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EVALUATION OF GROUNDWATER RESOURCES STUDIES OF CHAMARAJANAGAR TALUK, CHAMARAJANAGAR DISTRICT, KARNATAKA, INDIA, USING REMOTE SENSING AND GIS TECHNIQUES

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Abstract

Ground water resources were evaluation for Chamarajanagar taluk is drought prone area of Chamarajanagar District, Karnataka. The area receives an average annual rainfall of 696 mm. Groundwater is the major sources of irrigation and drinking. The increasing population and growing demands of threatens the sustainability of water resources. Hence, the evaluation of groundwater resources and status in groundwater development of Chamarajanagar taluk is carried out utilizing the Remote Sensing and GIS techniques in conjunction with conventional methods. Recharge from precipitation forms major part in groundwater recharge and depends on geomorphology, soils and slope**.** Therefore, geomorphology and soils of the taluk are prepared for using mapped IRS-ID digital data of LISS-III AND PAN coupled with field work. Soil units' are delineated and utilized for groundwater recharge from precipitation. Each soil unit is assigned different infiltration rates falling and range from 5% to 15% and is in line as indicated by groundwater estimation committee (GWEC). The seepage from the irrigation tanks with red gravelly soils below the tank bed has been estimated considering 15% seepage factor. Similarly the return seepage from percolation tanks has also been estimated by adopting 50% of gross storage. The return seepage from irrigation fields is worked based on the double cropped areas (Ragi) delineating from IRS digital data. Thus the groundwater recharge from various sources is computed .the annual groundwater draft has been estimated based on the well census, type and unit draft. The status of groundwater development for chamarajanagar taluk as per GWEC norms workout to 78% and is falling in semi critical category.

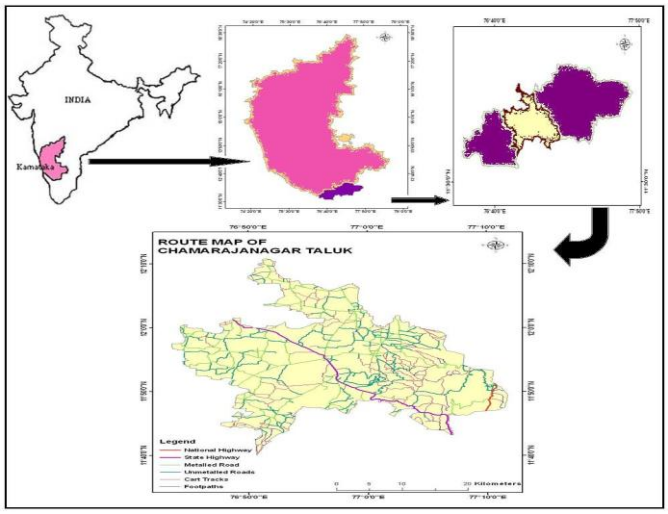
Key words: Geomorphology, water level, over exploited and Remote Sensing and GIS.

Introduction

Ground water is precious resources, which is being exploited in a non-scientific way. If this situation continuous, water would be a payable commodity, which cannot be afford--able by a common man for his live hood. This is time to be awaked by decision makers and planners to save these precious resources for sustainable utility. To save this recourse, evaluation of ground water resources is essential. An attempt has made to evaluation these resources using Remote Sensing and Geographical Information System.

Study Area

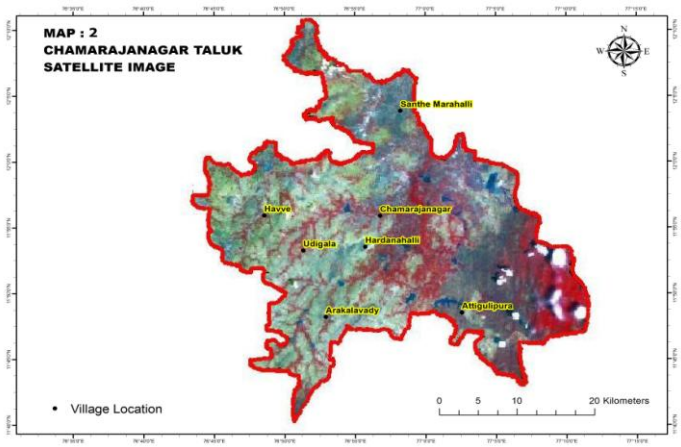
Chamarajanagar taluk comes under the semi arid region. It lies between 11^0 40^1 to 12^0 10^1 east latitude and 76^0 40^1 to 77^0 15^1 north longitude with the geographical area extent of 1235.9 sq.kms covering 190 villages coming under survey of India toposheet Nos.57D/12, 57D/16, 57H/4, 58A/9, 58A/13, 58A/14, 58E/1, 58E/2,58E/5, on a scale of 1:50,000. The annual average rainfall in the taluk is around 696mm. Chamarajanagar taluk enjoys a salubrious climate with mean maximum temperature of 34°C and a mean minimum temperature of 16.4°C. The major river does not have in the taluk, however drained by Suvarnvati and Chikkahole, which are the tributary of Cauvery river border of Kollegal taluk, Chamarajanagar District. The topography of the study area is an undulating plain with hard rock terrain comprising peninsular gneiss, Charnockites .Charnockites is wide spread formation in this taluk.



