ISSN(Online): 2320-9801
ISSN (Print): 2320-9798

International Journal of Innovative Research in Computer and Communication Engineering

(A High Impact Factor, Monthly, Peer Reviewed Journal) | Impact Factor: 7.422|

Website: www.ijircce.com

Vol. 7, Issue 1, January 2019

Generation of Soil Erosion and Groundwater Prospect Map

Bhagyalakshmi T M*[1], Anand C*[2], S K Shashi Kumar*[3]

Lecturer, Department of Civil Engineering, Government Polytechnic, Arakere, Srirangapatna, Mandya, Karnataka, India[1]

Lecturer, Department of Civil Engineering, Government Polytechnic Udupi, Udupi, Karnataka, India[2]

Lecturer, Department of Civil Engineering, Government Polytechnic Udupi, Udupi, Karnataka, India[3]

ABSTRACT: Remote sensing and Geographic Information System (GIS) is a rapid and effective techniques, it provides information of large and inaccessible area within short period for assessing, monitoring and management of groundwater resources. In the present study, an attempt was made to estimate the morphometric parameters to understand the hydrologic behavior of the watershed at sub watershed level, Soil loss due to erosion was also estimated using USLE model and groundwater prospect zone map was created to find the groundwater prospect zones in the study area. Ground water potential zone map was created by weightage overlay analysis. The weighted composite map was further classified into very good, good, moderate, moderate to poor and poor to nil. The catchment covers about 65.11% moderate ground water prospect zone. The study has demonstrated the use of remotely sensed data in conjunction with GIS for better management of natural resources for sustainable development of watershed.

KEYWORDS: morphometric parameters, hydrologic behavior, zone map, weightage overlay analysis, weighted composite map

I. INTRODUCTION

The present study is intended to classify the land for its best suitability based on the various parameters which are derived from remote sensing and other data. The study area selected for the present study was T G Halli catchment. The study area stretches geographically from 77°14' and 77°41' E longitude and 12°57' and 13° 24'N Latitude. It covers an area of 1448.64 km^2 and shows the relief of 0.650km (Highest being 1460m and lowest being 810m). The watershed has length and width of 61.3 km and 36.8km respectively. The mean annual rainfall of the watershed for about 25 years is found to be 825.02 mm.

The parameters estimated in the present study are morphometric parameters, soil loss and Groundwater potential zone. Morphometric analysis was carried out to understand the physical characteristics of the watershed, which is useful in further analysis such as soil loss, land use planning, terrain elevation, etc. The knowledge of drainage basin characteristics is an important prerequisite to evaluate the basin hydrology. The amount of water reaching a system is dependent on morphometry, total precipitation, loses due to evapotranspiration by soils and vegetation. The quantitative morphometric parameters throw lights on the lithology and structural control of the basin, relative runoff, recharge, erosion aspects and stage of development of the basin itself. The inferences drawn from the morphometric analysis are very useful for watershed management for sustainable development.

Soil loss estimation was carried out in order to assess the erosion rate. If the erosion rate is severe, immediate steps should be undertaken to conserve the soil. Top few centimeters of the soil will usually be fertile, which is very important for the agricultural practices. Several methods were suggested in the past but due to its robustness, USLE (Universal Soil Loss Estimation) model has been adopted in the present study. In the present study, an attempt has been made to delineate possible groundwater potential zones in the T G Halli catchment using GIS and RS.

ISSN(Online): 2320-9801
ISSN (Print): 2320-9798

International Journal of Innovative Research in Computer and Communication Engineering

(A High Impact Factor, Monthly, Peer Reviewed Journal) | Impact Factor: 7.422|

Website: www.ijircce.com

Vol. 7, Issue 1, January 2019

The objectives of the present study are:1) Estimation of Morphometric parameters. 2) Generation of K-factor, C-factor, Soil erosion and other thematic maps. 3) Generation of Groundwater prospect zone mapping by weightage overlay analysis method. 4) Identification of sites for groundwater recharging structures.

II. METHODOLOGY

Morphometry is the measurement and mathematical analysis of configuration of the earth surface and the shape and dimensions of its landforms. Geomorphologists and hydrologists often view streams as part of drainage basin. A drainage basin is the topographical region from which a stream receives runoff through flow and groundwater flow.

