

ASSESSMENT OF WATERSHED CHARACTERISTICS

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Abstract—The present paper provides watershed delineation associated with the watershed of Pakhal lake which is located near Narsampet, Warangal Rural District, Telangana, India. Watershed is a natural hydrological entity which allows surface run-off to a defined channel, drainage, stream or river at a particular point. The input data used for this analysis is downloaded from Open Data Archive SRTM 1 Arc second global of United States Geological Survey, USGS website. It has horizontal resolution of one arc-second (approximately 30m). There are four DEM (Digital Elevation Models) files which are covering the watershed of the Pakhal lake, initially these DEM files are merged into mosaic raster by raster dataset tools in ArcGIS. The merged file is then delineated using ArcGIS Hydrology tools. The outlet point is considered for the separation of watershed of Pakhal lake from other watersheds that are covered by the four DEM files. The delineation of watershed has provided fill, flow direction, flow accumulation, generating basins, basin selection, basin to polygon, stream networking of the watershed of Pakhal lake.

Keywords— Watershed, delineation, digital elevation model, outlet, mosaic.

I. INTRODUCTION

A watershed is an area of land that drains into a common water body, such as a stream, river or lake. Watershed comprises of surface water, groundwater and other natural resources, which are influenced by human activities. To observe the hydrologic characteristics of drainage basin there were various techniques in which remote sensing and GIS techniques was used in this study. Geographic Information System has a number of advantages over to the conventional mapping systems. . Conventional maps are static, with fixed projection, scale and coordinate systems; it is difficult to combine multiple map sheets and overlays are restricted. GIS provides easy way to update and analysed the spatial data. For effective planning and implementation of watershed management program, Watershed boundary delineated by government organization is often available at ‘macro level’ only which is not at all suitable for watershed management at ‘micro level’. Therefore, watershed delineation at micro watershed level is an essential task. Digital elevation models (DEMs) are elevations that consist of thousands of grid cells that represent the topography of an area and are being widely used for watershed delineation. It defines a boundary by all points that shed water to the outlet. Identify ridge lines from topo-sheet. Water will travel perpendicular to the elevation contours which is the direction that maximize slope contours. Watershed boundary is delineated by drawing lines perpendicular to the elevation contour lines for land that drains to outlet. Watersheds are important because the surface water features and stormwater runoff within a watershed ultimately drain to other bodies of water. It is essentially to consider these downstream impacts when developing and implementing water quality protection and restoration actions. A healthy watershed conserves water, promotes stream flow, supports sustainable streams, rivers, lakes, and groundwater sources, enables healthy soil for crops and livestock, and also provides habitat for wildlife and plants.

II. STUDY AREA AND METHODOLOGY

Pakhal is situated about 50 km east of Warangal and it is well connected by road passing through the east while taluk headquarters of Narsampet which is about 12 km away. The study area is located 17° 57' 0" N, 79° 59' 0" E in Warangal, Telangana. The lake was constructed around 1213 A.D. by Kakatiyan Ruler, Ganapatideva is spread over an area of 30 km².



Fig 1 Pakhal lake

Our first step is to research into what data sets are available. The United States Geological Survey (USGS) provides very current GIS data files that are essential for accurate results. DEM of the study area was prepared using earth explorer available on USGS of the study area. A polygon covering Pakhal Lake is drawn in the map provided by usgs. A dataset is calculated by the polygon and shows the number of grids covered by the polygon. These grid cells covering the study area are known as DEM files. Get SRTM1 Arc-second (30meter resolution) from dataset of usgs for free to make Digital Elevation Modules & are downloaded with high quality which is chosen from the given options. These DEM files are used to delineate the watershed covering Pakhal Lake. If DEM files have low quality the results may not be accurate and errors are also more.

