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Study of Interlinking of Rivers by using Geographic Information System (GIS) With Quantum-GIS

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Abstract **- River interlinking is a very common term used these days. The basic idea behind river interlinking is to provide water in the region which faces worst water scarcity is most part of the year. The concept through which this river interlinking project is undertaken is to divert some water from heavy discharged rivers into dry rivers. The catchment area requires a host of inter-related information to be generated and studied in relation to each other. GIS (geographical information system) and Open source Map (OSM) is used in this study. qGIS 2.14.12 with grass 7.2.0 and CGIAR-CSI has been applied to analyse terrain characters and potential of water storage capacity with water shading, to get 30 m srtm elevation data for determining the elevations and computing the geographical references data, which add new dimensions to environmental management for a part of Vidharbha catchment area in Maharashtra and is located between longitude 17°27'33"North and latitude 76°58'16"East. The Major rivers flowing in vidharbha region is wainganga, kanhan and wardha out of which wainganga being the largest river serves the whole region and kanhan and wardha are tributaries generating from Godavari river.Tapti is another river serving the region. It has five tributaries named khapra, sipna, gadga, dolar and parna. Next large rivers comes is Penganga which flow start in Buldana and flows through Washim and it creates a border between vidharbha and marathwada as well as vidharbha and telengana. Flowing further through chandrapur Penganga meets Wardha River and then Wainganga River. Then it flows as Pranhita River which is major tributaries of Godavari.**
The study area under vidharbha region is 973211cm^2.

Amravati region has 54.3% water stoked which declined to 21.5% in year 2017. The Nagpur region the water stock comes down from 50.5% to 20.9%. The people in that region faced water scarcity at worst level until Indian govt. started a water transporting program to consumer. The misuse and over exploitation of water source has led to UN sustention condition and extreme degradation of environment. The information of water accumulation and water shed of different region will help us to analysis how to transport water in different region and where the reservoir can be constructed.GIS OSM helps to analysis the geo-hydrological process, terrain characters leading to the catchment area obstacles for ground water recharge

Keywords – Topography; Watershed; Elevation terrain; Catchment area; GIS (geographical information system) and Open source Map (OSM).

I. INTRODUCTION

The water level is decreased at an alarming rate. It is very important to understand. The important of exhausting water quality has degraded as well as river interlinking is one of the ways to solve the issue of the people facing water scarcity or shortage. The river which is heavily flooded during monsoon can be used for river interlinking project. The water from the flood river can be diverted into Dry River or can be stored in reservoir. Stored water reservoir can later be transported to the places facing water scarcity. But before working on this process it is necessary to knew about the flood discharge of each river.

Now here comes the role of QGIS i.e. quantum GIS which is used for river interlinking.
Before working on any river interlinking project we must look into the following aspects:-

- Discharge of flooded river.
- Past record of flood in river.
- Area facing water scarcity.
- Elevation of each area considering under study.
- Water required in each dried up river.
- Possibilities of construction of reservoir.
- Accumulation of water.

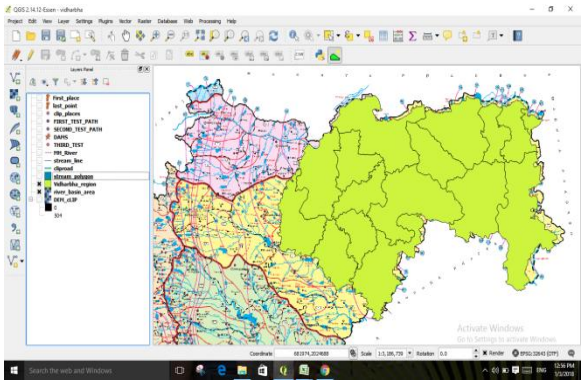

Fig no. 1: study area

Cut and fill required during interlinking of river.
QGIS generates the accumulation map, cut and fill map. There are certain graphics generated on SRTM maps which

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shows the elevation of the area where the path of interlink the river is made or proposed to be made. QGIS help in generating accumulation map through which data of water accumulated can be used for river interlinking.