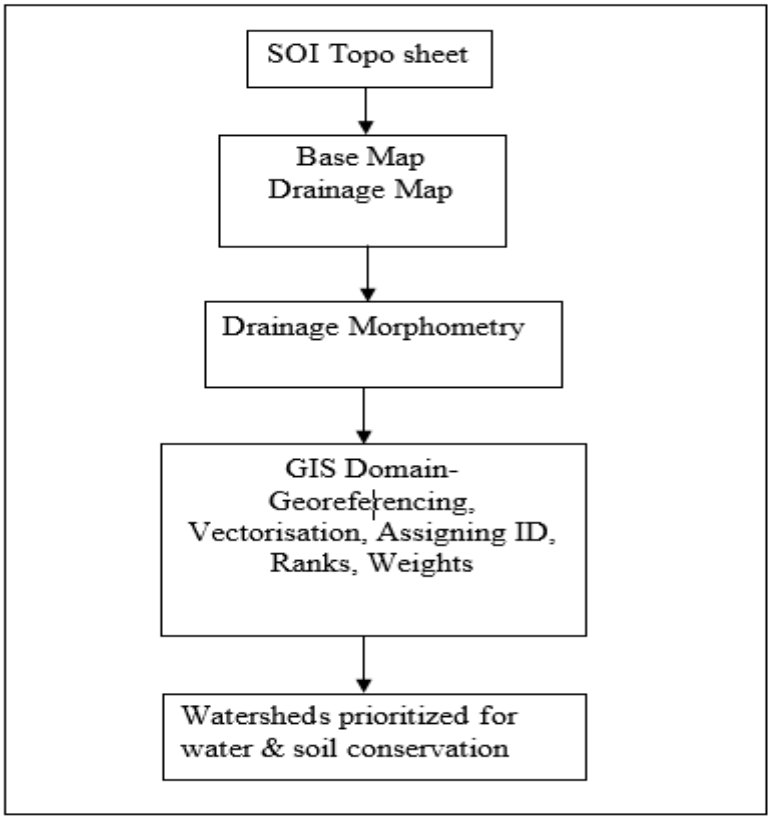

Fig 4.1: Methodology of Morphometric analysis

One of the first attributes to be quantified in morphometric analysis is the designation of stream orders. The concept of channel ordering was first described by Strahler (1952) to decrease the subjectivity of the analysis. According to Strahler (1952), channel segments were ordered numerically from a stream's headwaters to a point somewhere downstream. Numerical ordering begins with the tributaries at the stream's headwaters being assigned as 1. A stream segment resulting from the joining two 1st order segments is given an order of 2. Two second order streams form a third order stream and so on. The highest order stream is known as trunk or principal stream through which all the discharge of the watershed passes through the outlet. The concept of stream order is used to calculate other indicators of drainage character of a watershed. Fig 4.3 shows the stream order map of T G Halli catchment.

ISSN(Online): 2320-9801
ISSN (Print): 2320-9798

International Journal of Innovative Research in Computer and Communication Engineering

