International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 04 Issue: 08 | Aug -2017 www.irjet.net p-ISSN: 2395-0072

# FLOODPLAIN MAPPING OF RIVER KRISHNANA USING HEC-RAS MODEL AT TWO STREACHES NAMELY KUDACHI AND UGAR VILLAGES OF BELAGAVI DISTRICT, KARNATAKA

**Sandhyarekha[1], A. V. Shivapur[2]**

*[1]M.tech Student, Dept. of Water and Land Management, CPGS, VTU Belagavi, Karnataka, India*
*[2]Professor, Dept. of Water and Land Management, CPGS, VTU Belagavi, Karnataka, India*

---***---

**Abstract** - *natural hazards are synonym for Floods that influencing severe economic damages and cause impact to human lives. It is always necessary to estimate scenarios of flood for accurate temporal and spatial information on the risks of floods and its potential hazards. This study includes two main objectives; during the worst flood event the flooded area cover, along Krishna River to be calculate and to produce floodplain map of flooded areas. In order to achieve these objectives, the HEC-RAS hydraulic model were used as tools. As a result, the watershed area of the Krishna basin has been successfully modelled and map showing the flooded areas along the part of Krishna basin has been delineated. The floodplain map produced clearly shows the spatial distribution of the flooded area. Generally, high water depth flow along the main channel and spreads gradually to the floodplains. The total flooded area covers at 100 yr. return periods approximately 300 acres near Kudachi and 116 acres near Ugar village along Krishna River. Thus, integration of geospatial process and hydraulic modelling can produce inundation flood map with good accuracy.*

***Key Words***: Flood plain, mapping, HEC-RAS, HEC-GeoRAS, Arc-GIS.

## 1. INTRODUCTION

India receives precipitation in the form of rainfall which causes flood in some areas and drought at other. To determine the flood in advance and to prevent the damages due to overflow of adjoining river banks, the floodplain mapping plays an important role in the field of Hydrology. Floodplain mapping determines extent of flood and the land areas submerged by flooding. Flood damages can be mitigated by two fundamental sorts: By constructing flood protection wall or by giving warnings or

By giving warnings or by evacuating people from the area at the time of flood.

## 2. STUDY AREA AND DATA USED

River Krishna is the fourth biggest river among the river basin in India. Krishna River is about 1300km long, it feeds command area of different reservoirs constructed in states of Maharashtra, Andhra Pradesh, Telangana and Karnataka. Birth of Krishna River is in the Western Ghats near Mahabaleshwar at an elevation of 941m with its latitude and longitude as 17° 59’ 18.8”N and 73° 38’16”E respectively. In the present study two stretches of Upper Krishna River are selected namely Kudachi and Ugar villages which are often experiencing flooding. The Krishna River is the only surface source to Kudachi and Ugar. Kudachi lies at an elevation of 536m.

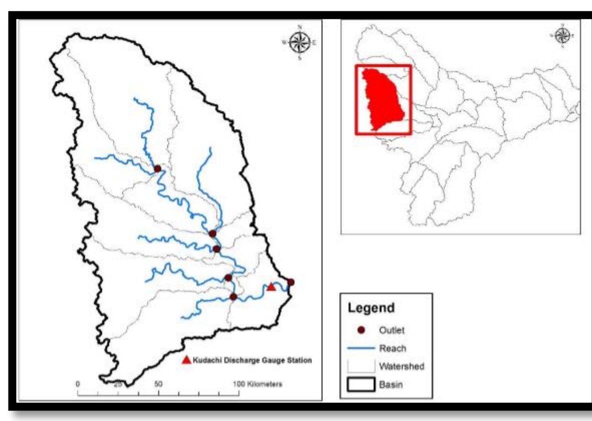


**Fig. 1:** Location map of the study area

The data required for this study were obtained from different sources and means of obtaining them have been discussed in proceeding sections. DEM of 32m resolution is downloaded from Bhuvan site using CARTOSAT-1 satellite data. A part of Upper Krishna basin boundary shape file was used to clip the DEM for study area.. Daily discharge data from 1989 to 2016 were collected from Gauging Sub Division, Bagalkot.