II. OBJECTIVES

The main objective of our study is:
I. The application of QGIS as a new technique of to determine the potential water catchment area and shading of Vidarbha Region.
II. To compute processing of geographically referenced data, which are add new dimension on environmental planning, management and development.
III. To understand the geo-hydrological process to analyse terrain characters.
IV. To generate watershed maps and topography levels.
V. The drainage patterns of the study area.
VI. To determine suitable sites for check dams and percolation tanks.
VII. To identify the elevation in the region to get most economical path for interlinking.
VIII. Determine the Water Accumulation points in the region by creating watersheds.
IX. To create a path and generate the cut & fill volume of earthwork.

III. LITERATURE REVIEW

[A]. **Indra Prakash**(Faculty BISAG, Gandhinagar and PhD Supervisor, GTU, Ahmedabad). He stated that River Linking means linking two or more rivers by creating a Network of manually created canals, and providing land areas That otherwise does not have river water access. It is based onThe assumptions that surplus water in some rivers can be diverted to deficit Rivers by creating a network of canals to interconnect the rivers. In Bhavnagar district (India) the Shetrunji dam was built for irrigation on river Shetrunji. The surplus water availability in the dam is high as dam overflows quite often .Water deficiency analysis is also done on the basis of yearly availability of water in the Dhatarwadi II dam,Rajula Taluka, Amreli district (India) .Dhatarwadi dam was constructed on Dhatarwadi River. So surplus water diversion is possible through canal to feed the dam having deficiency of water. The present study is to deal with the surplus water diversion via canal along with consideration of various grounds Features, contours and slope of the study area using GIS And Remote Sensing. Location of canal falls and location of Cross drainage work is also presented in the present study. [1]

[B].Sharifuzan Haji Anuar. (International Islamic University, Malaysia).He reported that Malaysia has a vision to be a full developed and industrialized country by the year 2020. In order to achieve the vision, the government is still confronting with one main enigma and obviously referred to the water supply system, especially in the generation and the distribution process. This situation becomes critical in 1998 where 80% of Klang Valley area mostly is residential and industrial consumer experienced a very painful insufficient water supply until the government imposed a water-rationing program to the consumer. Thus, according to Department of Forestry of Selangor State, the water problem mostly caused by illegal logging, uncontrolled agricultural land opening and illegal or unsuitable industrial site location includes harvesting activities which, eventually at the end altering and declining the existing and potential water catchment areas. To address it, this paper describes on the application of GIS as a new technique of approach to determine the potential of water catchment areas in Selangor State and to provide an opportunity to computer processing of geographically referenced data, which add a new dimension on environmental management and planning development. [2]

[C].SREENIVASULU et.al, (J&K 2001).He reported that Estimation of Catchment Characteristics using Remote Sensing and GIS Techniques an attempt has been made to evaluate the physical characteristics of the Devak Catchment up to Gura Slathian in Jammu region of Jammu and Kashmir (J&K), India. The results of the study are useful for further findings the Devak Catchment there is no existing network of hydro meteorological observation. The slope, order of streams was also determined. The estimated catchment characteristics and relationships are useful to simulate hydrological response of the catchment.[3]

[D].MAIDMENT(UNIVERSITY OF TEXAS).He reported that "Arc Hydro GIS for Water Resources" is a data structure that links hydrologic data to water resources modeling, designed by the Center for Research in Water Resources at the University of Texas at Austin. Arc Hydro software is used with Arc Map for water resource modeling. Arc Hydro is an extension for ESRI ArcGIS software, used for Watershed delineation, stream network generation and surface water flow tracing. The Arc Hydro Tools can be used to perform the different functions like terrain preprocessing stream burning, sinks filling, flow direction and flow accumulation calculation, stream definit-ion, stream segmentation, catchment delineation, drainage point processing, etc.[4]

[E].J.P. SINGH, (UTTARANCHAL).He conducted a case study to identify the suitability of potential sites for groundwater recharge structures in Bandal watershed, Uttaranchal, using Remote Sensing (RS) and Geographical Information System (GIS). Watershed concept was used for conserving excess water during monsoon period and storing in water harvesting structures such as check dams, percolation tanks and farm ponds. The check dams were constructed across the ephemeral streams to intercept runoff and storing it for optimum utilization. These structures were found to significantly help in raising the water table from 0.3 m to 2.5 m in wells at different locations. It also emerged that these structures would differ due to variations in location, land slope, soil type, rainfall, land cover and settlements. Sites for 8 check dams, 86 groundwater recharge structures (percolation tanks) and 15 farm ponds and check dams were identified covering an area of 449,531 m2, 449,531 m2 and 36,448 m^2 respectively.[5]

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IV. MATERIAL AND METHODOLOGY

The complete study is done using QGIS and OSM. The basic reason to choose this software is that it is able to generate maps, manage data and it is capable to edit and create analysis within a shorter time in map development.

