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Watershed Delineation for Lake Chamo Basin, Ethiopia

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Abstract

Background: In this study watershed was delineated by using ArcGIS 10.4 for Lake Chamo basin and necessary procedures was described. Area for Lake Chamo basin was calculated and the result shows that the total area contributes flow to Lake Chamo was 8112.98 Kilo meter square based on the delineated water shed. Location map for the water shed was also created. This finding are important for water resource planning and decision making at Sub water shed level to minimize problems in the water shed and take remedial action for water resource planning and management to utilize the limited resource optimally. It was also important to scholars to use as the source of data in the water sheds to conduct further research in the watershed.

Keywords: ArcGIS • Watershed • Watershed delineation

Introduction

Watershed was not only hydrological condition of water bodies but it indicates socio-political and ecological condition of the water system which plays important role to identify socio- economic condition of the entire community and support the livelihood rural development of the community [1]. Ethiopia was a country having 113 million hectares of land which was covered by different climatic and physiographic characteristics with high water potential resource having 122 BMC surface runoff annually and 2.9 BMC of ground water which was characterized by temporal and uneven spatial distribution throughout the country [2]. The water resource of Ethiopia was grouped into 12 basins which have 8 River basin, 1 Lake Basin and 3 dry basins [3]. Melese B [4] uses arc hydro to delineate watershed. He developed the comprehensive geospatial model in ArcGIS model builder and use Arc hydro to delineate the watershed. He shows ways to delineate the watershed by ArcGIS model Builders and focus on ArcGIS, Arc Hydro and Watershed Delineation. According to Bal Gopal Guru, Janhabi Meher (2016) Watershed delineation for Mahanadi River conducted by using ArcGIS and SWAT model. They delineate the area in to five sub basins based on CWC operated discharge sites. They use DEM for their study area and use ArcSWAT to delineate the watershed of the Mahanadi River [5].

Watershed delineation was conducted by open source Geospatial Technology for Varahanadhi river according to Viswanathan et al (2015). According to their finding they focused on the need of watershed management by using Geospatial techniques. They formulate contour, slope and terrain profile of their research area. Awareness creation for the entire watershed at required places to utilize rainwater well was created [6]. Based on Sameh et al (2011) automated watershed evaluation for Flat was done. The aim of their finding was watershed delineation from flat and arid areas by means of DTM by removing hard techniques like river burning or other hydrological DTM correction. They use three ArcGIS packages like Arc hydro tools, TNTmips and River tool with in two DEM. In the study they recommend to implement a manual correction of DEM by using river burning technique to delineate watershed [7].

Know a day due to increasing population, high demand for hydropower, irrigation agriculture and increasing industrialization water demand were very high in Ethiopia. Due to that assessing water availability for optimal utilization and sustainable water resource managements was required which was important to reduce crises due to over utilization and underutilization of this resources and this was fulfilled by identifying available water at sub basin level. So, identifying watershed at sub basin level was the first option. Among the 12 River basin of Ethiopia river basin one of them was lake basin of Ethiopia which was also said to be Rift valley lakes which includes Lake Abaya, Lake Abiyata, Lake Chamo, Lake Hawassa, Lake Langano, Lake Shalla, Lake Ziway [8]. So, delineating this lake basin at individual level was very important to set out strategies for optimal utilization and management of the lake water resources. In this study watershed of Lake Chamo was delineated by using ArcGIS 10.4 and Bas map for the research area was created. Watershed of Lake Chamo lake basin necessary for decision makers and other researchers.

Materials and Methods

Data required for the study

The shape file of Ethiopia, water body and River for ArcGIS was downloaded from **www.diva-gis.org**

The shape file of the world at global level was downloaded also from **www.diva-gis.org**

Digital elevation model was downloaded from **https://earthexplorer.usgs.gov**

Developing data for watershed delineation

The steps used for delineation of watershed uses a serious of sequences as follows

Digital elevation model was downloaded from and Mosaic the DEM, Filling the sinks, compute flow direction and accumulation, raster calculation by map

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algebra, stream flow creation, basin, conversion of created raster stream flow and basin into stream line and basin shadflies.

