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GROUNDWATER POTENTIAL OF KARHA RIVER BASIN FOR WATERSHED DESIGN

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ABSTRACT

Land and water are the two most valuable and essential resources which forms the basis for all the lives and are the key resources in all the economic activities belonging to agricultural as well as industrial. The present study emphasizes on the spatial database like hydro-geomorphology, land use/land cover, soil slope, geological study and rainfall-runoff model. The study involves determination of runoff layer and weighted overlay analysis using ArcCN-Runoff and Arc-GIS environment respectively to integrate the reclassified raster layer. The study also proves spatial techniques and Artificial Neural Network techniques (ANN) to be exceedingly efficient to demarcate the groundwater prospecting zones. Along with this, the study also elaborates the rock formations; surfacial and sub-surfacial which helps the region for the preservation of the surface runoff.

Keywords: Groundwater, Geomorphology, ArcCN-Runoff, Arc-GIS.

INTRODUCTION

The socio-economic development of any state is interlaced with the manner of its natural resource management. The unplanned use and overexploitation of resources results in various kinds of land degradation, biomass deterioration and siltation of tanks.

As downstream is affected due to the developments in the upstream, providing a watershed as a basic unit in planning development is a necessity. A watershed being an open physical system in terms of inputs such as precipitation, solar radiation and outputs as discharge, evaporation, re-radiation, can be considered as a balanced system either in terms of water or energy. Thus, watershed development through an integrated approach has been conceived and adopted as a tool for development of dry land farming system.

PROBLEM STATEMENT

a) Through recourses survey, the average rainfall in Karha basin was found to be 635 mm which has clearly indicated the need for designing a feasible model of watershed.
b) Excess in Surface runoff in the study area, instigates the need to design a proper consumption methodology.

Remote Sensing (RS), GIS studies will assist to understand the mapping techniques for watershed designing and geomorphological studies with ANN will facilitate the model designing of the same watershed.

OBJECTIVES

a) To study the landform, topography, geomorphology.
b) To study the available water resources and evaluate the natural resources using Remote sensing data for the extraction of feasibility condition.
c) To map all the thematic information by interpreting the satellite imageries, Survey of India (SOI) Toposheets and Geographic Information System (GIS) Maps.
d) Mapping of groundwater prospect zones using GIS and remote sensing applications.
e) To understand the Sub-Surfacial rock stratas by geophysical investigations.
f) To develop ANN models for estimating runoff from rainfall data available.

LITERATURE SURVEY

A. Narayan Pethkar A. B. *et al*. (2009) - Resistivity sounding is carried out for the provision of very useful subsurface information regarding subsurface resistivity distribution and the thickness of various layers which can be correlated with the local geology in Dhubdhubi basin. Wenner configuration has been used to carry out resistivity sounding. Interpretation of resistivity sounding data has been done using curve matching technique mostly in the field with the help of the standard master curves and later with the help of computer – aided techniques.

B. *Saha S.K. et al.* (1992) - A study was undertaken to determine priority classes of sub watersheds in a part of Song river watershed, based on spatial erosion soil loss estimates using IRS-1A, LISS–II digitally classified physiography, Soil, Land use/land cover map, terrain slope information and rainfall data. The results indicated that out of fifteen sub-watersheds, nine sub-watersheds belong to high to very high priority classes covering 36.2 per cent area of the watershed. The remaining six sub- watersheds covering 63.8 per cent area of the watershed were classified as low to moderate priority categories.

C. *Rajiv Mohan et al.* (1999) - An action plan for the development of water resources has been prepared by using information obtained from remote sensing and other

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collateral sources on slope, land cover, terrain characteristics, hydro-geomorphology and drainage characteristics. Surface water harvesting structures such as check dam with diversion channels or gates, spring storage tank etc., have been recommended.

RESEARCH METHODOLOGY

For the action plan preparation steps involved are: Delineation of different resource themes; Generation of attribute data; Digitization of watershed boundary; Extraction of the study area; Analysis of the remote sensing data and Geophysical investigation to understand the sub-surfacial strata.

DISCUSSION AND CONCLUSIONS

Results from Remote sensing and GIS analysis

i. Hydro geomorphology: The feature identified and rated based on their groundwater potential is alluvial plain (0.74%), (Figure-1) mainly present on very small area as the river was not perennial, the soil type mainly shows clay, fines. Groundwater prospects in alluvial plains are good.