A. Geographic Information System (GIS)

A system which is used to store, manipulate, capture, analyse, manage & present all types of geographical data is known as geographic information system. Geo-referencing can be easily done in GIS and a database is created.
Database is a collection of information about things and their relationship to each other & geo-referencing refers to the location of a layer or coverage in space defined by the coordinate referencing system.

B. Software scenario

In recent years there has been a rapid and increased number of free-to-use and easily accessible mapping software such as the proprietary web applications Google Maps and Bing Maps, as well as the free and open-source alternative Open Street Map. This software gives the public access to huge amounts of geographic data; perceived by many users to be as trustworthy and usable as professional information.

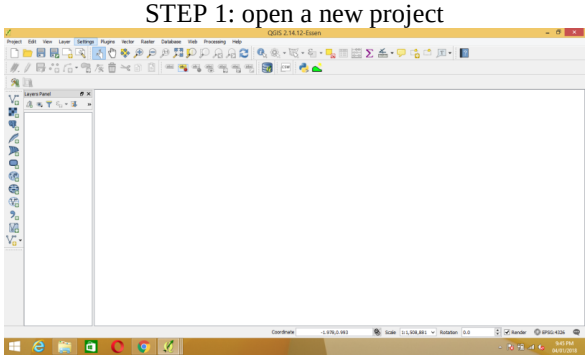
Some of them, like Google Maps and Open Layers, expose an application programming interface (API) that enables users to create custom applications. These toolkits commonly offer street maps, aerial/satellite imagery, geo-coding, searches, and routing functionality. Web mapping has also uncovered the potential of crowd sourcing geo-data in projects like Open Street Map, which is a collaborative project to create a free editable map of the world. These mash up projects have been proven to provide a high level of value and benefit to end users outside that possible through traditional geographic information.

QGIS functions as geographic information system (GIS) software, allowing users to analyse and edit spatial information, in addition to composing and exporting graphical maps.[2] QGIS supports both raster and vector layers; vector data is stored as either point, line, or polygon features. Multiple formats of raster images are supported and the software can geo-reference images. QGIS supports shape files, coverage, personal geo-databases, dxf, MapInfo, Post GIS, and other formats. [3] Web services, including Web Map Service and Web Feature Service, are also supported to allow use of data from external sources.

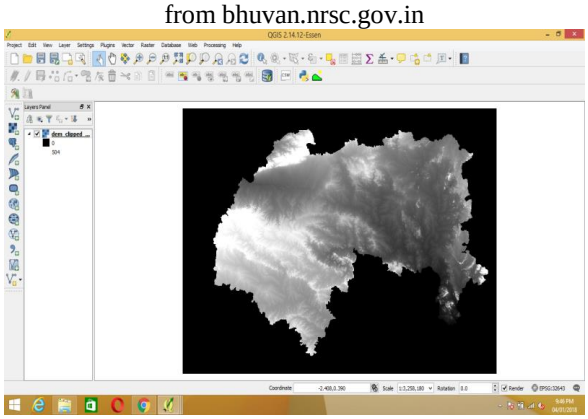
QGIS integrates with other open-source GIS packages, including Post GIS, GRASS GIS, and Map Server. Plug-in written in Python or C++ extend QGIS's capabilities. Plug-in can geo-code using the Google Geo-coding API, perform geo-processing functions, which are similar to the standard tools found in ArcGIS, and interface with Post gre SQL / Post GIS, SpatiaLite and My SQL databases.