Data downloaded from usgs.org (Figure 1)

Mosaic the DEM: Two or more downloaded DEM based on image overlay were loaded in to ArcGIS. By selecting data management tool from Arc Toolbox, from Data management tool raster was selected, then from raster then raster data set was selected, finally from raster data set mosaic the DEM. The function of mosaic was to create the full required DEM for the study area downloaded from earthexplorer during download it shows more than one image to download and one image may not cover the entire study area. So, more than two images were downloaded and mosaic (Figure 2).

Fill the sink: Filling the sinks was very important to remove maximum and minimum elevation which affect water flow in the watershed in the direction of water flow. To create fill of raster from the mosaic DEM from the Arc Toolbox spatial analysis tool was selected, from spatial analysis tool hydrology then fill tool was selected and fill raster was created for Lake Chamo river basin (Figure 3).

Flow direction: From the created fill raster data flow direction was calculated. From spatial analysis tool of Arc Tool box hydrology was selected and from hydrology flow direction of the lake Chamo was generated (Figure 4).

Flow accumulation: From generated flow direction by using spatial analysis tool box then hydrology flow Accumulation tool was selected and flow accumulation was generated (Figure 5).

Raster calculation: By using map Algebra from hydrology tool raster calculation was done by using flow accumulation greater than 8000 cells of the raster forms stream networks and stream network was created (Figure 6).

Basin: The basin of the watershed was created by using spatial analysis tool then hydrology and finally select basin by using flow direction as input data and basin raster file was generated (Figure 7).

Basin shape file: From the generated basin raster file by using conversion tool polygon of the watershed was created (Figure 8).

Stream flow polyline: By using conversion tool from Arc Toolbox stream flow raster file was converted from rater to polyline (Figure 9).

Clip: By using selection tool the watershed of the study area was selected and clipped by making layer from the selected shape file or by using Reprocessing tool and the watershed of the chamo lake was generated. In similar way steam line for the watershed was clipped at the extent of clipped watershed boundary (Figure 10). The delineated watershed was clipped to within the great rift vally basin as a sub basin of rivet valley. This was the study area of the project. Area of the watershed was calculated by projecting the clipped watershed shape file in to projected coordinated system and the by opening attribute table and create field area and calculate the area by using calculate geometry (Figure 11).

Bas map for the study area was developed by using Geoprocessing tool and clipped to the required target map.

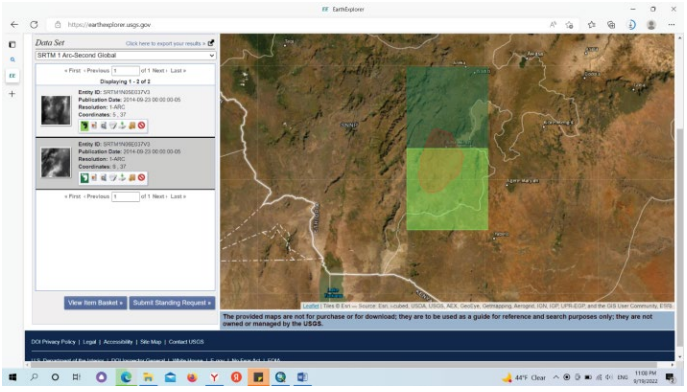

Figure1. Image for downloaded data.

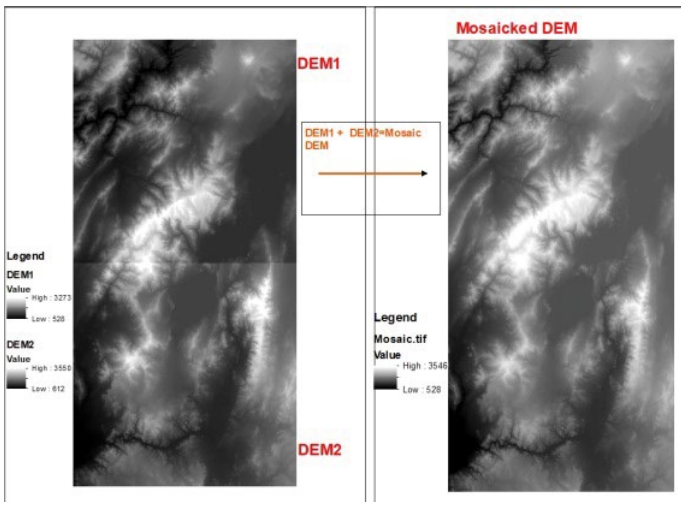

Figure 2. Mosaicked DEM from two raster data set.