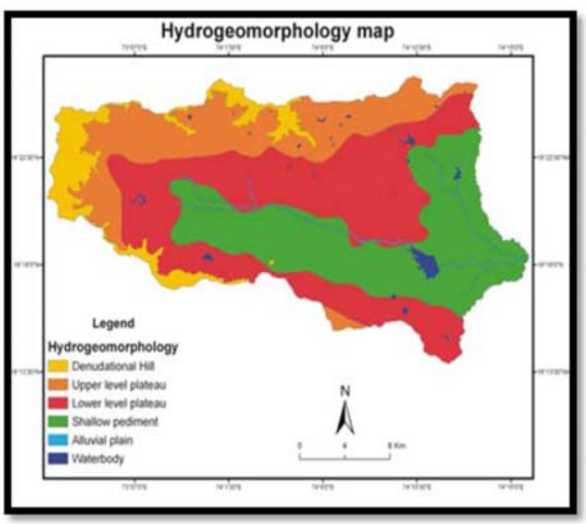

Figure-1. Hydro geomorphology map of study area.

ii. Slope: The study area shows low slope (0–5%) 70.57%, indicating the presence of good groundwater potential. Medium slope (5-15%) 22.53% of study area indicates moderate groundwater potential; moderate to high slope (15-35%) 5.33% of study area indicates low groundwater potential. High slope (>35%) 1.58% of study area indicates presence of poor groundwater potential.

iii. Soil: The soils in the study area can be grouped under three hydraulic soil groups, i.e. groups B, C and D (Figure-2). Soil group B is very shallow, somewhat excessively drained loamy, calcareous soils on very gently sloping plains with moderately deep, well drained clayey calcareous soils with moderate erosion (9.18%) of study area.

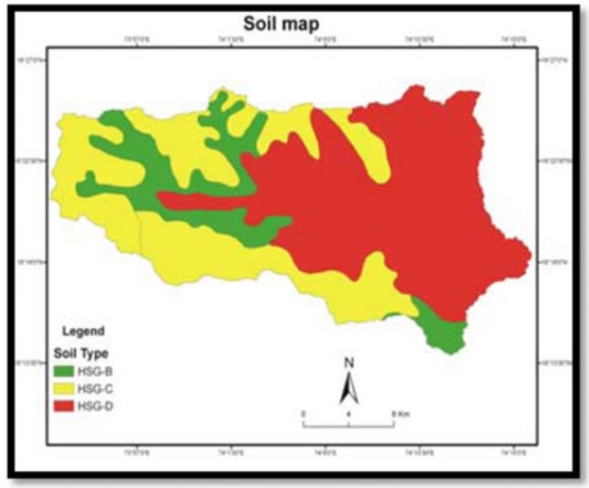

Figure-2. Soil map of study area.

Results from ANN analysis

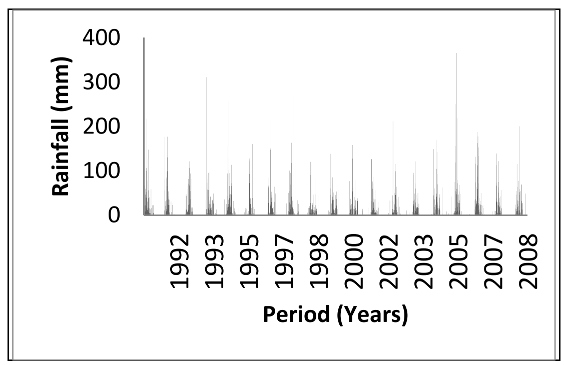

Figure-3. Rainfall pattern data for period 1990 to 2008 at station Saswad.

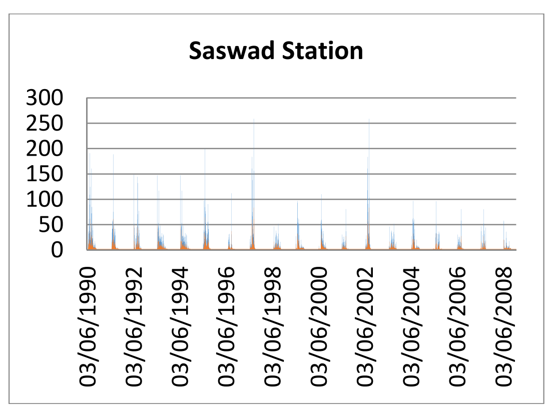

Figure-4. LR plot for observed and predicted discharge over a period from 1990 to 2008 (Saswad).

iv. Geology: The study area shows two lithological units belonging to Diveghat formation and Purandar formation respectively. Diveghat formation

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shows 65.76% of study area with poor groundwater potential and Purandar formation with 34.24% study area shows moderate ground water potential as shown in figure-5.