C. Methodology to Generate Watershed Map of Study Area

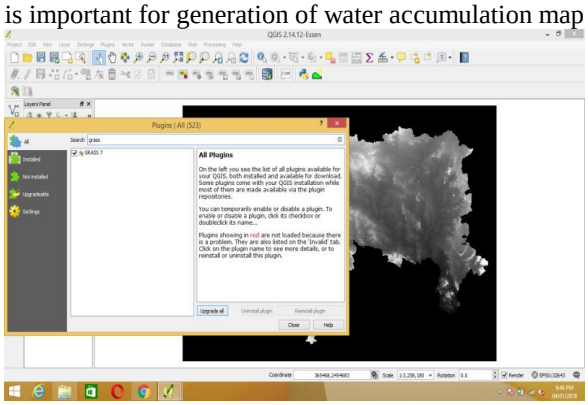
STEP 1: open a new project



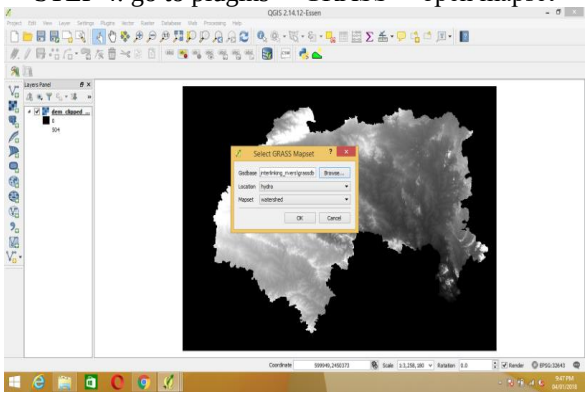
STEP2: open the raster file for which watershed is to be obtained. Raster map of any area can be directly downloaded from bhuvan.nrsc.gov.in



STEP 3: install GRASS plugins. GRASS plug-ins installation is important for generation of water accumulation map



STEP 4: go to plugins→ GRASS→ open mapset



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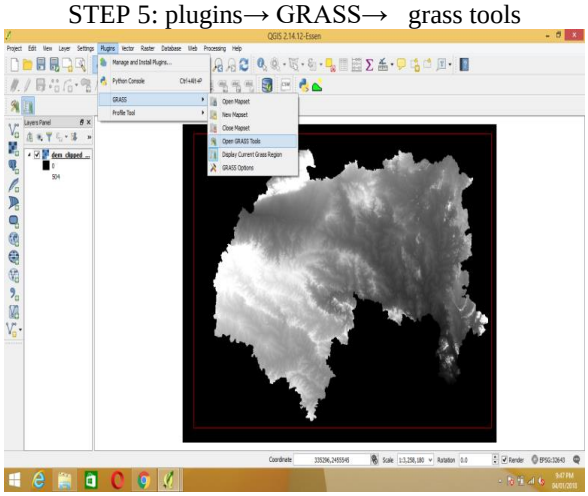
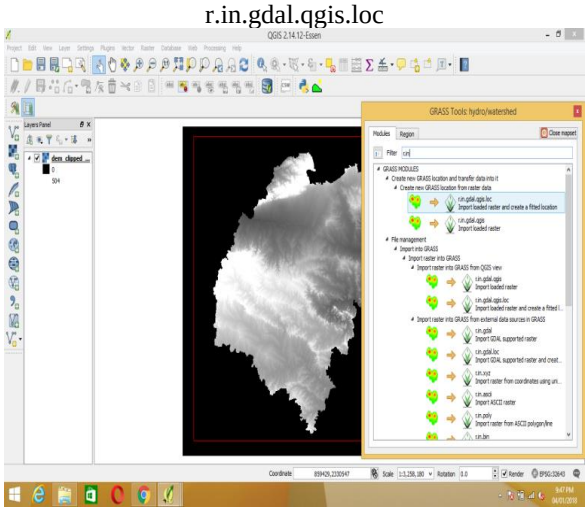
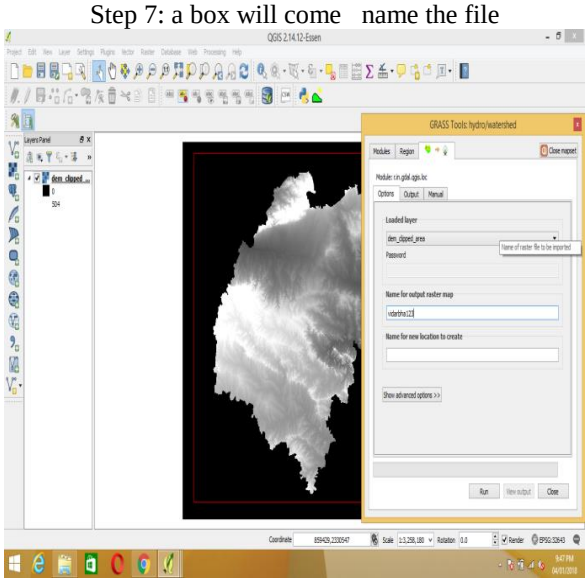
STEP 5: plugins→ GRASS→ grass tools