## 1. METHODOLOGY

In this study the HEC-RAS model has been used to get the surface water profiles of areas near Kudachi and Ugar. Frequency analysis of discharge data was carried out Gumbel's Extreme Value Type -1 distribution and Log Pearson Type III methods. Secondly, geometry data were collected from the DEM downloaded from Bahuvan site of 32m resolution. Digitization of selected stretch of study area on DEM is done using Hec-GeoRAS Tool the results of HEC-GeoRAS are exported to HEC-RAS in .sdf format. HEC-RAS which simulates the annual flood peak

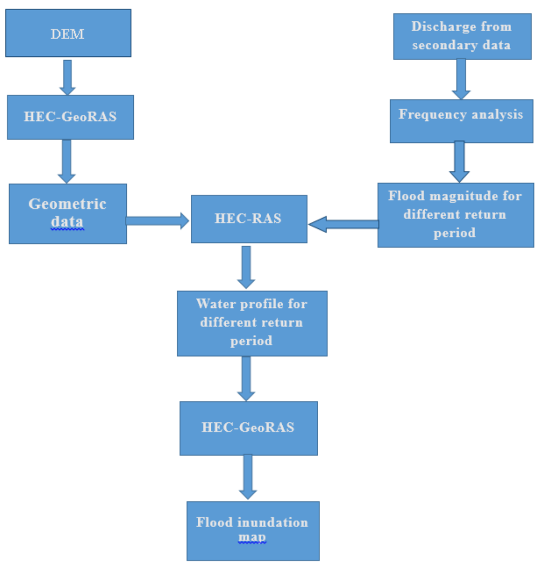


**Fig. 2**: Work flow

## 2. HEC-RAS MODEL SETUP

Various data are required in setting up of the HEC-RAS model. One of the vital information is the geometrical information of a specific river stretch.

The geometrical data of a river is prepared using a tool called HEC-GeoRAS which assists in preparing input file as well as post processing of the HEC-RAS results in GIS environment. Using Cartosat-1 DEM on the study area, HEC-GeoRAS help to prepare the geometric data which is required for HEC-RAS. The important layers that are created are the stream centerline, Flow path centerlines, main channel banks and cross section cut lines as RAS layers. These parameters are used to establish series of cross-sections along the stream. HEC-RAS is a one dimensional flow model, intended for computation of water surface profiles for both steady and unsteady cases.

The present case, steady state is performed using standard step method. The initial boundary condition was assumed for normal depth condition as it was the only available data for the study area. Before simulating the model, certain initial conditions have to be defined viz- Normal depth, discharge at the inlet, manning's "n" value, expansion and contraction values, etc., The model was simulated for various return periods to estimate the water surface profiles for subcritical condition as the Froude's number was found to be less than 1 for the stream. The input data for the steady state will be peak discharge data for the particular return period. The model yields the water surface profiles for each of the flood magnitudes and the results are then again exported to HEC GeoRAS.

## 3. RESULTS AND DISCUSSIONS

HEC-RAS model determines the water profiles for various return periods by using the annual flood peaks obtain by discharge data collected from gauging division. The frequency analysis determines magnitudes of peak flood corresponding to various return periods (Table 1). These annual peak discharges are used in hydraulic model to determine the water surface profiles with respect to various return periods to know, damage caused and flood extent etc.

**Table 1**: Flood discharge for desired return periods

| Return Periods (years) | Flood Discharge ($m^3/s$) |
|---|---|
| 3 | 8438.171 |
| 5 | 10062.440 |
| 10 | 12103.391 |
| 20 | 14061.121 |
| 30 | 15187.354 |
| 50 | 16595.201 |
| 100 | 18494.137 |

## 5.1. GENERETION OF FLOODPLAIN MAPS

The HEC-RAS model help us to generate floodplain maps corresponding to various return periods. Using the water surface profiles for various return periods obtain from

HEC-RAS model floodplain maps are drawn for respective areas as given bellow.

