

FLOOD DELINEATION OF DBATU SURROUNDING REGION USING ARC SWAT MODELING

P. R. Bhamre¹, M. S. Malandkar², S. R. Bhagat³, R. S. Godbole⁴, P. U. Gaikwad⁵, S. B. Jagtap⁶

³Head of department, Department of CIVIL Engineering, Dr Babasaheb Ambedkar Technological University (DBATU) Lonere, Mahad, Maharashtra, India.

²Associate professor, Department of CIVIL Engineering, Dr Babasaheb Ambedkar Technological University (DBATU) Lonere, Mahad, Maharashtra, India.

^{1,4,5,6}U.G. Student, Department of CIVIL Engineering, Dr Babasaheb Ambedkar Technological University (DBATU) Lonere, Mahad, Maharashtra, India.

Abstract: Floods are one of the hazardous natural calamity world is facing from many years which causes destruction of private property and living of people which costs them their lives. India is one of the countries in the world which is highly prone to annual flooding because most of the areas are geographically present in flood prone region. In six decades India have cost more than Rs 4.7 lakh crore, there are many regions in India like Himalayan rivers covering parts of Punjab, Himachal Pradesh, Delhi, Rajasthan, Uttar Pradesh, Bihar, West Bengal and Raigad district which have problem related to flooding due to rainfall water. This causes water logging also there is an immense need to detect the basins of this watershed which causes. Accumulation of rain water and does not allow Percolate the water through the soil and also affect the quality of the water. Both flooding and droughts have negative impact on the population of any region. According to National Disaster management Authority (NDMA), on average 75lakh hector land is affected, 1,600 lives are lost and damage of Rs 1,805 crore is recorded. Major flood frequency is more than once in five years. Rainfall is not the he only reason for the flooding this needs to be understandable. So it is very important that we should study each and every dam breaching Carefully and adopt the new studies as soon as possible which saves lives of people.

The main focus of this research paper is to study the flooding situation using Arc SWAT modeling. We can perform several tasks like discharge at watershed outlet, watershed and water delineation, the SWAT model for my region on Earth, ground water Recharge, water yield and quality, watershed simulation and Preparation of soil map of any country using the arc SWAT modeling.

Key words:- Flow accumulation, DBATU, flood delineation, ARC SWAT model, DEM, ARC GIS, remote sensing,

1. INTRODUCTION

1.1 Background

Water is a vital thing for all living things. Without water no life form can sustain. But when water came in the form of floods it takes away thousands of human and animal lives. Floods are one of the natural phenomena that can cause a huge threat to the people and building objects located in the flood terrain. Let's talk about flood in detail, flood is an overflow of a water from water bodies such as river, lake, ocean which overtop or submerged the land within it which is usually dry. These are the deadliest and severe type of disaster which can cover from inches to several feet, can come quickly or gradually.

•There are five types of flood

1. River flooding:- These flooding occurs when water overtops the river banks, it can happen in all rivers from smallest to largest. Excessive rain, combined snowfall and snowmelt, ice jam can cause river flooding.
2. Coastal flooding:- It is the overflow of seawater to dry land area along the coast. High winds, Sea tidal surges, barometric pressure.
3. Storm surge:- It is the rapid and unnatural rise of water level in coastal area above the astronomical tide. Wind, waves and low atmospheric pressure can cause storm surge.
4. Inland flooding:- A flooding that occurs in inland or urban areas is known as inland flooding. Generally it happen due to heavy rain or sometimes due to intense rainfall.

5. Flash flooding:- A flooding which can begin within 6 or 3 hours of intense flooding. These can happen due to intense rainfall and from severe thunderstorm.

•Flood effect

1. Loss of lives –

The worst effect of flood is loss of lives, generally it take 6 inches of water to wash a person away, history has seen a thousands of deaths due to flooding. Flood also kills people by invade/ destroy into property.

2. Property damage –

Huge property damaged takes place in flooding. We all seen floating cars, water invade into houses, damaged furniture, doors, windows etc.

3. Economic impacts –

Flood makes huge hinders in economic growth and development due to high cost of relief and recovery. Road, bridges, infrastructures, industries affect in a large way.

4. Psychological impacts –

Flooding can create a long lasting trauma for victims, one who lost their loves ones, family, friend, home, business etc. especially on children.

1.1.1 Floods in Maharashtra and Raigad

Over 4.24 hundred thousand people were affected by the floods in the six districts of Western Maharashtra in 2019 flood in India. About four lakh people were evacuated and 30 people died in the rain related incidents. The floodgates of Almatti Dam were open and NH-4 (Mumbai- Bengaluru National Highway) was closed after landslide standing about 18000 vehicles on highway. Most affected districts were Kolhapur, Sangali, Satara, Thane, Palghar and Pune. Tropical cyclone tauktae leaves 23 dead and over 200000 displaced in 2021. On 2 September 2020, thousands evacuate floods in Maharashtra and Gujarat. Raigad is a district within the Konkan division of Maharashtra India. Raigad faces many flood disasters due to heavy rainfall, releasing the dam gates due to overflow, the dam burst, cyclones. Raigad has been always in the news due to heavy rainfall such as at 16 August 2020 (Maharashtra Rains – Heavy rainfall expected in Mumbai, Raigad, Palghar..), 15 October 2020(heavy rainfall to lash Mumbai, Thane, Raigad – IMD issues red alert (extremely heavy rain) for districts including Mumbai, Thane, Palghar, Raigad and Ratnagiri.), 3 August 2020 (Mumbai, Pune, Thane, Raigad red alert issued, to get extremely heavy rainfall...), 28 July 2019 (Rains cause floods, cuts off coastal Maharashtra), 5 August 2019 (heavy showers flood Raigad district – The Hindu), 1 August 2014 (Heavy showers flood Thane and Raigad districts), 23 June 2003 (Flood like situation in Raigad district) etc. Therefore, there is an immense need to detect the basins of this watershed. Now here we have to know the concept of watershed.

