Journal of Environment and Earth Science www.iiste.org
ISSN 2224-3216 (Paper) ISSN 2225-0948 (Online)
Vol.5, No.5, 2015

Groundwater Potential Mapping in a Part of Malaprabha River Basin using Remote Sensing Data and Geographic Information System (GIS)

Naveenkumar[1] Dr Veena S. Soraganvi[2] Satish S Hooli[3]
1.M.Tech Scholar, Department of civil, Basaveshwar Engineering College Bagalkot, India
2.Professor, Department of civil, Basaveshwar Engineering College Bagalkot, India
3.M.Tech Scholar, Department of civil, Basaveshwar Engineering College Bagalkot, India
E-mail Id: naveendg45@yahoo.com

Abstract
The objective of this study is to explore the groundwater availability for agriculture in a part of Malaprabha river basin. Remote sensing data and Geographic Information System (GIS) are used to locate potential zones for groundwater in the part of Malaprabha river basin. Various maps (i.e., base, hydrogeomorphological, geological, aspect, drainage, slope, land use/land cover and groundwater prospect zones) are prepared using the remote sensing data along with the existing maps Ranks and weights are assigned to the categories and maps to show the importance of a hydrologic parameter or parametric map on the ground water potentiality. It determines the influence of each parameter on the potentiality. Each category of a particular map is assigned ranks according to their suitability and each parametric map is given certain weightage based on its influence on the ground water availability. Higher ranks are given to most suitable category and ranks decrease as per the decrease in suitability. This study helped to delineate the potentiality as very good, good, moderate and poor potential zones.
Keywords: Remote sensing, Geographic Information System, Malaprabha river basin, ArcGIS.