## 5.2. FLOOD INDUNATION MAP OF RIVER KRISHNA NEAR UGAR VILLAGE

After simulation using HEC-GeoRAS for discharge data under study state condition for different return periods water spread area has been obtained for respective return periods. HEC-RAS model is used to simulate water spread for 5yr, 30yr, and 100yr flood. The maps shown in Fig. 3 to Fig. 5 shows the extent of flood, corresponding to different return periods.

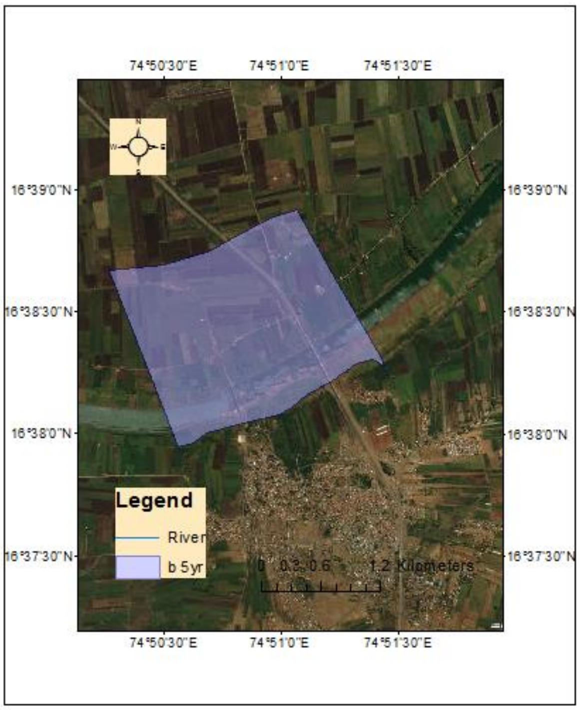


**Fig. 3:** Flood map for 5year return period (Kudachi Village)

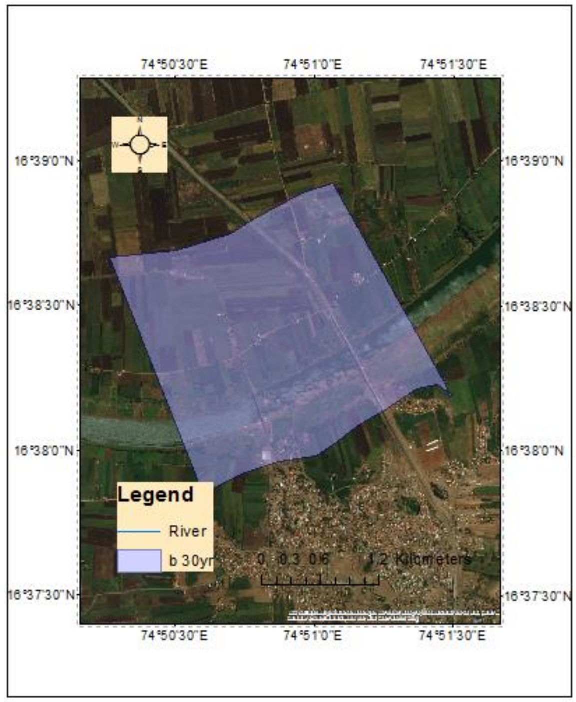


**Fig. 4:** Flood map for 30year return period (Kudachi Village)

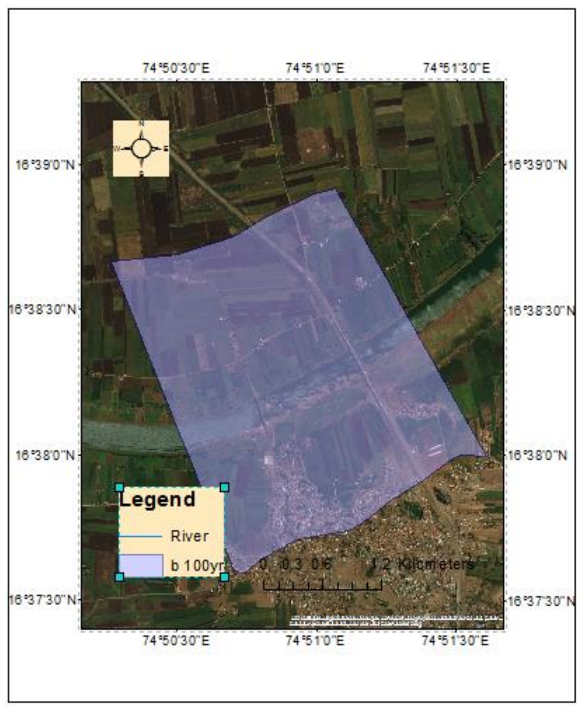


**Fig. 5:** Flood map for 100 year return period (Kudachi Village)

The extent of flood area corresponding to various return periods are summarized in Table 2 below.

**Table 2:** water spread area for various return period for river stretch near Kudachi.

| Sl. No. | Return Period (yrs.) | Water Spread area (acres) | Water spread area to the right side of river course(acres) | Water spread area to the left side of river course(acres) |