(A High Impact Factor, Monthly, Peer Reviewed Journal) | Impact Factor: 7.422|

Website: www.ijircce.com

Vol. 7, Issue 1, January 2019

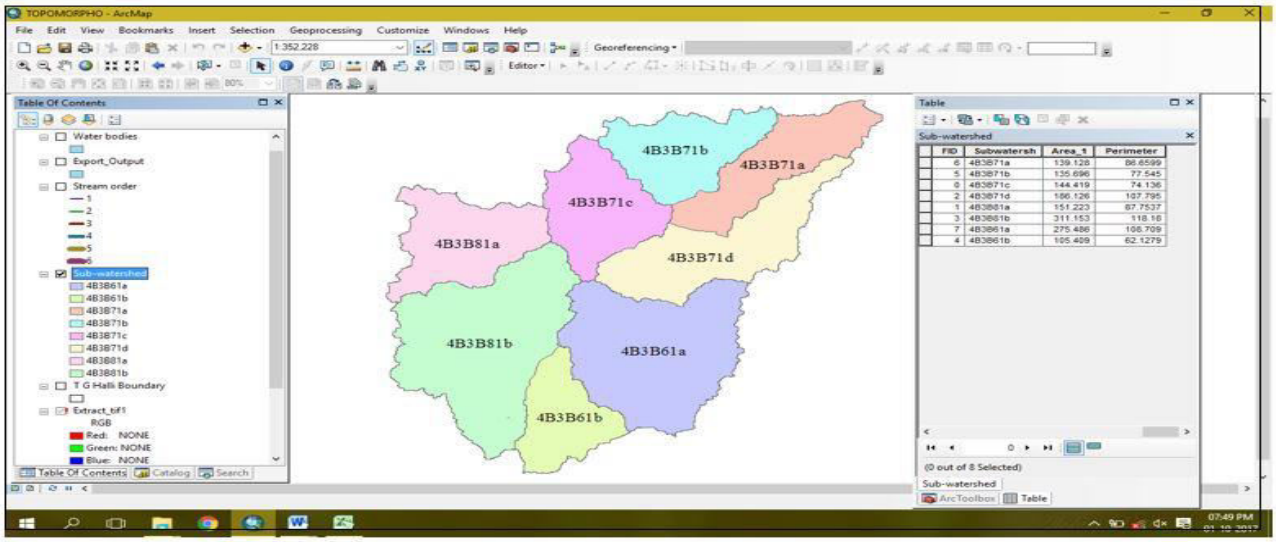

Fig 4.2: Sub-watershed map of T G Halli catchment

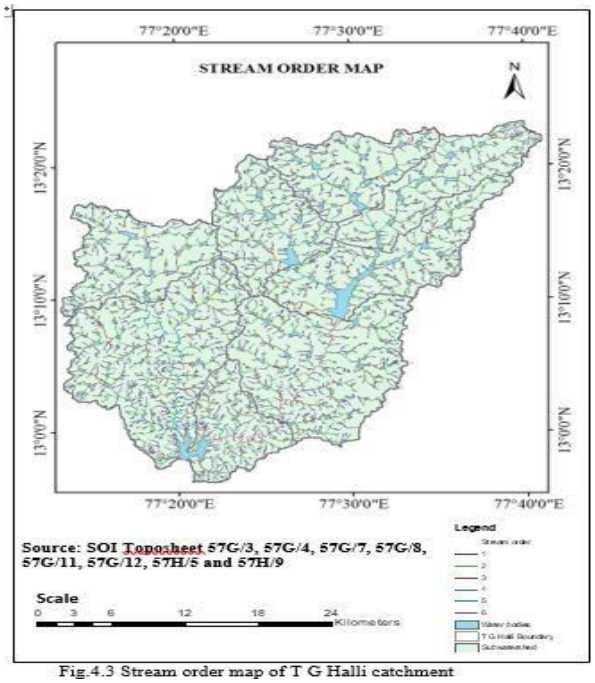

Fig.4.3 Stream order map of T G Halli catchment

Erosion model adopted for the study: The drainage map of T G Halli catchment from Survey of India topographical maps, updated using satellite data and carried out morphometric analysis with GIS. Linear, areal and relief morphometrical aspects are computed and the sub-watersheds are prioritized for water and soil conservation by giving hierarchical order to the areal and linear morphometry parameters. The highest value of bifurcation ratio, drainage density, stream frequency, and texture ratio among 8 sub-watersheds were given a rating of 1, the next highest value was given a rating of 2, and so on. The lowest value was rated last in the series of numbers. For the shape parameters (form factor, circularity ratio, and elongation ratio) the lowest value was given a rating of 1, the next lowest value was given a

ISSN(Online): 2320-9801
ISSN (Print): 2320-9798

International Journal of Innovative Research in Computer and Communication Engineering

(A High Impact Factor, Monthly, Peer Reviewed Journal) | Impact Factor: 7.422|

Website: www.ijircce.com

Vol. 7, Issue 1, January 2019

rating of 2, and so on. After the rating had been done based on every single parameter, the rating values for every sub-watershed were averaged to arrive at a compound value. Based on the average value of these parameters, the sub-watershed having the least rating value was assigned the highest priority number of 1; the next highest value was assigned a priority number of 2, and so on. The sub-watershed that got the highest value was assigned the last priority number. This method will not quantify the erosion, but it compares the erosion rate among the sub-watersheds considered. Also they have identified the sites for the check dams using land use, soil and hydro geomorphology themes by assigning weights to different classes of the themes.

Ground water is attracting an ever increasing interest due to scarcity of good quality subsurface water and growing need of water for domestic, agricultural and industrial uses. It has become crucial not only for targeting of groundwater potential zones, but also monitoring and conserving this important resource. In hard rock terrains, availability of groundwater is of limited extent. Occurrence of groundwater in such rocks is essentially confined to fractured and weathered horizons. Efficient management and planning of groundwater in these areas is of the utmost importance. The concept of integrated remote sensing and GIS has proved to be an efficient tool in integrating urban planning and ground water studies. Hydrogeomorphological studies coupled with hydrogeological and structural/lineament have proved to be very effective tool to discern ground water potential zones in the watershed.