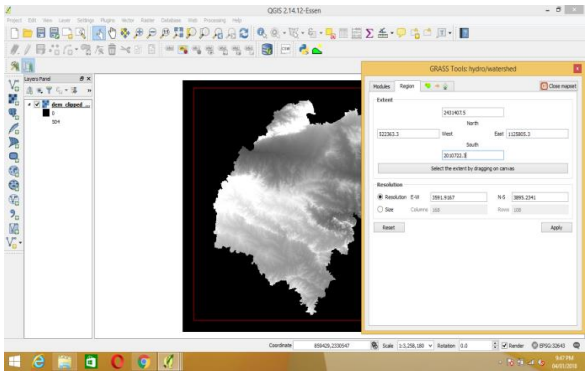
Step 6: type r.in in filter select the first option r.in.gdal.qgis.loc

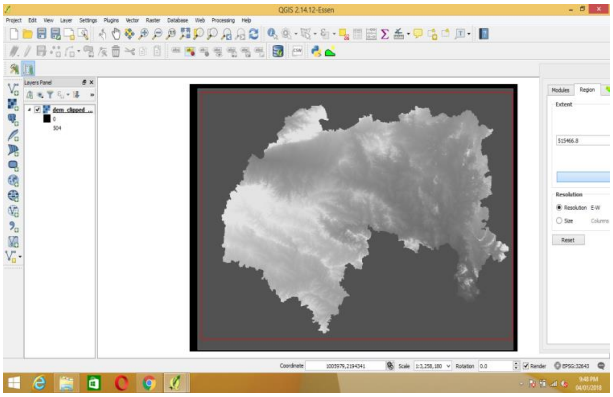


Step 7: a box will come name the file

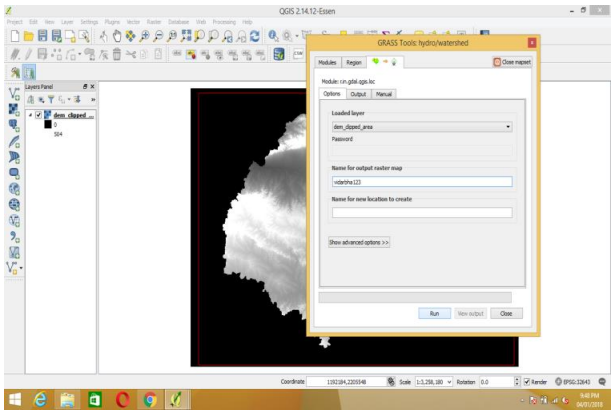


STEP 8: select the region for which watershed is to be created.

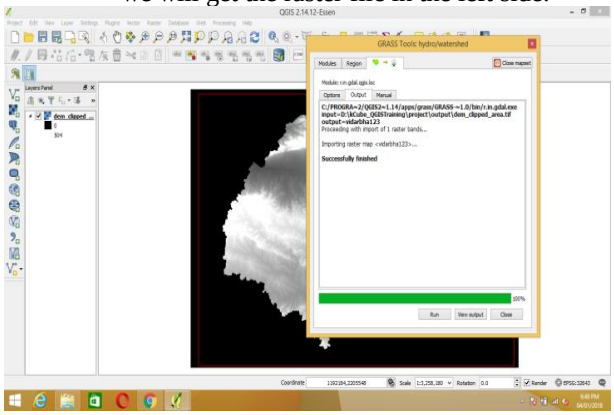




Step 9: Run the program.



STEP 10: After the completion of process click view output we will get the raster file in the left side.