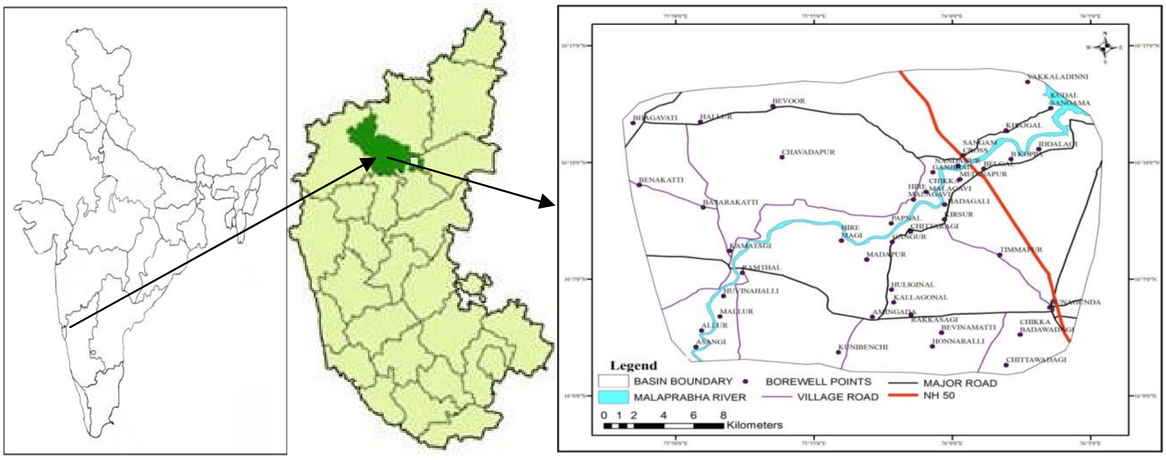
1. INTRODUCTION

Groundwater is a form of water occupying all the voids within a geological stratum. Water bearing formation of the earth's crust acts as conduits for transmission and as reservoirs for storing water. The occurrence of groundwater in a geological formation and the scope for its exploitation primarily depend on the formation porosity. In the presence of interconnected fractures, cracks, joints, crushed zones (such as faults zones or shear zones) or solution cavities, rainwater can easily percolate through them and contribute to groundwater. The conventional methods used to prepare groundwater potential zones are mainly based on ground surveys. With the advent of remote sensing and Geographic Information System (GIS) technologies, the mappings of groundwater potential zones within each geological unit have become an easy procedure. The groundwater conditions vary significantly depending upon the slope, depth of weathering, presence of fractures, surface water bodies, canals, irrigated fields etcetera. These factors can be interpreted or analyzed in GIS using remote sensing data and GIS techniques used to locate potential zones for groundwater in the Musi basin using various maps (i.e, geological, hydrogeomorphological, structural, drainage, and slope and land use/land cover maps)[1]. Potential zones was determined the most important contributing parameters that indicate the groundwater potential such as slope, stream networks, lineaments, lithology and topography[2]. Remote sensing, evaluation of digital elevation models (DEM), geographic information systems (GIS) and fieldwork techniques were combined to study the groundwater conditions in Mamundiyar basin, Tamilnadu. Several digital image processing techniques, including standard color composites, intensity-hue-saturation (IHS) transformation and decorrelation stretch (DS) were applied to map rock types [4].

2. Methodology

2.1 Study area

In the present study, the area is in and around Hunagund taluk and Bagalkot taluk which is in Bagalkot district, Karnataka state, India. It is situated 50 km apart from the east of Bagalkot. The area falls in Survey of India toposheets 47 P/16, 56 D/4 covering an area of 664 Sq.km. It is bounded between latitude 16º 1' 11" - 16º 14' 1' N and 75º 48' 8"- 76º 5' 28'' E longitude. The area is a gently undulating to a plain terrain, dotted with isolated hills. The elevation ranges from around 525 m to 705 m almost slopping from west to east. The area falls in northern dry agro – climatic zone and experience semi arid climate. The main drainage of study area is Malaprabha River. The soil characteristic of study area shows sandy clay and the average rainfall of study area is 584 mm. The Malaprabha flowing in the southern part joins the Krishna at Kudal Sangama in Hungund Taluk.



2.2 Groundwater Potential zones

Spatial data

Survey of India topomaps, soil map, drainage map, geology and geomorphology, land use/land cover map are used in analysis.

2.3 Physiographic Characteristics

Soil: The soil of the study area is like deep alluvial soil, deep black clay soil, clay calcareous soil, moderate black clay soil.

Land use/Land Cover: Eight type of land use patterns are identified in the entire study area, which includes agricultural land, forest, mining process, settlements, water bodies, stone waste, stone quarry and land with scrub.

Geology and Geomorphology: The types of morphology features are found to be pediment, hills and valleys on sedimentary rocks, older floodplain and structural plateau on proterozic rocks respectively.

2.4 Preparation of thematic maps

The following maps are geo-referenced and digitized the study area using ArcGIS 10.1

- Drainage map
- Soil map
- Land use/Land cover map
- Geology and geomorphology map

DEM and Slope: The Dem is generated through 20m contour lines which are obtained from Survey of India (SOI) topomap (1:50,000). The slope is derived from DEM.

GIS database development: The features of the study area such as topography, soil type, land use pattern and drainage pattern, geology and geomorphology are obtained and thematic maps are prepared and generated the attributes for each thematic map are generated. All the thematic maps were superimposed by weighted overlay method using spatial analysis tool.

2.5 Assessment of groundwater potential zones

Ranks and weights are assigned to the categories and maps to show the importance of a hydrologic parameter or parametric map on the ground water potentiality. It determines the influence of each parameter on the potentiality. Each category of a particular map is assigned ranks according to their suitability and each parametric map is given certain weightage based on its influence on the ground water availability. Higher ranks are given to most suitable category and ranks decrease as per the decrease in suitability. The product of rank and weight was given as Index field for each map. The index fields were used to reclassify the area into five classes, like excellent, good, moderate, poor and very poor potential zones. Ranks and weightage of different parameter for groundwater potential zones are represented in below table 1