1.2 Google Earth Pro:

Google earth is a software is basically used for view satellite images, terrain, 3D buildings, we can explore geographical content, save your toured places, and share with others. We also make maps on google earth pro by using local data. It is best for making maps of road, river, cities, etc.

Google Earth Pro uses the data from Digital Elevation Model (DEM) files to making any 3D images or map.

Google earth pro virtual globe, map and geographic information program that was originally called Earth Viewer. It maps the Earth by the overlapped of images obtained from satellite imaging, aerial photography and GIS 3D globe.

Google Earth shows satellite images of varying resolution of the surface of Earths, software allows users to see things visually like towns, cities and houses are seen at a various angle, with see also, with see also bird's eye view. The degree of resolution available is based on the popularity.

Most land areas are covered in satellite imaging with a resolution of about 15 m per pixel. This base imaging is 30m multispectral landsite which is pan sharpened with the 15m Land sat imaging. However, Google is actively replacing this base imagery with 2.5m spot images imagery and several higher resolution datasets mentioned below. Some population centers are also covered by aircraft imaging with several pixels per meter. Oceans are covered at a much lower resolution, as are a number of islands; noticeably, the Isles of Scilly off southwest England, were at a resolution near 500 m, however this has now been addressed.

Google has solved many inaccuracies in the mapping of the vectors since the original public release of the software, without requiring an update to the software. This was the absence from Google Earth's map borders of the Nunavut territory in Canada, a territory that had been created on April 1, 1999. But these mistakes were corrected by one of the data updates.

Google Earth Pro has all the easy to use features, and detailed imagining of Google Earth, along with advanced tools that help you measure area, radius, length and 3D buildings.

1.3 ARC GIS

ARC GIS, geographic information system used for working with maps and other geographic information developed by Esri (Environmental Systems Research Institute). There are many uses of ArcGIS, which includes mapping, combining of geographic data, analyzing maps, sharing geodata and managing information in a database. ArcGIS is also free available on the internet which allows user to get open access of software who ever like to use the ARCGIS. We can use anywhere in the world and the latest version of ARC GIS is available for 21 days free and then it requires the purchase we can get it and use for latest features possible in the field. It has many capabilities some of them are mentioned below.

Capabilities

- 1) Spatial Analysis and Data science.
- 2) Field operations.
- 3) Mapping.
- 4) 3D modeling.
- 5) Imagery.
- 6) Data collection.

1) Spatial Analysis and Data:- ARC GIS uses analytical methods and spatial algorithm available for the user to know the hidden patterns, improve prediction of modeling and data science.

2) Field operations:- Location is the most important component of field activities. ArcGIS application can be used to support field workflows and lets the personal to work with office as well as field.

3) Mapping:- Mapping is used to spot the patterns in your data so we can make our decision with our desire without any doubt. We have many types of maps available like geographic, topographic and terracing maps helps us in making and innovating project. It so allows us to create, use and share maps to any other device.

4) 3D CAIS:- 3D GIS gives us the feel of real world in our data which also helps us to create DEM. It can instantly transform your data into the smooth 3D model also helps us to visualization and problem solving and sharing solutions of the problems.

5) Imagery and Remote Sensing:- It provides us imagery data and remotely sensed data which also includes managing, data tools and many other workflow diagram and lets us access the world largest geospatial data.

1.4 DEM (Digital elevation model) -

DEM stands for digital elevation model which is a graphical representation (in 3D) of elevation data. DEM generally represent terrain and also used to determine terrain attributes such as slopes, elevation at any point and aspects. Talking about the examples of terrain such as planet, moon or even asteroids. Also DEM is frequently used for digital representation of topographic surface and geographical information system. It is the simplest form to digitally represent the topography. Even most of the time DEM is used to make digitally relief maps. Data used for DEM is most commonly preferred by remote sensing as DEM is built using data collected by it, but one can also take data from land surveying. Talking about the older method used to make DEM involves interpolating digital contour maps doing direct survey of land. DEM are most popular for analysis of elevation.

Uses of DEM –

- Making of relief maps
- Extracting terrain parameters for geomorphology.
- Making models of water flow for mass movement or hydrology (ex. Landslides, avalanches)
- Rendering of 3D visualization.
- Making of physical models such as raised relief maps
- Geographical information system.
- Flight simulation
- Train simulation
- Topographic parameterization (such as drainage analysis, watersheds, groundwater flow etc.)
- Hydrology and flow direction study

1.5 ARCSWAT –

ARCSWAT is a tool in ARC-GIS (ARC-GIS is a software generally used for zone mapping). ARCSWAT is mostly used for watershed modeling in ARC-GIS. Talking about SWAT is a soil and water assessment tool which is river basin scale and continuous time model. It is used to predict for impacts of land management practices on water, sediments, watershed, lands use etc. SWAT models is used to run hydrological models to get water balance ratio like- stream flow precipitation ratio, base flow-total flow ratio and it also provide upland sediments yield. Data require for ARCSWAT is digital elevation model (DEM), soil map of the study area, land cover or land use data, meteorological data which consist of rainfall in mm, maximum and minimum temperature, wind speed, relative humidity etc.