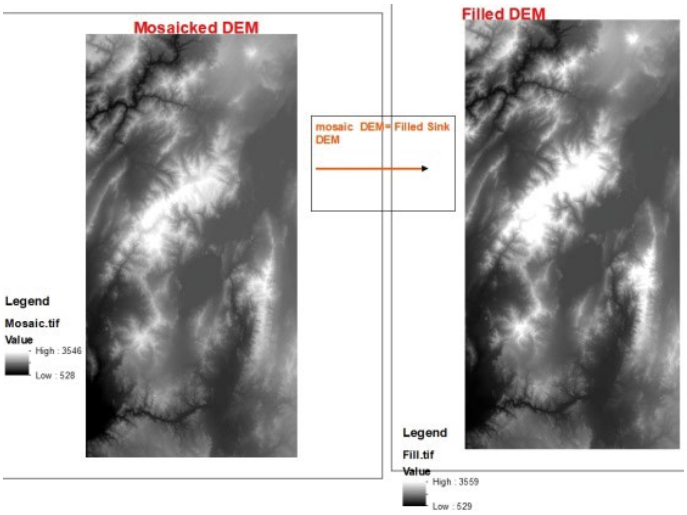

Figure 3. Filled sinks of DEM.

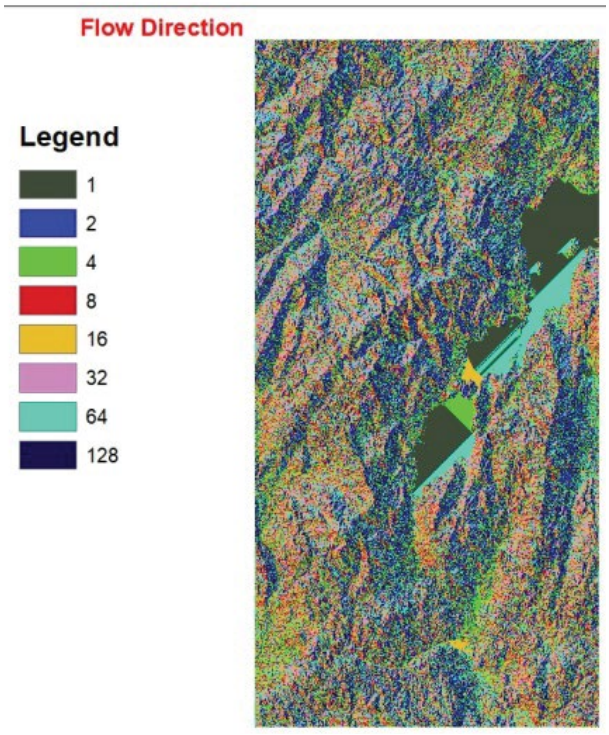

Figure 4. Analyzed flow direction.

Figure 5. Generated flow accumulation.

Figure 6. Raster calculated for flow accumulation.