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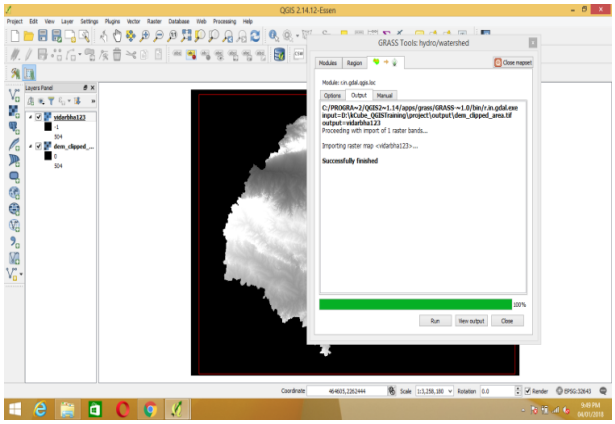
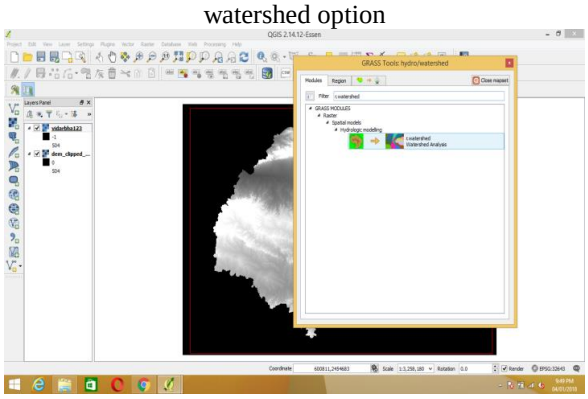
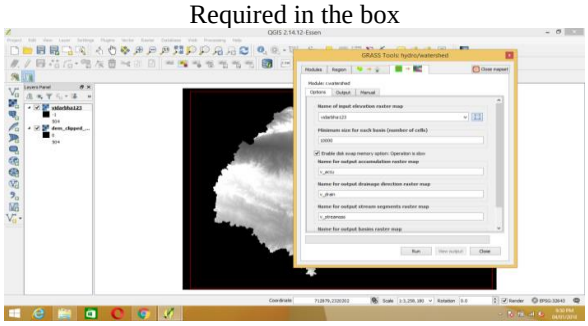


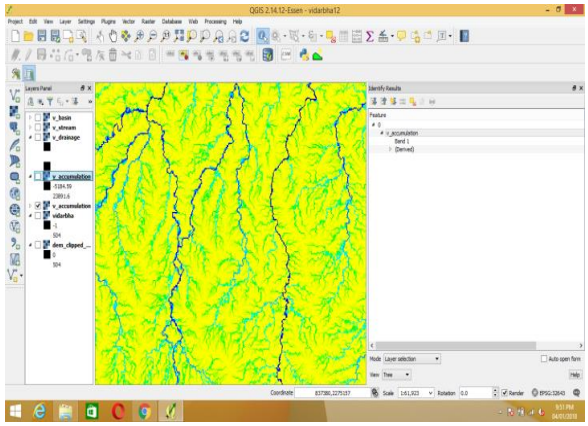
STEP 11: type r.watershed in filter area. Select the watershed option



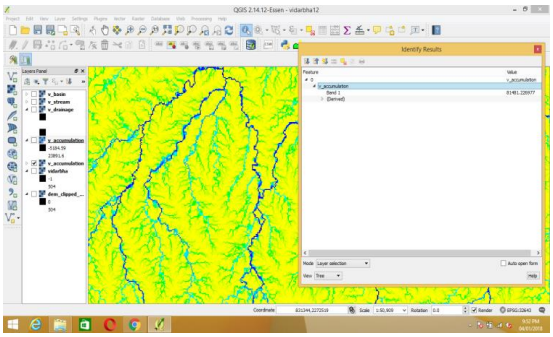
STEP 12: a box will come insert the data Required in the box



STEP 13: run the program we will get the output. Click on view output after the process is complete.



STEP 14: in the second row of toolbox select identify features click anywhere on the watershed region. We will some value for band 1.



V. RESULTS AND DISCUSSION

The final generated maps of watershed shows different water accumulation. The area which is at low elevation has higher water accumulation while the area at high elevation has less water accumulation. Hence through this map we can analyse that which place requires more water and which place has sufficient water. Reservoirs can be constructed at places where water accumulation is more. The water stored in these reservoirs can be transported at different places situated at higher elevations. The colour intensities show the presence of water. The dark blue colour on watershed map shows that there is high water accumulation while the yellow colour shows zero water accumulation in the area. As colour starts fading from blue to yellow the water accumulation start decreasing.

After getting this data, hydrological data of rivers which gets heavily flooded during monsoon must be collected. As per elevation maps downloaded from BHUVAN, the suitable path must be created to interlink the suitable rivers. The direction of flow of water must be known. Runoff of the river whose water is to be diverted must be known. By collecting all the above data it becomes very much feasible to analyse any river interlinking project through QGIS software.

