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GIS And Remote Sensing Methods Based Assessment of the State of Ground Water Resources with Special References to Western Indian River Basins

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Abstract – The accessible water ought to be prudently used through legitimate improvement and the executives systems. The point of this assessment is to contribute towards efficient groundwater ponders utilizing Remote Sensing, Field Studies, remote sensing and GIS in making ground-breaking rules for groundwater resource assessment in equivalent hydrological domains. The Godavari river basin of western Maharashtra is waterway water system framework, significant development crops are paddy and sugarcane. Likewise, the methodology at effectively in the areas with equivalent environment and geology, for instance Western Indian River Basins which encounters serious absence of water driving.

Keywords: GIS, Remote Sensing, Ground Water, River Basins, Geology

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INTRODUCTION

Water is one of the significant components, basic for sustenance of all types of life and prime common asset. Groundwater happens both in endured zone overlaying the hard rock and in cracks, gaps and in jointed hard shakes. The thickness of the endured zone shifts from place to place. It relies upon the geology and the degree of enduring. The event, development and availability of groundwater in the subsurface skyline relies upon the geology, structure, demeanor and geometry which shift from one stone arrangement to other, place to place and at various profundities. Rainfall is the only wellspring of groundwater. Rainfall that falls on the ground, a piece of which vanishes, some as surface spillover and part of it percolates into the soil and further flows descending to energize the groundwater stockpiling in the endured and cracked zones of rocks. The climate, which allows only a little piece of the rainfall to add to the groundwater energize and the geological condition are the two limiting and controlling components for the event of groundwater and its development.

Essentialness of translating lineaments from the satellite picture with respect to helper evaluation was stressed by the appraisal of break occurrence of Mendha stream bowl, India (Ghosh et. al., 1991).

Generally, an appropriate estimation of water resources includes consistent cross-sectional hydrological limits over which all surface water and groundwater flows can be either measured with reasonable certainty or essentially presumed to be zero. For a river basin, the broadest scale of appraisal will be from the watershed with contiguous river basins to the outlet to the ocean. Be that as it may, for some reasons, evaluations will be led on smaller sub-basin zones. Regardless, care is always required in characterizing watershed limits, particularly in geological arrangements where groundwater flows are critical, as the degree of springs doesn't necessarily relate with basin limits.

Shiv Kumar et al., (2004) completed analysis of groundwater data for the appraisal of groundwater conduct, its potential and water table pattern in Bareilly locale ofUttar Pradesh. The water table pattern was contemplated and groundwater stock was set up to watch the phase of ground water development.

Ahmad et al. (2005) examined another strategy for assessing the cross-sectional use of net groundwater over large flooded territories by consolidating the approaches to remote sensing and water balance in Rechna Doab, located in Pakistan's Indus basin water system arrangement.

IMPACTS ON WATER RESOURCES

Abstractions

Abstractions from the water resources framework spread all regions of water use whether sourced from surface or groundwater frameworks.

Public water supply

Public water supplies spread all those abstractions used to supply multiple clients including households, trade and industry through a typical reflection treatment and circulation framework. In general, expanded affluence in the public arena will in general increment per capita local water use, since more water-utilizing appliances are installed, more water is utilized for personal washing, etc, and at the most elevated levels critical measures of water are utilized for garden watering, pools and other pleasantry employments.

Irrigation

Water use for water system relies upon the zone inundated, crops cultivated, trimming designs, climatic conditions and the sort of water system framework utilized. Likely expansions to watered territories may should be surveyed by considering climate changes and generation pressures that could lead to expanded interest. Future changes in crops or editing designs are difficult to foresee however should be considered in forward water resources projections. Changes in climate that could change examples of precipitation or evapotranspiration should be a key thought in water resources appraisals.

Agriculture

It is assessed that some 70–80 percent of global water use is for agriculture. Various harvests and kinds of agriculture will have diverse evapotranspiration rates and in this manner various levels of water request. A few examples of the water necessities of various yields are given in Table 2.

Serious stock raising will require a more noteworthy supply of water than broad nibbling, and water request will generally increment in transformation from grassland to arable. Also, various strategies for cultivation will influence the pace of spillover and infiltration.

Urbanization

Urbanization makes broad zones of hard surfacing as rooftops, streets and other cleared territories. These lead to fast overflow of tempest precipitation and noteworthy decreases in infiltration to groundwater. Urban zones are also significant sources of pollution from human waste, industry, cleaning fluids and nourishment handling. Transport frameworks also produce pollution from spilt petrochemicals, elastic mixes and, in cold climates, salt utilized for de-icing.

Pollution

Whilst sources of pollution don't directly influence the amount of water in a catchment, they do largy affect the successful measures of useable water that is available and the environmental quality of water bodies. Cumulatively, all sources of pollution can significantly affect powerful net asset availability.

Climate change

Climate change will generally be a noteworthy element in forward projection of water availability.

Normally a scope of climate situations will be considered to survey the affectability of appraisals and policy alternatives.

REMOTE SENSING METHOD

Remote sensing makes it possible to collect data from areas that are risky or unavailable. Applications for remote sensing include witnessing deforestation in regions such as the Amazon Basin, glacial highlights in Arctic and Antarctic districts, and deep sounding of coastal and sea depths. During the Cold War, military analysis used confrontation data collection on dangerous edge areas. Remote sensing often eliminates expensive and slow collection of data on the ground, ensuring that areas or objects are not disturbed during the process.

