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Morphometric Analysis of Sukhna Catchment Area Using GIS

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Abstarct : *Management of watershed encompasses various activities from watershed delineation to monitoring. The suitability of land for development is not only based on a set of physical parameters (geography/terrain, soils, slopes, forest, geology etc.) of the land but also very much on the economic factors. The cumulative effect of these factors determine the degree of suitability and also helps in further categorization of land into different priority orders for development.*

Catchment area of Sukhna Lake falls under 3 territories: Punjab, Haryana and Chandigarh. Chandigarh portion comprises of Shivalik Hills which are prone to erosion. Catchment is drained by 2 seasonal rivulets namely KANSAL and NEPLI NADI (both originating from Haryana).The present study makes an attempt to prioritize Sukhna sub-watersheds based on morphometric and GIS techniques. The prioritization is done take various treatment and soil conservation measures. The software used is QGIS (Quantum GIS).

Watershed prioritization is the ranking of different micro watersheds of a watershed according to the order in which they have to be taken up for development. Holistic integrated planning, involving remote sensing and GIS has been found to be effective in planning for regional development based on watershed approach.

Keywords: *Anatomical Model, Fused Deposition Modeling, Mock Surgery, Pre-Surgical Planning, Temporal Bone.*

I. INTRODUCTION

Identification of suitable land for development is one of the critical issues of regional planning. The suitability of the land for development, as well as, for ground water occurrence is influenced by climate, physiography, drainage, geology, degree of weathering, etc. The various parameter characteristics of a watershed behave in more or less perceptible manner. Also any change made to factors upstream directly affects the downstream of watershed. A watershed is an area from which runoff, resulting from precipitation, flows past a single point into a large stream, a river, lake or an ocean. Morphometry is measurement and mathematical analysis of the configuration of earth's surface and shape. Morphometric analysis is commonly applied in prioritization of watershed. While remote sensing can provide a variety of latest and updated information on natural resources, GIS has the capability for captures, storage, manipulation, analysis, retrieval of multiple layer resource information occurring both in spatial and aspatial forms. The response of a watershed to different hydrological processes and its behaviour depends upon various physiographic, hydrogeological and geomorphological parameters. Though these are watershed specific and thereby unique, the characterization of a watershed provides an idea about its behaviour. Watershed characterization involves measurement of parameters that influence the characteristic behaviour of a watershed whereas analysis aims at the critical study of these parameters to arrive at conclusions on watershed response and behaviour. The large variety of factors that can affect the behaviour of a watershed fall into two categories, first the permanent characteristics of the drainage basin, such as, its size or drainage density i.e., drainage morphometry and second, transient or variable characteristics, such as the amount of precipitation, type of land use and so on. Most of these permanent characteristics and some of the parameters from which inferences can be drawn about the transient characteristics can be drawn from remotely sensed data and other ancillary data.

It is always better to start management measures from the highest priority micro-watershed available. Watershed prioritization is the ranking of different micro¬watersheds of a watershed according to the order in which they have to be taken up treatment and soil conservation measures.

II AREA OF STUDY

- Catchment area of Sukhna Lake falls under 3 territories : Punjab, Haryana and Chandigarh
- Chandigarh portion comprises of Shivalik Hills which are prone to erosion.
- Catchment is drained by 2 seasonal rivulets namely KANSAL and NEPLI NADI (both originating from Haryana).

III OBJECTIVE

- Extraction of drainage details using QGIS.
- Morphometric analysis includes :
  - Length of drainage channels

- Bifurcation ratio
- Drainage density
- Stream frequency
- Elongation ratio
- Texture ratio
- Circulatory ratio
- Form factor
- Compactness ratio

• To suggest best location for soil conservation measures such as check dams.

IV MORPHOMETRIC ANALYSIS

Morphometry is the measurement and mathematical analysis of the configuration of the earth's surface, shape and dimension of its landforms. Morphometric studies in the field of hydrology were first initiated by. The morphometric analysis of the drainage basin and channel network play an important role in understanding the geo-hydrological behaviour of drainage basin and expresses the prevailing climate, geology, geomorphology, structural antecedents of the catchment. The relationship among various drainage parameters and the aforesaid factors are well recognized by many workers. The drainage basin analysis is important in any hydrological investigation as assessment of groundwater potential, groundwater management, pedology and environmental assessment. Hydrologists and geomorphologists have recognized that certain relations are almost important between runoff characteristics, and geographic and geomorphic characteristics of drainage basin systems. Various important hydrologic phenomena can be correlated with the physiographic characteristics of drainage basins such as size, shape, slope of drainage area, drainage density, size and length of the contributories etc.. Geology, relief and climate are the primary determinants of running water systems functioning at the basin scale. Geographical Information System (GIS) techniques are now-a-days in use for assessing various terrain and morphometric parameters of the drainage basins and watersheds, as it provide a flexible environment and an important tool for the manipulation and analysis of spatial information.