Uses of ARCSWAT –

- Watershed and sub-watershed delineation using SWAT
- Quantifying the impacts from land use changes on the runoff
- Development of inflow and outflow model
- Water quality
- Estimation of available water resource
- Managing check dam
- Long the long term impact of managing practices modeling
- Groundwater recharge
- Water yield

1.6 WATERSHED DELINEATION

Watershed analysis refers to the method of victimization DEM and formation information operations to delineate watersheds and to derive options like streams, stream network, construction areas, basin etc. historically, watershed boundaries square measure drawn manually onto a geographic map. The one that attracts the boundaries uses geographic options on the map to see wherever a divide is found. However, with introduction of computers things become abundant easier. Now, one will generate preliminary watershed boundaries during a fraction of the time required for the normal methodology. The delineation of watersheds will manifest itself at completely different abstraction scales. An outsized watershed could cowl a whole stream system and, inside the watershed, there could also be smaller watersheds, one for every tributary within the stream system. Watersheds are often as tiny as a footprint or massive enough to include all the land that drains water into rivers that drain into Bay or ocean. The watershed will additional be divided into 5 components: watershed boundary, Sub basin, voidance divides, Stream network, Outlets Steps concerned in Delineation of Watershed 1. DEM Acquisition:- The first input needed for watershed analysis is DEM. Digital Elevation Models (DEMs) square measure a kind of formation GIS layer. In a DEM, every cell of formation GIS layer incorporates a worth admire its elevation (z-values at frequently spaced intervals). DEM information files contain the elevation of the tract over a nominal space, sometimes at a hard and fast grid interval over the “Bare Earth”.

2. Fill:- Fills sinks during a surface formation to get rid of tiny imperfections within the information. A stuffed DEM or elevation formation is devoid of depressions. A depression may be a cell or cells in associate elevation formation that square measure encircled by higher elevation values, and so represents a district of internal voidance. Though some depressions square measure real, like quarries or frozen potholes, could also be state within the DEM. Therefore, depression should be removed.

3. Flow Direction:- A flow direction formation shows the direction water can emanate of every cell of a stuffed elevation formation. A wide used methodology for explanation flow direction is that the D8 methodology, utilized by Arc GIS. In D8 methodology, assigns a cell's flow direction to the one among its eight close cell's that has the steepest distance-weighted gradient. D8 methodology produces smart leads to zone of convergent flows and on well-defined valleys. It fails to represent adequately divergent flows over complicated slopes and ridges. Another rule is well utilized in calculation of flow direction is $D \infty$ (infinity). Use the BASIN tool on the flow direction map to spot the basins that flow to every outlet purpose on the map edge. Use the establish button to see the worth of the actual basin you would like to analyze, and use the formation calculator to form a 0-1 formation map of simply that one basin.

4. Flow Accumulation:- A flow accumulation formation tabulates for every cell the quantity of cells that may flow to that. The tabulation is predicated on the flow direction formation. A flow accumulation formation is often understood in 2 ways that. One is that the cells having accumulation values typically correspond to stream channels, whereas cells having associate accumulation worth of zero typically corresponds to ridgelines. And second if increased by cell size, the build-up worth equals to geographical region.

1.7 STUDY AREA

The following is the study area of the place were our Project is based upon. Lonere is a village in Raigad district, Maharashtra, India. It is situated merely 22km away from the renowned Raigad fort of the Maratha king Shivaji. The village is situated on NH-17 (Mumbai-Goa National Highway), approximately 25 km north of Mahad city and 10 km south of Mangaon tehsil. Travelling from Mumbai, the junction at Lonere on NH-17 serves as entry road to the towns of Goregaon, Mhasla, Mandangad, Dapoli, and the seaside resort- towns of Shrivardhan and Harihareshwar. Lonere is also known for the Dr. Babasaheb Ambedkar Technological University. Established in 1989 under the Government of Maharashtra Act 1983, the university is an affiliating in nature, and affiliated to the Engineering, Pharmacy, Architecture, HMCT colleges of the Maharashtra state University.

The campus covers 525 acres (2,120,000 m²) in the college town of Lonere. It is approximately 20 km north of Mahad city and 10 km south of Mangaon tehsil.

The campus is near the industrial belt comprising Thane, Belapur, Nagothane, Patalganga, Roha and Mahad

1.7.1 PHYSIOGRAPHY

The highway spot which is located in Raigad has three physiographic regions that are: 1) Coastal zone 2) Central zone consisting of fertile land 3) Hilly areas in eastern part covered with forest. This hilly range is characterized by roughness and unevenness in topography with line of peaks. The Sahyadri (Western Ghats) hills are present in the east and several transverse numbers of subsidiary hills are in westwards direction. The western part of district consists of basalt and some of late rite. However, there are recent deposits found comprising of beach sand and alluvium along cost and river mouth.

The district can be divided into 6 parts Sahyadri Hills, Konkan Forested Hills, Sudhagad Plateau, Ulhas Basin, Kal- Savitri Valley, Raigad Coast

Raigad District

Raigad district is one of the four coastal districts situated along the western coast of the State and is located between north latitude 17°51'00" and 19°08'00" and east longitudes 72°50'00" and 73°40'00". It is bounded by Thane district in the north, Ratnagiri district in the south, Pune district in the east and Arabian sea forms the western boundary having a length of about 250 km.

The district covers an area of 7152 sq. km and has been divided into four revenue division's viz., Alibag, Panvel, Mahad and

Mangaon which are further divided into fourteen talukas viz., Alibag, Panvel, Uran, Karjat, Khalapur, Pen, Sudhagad, Mahad, Roha, Mangaon, Poladpur, Mahasala, Shriwardhan and Murud. It has total population of 22,07,929 with density of 309 persons/sq.km as per 2001 census.

The district has 19 towns and 1919 villages out of which 60 villages are un-habituated. Ulhas, Panvel and Patalganga are the three main rivers in northern part. Kundalika River is the main river in central part whereas in the southern part Savitri River is the main river.