Table: 1 Ranks and weightage of different parameter for groundwater potential zones

S.No	Thematic data	R	Features	W	TW
1	Geology	9	Granite	1	9
			Dolomite, Chert	2	18
			Argilite, Conglomerate	2	18
			Metasediments and Metavolconics	3	27
			Sandstone, quartzite, Shale, Limestone	4	36
2	Geomorphology	8	Pediment	1	8
			Structural hill	2	16
			Structural Pleatu	2	16
			Vally fill	4	32
			Older flood plain	4	32
3	Drainage	7	First order	1	7
			Second order	2	14
			Third order	3	21
4	Land use/Land cover	6	Mining process	1	6
			Stone quarry	2	12
			Stone Waste	2	12
			Land with scrub	2	12
			Forest	3	18
			Water bodies	4	24
			Agricultural land	5	30
5	Soil	5	Calcareous clay soil	2	10
			Moderate black soil	3	15
			Deep black soil	4	20
			Alluvial soil	5	25
6	Slope	4	Gently sloping	5	20
			Moderate sloping	4	16
			Moderate Steep sloping	3	12
			Steep sloping	2	8
			Very Steeply sloping	1	4

R- Rank W- Weightage TW- Total Weightage

3. RESULTS AND DISCUSSION

3.1 Groundwater Potential Zones

In order to delineate the location of the groundwater prospect zones in the study area, different thematic maps (such as geology, geomorphology, drainage, land use/land cover, slope, and soil) are prepared. The methodologies followed for preparing groundwater prospective zones are based on determining the most important contributing parameters that controlling groundwater storage. These parameters includes: (1) slope, which controls the runoff of water or remain on the ground surface for long enough to infiltrate, (2) stream network, which influences the distribution of runoff and groundwater recharge (3) lineament, which enhance significantly the permeability by inducing secondary porosity and thus hence vertical water percolation to recharge the aquifers, (4) lithologic or rock type, which determine the soil and exposed rocks infiltration capabilities and govern the flow and storage of water and (5) topographical map layers. The input layers are ranked, with a numerical number as shown in Table 2. For example each layer multiplied by its rank number e.g., geology-9, geomorphology-8, drainage-7, land use/landcover-6 soil-5, slope- 4. The ranked layers are defined according to their relative importance to control groundwater potential. Each layer has divided into classes based on hydrogeological properties. The classes are then weighted according to their relative importance to control groundwater potential (Table.1). All the weighted layers are integrated through GIS analysis and integrated into groundwater prospective zones mapping.

