the QGIS software which generate elevation for line features to getting the profile map of the study area as shown in fig 4. The x axis shows the places from Cheraman Juma masjid to Station Kadavu and y axis shows the RL of each point.

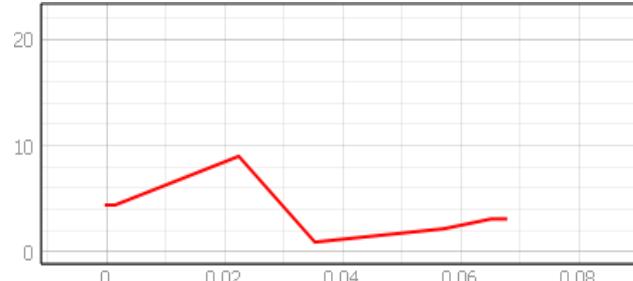


Fig.4. Profile map of the study area.

The fig 5 shows the profile of the region which is plotted against both the reduced levels from the field survey and the google earth. The red line indicates the RL from the field survey and black line shows the RL from the google earth.

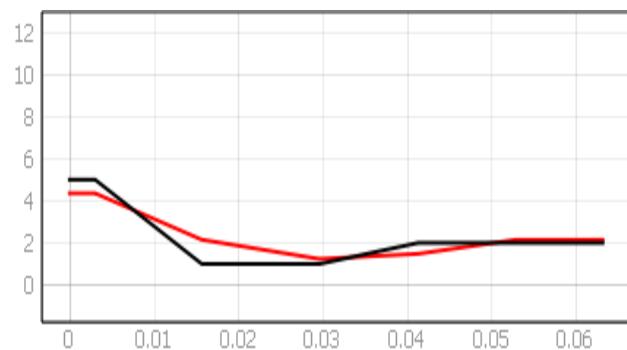


Fig.5.Profile map which compares the RL of field survey and google earth of the study area.



Fig.6. Profile map compares the RL of the field survey and google earth of the various railway stations.

### RESULT AND DISCUSSION

Reconnaissance survey indicate that the topography of the study area is an undulated region. The observations from the reconnaissance survey is revealed by conducting the field survey. Thus understand that the Puthenvelikara Gram Panchayat is region with many undulations in the ground. This is the one main reason behind the drastic entry of flood water in the previous years.

By analyzing the profile map, the regions with low altitude and high altitude can be effectively determined. Thus it helps in distinguishing the low lying and high altitude region of the panchayat. From Cheraman Juma Masjid to Cheraman prambu the variation in RL is almost 1 meter. After Cheraman prambu to the starting of Thiruthipuram bridge including the kotta bridge the RL is reducing i.e. from 5.070 meter to 1.680 meters which containing a variation of 4 meter. Then the RL at the bridge and it reducing to the end of bridge. Then the RL has almost constant nature with a variation of 1 meter to 0.5 meter. Then the RL is reducing to 0.885 meters at the Bakery padi which is one of the low lying

and sensitive region of the Puthenvelikara Gram panchayat. Then the region preceding from to Bakery padi to 1.5 kilo meters having slight variation. From here to a 300 meter of regions having a different nature in RL. The RL is suddenly increasing to 5.615 meters and then it is decreasing to 2.180 meters. This region is nearer to the Sree Dhandidayudha Paani temple. Then from this region to station kadavu bridge having low altitude. Thus the topography of the Puthenvelikara is mixture of high and low altitude region.

### CONCLUSION

This study paved the way to found out the actual reduced levels of the Puthenvelikara panchayat. Commonly the levels of the region are taken from the google earth, somehow there exist a slight variation. But in this case, RL from the google earth is not perfectly applicable. Because the study area is not a plane surface it includes many undulations. However, the advanced data from the google earth cannot be completely avoided. So due to this an alternate survey is conducted among the various railway stations to proving the accuracy of the field survey. So the study is carried out by using the data from the field survey and the data from google earth is used as reference for comparison purpose. Thus a new benchmark is established at Station kadavu of Puthenvelikara. Establishment of this new benchmark will help in the any further studies related to the topography. The main reason behind the dramatically effect of 2018 and 2019 flood is due to the unawareness of the actual reduced levels of the region. This newly established benchmark will help to minimize the devastating effect of flood at Puthenvelikara panchayat and for delivering appropriate service at the time of emergency. Besides this all future construction should also be undertaken accordingly. Also this benchmark helps in installing a gauge in river. This gauge helps in monitoring and identifying the rise in river water level especially on the release of water from dams and increase in sea level due to the climate change. It also helps in monitoring the tidal flood.

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