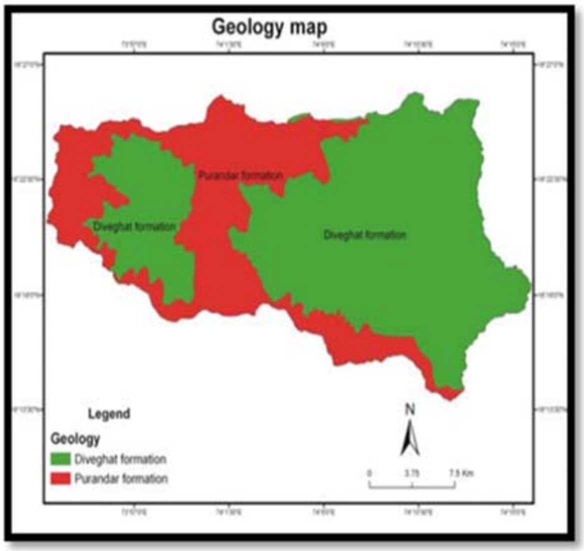

Figure-5. Geology map of study area.

v. Runoff

The calculation of average annual runoff for different landuse and soil classes from the study area is given in Table-1 The runoff value which was calculated from the ArcCN-Runoff was put in the GIS environment to generate the runoff map. The runoff map has been classified on the basis runoff into 5 groups low (4.90%), low to moderate (13.18%), moderate (26.06%), moderate to high (54.15%) and high (1.69%) of study area. More than half of the area i.e. 52.87% is dominated by low runoff potential zones, whereas high runoff potential zone covers an area of 20.57% and the suitable zone for selecting rainwater harvesting structure i.e. moderate runoff potential zone covers an area of 26.56% of upper Karha watershed as shown in figure-6.

The entire GIS database can be built to a scale and hence all the mapping units were in true dimensions. The entire themes are organized in separate layers and the respective legends were saved as legend files. This type of database is useful in extracting the information and to derive statistical outputs that are required for planning purpose. According to information from GIS, geomorphology and field study, design criteria and action plans are to be prepared.

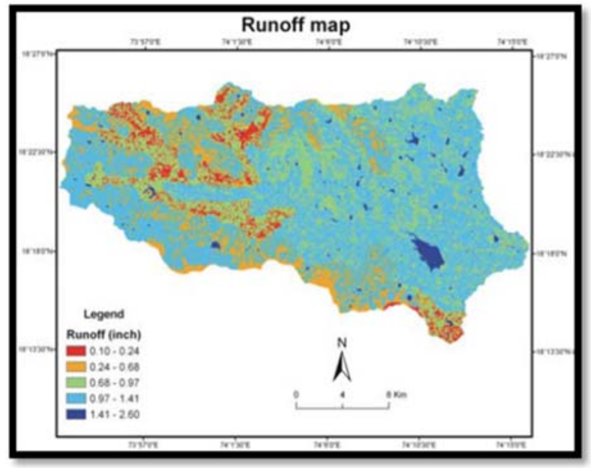

Figure-6. Runoff map of study area.

Table-1. CN with Runoff.

ID	Soil type	Class name	CN	Runoff (inch)
1	B	Dense forest	55	0.1
2	B	Dense scrub	58	0.16
3	B	Open forest	58	0.16
4	B	Open scrub	61	0.23
5	B	Settlement	66	0.37
6	B	Agriculture	77	0.8
7	B	Harvested land	77	0.8
8	B	Waterbody	100	2.6
9	C	Dense forest	70	0.5
10	C	Dense scrub	71	0.54
11	C	Open forest	71	0.54
12	C	Open scrub	74	0.67
13	C	Settlement	78	0.85
14	C	Agriculture	83	1.13
15	C	Harvested land	83	1.13
16	C	Waterbody	100	2.6
17	D	Dense forest	77	0.8
18	D	Open forest	78	0.85
19	D	Dense scrub	78	0.85
20	D	Open scrub	80	0.96
21	D	Settlement	83	1.13
22	D	Agriculture	87	1.4
23	D	Harvested land	87	1.4
24	D	Waterbody	100	2.6

CONCLUSION

Following conclusions are made from ANN analysis study: Two separate models were developed for stations - Saswad and Jejuri. It was observed that the predictions were admirable for Saswad whereas Jejuri have less accurate predictions.

a) This is because there are large variations in the rainfall pattern over the year of data collection; hence it counts in the difficulty of modelling the extreme value.
b) By incorporating climatic parameters, results can be improved at Jejuri Station too.

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