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Watershed Delineation in Mathwad Range, Alirajpur Forest Division for Soil-Water Conservation for management of displaced wildlife due to construction of Sardar Sarovar Dam

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ABSTRACT: -Sardar Sarovar Project (SSP) is the largest and the most ambitious project. The dam site is located near Navagaon in the state of Gujarat, the impact of SSP that some area of Madhya Pradesh in under submergence at the rainy season or at Full Reservoir Level (FRL) condition. To improve the adjoining area of submergence for wildlife which may stop wildlife escapes.The delineation of watershed area is done using GIS, its delineation is very common task in hydrology but it is tedious while delineating in field.The manual computation and graphical representation of drainage lines and watershed boundary is a time taking process but with the help of Geographical Information System (GIS) using Digital elevation Model (DEM) it can be done with accuracy in limited time period. This Research paper present a case study of Mathwad Range Alirajpur Forest Division to delineate watershed boundaries and drainage line using GIS or DEM. The result clearly shows the applicability of GIS indelineation of watershed.As a result 39 micro watershed in which 32 have in Narmada River Basin and 7 in other catchments. This study can be helpful for the watershed development and management planning of the studied area.

Keywords: Mathwad, GIS, DEM, Watershed delineation, Drainage, Catchment area, SSP.

I. INTRODUCTION

The present study is a part of impact of Saradr Sarovar Project (SSP) in Madhya Pradesh, Sardar Sarovar Project (SSP) is the largest and the most ambitious project. The dam site is located near Navagaon in the state of Gujarat at $21^0 49' 49"$N latitude and $73^0 44' 50"$E longitude. As a result of construction of the dam under SSP, about 19628 ha of land in the state of Madhya Pradesh had been estimated to be submerged, The submergence area situated in Mathwad range, Alirajpur forest division, in that submergence area wildlife habitat get submerged at the rainy season or at full dam condition, as a result the wild animal escapes from that area, to resolve that problem of wildlife the habitat improvement near that are is very important, for habitat improvement soil-water conservation and watershed management work plays a very important role.

Watershed is a region or area bounded peripherally by a divide and draining ultimately to a particular watercourse or water body. A watershed describes an area of land contains a common set of streams or rivers that all drain into a single larger water body, such as larger river, a lake or an ocean. All the streams flowing into small rivers, larger rivers and eventually into the ocean form an interconnection of waterways. A large watershed of river is divided into a several micro watersheds of smaller rivulets joining the same stream.

Now a days Digital Elevation Model (DEM) is used for delineation of Watershed, and extraction of drainage line finding of stream network, watershed topography like slope map, aspect map, drainage map with the help of hydrology tools in GIS software. Digital Elevation Model is a three-dimensional representation of a terrain surface. Besides digital elevation model

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(DEM's) is also used with little variations in their meanings. Whereas the DSM represents the Earth's surface and includes all objects on it, the DTM represents only the bare ground surface without any objects, such as plants and building. DEM is often used as a generic term for DSMs and DTMs, only representing height information without any further definition about the surface. DEM's are often used in geographic information systems and are the most common basis for digitally produced relief maps. The most striking feature of a DEM is its 3-D visualization. It helps in extracting terrain parameters for geomorphology; modelling flow; creating relief maps, terrain analysis and even in precision faming and forestry.

II. LOCATION OF STUDY AREA

The study area is located in Mathwad Range of Alirajpur Forest Division in Alirajpur district of Madhya Pradesh**(Fig-1)**, the study area spread over 26 forest compartments, with gross area of 7445.28 ha and net workable area i.e. Thearea excluding the area under encroachments of 6344.22 ha. Sampling its adjoining forest area comprise of 34 compartments with gross area 7791.47 ha and net workable area 5821.58 ha and located within a distance of 5 km from the boundary of the project area. The Narmada River forms the southern boundary of the project area. The whole study area is 12165.80 ha, including the project area and its adjoining forest area. It is geographically located between, $21^0$55'34.449" N and $22^0$2'21.127" N parallels of latitude and between $74^0$8'14.736" E and $74^0$20'39.076" E meridians of longitude.

III.DATACOLLECTION

In this study the DEM's is downloaded from USGS earth explorer website https://earthexplorer.usgs.gov/, Range Map or Division map is collected from Forest circle office, Indore Madhya Pradesh. Fig:-2 shows the boundary of the study area is created in ArcGIS software with the help of range and compartment boundary which collected from circle office Indore.