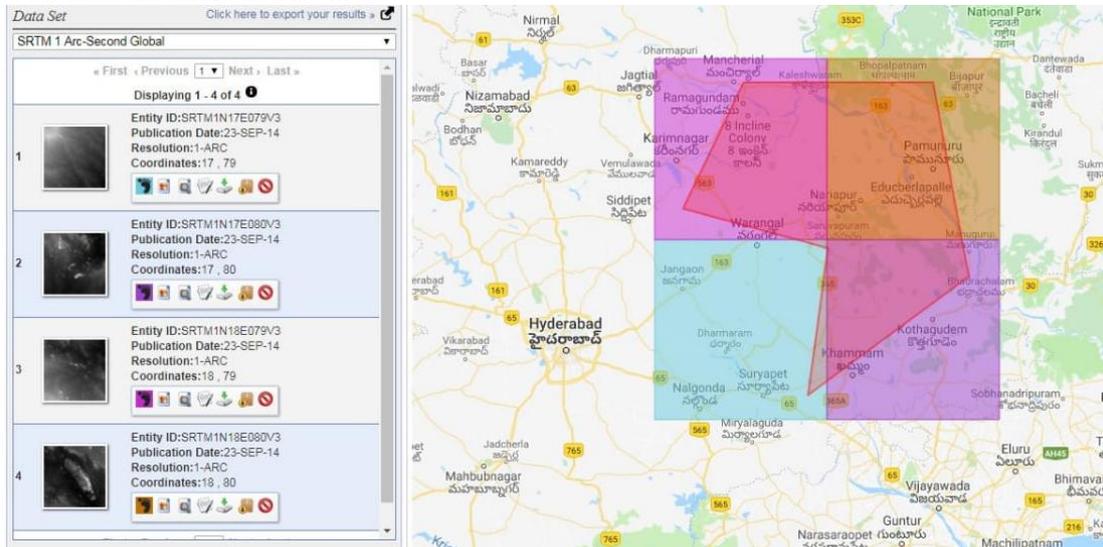


Fig 2 SRTM 1 Arc second DEM files from USGS website, in which the polygon with red colour outline consists of Pakhal Lake.

Methodology of Mosaic Raster

The ‘Watershed delineator tool’ of ArcGIS watershed modelling software package was used for watershed delineation and stream-network generation from the DEM. Before starting the delineation merge the DEM files to Mosaic Raster.

Methodology for Delineating watershed

Watershed is delineated using the tools in the ArcGIS like spatial analyst extension toolbox. The step by step procedure is as follows:

Our first step is to set up your work environment. Create a new, blank map document. Use the Add Data button to add the DEM for your area of interest to the map and expand the Spatial Analysis Tools > Hydrology toolbox to view its contents. Establish the working directory you will be using throughout the watershed delineation process. Create a depressionless DEM. The Fill tool in the Hydrology toolbox is used to create a depressionless DEM & removes any imperfections in the digital elevation model. A sink is a cell that does not have an associated drainage value. The direction that water will flow out of the cells are indicated by drainage values, and are assigned during the process of creating a flow direction grid for the landscape. The resulting drainage network depends on finding the ‘flow path’ of every cell in the grid, so it is important that the fill step is performed prior to creating a flow direction grid. Double click the Fill tool to open its dialog and enter the following parameters.

1. Set the DEM grid as the Input surface raster
2. Set the Output surface raster to your working directory and provide a descriptive name for the output.
3. Accept all other defaults and click OK to run the tool.

Then create a flow direction, creating the watersheds is to set the flow direction for the elevation raster. Determining the direction of flow through each cell is always the first step in surface hydrology analysis, because all the other hydrology tools need this information to work. The direction of flow is indicated by a flow direction grid and assigns a value to each cell that is, the direction that water will flow from that particular cell based on the underlying topography of the landscape. This is a crucial step in hydrological modelling, as the direction of flow will determine the ultimate destination of the water flowing across the surface of the land. Double-click the Flow Direction tool to open the tool dialog and input the required parameters. This process may take quite some time to run through to completion. When the tool has finished, the new flow direction grid will be added to the map document. Create a flow accumulation. The Flow Accumulation tool calculates the flow into each cell by identifying the upstream cells that flow into each down slope cell. In other words, each cell’s flow accumulation value is determined by the number of upstream cells flowing into it based on landscape topography. Double-click the Flow Accumulation tool to open the tool dialog and input the required parameters and provide a descriptive name for the output. Create a raster delineating all drainage Basins. Transfer the basin to vector polygon using the raster to polygon tool and select the basin polygon and clip it shape file of all basin polygons using the clip tool under geoprocessing to create a stream network. Stream networks can be delineated using the