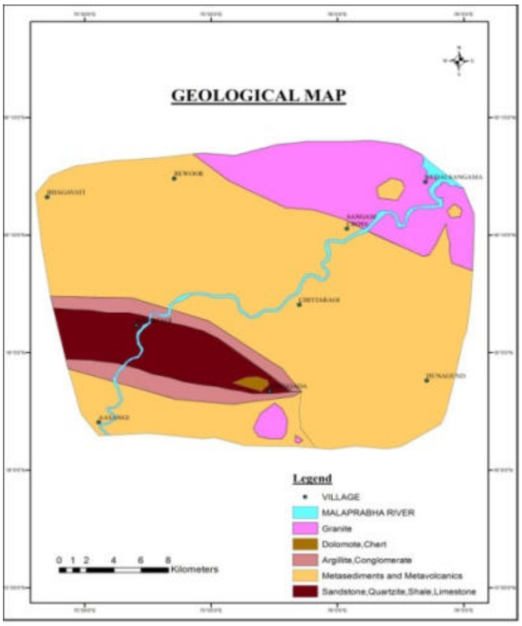


Fig 1: Geology Map of the Study Area Fig

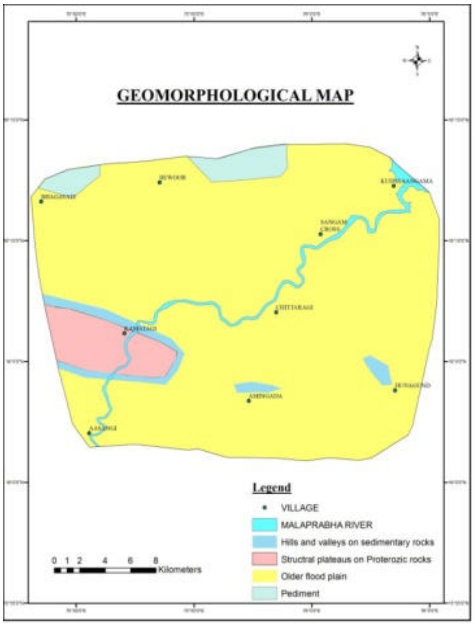


Fig 2: Geomorphology Map of the Study Area

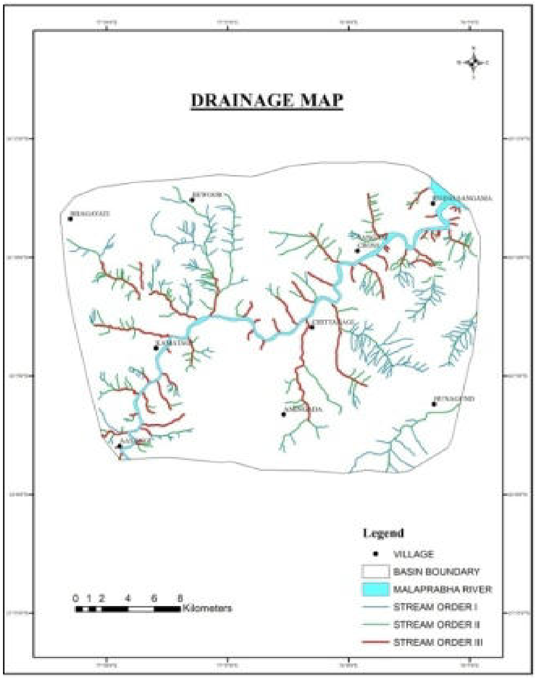


Fig 3 Drainage Map of the Study Area

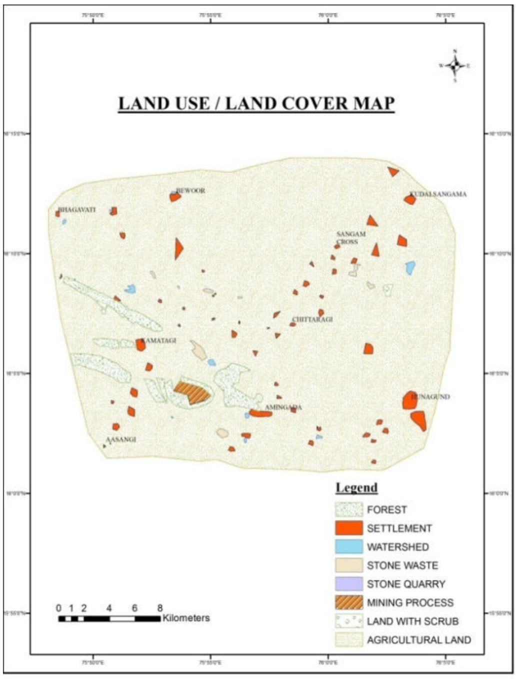


Fig 4 Land use and cover map

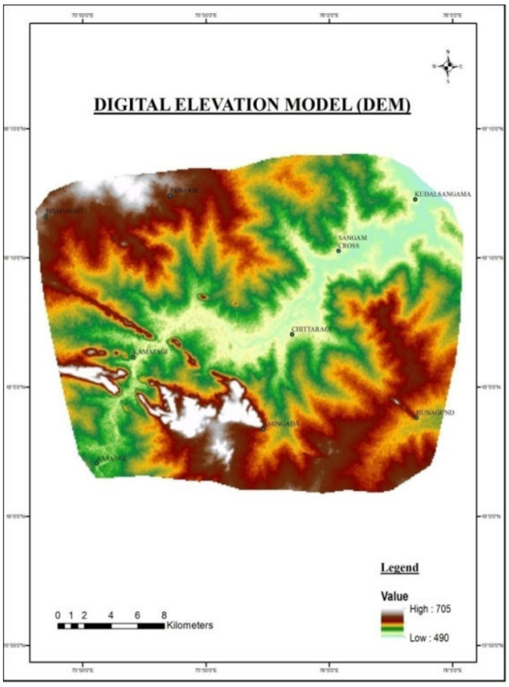


Fig 5 Digital Elevation Model (DEM) Map of the Study Area

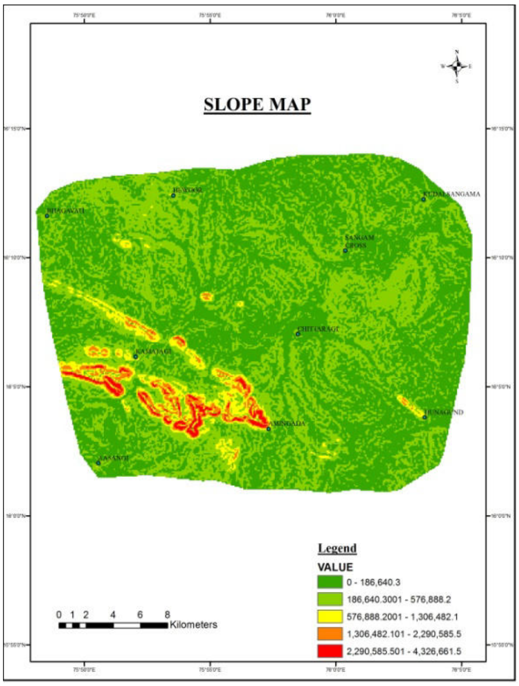


Fig 6 Slope Map of the Study Area

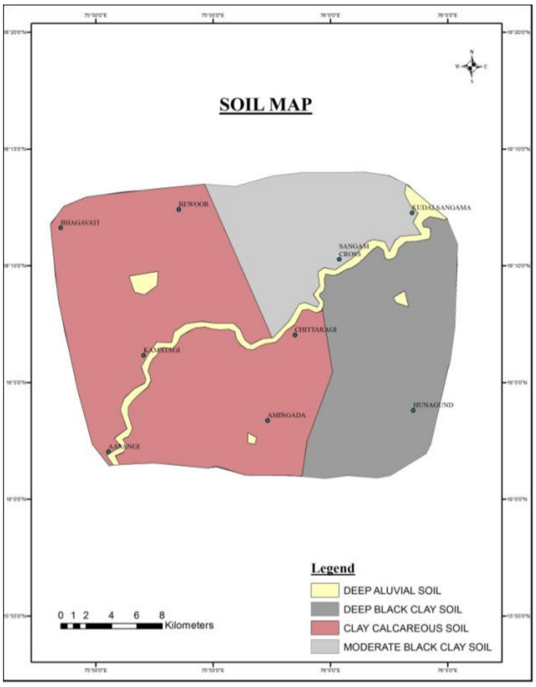