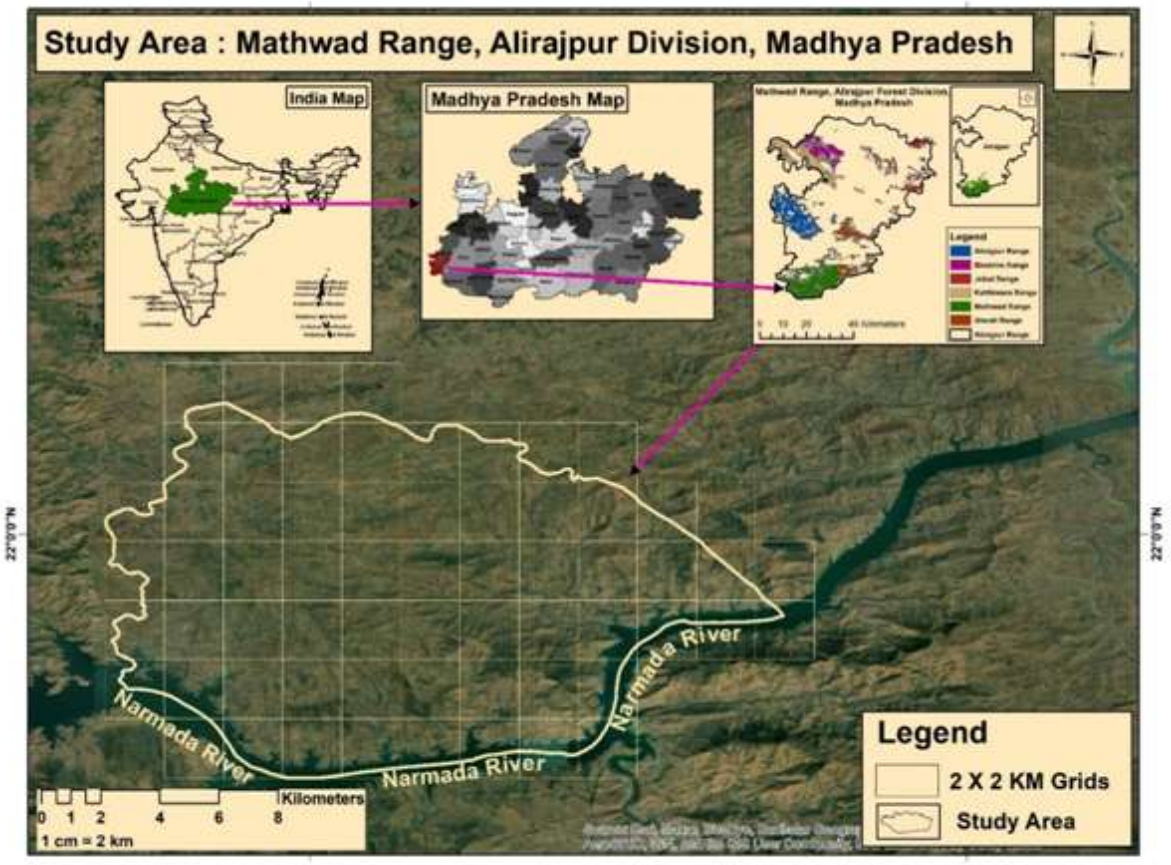

Fig-1: Location of Study Area of Mathwad Range, Alirajpur Forest Division

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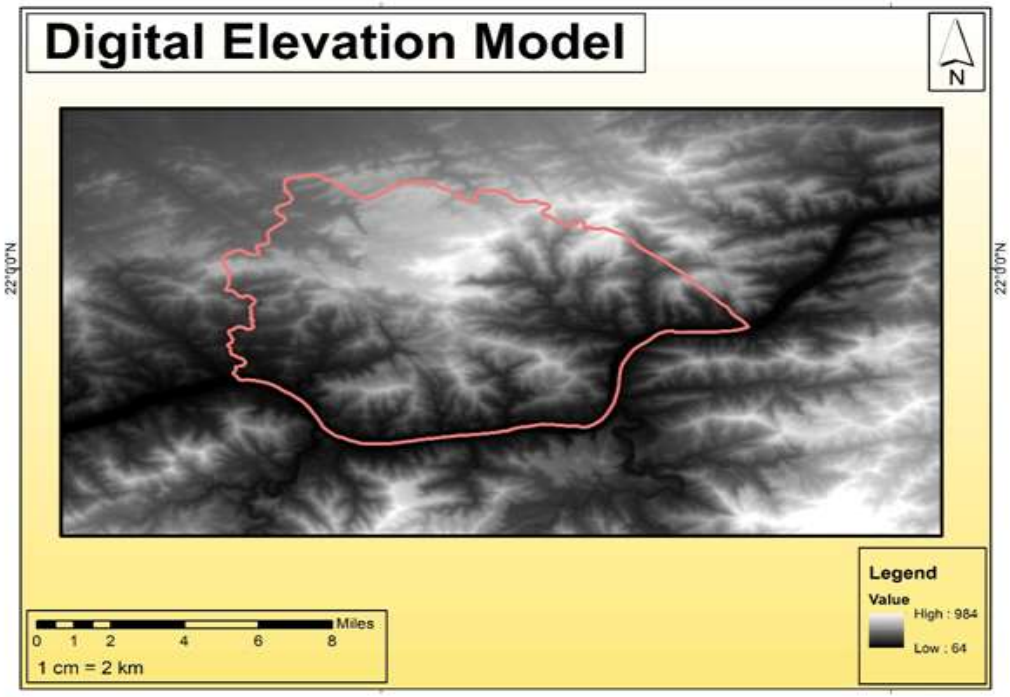