output from the flow accumulation form is the number of upslope cells that flow into each cell. Threshold can be specified on the raster derived from the flow accumulation tool. The initial stage is defining the stream network system. This task can be accomplished with the map algebra. For example, if we set the accumulation more than 40000 all sales with more than 40,000 cells flowing into them will be part of stream network, this value depends on the size of pixel and the raster the larger the watershed to use a higher value. Transfer the stream network raster to a polyline layer using raster to polygon tool. Clip the stream network by watershed limits using the clip tool.

III.RESULTS AND DISCUSSION

The results present general watershed delineation associated with the watershed which is located near Narsampet, Warangal District, Telangana, India. The input data used for this analysis is downloaded from Open Data Archive SRTM 1 Arc second global of United States Geological Survey USGS website. It has horizontal resolution of one arc-second (approximately 30m). Red colour outline describes the outline of watershed and stream network is represented by yellow lines. The outlet point of Pakhal lake is within the Pakhal lake located near the dam.

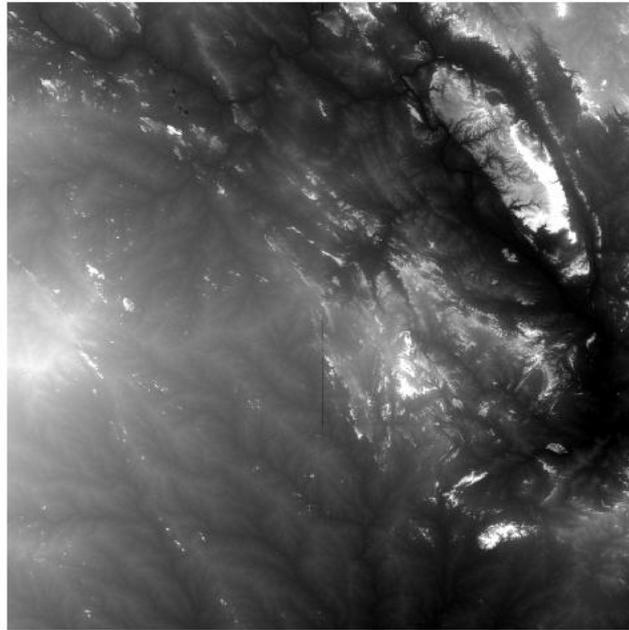


Fig 3 Merging of DEM files to Mosaic Raster with 17° 57' 0" N, 79° 59' 0" E coordinates

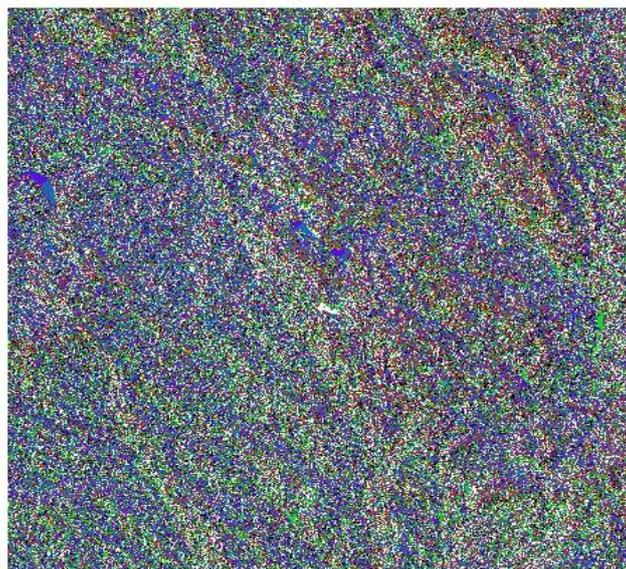


Fig 4 Flow direction raster has 8 different Labels, each label had different directions respectively