As per land use details (2000 – 01) the district has an area of 1486 sq.km occupied by forest. The cultivable area of district is 3286 sq.km whereas net sown area is 1356 sq.km.

Central Ground water Board has taken up several studies in the district.

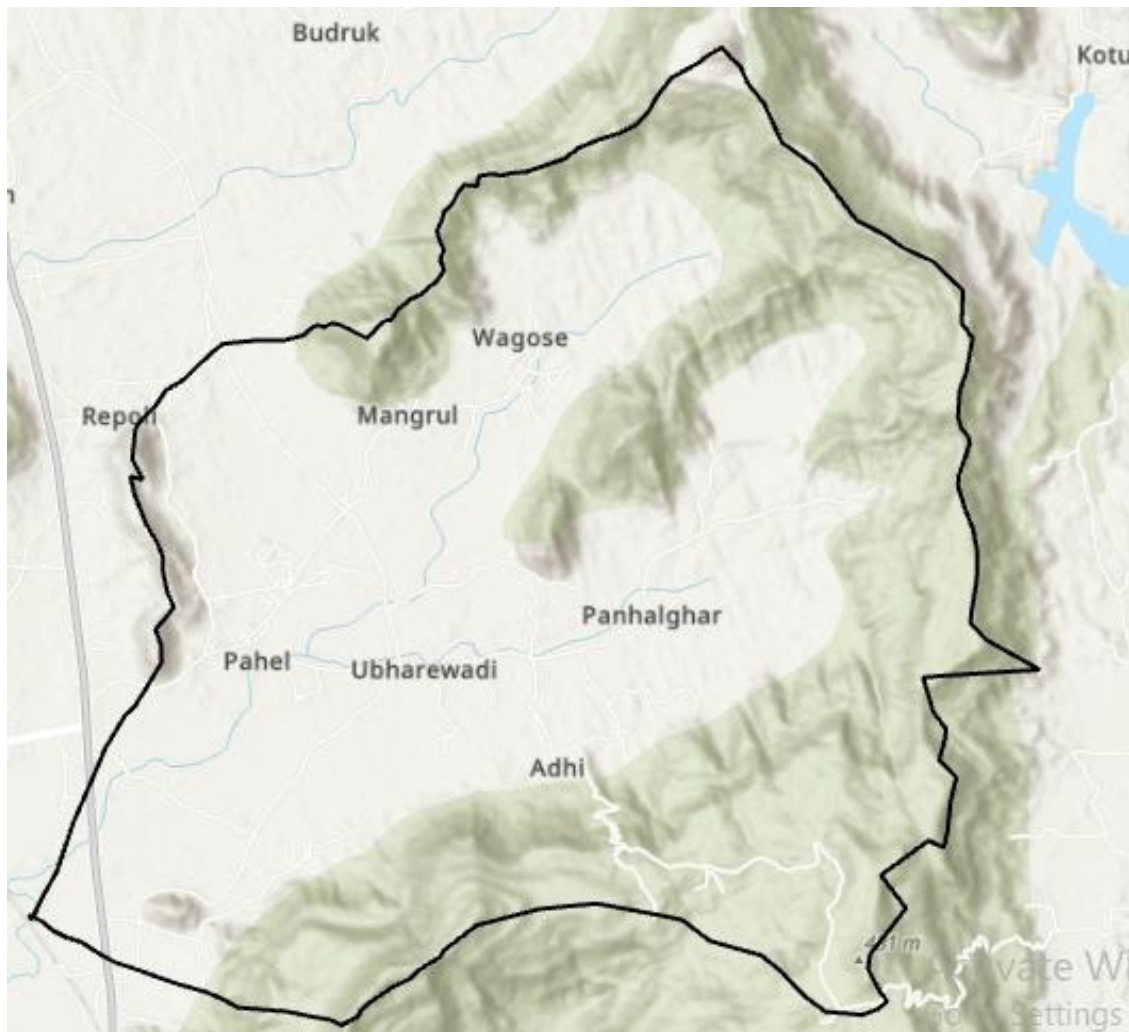


Image1:- Study area

1.7.2 CLIMATE

Climate of Area: Area around study spot has generally moist and humid climate. As the study area is in coastal region so the temperature variation seen is not much large. The rainfall is from June to September and in this period mostly the road transportation is prone to landslides as due to loosening of soil. Winter is from November to January and temperature rises from February till May due to summer season.

1.7.3 RAINFALL PATTERN

The Konkan region is the coastal part of Maharashtra of India covering a total geographical area of 3.09 Mha. The Konkan region lies between 1506' N to 20022' N latitude and 72039' E to 73048' E longitudes, falls under heavy rainfall ranging from 2500 mm to 4500 mm. The region receives 46 % of total precipitation of the state on just 10 % of total geographical area of the state (NIDM, 2014). The climate is tropical in Mahad. During most months of the year, there is significant rainfall in Mahad. There is only a short dry season. According to Köppen and Geiger, this climate is classified as Am. The average annual temperature is 27.2 °C | 80.9 °F in Mahad. The annual rainfall is 3863 mm | 152.1 inch

Here are some average weather facts we collected from our historical climate data:

On average, the temperatures are always high.

1. A lot of rain (rainy season) falls in the month of: June, July, August and September.
2. Mahād has dry periods in January, February, March, April, May, November and December.
3. The warmest month is May with an average maximum temperature of 33°C (92°F).
4. The coldest month is January with an average maximum temperature of 29°C (85°F).
5. July is the most wet month. This month should be avoided if you are not a big fan of rain.
6. March is the driest month.
7. May is the most sunny month.