Fig 7 Soil Map of the Study Area

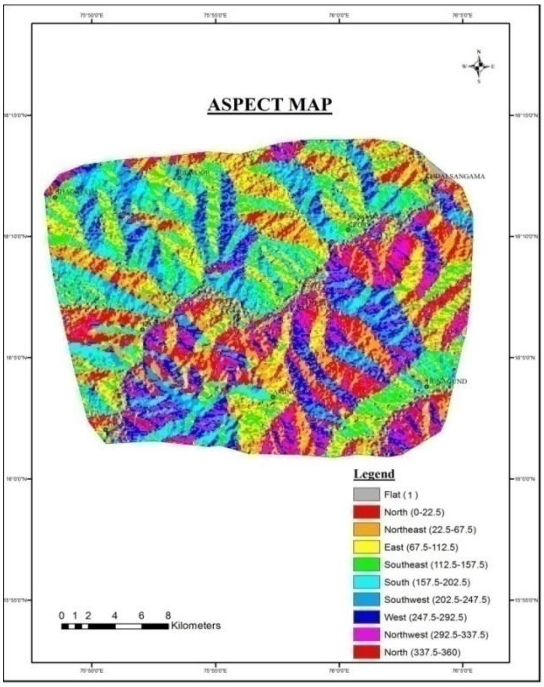


Fig 8 Aspect Map of the Study Area

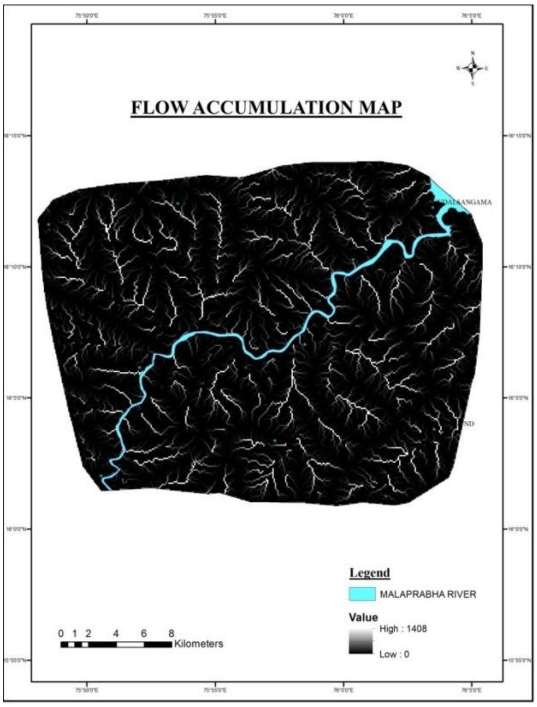


Fig 9 Flow Accumulation Map of the Study Area

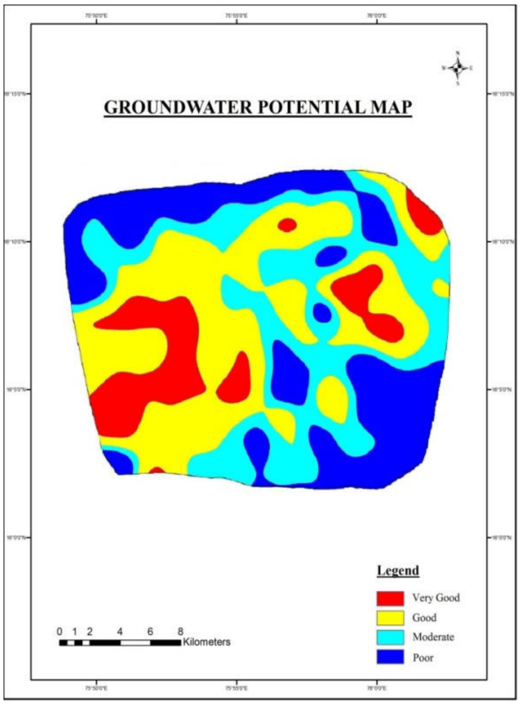


Fig 10 Groundwater potential Map of the Study Area

5. Conclusion

Mapping of groundwater resources have been increasingly implemented in recent years because of increased demand for water. The data most commonly available for groundwater study are geological, geomorphological and hydrological information. In this study we attempted to identify groundwater potential zones using remote sensing and geographic information system techniques in the part of Malaprabha river basin. To demarcate the groundwater availability of the part of Malaprabha river basin, various thematic maps such as, geological map, geo-morphological map, soil map and slope map were prepared using Arc GIS software and these maps are integrated for preparing groundwater prospects map. From Groundwater potential map (Fig No.10), it is observed that is having moderate Ground water prospect zone.