Map No.1Location map of study area

Methodology

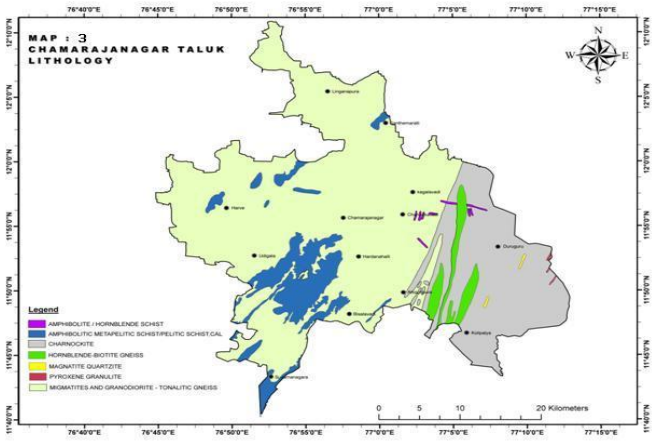
Satellite data of IRS-ID, LISS-III +PAN merged was used to prepare geomorphological map of Chamarajanagar taluk(.Map No.2)The Geomorphological map was generated in digital form and computed each unit's geographical area using Arc view GIS. Ground water resources were evaluationed for the each geomorphic units of the study area based GEM-1997 methodology. (Groundwater Estimation Method-1997) Data used resources evaluation for taluk were proportionally taken for each geomorphic unit.



Map No.2 Study area of satellite Image

Geology of the area

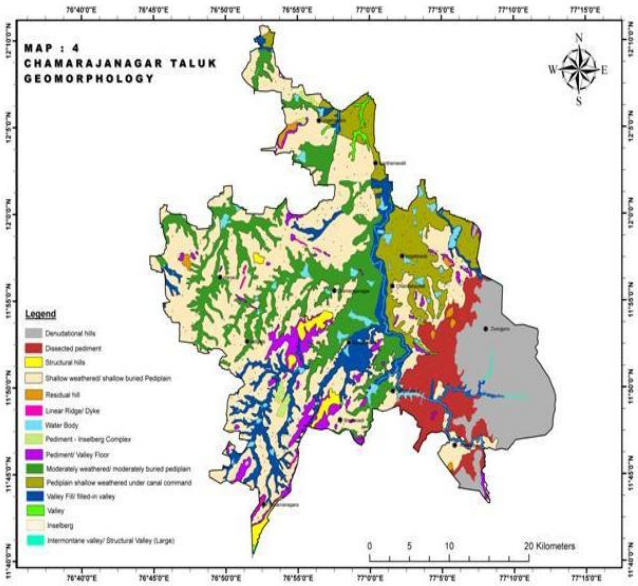
The area comprises litho units of amphibolite, hornblende and charnockite, granitic gneisses of Proterozoic basins of Southern Karnataka. Ultramafic rocks are found in the granite gneisses and are intruded by quartz and dolerite dykes. Granitic gneiss is the wide spread formation in the taluk as below the map no.3



Map No.3Lithology map of study area

Geomorphology

The taluk may be classified as partly maidan, general table land with plain and undulating region. The different landforms discernible on the imagery have been broadly classified into denudation and very less fluvial landforms. The landforms delineated are pediment, pediplain, valley fills, residual and insulberg. The Chamarajanagar taluk general elevation is 656 M AMSL. (Map No.4)



Map No.4 Geomorphology of study Area

Pediment: Pediment is gently undulating rock surface and wears a thick cover of weathered materials. It has been carved over ultramafics formation exposed in the taluk. Pediment zones permit poor infiltration and act as run-off zones; however the fractures, which traverse these zones, could act as limited recharge zones.