1.7.4 GEOLOGY

The Konkan region is fully covered by late rite and Deccan trap, which is formed due to volcanic eruption of about 65 million years back. The study area characterized by moderate (50) to steep (800) slopes with a maximum relative relief of 280 meters. Late rite formation is noticed about 70.7% of the study area. The flow of water, washed away the weathered materials along the slope, which left the trap exposed along the valleys. The Konkan Coastal Belt (KCB) is narrow and elongated strip of land whose average width is about 40 km. most of this region is covered by basaltic lava flows of the Deccan Trap of upper cretaceous to Eocene age. It is traversed by several east's - west trending ridges and west flowing rivers and their tributaries with steep to moderate gradients. Summer and rainy are two major seasons and hence whether is hot and humid. It receives 2000 to 3000 mm rainfall per year. Most of this belt is under forest and soil cover of varying density and thickness respectively

2. LITERATURE REVIEW

VIDULA ARUN SWAMI (2015) discussed about the historical development of Watershed Management, theoretical aspects of Watershed Management, various existing case studies and various structures developed for watershed management as per the topographical conditions. The development of hydrological models and their applications actually on site are also dealt in the topic. The recent developments in hydrological modeling and published research work are also discussed in this chapter. Various applications of SWAT model and recent research works on this model. The conclusions obtained from the hydrological simulation model were summarized, the contribution of the present study was presented and the recommendations were given for the use of developed modified model in future for detailed study of soil and water conservation techniques. Only few structures on limited area could be constructed for watershed development in this research paper. It was recommended to implement all the structures according to requirements in future.

Kusre, Bharat Chandra (2008) stated about how SWAT model divides the whole watershed into Hydrological Response Units (HRUs) based on unique soil and land use features. The SWAT model was interfaced with a GIS tool (Arc View) to handle spatial input parameters of the watershed. Digital Elevation Model (DEM), stream network, soil maps, land use maps and meteorological data were the required model inputs. The maps were digitized through ILWIS GIS software. They demonstrated the use of a hydrological model SWAT for simulation of water and sediment yield opened scope for varied

applications such as planning water harvesting structure, erosion control structure, planning flood moderation in the plain areas downstream, creation of irrigation structure and planning irrigation scheduling, estimate hydropower on temporal basis. Rainfall to runoff conversion capability was assessed using model outputs. This information helps to predict amount of water that will be available at the outlet under different rainfall event. The necessary protection against floods can be planned in the downstream and also to harvest in the upper watershed.

Ibrahim Sufiyan, Razak Bin Zakariya, Rosnan Yacoob, Md. Suffian Idris, Nasir M. Idris (2018) discussed about how the application of SWAT has categorized the sub-basins and identified them on the basis of parameters. The use of GIS technology produces the flood risk zone through the 3D Arc Scene 10.3. The ArcGIS 10.3 and Arc SWAT 2012 were employed for the analysis of the result. The remote sensing information from ASTER DEM was additionally been used for providing the high-resolution platform. one amongst the significances of this study is that the identification of twenty-five completely different sub-basins with their individual parameters that build easier to classify and explore. Different categories of flood risk zone from very high vulnerability of flood to no flood risk zone is being produced by 3D simulation. The SWAT output of Hydrologic Response Units (HRUs) was obtained as the first objective. The 3 crucial SWAT input data of land covers, local soils and slopes were calculated based on the percentages each is representing the catchment.

Umang S. Visharolia, Narendra J. Shrimali, Indra Prakash³ (2017) opined that catchment area and watershed delineation is common task in hydrology. DEM based Arc-Hydro model was run on the dataset of the river basin. Several intermediate results were produced while model run and basic parameter of the Purna river, its catchment area has been defined at the end of model. The result of this study can be used in Rainfall-Runoff analysis and other advance research on the catchment area. Moreover, it might have support for deciding on ground and surface water resource, distribution and management... Also, the delineated watershed shape file can be further used to divide basin into sub-basin and calculate their hydrologic and topographic features by HEC-geoHMS for developing a Rainfall-Runoff model in HEC-HMS.

M RUDRAIAH, S. GOVINDAIAH and S. SRINIVASA VITTALA (2008) stated that ground water potential zones have been delineated on the basis of geomorphic units and been delineated on the basis of geomorphic units along with geological setting, lineaments indicating bore well locations using remote sensing and GIS. The lineaments representing drainages and dykes are oriented in NNW, NW, EW and NE directions. Most of boreholes are located nearer to the lineaments indicating that the lineaments are acting as pathways for the movement of groundwater. Based on the presence of maximum number of existing bore wells near the lineaments indicate that the lineaments are considered to be pathways for the accumulation and movement of groundwater.

R. B. Shendge, Dr. M. P. Chockalingam, B. Saritha and A. Ambica (2018) discussed about study is related to the use of SWAT model for the prediction of sediment yield from the rainwater runoff. The trend of results of SWAT model applied to Ujjani reservoir can function a clue to similar studies in major reservoirs in India, in estimating the sediment yield from the fresh water surface runoff. These estimates have relevance to soil conservation schemes envisioned in the catchment areas, and for ensuring adequate water storage needed for meeting the requirements of the various human uses. The sediment yield in every sub-basin varied significantly, relying upon the soil surface characteristics, quantum of surface runoff flow, and different relevant factors. This needs to be checked through studies conducted in each sub-basin. Appropriate measures can be suitably planned for controlling/reducing the sediment transport. The benefits can be categorized as based on the results obtained in the study, suitable remedial measures will be identified and recommended, for water and soil conservation in the catchment area. Prevention and control of silt transport in the catchment area will eventually reduce the eutrophication problem faced in the reservoir, and the result will be adequately useful for a long-term planning of annual schemes of desalting/dredging operations.