A.TOPOSHEET OF CATCHMENT AREA MAP

The map given below shows the contours of the study area. Now the major importance of contour map is that it gives the user the ability to view a 3D map in 2D dimension. Once the map is generated, the planner can create a suitable path to join two rivers which will have minor undulations in between. Basically the contour map helps in reading elevations of some area. With the help of these elevations desired work of construction can be carried out.

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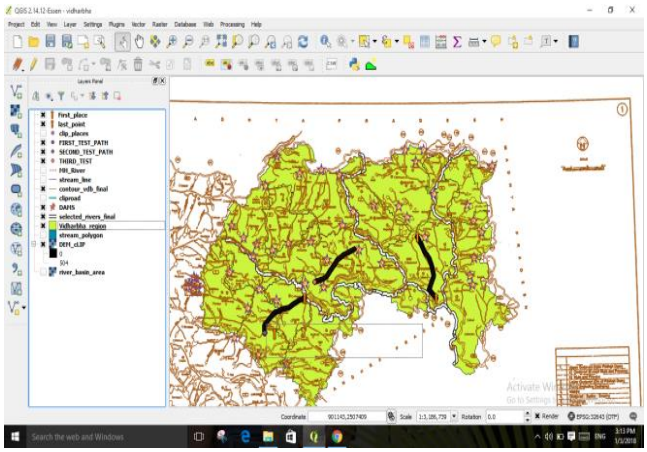

Fig 5.1:- Contour map

B. RIVERS AND STREAMS MAP

The below figure which shows the rivers and streams of the study area is known as drainage map. As the rivers and streams are shown on elevation map, it becomes easy to analyze the flow of river and the direction of flow. Here the hydrological data like discharge of river, yearly flow of river; maximum flood level etc. must be known. These hydrological data is very helpful in determining if river interlinking is possible or not. The drainage map is also useful in determining where the accumulation is more. Once the actual situation of water availability in any river is known then this map can be used to calculate approx water accumulation in respective area.

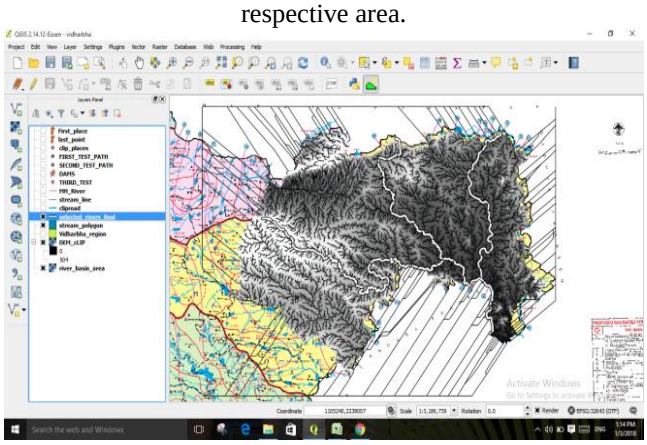

Fig 5.2:- Rivers and streams map

C. ELEVATION MAP

The given below elevation map is downloaded from bhuvan.nrsc.gov.in. The elevation map helps in deciding the path through which two rivers can be interlinked. The white colour shows high terrain or higher elevations while the black colour shows lower elevations. As the colour starts fading from black to white, the elevation starts increasing.

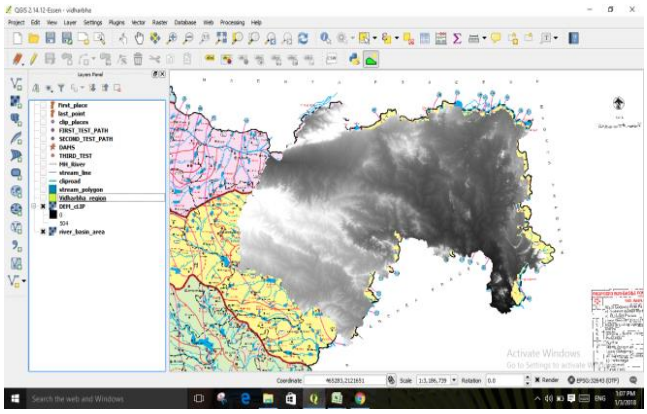

Fig 5.3:- Elevation map

Given below is a graph which shows the elevation at each point on the created path. The green line on the elevation map is a path which was selected just to see the elevation graph. Below the elevation map there is a graph which shows the elevation of the selected path. As we move the cursor on elevation graph, there is another arrow on elevation map which moves simultaneously on the created path. Below the graph we get a table which contains the reading of elevation. This table is copied in Microsoft Excel and a CSV file is created. The values contained in the table will help the administrative people to decide a datum for the path and then further work of cut and fill can be carried out.