Pediplain: This landform is covered by soil ranging in thickness from <1– 6m and occurs over the entire terrain. The development of soil is mainly due to disintegration of county rock. The country rock is granite gneiss and has undulating topography. The thickness of weathering zones ranges from 10 to 35m and this zone act as good infiltration zones some others villages.(CGWB, 2012)

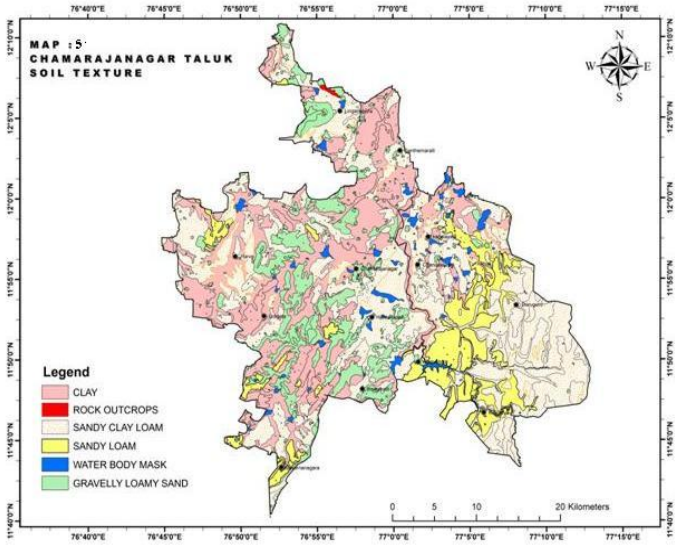
Valley fill: Valley fill has been developed mainly in the valley portions over granite gneiss due to deposition of unconsolidated materials by fluvial agencies. The materials are silt, fine sand and at places pebbly. The thickness of fill and weathered zones are ranging from 1 to 15 m and it act as good recharge zone in some villages.

Residual hill: (Joints, Fractures, Lineament) isolated low relief formed due to differential erosion so that a more resistant formation and as residue like small hills below the fig.1.

Fig.1 Residual hill of the study area

Soil

The soils of the taluk are derived from granitic gneisses and Charnockite rock formations. Red soil is present in upland areas and at the contact of granites and schist. These soils are admixture of sand and silt. Organic matters in these soils are low and respond well for irrigation, manuring and other management practices. The thickness of the soil varies from less than a meter to 6.5m. Black soils are clayey and black in colour, mostly of transported origin, occurring along depression where regular irrigation practices are in practice. It has a high moisture holding capacity. Mixed type of soils is localized at places along the contact of schist and other intrusions. These are derived either from gneisses or schist. These are medium to grained and moderately permeable. The thickness varies from 1m to 16.5m (Map No.5).



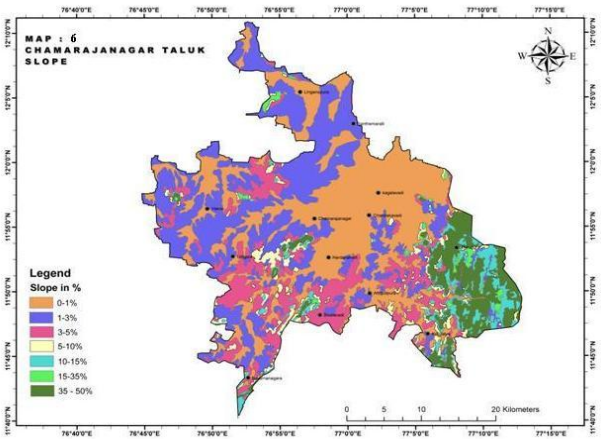
Map No.5 Soils of the study area

Slope

The slope percentage in the area varies from 0 to 50%. On the basis of the slope, the study area can be divided into seven slope classes. The areas having 0 to 1% slope fall into the 'very good' category because of the nearly flat terrain and relatively high infiltration rate. The areas with 1 to 3% slope are considered as 'good' for groundwater storage due to slightly undulating topography with some runoff. The areas having a slope of 3 to 5% cause relatively high runoff and low infiltration, and hence are categorized as 'moderate.' The fourth (5–10%) slope are consider as moderate to Steep (Poor)and fifth (10–15%) slopes are considered as moderate to very steep (Poor) and (15-35%) slopes are steep , 35-50% slopes are considered as precipitous slope categories are considered as 'poor' due to higher slope and higher runoff Map No.4.6. In the present study slope map has been prepared on 1:50000 maps based on the guidelines of All India Soil (AIS) and Land use Survey (LUS, 1995) on slope categories (Table 1)

Table 1 General slope category guideline

Sl. No.	Slope category	Slope (%)
1	Nearly level	0-1
2	Slightly sloping	1-3
3	Gently sloping	3-5
4	Moderately sloping	5-10
5	Strongly sloping	10-15
6	Moderately steep to steep sloping	15-35
7	Precipitous slope	35-50



Map No.6 Slope map of the study area

Results and Discussion

Depth to water level of monsoon was collected and derived average water level for each geomorphic units for computation. This data were used for evaluation of return flow from irrigation. The deeper water level was observed in the pediplain where as the shallow water level found in the pediment zone. The water level data are shown the Table: 1and 2.The studies of Chamarajanagar ttaluk have been revealed that the existence of ground water is in the depth of 120 t0 150 feet. While in the summer season the depth of under ground water depicted by 30 to 50 feet. But the Harve and Haradanalli hobli in Chamarajanagar taluk is the driest region and has less rainfall, where the water level is about 250 feet. This we have taken from the sample through the district mines and Geology, Chamarajanagar after the consolidation of the total bore wells dug during the year 2002 and 2012 (9/08/2012) and the data from the department of Mines and Geology (ground water survey),