3. METHODOLOGY

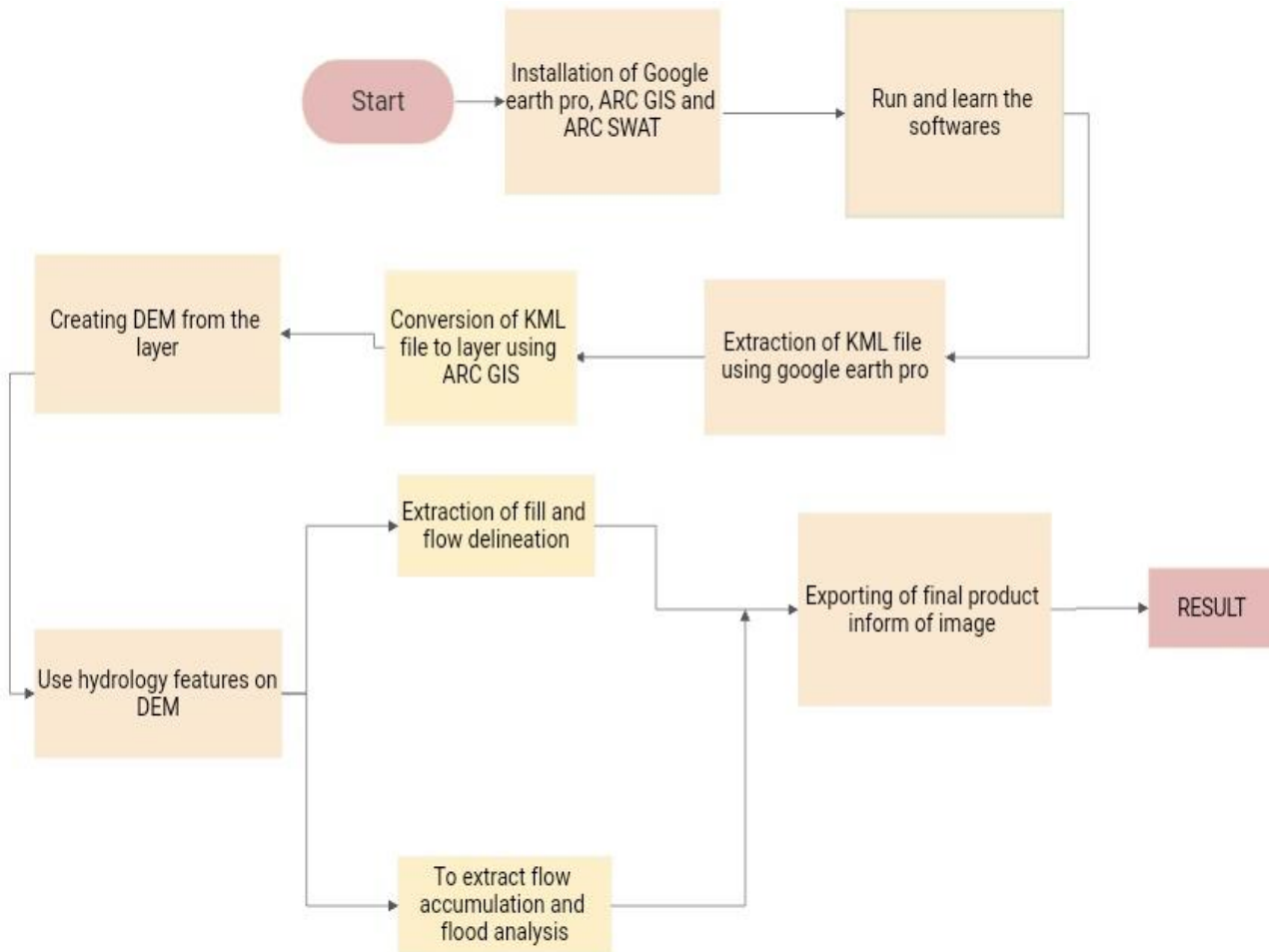
Introduction :- For analysis of study area, we are first going to install the main two software which will help us in making of Watershed delineation map, after installation of ARC GIS and ARC SWAT run the software and just get use to it. First step is to extract DEM of the study area using ARC GIS and after that, comes the second step to convert DEM to watershed delineation map. For complete information follow the steps below. Here we had selected the region of river stream near DBATU campus which causes the flooding.

3.1 Use of Arc SWAT model in flood analysis:- There is a vast scope Para mounted with the GIS application for solving Problem like flooding, analysis and management of every Possible which tools surface of the earth. ARC SWAT which itself

stands for soil and water assessment Tool have ability to calculate discharge, watershed, sub-watershed delineation, SWAT model for any area in the world, ground water Recharge, soil erosion, water quality and simulation of data. Soil map Preparation for any region of any country is now possible using this software. We want to assess water quality in region and ground water potential and can easily use this software to make the resources manageable. Mainly for flooding impacts we can use watershed delineation map to get the preview and the amount of water possibly getting flooded into the region. It allows us to calculate the catchment area of the region and detect the basin and the outlet from where the water will Shed. We can also make a delineation map with the help of the Topographic map, but this is the easiest way through ARCSWAT. It shows us the following parameters after assessing the watershed like monthly flow volume, discharge and efficiency of the Project to be dependent on.

There is a new updated version of SWAT available in the market which allows Prediction of the hydrological responses in watershed management Practices during flood situation and this is the tool need do the assessment of the flood. This tool also allows the quality of water analysis in changed scenarios and also provides flood simulation of the model. In addition the SWAT also have fixed basin level parameter which allows ignoring spatial heterogeneity.