|---|---|---|---|---|
| 1 | 5 | 522.970 | 212.12 | 310.85 |
| 2 | 10 | 541.865 | 231.30 | 310.56 |
| 3 | 20 | 563.627 | 251.75 | 311.87 |
| 4 | 30 | 592.879 | 279.92 | 312.95 |
| 5 | 50 | 664.959 | 351.37 | 313.58 |
| 6 | 100 | 800.222 | 484.94 | 315.28 |

## 3.1 FLOOD INDUNATION MAP OF RIVER KRISHNA NEAR UGAR VILLAGE:

After simulation using HEC-GeoRAS for discharge data under study state condition for different return periods water spread area has been obtained for respective return periods. HEC-RAS model is used to simulate water spread for 3yr, 30yr, and 100yr flood. The maps shown in Fig.6 to Fig. 8. Shows the extent of flood, corresponding to different return periods.

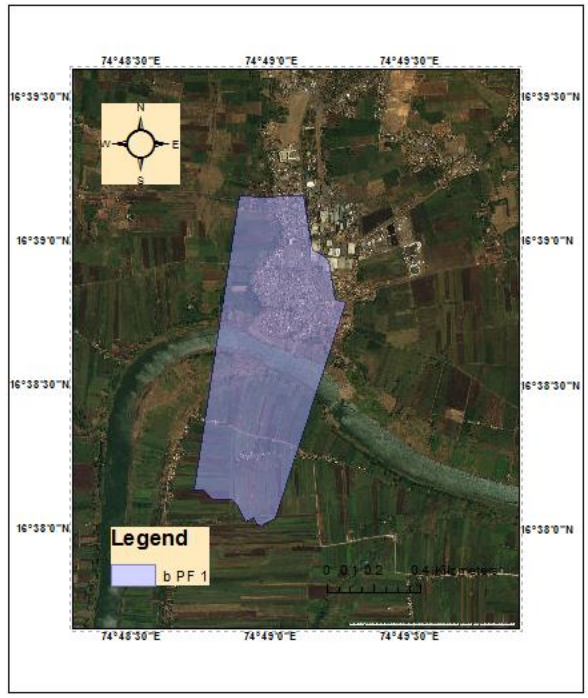


**Fig. 6:** Flood map for 3year return period (Ugar Village)

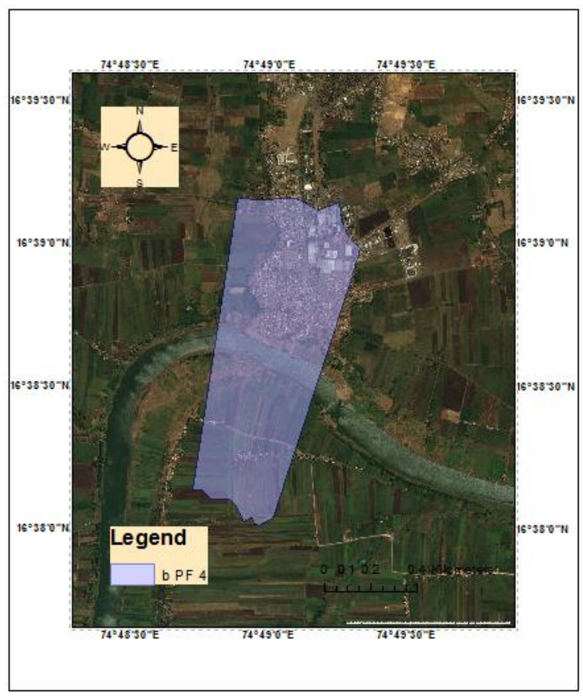


**Fig. 7**: Flood map for 30year return period (Ugar Village)

The extent of flooding corresponding to various return periods are summarized in Table 3below