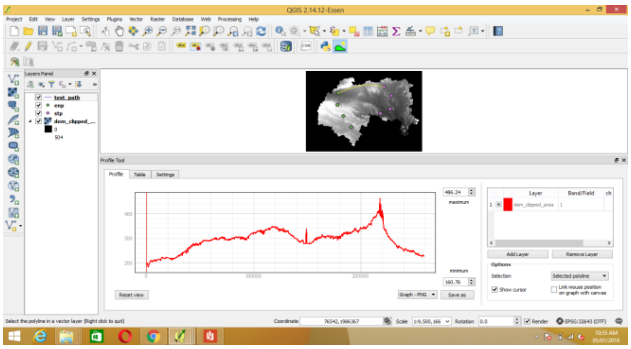

Fig 5.5:- Major Dams

D.LOCATION OF DAMS IN THE STUDY AREA

The major dams of VIDARBHA region are located in the map below. With the help of this map it becomes very easy to know the position of reservoirs and where more reservoirs can be constructed. In the given map some paths are created which is joining two reservoirs. Once the hydrological data of the study area is collected then it is possible to decide if the created path is feasible for river interlinking or not.

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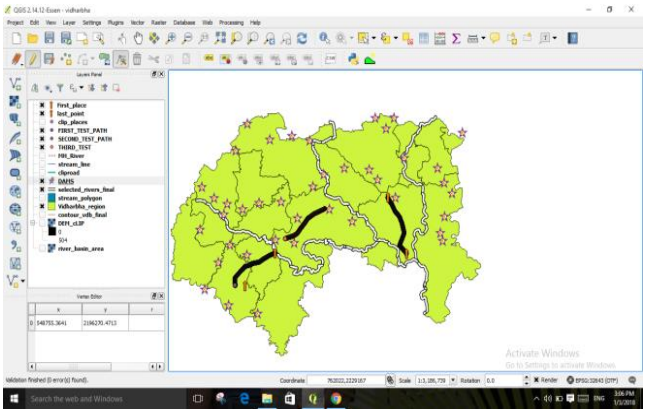

Fig 5.5:- Major Dams

E. ACCUMULATION MAP:

The watershed map given below is again a very useful map which is generated in QGIS. Through this map it becomes easy to know where water accumulation is more and hence it becomes easy to analyse if construction of reservoir is possible or not. The hydrological data which is necessary for construction of reservoir must be collected. This map is generated with the help of elevation map. More water accumulation means more possibility of river interlinking and reservoir construction. Less elevation means more possibility to get the desired path for interlinking of rivers.

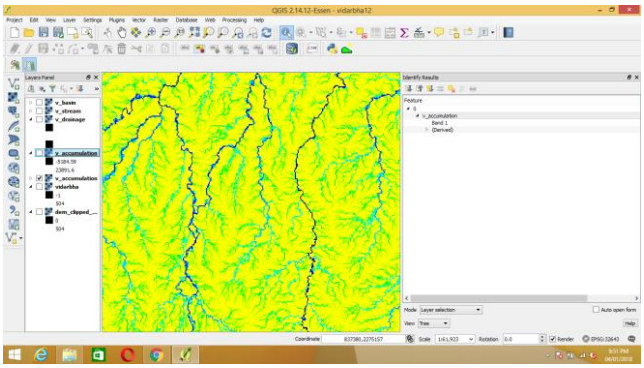

Fig 5.1:- Water Accumulation map

VI. CONCLUSION

From the study we analysed area of VIDARBHA region which has more water accumulation. It may be possible that area in low lying regions have less water accumulation in reality in comparison with area lying in higher elevations. From the hydrological data of the study area and the respective rivers it becomes very easy to decide how to interlink the rivers. If regions on high elevations have more water then it becomes very easy to transport water in low lying regions. Suitable paths on elevation map must be created. Through the created path it becomes easy to analyse the project. This information could be very useful for the administrative authorities to take certain measures in the management of water resources in the study area and they can also make plans for construction of check dams, reservoirs and percolation tanks for improving water availability. Analysing such environmental problem through this software is a major step towards enhancement.

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