The objective of the present study was to analyze the linear, areal and relief morphometric attributes of Sukhna drainage basin geo-spatial technology. This study is attempted to use the morphometric technique vis-a-vis GIS to give an insight of the different geo-hydrological characteristics of the drainage basin to help in the identification of flood prone zones and overall management of the basin with focus on groundwater.

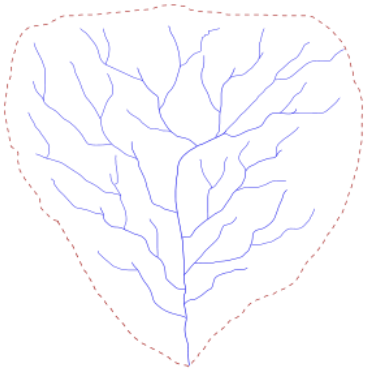

Figure1: Morphometry Analysis

V CATCHMENT AREA/ DRAINAGE BASIN

A drainage basin or watershed is an extent or an area of land where surface water from rain and melting snow or ice converges to a single point at a lower elevation, usually the exit of the basin, where the waters join another waterbody, such as a river, lake, reservoir, estuary, wetland, sea, or ocean. For example, a tributary stream of a brook which joins a small river, which is tributary of a larger river is thus part of a series of successively smaller area but higher elevation drainage basins (watersheds). Similarly, the Missouri and American rivers are each part of their own drainage basins/watersheds and that of the Mississippi River.

Other terms that are used to describe a drainage basin are catchment, catchment area, catchment basin,drainage area, river basin and water basin.

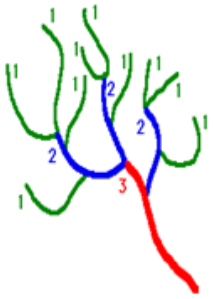

Figure2: Catchment area

Table1. Segments and Ratio

Order	Number of Segments	Bifurcation Ratio
1	10	3.33
2	3	3.00
3	1	

VI RESULTS (Table 2 a,b,c: Parameteric Analysis)

STREAM MORPHOMETRIC PARAMETERS

MINI WATERSHED NO.	BIFURCATION RATIO	DRAINAGE DENSITY	TEXTURE RATIO	STREAM FREQUENCY	CIRCULATORY RATIO	FORM FACTOR	COMPACTNESS RATIO	ELONGATION RATIO
SW1	8.77	0.425	1.1	1.56	0.205	0.3445	2.2	0.662
SW2	7.05	0.455	0.96	1.67	0.185	0.36	2.32	0.677
SW3	4.73	0.573	1.72	2.24	0.315	0.358	1.78	0.675

MINIWATERSHED PARAMETERS

DRAINAGE AREA (km^2)	PERIMETER (km)	NO. OF STREAMS OF ORDER 1	NO. OF STREAMS OF ORDER 2	NO. OF STREAMS OF ORDER 3	LENGTH OF STREAMS OF ORDER 1(km)	LENGTH OF STREAMS OF ORDER 2(km)	LENGTH OF STREAMS OF ORDER 3(km)	LENGTH OF BASIN (km)
46.64	53.47	59	46	64	13.575	10.521	13.204	11.635
33.54	47.64	13	9	11	5.445	3.185	4.313	9.648
34.81	37.205	1	1	3	0.818	1.551	2.433	9.854

PRIORITIZATION RESULTS OF MORPHOMETRIC ANALYSIS

MINI WATERSHED NO.	BIFURCATION RATIO	DRAINAGE DENSITY	TEXTURE RATIO	STREAM FREQUENCY	CIRCULATORY RATIO	FORM FACTOR	COMPACTNESS RATIO	ELONGATION RATIO	COMPOUND PARAMETER	FINAL PRIORITY
SW1	1	3	2	3	2	1	2	1	1.875	2
SW2	2	2	3	2	1	3	3	3	2.375	3
SW3	3	1	1	1	3	2	1	2	1.75	1

VII FACTORS AFFECTING FLOODS:

These factors are given as follows:

- Main made activity:
- Aforestation and deforestation
- Intensive rainfall:
- High flood occurs due to intensive rainfall.
- Slope of Catchment.
- Magnitude of Catchment
- Soil type.
- Catchment shape.
- Improve drainage system/poor drainage system.
- Climatic changes
- Water logging

VIII CONCLUSION

From the morphometric analysis, it has been found that Sub Watershed 3 comprising of Nepli River is most prone to erosion as the compound parameter value comes out to be the lowest for this watershed . Hence, it should be given the highest priority in Soil Conservation measures such as Check Dam building.

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