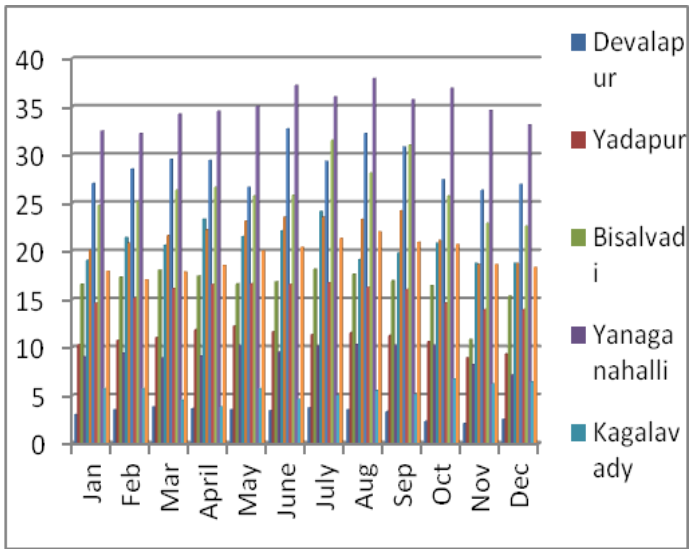
Table.1&, 2. Water level data of Study area for year of 1998-2012

Table.1

Sl. No	Well type	Name of the Station	Jan	Feb	Mar	April	May
1	Open well	Devalapur	3	3.5	3.8	3.60	3.5
2	OB well	Yadapur	10.25	10.7	11	11.8	12.2
3	OB well	Bisalvadi	16.56	17.3	18	17.4	16.6
4	Open well	Yanaga-nahalli	9	9.4	8.9	9.1	10.2
5	OB well	Kagala-vady	19.05	21.4	20.6	23.3	21.5
6	OB well	Yedayur	20.06	20.8	21.6	22.2	23.1
7	DWLR	Harve	27	28.5	29.5	29.4	26.6
8	OB well	Chamara-janagar	14.56	15.1	16.1	16.5	16.6
9	OB well	Masaga-pur	24.71	25.1	26.3	26.6	25.7
10	DWLR	Bedarapur	32.45	32.2	34.2	34.5	35
11	Open well	Bisalvadi	5.7	5.7	4.5	3.8	5.7

Table.2

June	July	Aug	Sep	Oct	Nov	Dec	Water level in meter
3.4	3.7	3.50	3.3	2.3	2.1	2.50	5.25
11.6	11.3	11.5	11.2	10.6	8.9	9.3	10.9
16.8	18.1	17.6	16.9	16.4	10.8	15.3	16.5
9.5	10.1	10.3	10.2	10.2	8.2	7.1	9.3
22.1	24.1	19.1	19.8	20.8	18.7	18.7	20.8
23.5	23.5	23.3	24.2	21.1	18.6	18.7	21.7
32.7	29.3	32.2	30.8	27.4	26.3	26.9	28.9
16.5	16.7	16.2	16	14.6	13.9	13.9	15.5
25.8	31.5	28.1	31	25.7	22.9	22.6	26.3
37.2	36	37.9	35.7	36.9	34.6	33.1	34.9
4.6	5	5.5	5.1	6.7	6.2	6.4	5.4



Groundwater resource of Chamarajanagar taluk-2012

Water Level fluctuation

Average Water level fluctuation was computed from ten years water level for each geomorphic unit. It is observed that the maximum water level fluctuation in pediplain area where as minimum in pediment area.

Categorisation of geomorphic units has been done considering study area on the basis of stage of development and the long term trend of water level fluctuation. Thus, the categorization of the taluk/study area indicates that the entire chamarajanagar taluk

97% area falls in safe category, where there is enough scope for further ground water development.

Fig 2 Measuring the Water level data of study Area

Conclusion

This approach for ground water resources evaluation reveals that the ground water resources are not uniform throughout the taluk/study area. Ground water assessment of geomorphic unit of chamarajanagar taluk was carried out as on August 2012 as per the guidelines of Ground Water Estimation Methodology - 97 taking geomorphic class as assessment unit. The resources work for the month of August 2012. Valley fill is completely safe and other geomorphic unit namely Pediment and pediplain are over exploited. maximum net ground water available for future irrigation development is available in valley fills. The development plan may be concentrated in the pediplain and pediment area.

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