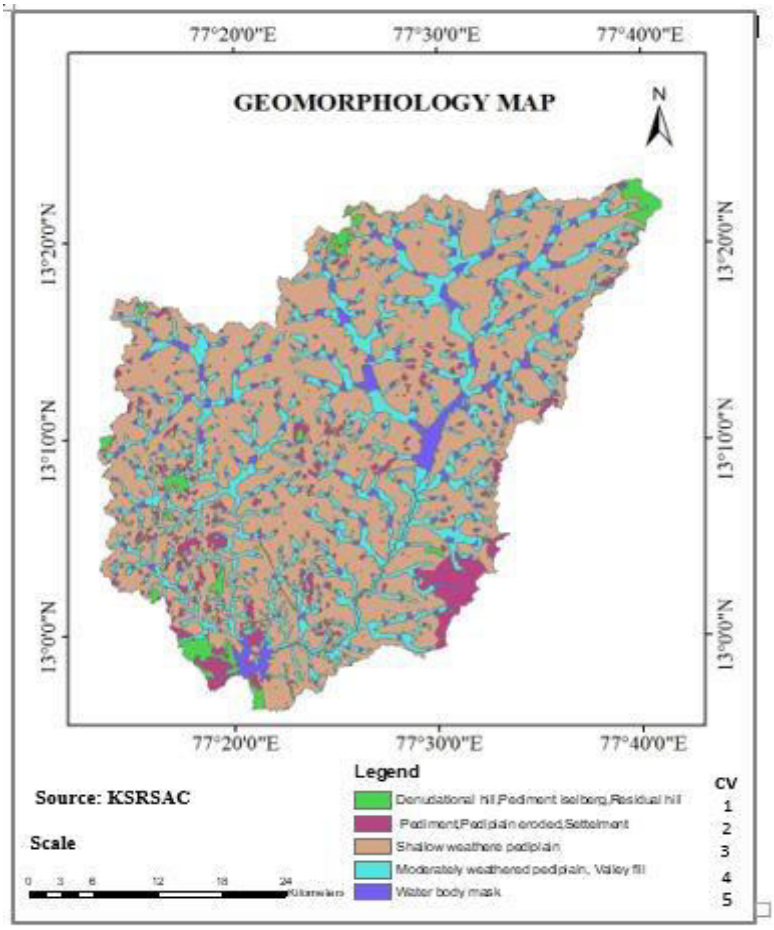

Fig 6.1: Weighted Geomorphology Map of T G Halli catchment

ISSN(Online): 2320-9801
ISSN (Print): 2320-9798

International Journal of Innovative Research in Computer and Communication Engineering

(A High Impact Factor, Monthly, Peer Reviewed Journal) | Impact Factor: 7.422|

Website: www.ijircce.com

Vol. 7, Issue 1, January 2019

III. SUMMARY AND CONCLUSIONS

This chapter includes the results, observation and conclusion of Morphometric analysis, Soil loss estimation and Groundwater prospect map

1. The highest stream order obtained in the study area is 6th order and hence designated as 6th order catchment.
2. The study area is classified into eights sub-watersheds. Out of the eight sub-watersheds, 4th order watershed is SW-4, 5th order watersheds are SW-1,SW-3,SW-4, SW-5 ,SW-6 and 6th order watersheds are SW-7 and SW-8
3. It is observed that in most of the watersheds there is a variation from total length of stream segment decreases as the stream order increases due to flowing of streams from high altitude, change in rock type and moderately steep slopes and probable uplift across the basin
4. It is observed that in most of the watersheds there is a variation from mean stream length of any given order is greater than that of the lower order but less than that of the next higher order due to change in topographic elevation and structural disturbance.
5. The Bifurcation ratio of watersheds varies from 3.25 to 5 hence these watersheds have not suffered any structural disturbances.
6. Lower bifurcation ratio values are characteristic shows that the catchment is suffered less structural disturbance, and the drainage pattern has not been distorted because of the structural disturbances.
7. The drainage density of watersheds varies from 0.91 to 1.74 km/km^2 which indicate that the catchment is very coarse and coarse texture in nature.
8. The drainage networks of the watersheds shows dendritic patterns with course to moderate drainage texture.
9. The stream frequency value of watersheds varies from 1.06 to 2.10 show stream frequency is low in the catchment.
10. The circularity ratio for the watersheds varies from 0.20 to 0.34. Its low, medium and high values are correlated with youth, mature and old stages of the cycle of the tributary watershed of the region.
11. The elongation ratio for the watersheds varies from 0.55 to 0.78, Form factor values of watersheds varies from 0.24 to 0.48 which indicates that the watersheds are elongated to circular.
12. Elongation and form factor values show that watershed possesses elongated shape which indicates the low runoff and flatter peak flow.
13. Morphometric parameters helps command area development on priority basis such as water and land resources development. It also provides more information on the areas, which are more vulnerable to land degradation. Also, suitable area for groundwater exploration and possible sites for rainwater harvesting structures can be suggested.
14. Priority class shown in fig 7.1 can be taken for conservation measures by engineers and decision makers planning for developments and management of natural resource.