Reference

[1] S. Ganapuram et al. Mapping of groundwater potential zones in the Musi basin using remote sensing data and GIS. Advances in Engineering Software 40 (2009) pp.506–518.

[2] Fathy Abdalla, "Mapping of groundwater prospective zones using remote sensing and GIS techniques: A case study from the Central Eastern Desert, Egypt", Journal of African Earth Sciences 70 (2012) 8–17.

[3] Hyun-Joo Oh et al. "GIS mapping of regional probabilistic groundwater potential in the area of Pohang City, Korea". Journal of Hydrology 399 (2011), pp. 158–172.

[4] Imran A. Dar, K. Sankar, Mithas A. Dar. "Remote sensing technology and geographic information system modeling: An integrated approach towards the mapping of groundwater potential zones in Hardrock terrain, Mamundiyar basin". Journal of Hydrology 394 (2010), pp. 285–295.

[5] Haleh Nampak, Biswajeet Pradhan, Mohammad Abd Manap. "Application of GIS based data driven evidential belief function model to predict groundwater potential zonation". Journal of Hydrology 513 (2014), pp. 283–300.

[6] Saro Lee, Yong-Sung Kim, Hyun-Joo Oh. "Application of a weights-of-evidence method and GIS to regional groundwater productivity potential mapping". Journal of Environmental Management 96 (2012), pp. 91-105.

[7] M Niranjan and Sujit Singh. "Assessment of groundwater Potential Zones using GIS Technique". J.Indian Soc.Remote Sens (March 2009) 97: pp.69-77.

[8] Sukumar Sand Sankar K." Delineation of potential zones for artificial recharge using GIS in Theni district, Tamilnadu, India. International journal of geomatics and geosciences Volume 1, No 3, 2010.pp.639-648.

[9] Pandian. M and Kumanan. C. J. "Geomatics approach to demarcate groundwater potential zones using remote sensing and GIS techniques in part of Trichy and Karur district, Tamilnadu, India". Archives of Applied Science Research, 2013, 5 (2), pp. 234-240.

[10] R. Neelakantan and S. Yuvaraj. "Evaluation of Groundwater using geospatial data – A Case study from

Salem taluk, Tamilnadu". India. International Journal of Remote Sensing & Geoscience. Vol. 1, Issue 2, Sept. 2012, pp. 7-12.
[11] S N Ramaiah et.al. "Geomorphological Mapping for Identification of Ground Water Potential Zones in Hard Rock Areas Using Geo-spatial Information – A Case Study in Malur Taluk, Kolar District, Karnataka, India. An International Quarterly Scientific Journal. Vol. 11 No. 3 pp. 369-376.
[12] Ismail Chenini and AbdallahBenMammou. "Groundwater recharge study in arid region: An approach using GIS techniques and numerical modeling. Computers & Geosciences 36 (2010), pp. 801–817.
[13] Murgesan Bagyaraj et.al (2010). "Application of remote sensing and GIS analysis for identifying groundwater potential zone in parts of Kodaikanal Taluk, South India". Front. Earth Sci. pp. 1-11.
[14] M. Kavitha Mayilvaganan, P. Mohana and K.B. Naidu. "Delineating groundwater potential zones in Thurinjapuram watershed using geospatial techniques". Indian Journal of Science and Technology. Vol. 4 No. 11 Nov (2011). pp. 1470 – 1476.
[14] DavidNdegwa Kuria et al. "Mapping groundwater potential in Kitui District, Kenya using geospatial technologies". International Journal of Water Resources and Environmental Engineering Vol. 4(1), pp. 15-22, January 2012.
[15] Ali El-Naqa et al. "Integrated Approach for Groundwater Exploration in Wadi Araba Using Remote Sensing and GIS". Jordan Journal of Civil Engineering, Volume 3, No. 3, 2009.pp 229-243.