3.2 Flowchart of the work:-



3.3 Extracting DEM through ARC GIS-

Extracting DEM which is digital elevation model from ArcGIS is the first step towards the watershed delineation map. DEM can be created by many software and in many ways. But the most efficient and easiest and under stable way is via ARC GIS. DEM are geospatial datasets having elevation according to a regular spaced grid and they can be used in terrain analysis, hydrological modeling and 3D visualization. DEM can be stored in many formats like Point Shape file, floating value and ASCH files. DEM can also be extracted from Contour lines.

In this article, we are going to extract DEM through contour lines and then we will create slope map from the DEM layers. And after that last step is to create watershed delineation through DEM layers.

Creating DEM from Contour Layer

3.3.1 Procedure: -

- 1) Click on system tools > Spatial analysis tool > Interpretation > Topo to raster.
- 2) Select the contour as per feature data.
- 3) Select output surface raster location.
- 4) Extent of output should be same as layers extend.
- 5) Click ok, a raster layer is created.

Creating slope map will also help us in finding the slope of region in catchment area where drainage basin is present.

3.4 Creating a slope map from DEM

- 1) Select System Toolboxes > Spatial Analysis Tools > Surface > Slope.
- 2) Select the output of the topo raster tool as same as the input raster.
- 3) Specify the location of the output raster.
- 4) Select the output measurement.
- 5) Click OK, a slope map is now created from the DEM layer After the above procedure we have to move to our next procedure which is converting DEM in watershed delineation map.

Converting DEM to watershed delineation map using Arc SWAT.

After creating of DEM, and installing arc SWAT. To create watershed delineate using Arc GIS there are several steps.

Step 1: Set up the map documents.

- 1) Open Arc Map and create a new blank document and click add button to add DEM which we have created before.
- 2) Click on environment setting, select current workspace and scratch workplace.
- 3) Browse to environment setting go to raster analysis and select cell size same as DEM layer.
- 4) Open Arc toolbar and expand spatial analysis to hydrology toolbox to view its content.

Step 2: Create a depression less DEM.

- 1) Double click the fill tool to open dialog. then Set DEM grid as surface raster input.

2) Accept all other defaults and click ok.

Step 3: - Create flow direction grid.

1) Double click flow direction tool, Set the input surface raster filled DEM created in Step 2.

2) Browse environment Setting > Raster Analysis and set cell size as same as DEM Parameter and run the tool.

Step 4 :- Creating flow accumulation grid

1) Double click flow grid created in Step 3.

2) Browse environment Setting > Raster Analysis and run the tool.

Step 5 :- Create outlet Points

1) Add Point file having Point location along with flow accumulation grid created in Step 4. As a result, cell reading is not some as water shed.

Step 6:- Snapping outlet points

1) Snap Point > Set input raster created in steps 5.

2) Set output Point created in Step 5.

3) Set accumulation raster to flow accumulation grid in Step 4.

4) Browse environmental setting > Run the Tool.

Step 7:- Delineate watersheds

1) Input flow direction raster as output.

2) Put Same data in to the field.

3) Select the UNKSUEID field created instep 5, click ok to run the tool a new watershed is created.

4. RESULTS

Flow direction map: It indicates the flow of water in that region. The different color schemes indicate the direction of flow which is also important to find out the slope of that specific region.

Watershed delineation: Extracted from the data of flow direction process here the area where all the water flows at a designated direction and forms the catchment area. Thus, we can obtain the catchment area of that designated region.

Final image: It shows the superimposed image of watershed delineation data and Google satellite imagery. Helpful for common audience to understand where the location lies.

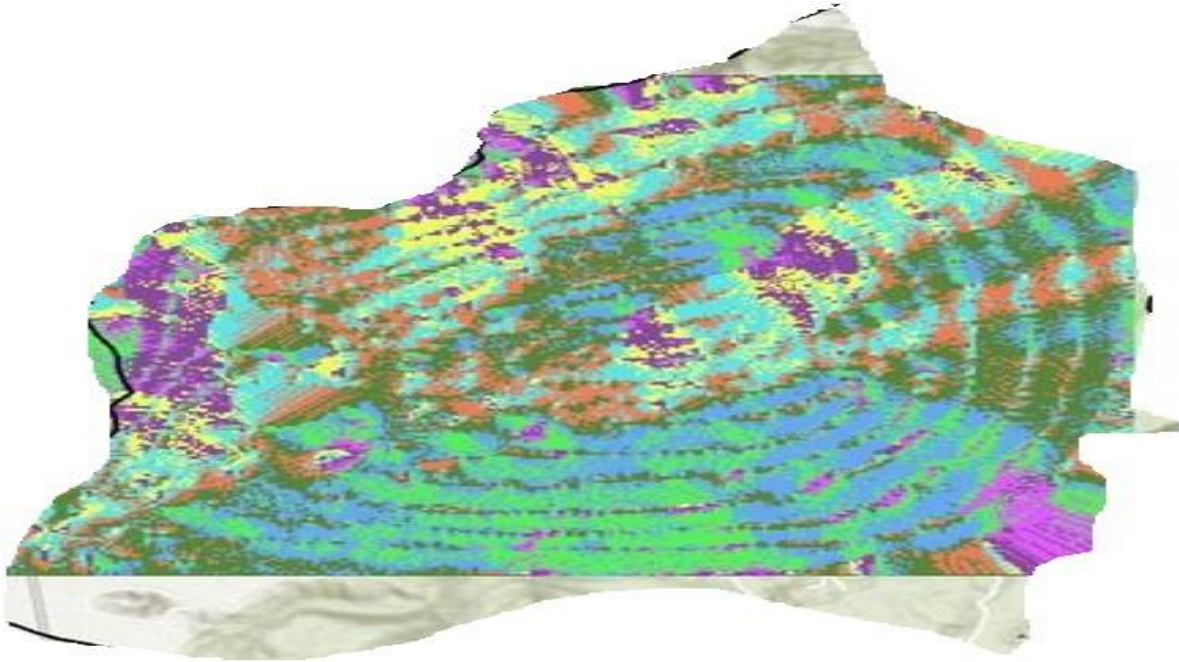


Image :- Flow direction map



Image:- Watershed delineation



Image:- Final result

5. CONCLUSION

The Konkan coastal belt receives heavy rainfall, ultimately leading to floods so there is huge need to study the impacts and area of flooding using the ArcGIS software and Arc SWAT application. By this project we get to know how the ArcGIS and Arc SWAT model works and how to use them to calculate catchment area, watershed delineation and the slope analysis. We are also able to trace the rivers which cause the flooding in surrounding area and also this data can be used for further research like flood alarm systems etc. Due to recent flooding situation there is immense need to study the impacts and area of flooding using the arc swat model and gis software.