Fig-2: DEM of Study Area of Mathwad Range, Alirajpur Forest Division

IV.MATERIAL&METHODOLOGY

DEM is used for finding out the contour lines, drainage line, watershed boundary, watershed, micro-watershed, depending on the quality and resolution of the data results can be differ from actuality.The DEM is used as primary data for determination of watershed delineation. In ArcGIS hydrological analysis like basin map, fill map, flow accumulation map, flow direction map, flow length map, drainage map, stream order map & watershed map are obtained, the detailed methodology is described in flow chart fig-No-4.

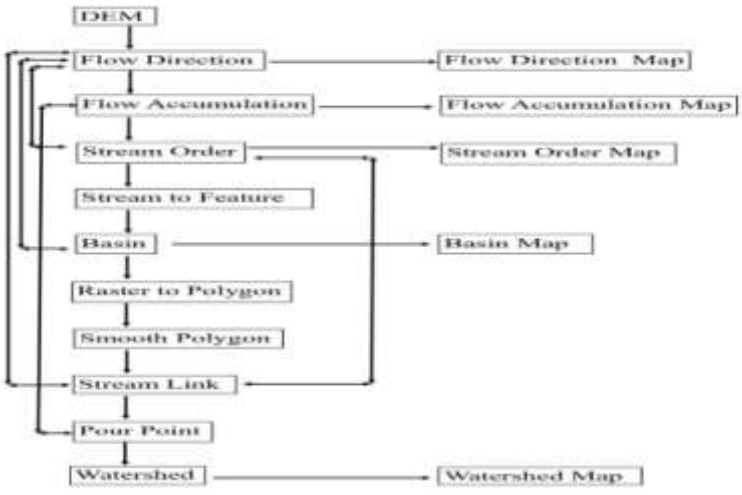

Fig-3: Methodology Flow Chart of Watershed Delineation

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V. RESULTS

Micro-watershed:-The total area of study sight is 174.252 sq. km. Catchment area of Narmada River was calculated as 134.774 sq. km. The study area has total 39 micro watershed in which 32 Watershed comes under the Narmada River Basin and 7 are other catchments, in Narmada River Basin have 134.771 square km or 77.3 percentage of study area and in others catchment have 39.481 square km
or 22.7 percentage of study area.

Drainage System:-735 first order stream, 181 second order stream, 40 third order stream, 10 forth order stream & 1 fifth order stream.

Sl. No.	WSH Code	Area (Sq.km)	Area in %
1	WSH-1	5.559	3.19
2	WSH-2	4.191	2.41
3	WSH-3	3.764	2.16
4	WSH-4	3.086	1.77
5	WSH-5	6.842	3.93
6	WSH-6	7.57	4.34
7	WSH-7	2.242	1.29
8	WSH-8	0.962	0.55
9	WSH-9	5.895	3.38
10	WSH-10	3.844	2.21
11	WSH-11	2.255	1.29
12	WSH-12	3.436	1.97
13	WSH-13	4.321	2.48
14	WSH-14	8.213	4.71
15	WSH-15	12.805	7.35
16	WSH-16	1.989	1.14
17	WSH-17	4.509	2.59
18	WSH-18	4.713	2.70
19	WSH-19	7.633	4.38
20	WSH-20	4.898	2.81
21	WSH-21	3.212	1.84
22	WSH-22	4.751	2.73
23	WSH-23	4.917	2.82
24	WSH-24	3.712	2.13
25	WSH-25	1.263	0.72
26	WSH-26	3.172	1.82
27	WSH-27	1.497	0.86
28	WSH-28	4.483	2.57
29	WSH-29	14.019	8.05
30	WSH-30	1.628	0.93
31	WSH-31	5.006	2.87
32	WSH-33	3.769	2.16
33	WSH-32	1.876	1.08
34	WSH-34	2.316	1.33
35	WSH-35	2.895	1.66
36	WSH-36	9.123	5.24
37	WSH-37	1.713	0.98
38	WSH-38	1.752	1.01
39	WSH-39	4.421	2.54
Total		**174.252**	