**Table 3:**water spread area for various return period for Ugar Village

| SI. NO | Return Period (yrs.) | Water spread area (acres) | Water spread area to the left side of river course(acres) | Water spread area to the right side of river course(acres) |
|---|---|---|---|---|
| 1 | 3 | 309.56 | 199.26 | 110.30 |
| 2 | 5 | 321.52 | 209.86 | 111.66 |
| 3 | 10 | 339.82 | 227.39 | 112.46 |
| 4 | 30 | 342.68 | 228.18 | 114.50 |
| 5 | 50 | 346.86 | 241.88 | 114.98 |
| 6 | 100 | 359.40 | 244.12 | 115.28 |

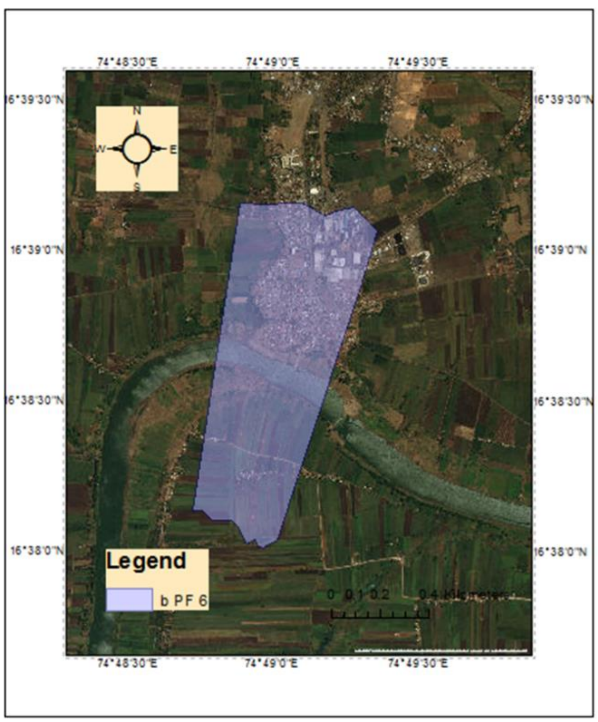


**Fig. 8:** Flood map for 100 year return period (Ugar Village)

The data on the area of submergence which occurs once in every five year was collected from the site-Kudachi and then it is overlapped on the flood map generated from Hec-Ras to know how well the discharge data fits a frequency distribution and the results of Hec-Ras. The ground truth data is matching with the Hec-Ras results indicating the acceptability of the methodology for application Table 4.

**Table 4:** Comparison of water spread area between field data and hec-ras data

| SI. No | Period | Water spread area (acres) | | Variation (acres) |
|---|---|---|---|---|
| | | **Field survey data (GPS)** | **HEC-RAS data** | |
| 1 | 2005 | 560.89 | 541.86 | 20.03 |