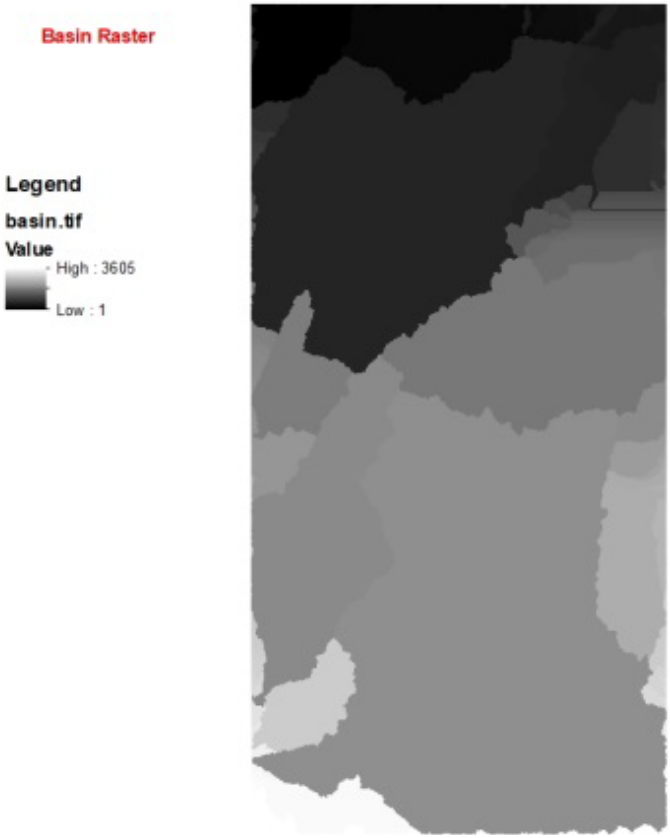

Figure 7. Generated basin raster for flow direction.

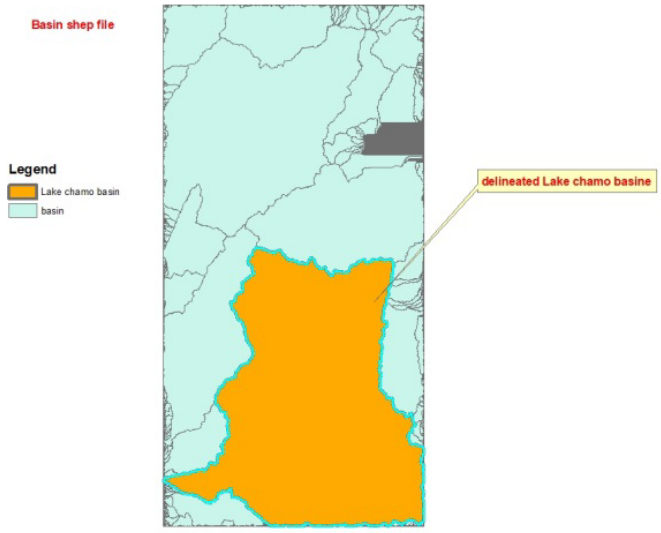

Figure 8. Shape file of the basins converted from created raster basin.

Result and Discussion

The watershed of Lake Chamo was delineated by using ArcGIS 10.4 and base map was created for study area. Thea area for the water shed was calculated by using Geometric calculation and the result was 8112.98 Kilo meter square. The bas map of the area was created for planning water management strategies and making decision to set implementation of water management to utilize the mater resources optimally in the water shed without

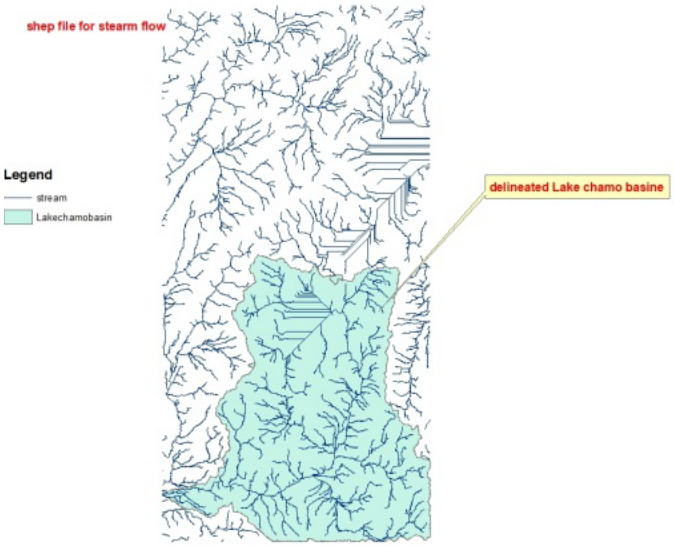

Figure 9. Shape file for stream flow converted from raster calculated DEM.

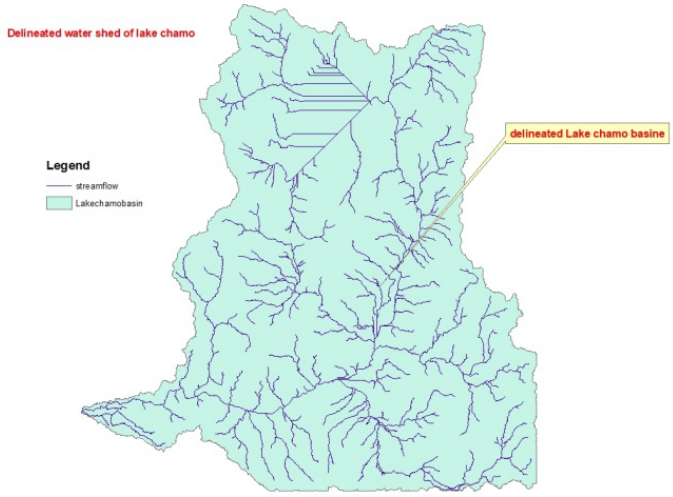

Figure 10. Clipped watershed of Lake Chamo and stream flow.