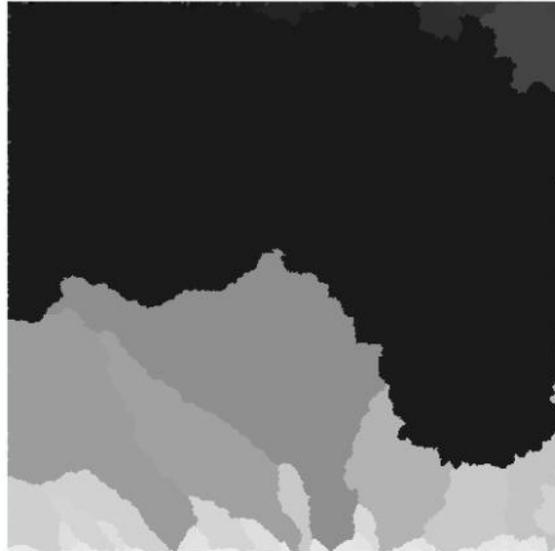


Fig 4 Basin to polygon

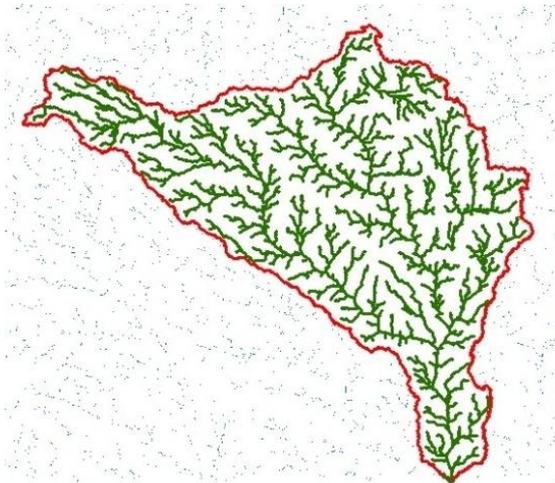


Fig 5 Stream Network

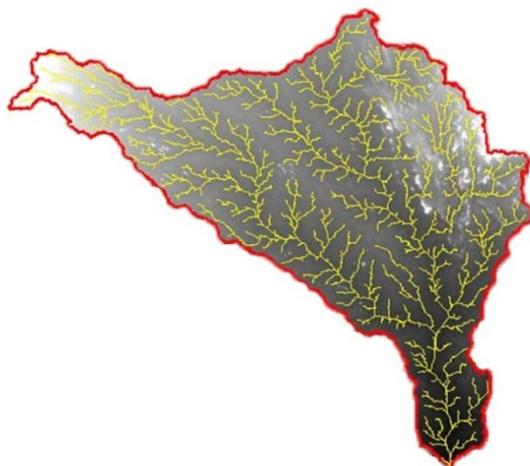


Fig 6 Watershed of Pakhal lake

IV. CONCLUSIONS

Aim of this study was to extract watershed characteristics with the help of GIS using DEM. Hence the work was carried out for the preparation of DEM using USGS. The input data used for this analysis is downloaded from Open Data Archive SRTM 1 Arc second global of United States Geological Survey USGS website. It has horizontal resolution of one arc-second (approximately 30m). These DEM files are merged into mosaic raster by raster dataset tools & then delineated using ArcGIS Hydrology tools. This process includes fill, flow direction, flow accumulation, generating basins, basin selection, basin to polygon, stream networking of the watershed. The raster GIS, Arc/Info GRID, proved to be very convenient environment to determine a wide range of watershed characteristics using digital elevation models etc. This research reveals that the ArcGIS hydrological tool used to delineate water is very convenient to calculate watershed characteristics. The flow patterns determine the direction in which water will flow.

V. REFERENCES

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