Acknowledgment

We express our heartily gratitude towards **Dr. S. R. Bhagat (H.O.D)** for his personal involvement and constructive criticism provided beyond technical guidance during the course of the preparation of the report. He has been keen enough for providing us with the valuable suggestions from time to time. Above all, his keen interest in the seminar helped us to come out with the best.

Thanks to Associate **prof.Dr.S.M. Pore**, of civil engineering department, Dr. Babasaheb Ambedkar Technological University, Lonere for encouragement and providing necessary information. We are ending this acknowledgement with deep indebtedness to **Prof.M. S. Malandkar** and all other faculty member and our friends who have helped us directly or indirectly for completing of the manuscript and funding.

REFERENCES:-

- [1] Al-Sabhan, W., Mulligan, M., Blackburn, G. A. 2003. A real-time hydrological model for flood prediction using GIS and the WWW. Computers, Environment and Urban Systems, 27 (1), 9–32.
- [2] Amatya D. M., Jha M., Edwards A. E., Williams T. M., Hitchcock D.R., (2011); "Swat based stream flow and embayment modeling of Karst affected chapel branch watershed, South Carolina", ASABE, 54(4), 1311-1323
- [3] Arun Babu E., Suresh B., Ravichandran S., (2013) ; "Application of SWAT Model to an agricultural watershed in Tamil Nadu, India", Proceeding of SWAT conference 2012, IIT Delhi. , 120-132
- [4] Ashok Mishra , Kar S. , Singh V. P.,(2007); "Prioritizing Structural management by quantifying the Effect of Land Use and Land Cover on Watershed Runoff and Sediment Yield" Water Resources Management , (21), 1899–1913
- [5] Bartosova, A., Clark, D.E., Novotny, V., Taylor, K.S. 2000. Using GIS to evaluate the effects of flood risk on residential property values.
- [6] Digital elevation modelling available at wikipedia page
[:https://www.google.com/url?sa=t&source=web&rct=j&url=https://en.m.wikipedia.org/wiki/Digital_elevation_model&ved=2ahUKEwjku9yjuw_3wAhXZUmMGHXfMCYEQFjAAegQIBBAC&usq=A0vVaw3WMQpSQtR_vyXJEaQeCxj5](https://www.google.com/url?sa=t&source=web&rct=j&url=https://en.m.wikipedia.org/wiki/Digital_elevation_model&ved=2ahUKEwjku9yjuw_3wAhXZUmMGHXfMCYEQFjAAegQIBBAC&usq=A0vVaw3WMQpSQtR_vyXJEaQeCxj5)
- [7] DeVantier, B.A., Feldman, A.D. 1993. Review of GIS applications in hydrologic modeling. Journal of Water Resources Planning and Management, 119 (2), 246–261.
- [8] Development of a Model For Watershed Management for the Rural Area In High Intensity Rainfall Situations
Swat Modeling for Hydrological Components and Discharge Rate to Ujjani Reservoir
- [9] Information about the Google Earth pro used during the course of project https://en.m.wikipedia.org/wiki/Google_Earth
- [10] Leopold, L.B., Wolman, M.G., Miller, J.P. 2012. Fluvial processes in geomorphology. Courier Corporation.
- [11] Information of flood available at:
https://www.google.com/url?sa=t&source=web&rct=j&url=https://en.m.wikipedia.org/wiki/Flood&ved=2ahUKEwivxb7jwv_3wAhVx4zgGHXNmCAMQFjAAegQIBRAC&usq=A0vVaw2WqSFQk_nBjvaVRSUC5PGG&cshid=1622794026800
- [12] Link for course of google Earth pro used during project
<https://www.google.com/amp/s/www.forbes.com/sites/amitchowdhry/2015/01/30/google-earth-pro-is-now-available-for-free/amp/>
- [13] NDMA guidelines available at:
<http://www.ndma.gov.in/Natural-Hazards/Floods#:~:text=An%20average%20every%20year%2C%2075,than%20once%20in%20five%20years.>
- [14] we got our course of ARC SWAT available at : <https://www.udemy.com/course/running-arcswat-model-with-arccgis-for-any-study-area-gis/>
- [15] study area history available at :
https://www.google.com/url?sa=t&source=web&rct=j&url=https://en.m.wikipedia.org/wiki/Raigad_district&ved=2ahUKEwiLmrD2wv3wAhWjyzgGHU_VDRAQFjABegQIAxAC&usq=A0vVaw09cFTaEkrNbVbUzxdQs_79
- [16] Vishwaheet tholia Arc SWAT: Arc GIS Extension of SWAT with Case study available at:
https://www.google.com/url?sa=t&source=web&rct=j&url=https://www.slideshare.net/mobile/vishvjeetholia/arc-swat-134373043&ved=2ahUKEwi88cWEw_3wAhVy4zgGHcFKBoIQFjAAegQIERAC&usq=A0vVaw2dOFpNEd29aHirSmDkdkd9