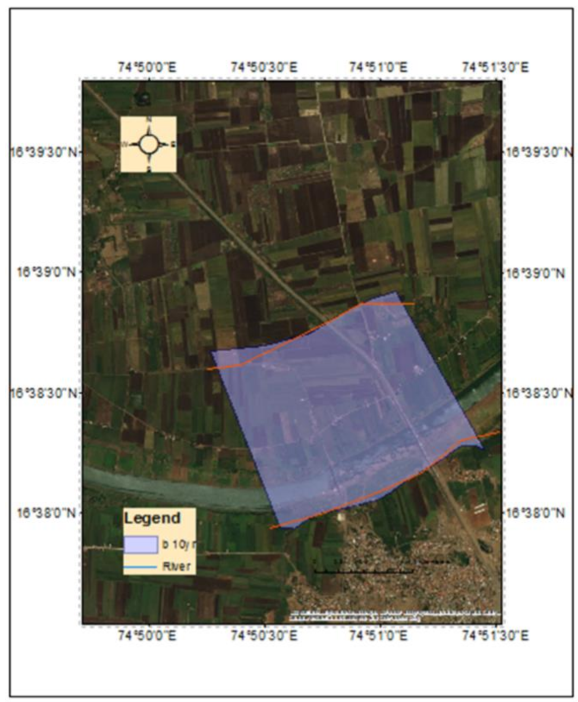


**Fig. 9:** Flood Inundation profile of HEC-RAS results and filed visit data

Hence it's concluded that the results of Hec-Ras are acceptable and can be used for calculation of inundation area for any desired return period.

## 4. CONCLUTION

This research work has shown clearly that HEC-RAS model coupled remotely sensed data (DEM) is vital in geospatial analysis of the hydrologic cycle including inundation mapping, watershed and flood plain delineation. The integration of HEC-RAS and GIS has become accepted worldwide, and provides accurate representation of discharge and stage due of flood events. The watershed area of Krishna River namely Kudachi and Ugar has been successfully modeled in the present case. The complete analysis did with hec-ras model using geometric data and discharge data can able to provide water surface profiles for various return periods.

The results of the study will help us to suggest certain measures to mitigate flood during flood season reducing the impact of flood on human and damage.

## 5. REFERENCE.

1. Patel, C.G, (2016). "Floodplain Delineation Using HEC-RAS Model-A Case Study of Surat City". Modern Journal of Hydrology, Volume 6, pp.34-42.

2. Sunil Kute, VrushaliBhoye SayaliKakad, (2014). "Flood Modeling of River Godavari using HEC-RAS." Civil Engineering department, International Journal of Research in Engineering and Technology (IJRET), pp. 81-87.

3. Chidinma Blessing Okoye and Vincent NdukaOjeh, (2015). "Mapping of Flood prone area in surelurlagos, Nigeria a GIS approach". Journal of Geographic Information System, Volume 7, pp. 158-176.

4. USACE, (2002). HEC-RAS River Analysis System, Hydraulic Reference Manual, U.S Army Corps of Engineers (USACE), Accessed on 10th August 2015.

5. Mohammad Hossein Q and Parviz K. (2013). "Efficiency of Hydraulic Models for Flood Zoning Using GIS (Case Study: Ay-Doghmush River Basin)."Science and Research Branch Islamic Azad University, Iran. Volume 10, pp. 915-924.

6. Benito and Gerardo, (2003) "Magnitude and frequency of flooding in the Tagus Basin (central Spain) over the last millennium" Publisher Springer Science & Business Media. Volume 58, Issue 1-2, pp.171-192.

7. SagarGawade, Dr. R. N. Sankhua, KalpanaPardeshi, (2015) "Flood Mapping of Yamuna River, Delhi, India" Global Journal Of Multidisciplinary Studies, volume 4(7), pp.62- 69.

8. USACE, (2009). GIS Tools for support of HEC-RAS using ArcGIS, HEC-GeoRAS User's Manual, U.S Army Corps of Engineers (USACE), Accessed on 25th August 2015.

## 8. BIOGRAPHIES

| | |
|---|---|
|  | **Sandhyarekha:** She is pursuing her M.Tech studies at Dept. of Water and Land Mgmt. CPGS, VTU, Belagavi. His research area includes Water resources, Disaster Management and Watershed Management. |
|  | **Dr. Anand V Shivapur:** He is currently working as Professor and HOD of Water and Land Management dept., Centre for PG Studies, VTU, Belagavi. He has total experience of 31 years in teaching, administration and research. He has published more than 25 research papers in National as well as International journals. 60 papers in conf., seminar etc. He has guided 2 PhD students and 6 scholars are pursuing research. His research areas are Watershed management, Hydrology, Use of RS and GIS for Irrigation and Watershed. |