REFERENCES

1. A. Irvem, F. Topaloglu and V. Uygur.,(2007). “Estimating Spatial Distribution of Soil Loss over Seyhan River Basin in Tur- key”. Journal of Hydrology, Vol. 336, No. 1-2, pp. 30-37
2. Amee K. Thakkar and S.D.Dhiman (2007).” Morphometric analysis and prioritization of miniwatersheds in Mohr Watershed, Gujarat using remote sensing and GIS techniques”. Journal of the Indian Society of Remote Sensing, Vol. 35, No. 4, 2007.
3. Amit Bera.,(2017).” Estimation of Soil loss by USLE Model using GIS and Remote Sensing techniques: A case study of Muhuri River Basin, Tripura, India”. Eurasian Jouenal of Soil Science, 6 (3) 206 – 215.
4. Basavaraj Hutti and Nijagunappa. R.,(2011).” Identification of Groundwater Potential Zone using Geoinformatics in Ghataprabha basin, North Karnataka, India”. International Journal of Geomatics and Geosciences, Volume 2, No 1.
5. B. Mahalingam, M. M. Malik and M. Vinay.,(2015).”Assessment of Soil Erosion Using USLE Technique: A Case Study of Mysore District, Karnataka, India”. Journal of Remote Sensing & GIS, Volume 6, Issue 3.
6. Bhattarai, R. and Dutta, D., (2007).” Estimation of soil erosion and sediment yield using GIS at catchment scale”. Water resource management, 21(10):1635–1647.

ISSN(Online): 2320-9801
ISSN (Print): 2320-9798

International Journal of Innovative Research in Computer and Communication Engineering

(A High Impact Factor, Monthly, Peer Reviewed Journal) | Impact Factor: 7.422|

Website: www.ijircce.com

Vol. 7, Issue 1, January 2019

7. Brema J and Julia Hauzinger.,(2016).” Estimation of the Soil Erosion in Cauvery Watershed (Tamil Nadu and Karnataka) using USLE”. IOSR Journal of Environmental Science, Toxicology and Food Technology Volume 10, Issue 12 , PP 01-11
8. Dhruvesh P. Patel, Chintan A. Gajjar and Prashant K. Srivastava (2013).” Prioritization of Malesari mini-watersheds through morphometric analysis: a remote sensing and GIS perspective”. Environmental Earth Science, 69:2643–2656 .
9. Horton, R. E. (1945). “Erosional development of streams and their drainage basins: Quantitative Morphology”. Bulletin of the Geological Society of America, 56, 275–361
10. Hsin-Fu Yeh, Cheng-Haw Lee , Kuo-Chin Hsu and Po-Hsun Chang.,(2009).” GIS for the assessment of the groundwater recharge potential zone”. Environmental Geology 58:185–195.
11. Jaiswal R.K., Krishnamurthy, J., Mukhergy, S., and Sameena, M., (2007).” Role of landform and topography in the development of drainage networks”. Journal of Hydrology, Vol 30, pp 1-13.
12. Kamal Ku. Barik, Dalai P.C., Goudo S.P., Panda S.R., Nandi D.,(2017).” Delineation of Groundwater Potential Zone in Baliguda Block of Kandhamal District, Odisha using Geospatial Technology Approach”. International Journal of Advanced Remote Sensing and GIS, Volume 6, Issue 3, pp. 2068-2079
13. Kapil Ghosh, Sunil Kumar De, Shreya Bandyopadhyay and Sushmita Saha.,(2013).” Assessment of Soil Loss of the Dhalai River Basin, Tripura, India Using USLE”. International Journal of Geosciences, Volume 4, 11-23
14. Kartic Bera and Jatisankar Bandyopadhyay (2013).” Prioritization of Watershed using Morphometric Analysis through Geoinformatics technology: A case study of Dungra sub watershed, West Bengal, India”. International Journal of Advances in Remote Sensing and GIS, Vol. 2, No. 1.
15. K. C. Krishna Bahadur.,(2009).” Mapping soil erosion susceptibility using remote sensing and GIS: a case of the Upper Nam Wa Watershed, Nan Province, Thailand”. Environmental Geology, 57:695–705.