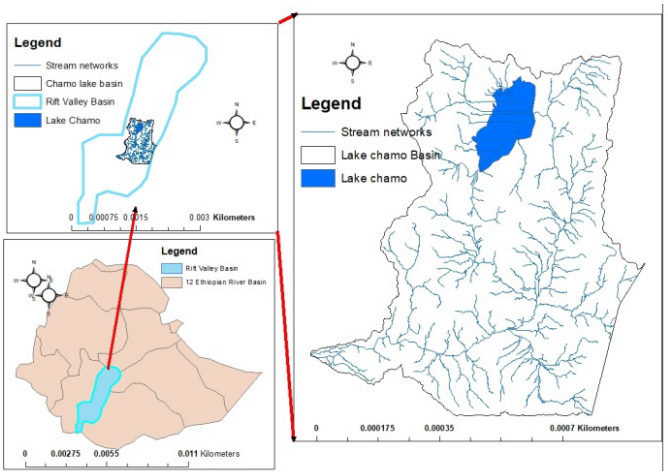

Figure 11. Generated watershed of Lake Chamo location in the river basin of Ethiopia.

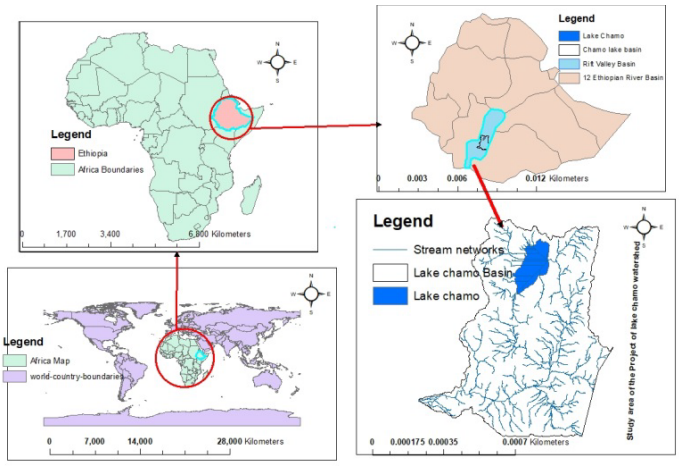

Figure12. General map of Lake Chamo water shed for the research project.

affecting socio economic activity and ecological characteristics of the water body (Figure 12).

Conclusion

Boundary for lake chamo watershed was developed and area for this water shed was calculated. The bas map for the lake chamo basin was created.

References

1. Bekele-Tesemma, Azene. A participatory agroforestry approach for soil and water conservation in Ethiopia. *WUR* (1997).
2. Ababa, Addis. "Water resources policy and river basin development as related to wetlands." In Wetlands of Ethiopia: Proceedings of a Seminar on the Resources and Status of Ethiopia's Wetlands (2003).
3. Berhanu, Belete, Yilma Seleshi and Assefa M. Melesse. "Surface water and groundwater resources of Ethiopia: potentials and challenges of water resources development." *NBI* (2014): 97-117.
4. Baye, Melese. "Watershed Delineation by Arc Hydro Tools."
5. Padminii K, G. Brindha and D. Venkatramaraju. "Quality work life-in medical field." *Int J Pharm Technol* 7 (2015): 8437-8446.
6. Valentina D S, K. Ilayaraja and A. Ambica. "Spatial distribution of groundwater quality in Selaiyur village, Chennai, India." *Ecol Environ Conserv* 20.
7. Divyaa K and K. Venkatraman. "Design of flexible pavement for an engineering college." *Int J Appl Eng* 9.
8. https://overlandethiopiatours.com/attraction-in-ethiopia/natural/rift-valley-lakes-in-ethiopia/

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