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Table - 1: Area under different micro watersheds in the study area

S.No	Drainage Order	No. of streams
1	First order	753
2	Second order	181
3	Third order	40
4	Fourth order	10
4	Fifth order	01

Table-2: Stream Order of Study Areaof Alirajpur Mathwad Forest Range

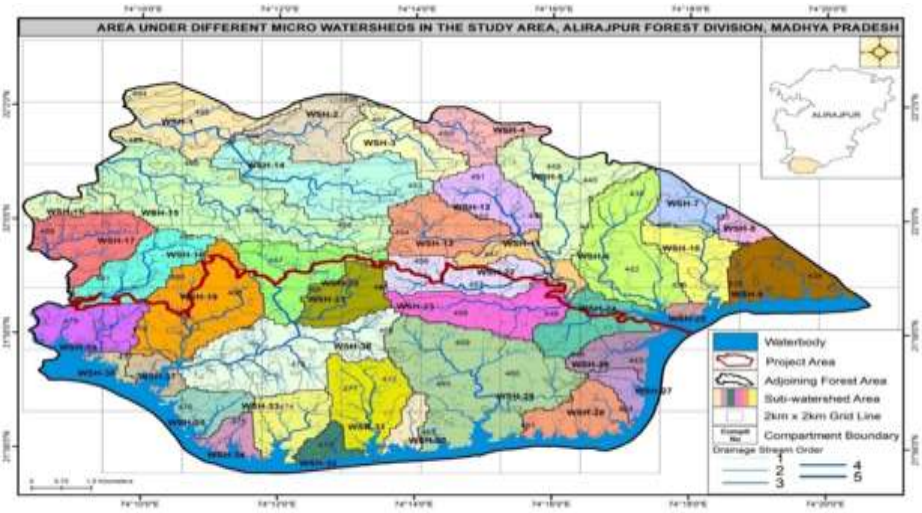

Fig-4: Watershed Mapof Study Area ofMathwad Range, Alirajpur Forest Division

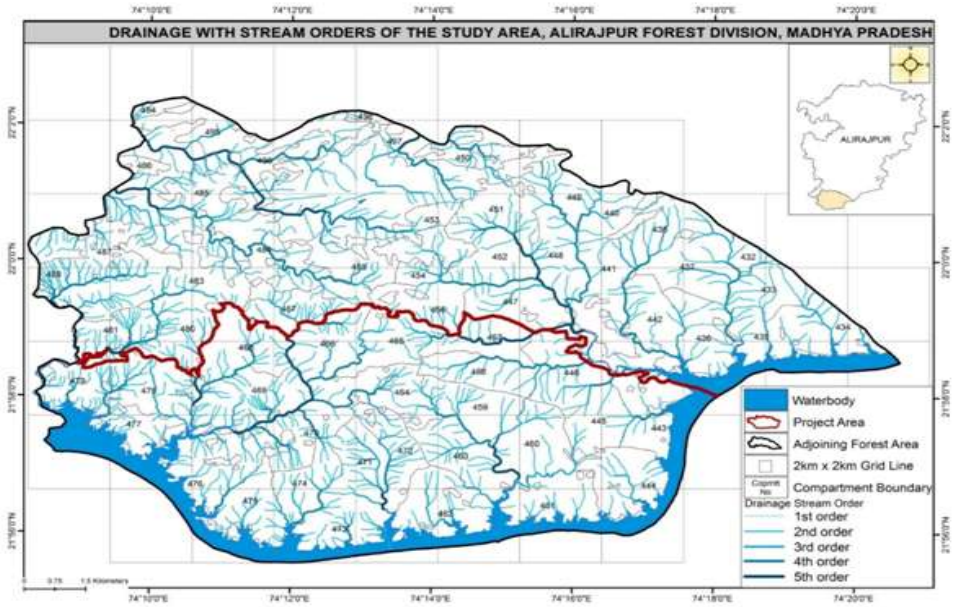

Fig-5: Drainage with Stream Order Mapof Study Area ofMathwad Range, Alirajpur Forest Division

VI. CONCLUSION

The aim of study was to delineate the watershed and find out the micro watershed, drainage line, basin and some others characteristics of watershed using DEM with the help of GIS application software, as a result we found the study area have 39 micro watershed in which 32 watershed comes under the Narmada River Basin and 7 are other catchments, in Narmada River Basin have 134.771 square km and 77.3 percentage of study area or in others catchment have 39.481 square km and 22.7 percentage of study area. The results can be differ from the actuality because it's a GIS based study and it depends on the resolution of the satellite image and DEM. This study may be helpful to take decisions for watershed planners and also important for forest department for the development of the study area.

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