Orbital platforms collect and transmit data from different parts of the electromagnetic range related to larger-scale aerial or ground-based sensing and analysis, providing scientists with sufficient data to screen patterns, such as El Niño and other long and transient natural wonders. Different uses include various zones of the earth sciences, for example, natural asset the board, agricultural fields, for example, land use and conservation, and national security and overhead, ground-put together and remain off collection with respect to fringe areas.

Remote sensing is the showdown collection using an assortment of gadgets for get-together data on a given article or region.

GIS METHOD

GIS remote sensing catches data on the earth utilizing strategies like arial photography and satellite imaging utilizing high power sensing gadgets. Sensors on airplanes and satellites collect data, which is manipulated, analyzed, and visualized into a graphical portrayal or converged on existing digital maps with ideal portrayal of the geographic directions.

GIS remote sensing gives pictures of territories in a quick and cost-effective way, and discovers what's going on right now in a given region. It gives significant inclusion, mapping and classification of landcover highlights, for example, vegetation, soil, water, and backwoods.

The multi organize study from regional level to close by was valuable to address the trademark resources related issues of the region utilizing IRS LISS III standard FCC and automated data to delineate for ground water prospect zone division and woods fire chance zonation in GIS environment.(Jaiswal, et.al., 2005)

Landforms, for example, alluvial fans, stream yards, palaeochannels, flood fields and other alluvial highlights are exceptional pointers of ground water potential zones (Srivastava and Murthy, 1992) in any case the fundamental inclinations, eager zones are normally poor in ground water potential (Ravindran et al., 1995).

In a typical khondalitic area, Venkateswara Rao (1994) suggested an improved technique for identifying potential groundwater zones. It involved appointing numerical loads and appraisals to different geophysical and geomorphic parameters leading to calculation of Groundwater Potential Index (GWPI) of a given site. It was discovered that the GWPI of any site should be 35 or more so as to have 75% achievement pace of wells with a yield standard of 8000 liters for each hour per well.

METHODOLOGY

Study Area

Godavari River basin located in the river basin region's western Maharashtra. Geographically, the zone falls to 79°7'45.337"E between 11°31'40.7"N and 11°51'53.185"N and 78°36'44.894"E. The river basin isal degree of around 1122.67 sq.km and spreads on a scale of 1:50,000 SOI toposheets 58I/9, 58I/10, 58I/13 and 58I/14.

The Godavari River flowing from west to east bearing and significant catchment is in the north western side of the hills. The hills are the significant scope of hills arranged in the Eastern Ghats of Tamil Nadu. The examination zone falls in the hills is around 369.5Sq.km and most noteworthy elevation point saw in the close by the region of Kallur village (1257MSL, 1298MSL) of north western area.

To portray groundwater potential zones

In the present investigation an endeavor has been made to delineate and portray groundwater potential zones of Godavari watersheds by utilizing GIS and remote sensing data. The distinctive topical maps viz, geomorphology, land use / land distribution, slope and lineament were developed using traditional visual understanding strategies (Lillesand and Kiefer, 2002) using topographical maps of both LISS IV and PAN-consolidated satellite data and their associated IRS 1C and 1D geocoded FCC (March 2012).

Visual Interpretation Techniques

The extraction of wanted data from the satellite symbolisms through visual translation has been completed utilizing several essential elucidation keys (Sabins, 1978, for example, color/tone, design, shape, size, affiliation, seepage and geology, and so on to get ready geomorphic and structural guide of the investigation territory.

Hydrogeomorphology

The geomorphological guide has been readied dependent on explicit tone, surface, size, shape and affiliation qualities of remotely detected data.

Land use/land cover mapping by visual image

Different land use/spread classifications have been delineated in the examination zone (Map 7.3). Tank/stream inundated cropland are delineated by fine red color along streams. The downpour nourished/groundwater inundated cropland is also visible in red color yet spread uniformly in the plain land, with clean example.

Geomorphology

Topographic maps of a scale of 1:50,000 (57G/11, 12, 14, 15, 16, H/9, 13 and 14) are obtained from Survey of India, Bangalore and equivalent to UTM (WGS 84 North, Zone 43) are enlisted. The waste system has been made manually by digitizing seepage lines in ArcGIS 9.3 (Map 2.1a).

The steps are as offered below to get watersheds and streams got from ASTER-DEM

Fill the sinks in the ASTER-DEM

- Apply the flow bearing capacity to the filled ASTER-DEM
- Apply the flow accumulation work on the flow course lattice
- Apply a threshold condition to the flow heading framework
- Get a streams framework from the threshold condition lattice Obtain the stream links matrix
- Get watersheds framework from the streams lattice Vectorise the streams matrix

- Vectorise the watersheds network.

Hydrochemistry

To check the groundwater quality, 97 groundwater samples have been collected for two seasons viz, premonsoon (April 2012) and postmonsoon (November 2012). The sample locations were noted utilizing 12 channel global situating framework (Garmin GPS map 76CSX) and the samples were collected in cleaned and thoroughly flushed 1000 ml plastic bottles (Map 8.1). The water samples are analyzed for the significant cations and anions, for example, Ca, Mg, Na, K, Fe, HCO3, CO3, SO4, NO3 and follow elements, for example, Cu, Mn and Zn in the division laboratory by analytical titration techniques, utilizing different instruments, for example, Flame Photometer, UV Spectrophotometer, Atomic Adsorption Spectrophotometer and Ionmeter (Table 8.1) and the results of the analysis has been tabulated in Tables 8.2a and b. The pH and electrical conductivity (EC) were resolved in the field itself immediately in the wake of sampling. The TDS were dictated by empirical formulae as in Rayamahashay (1996). The parameters, for example, total hardness, TDS, and so forth were resolved through calculations. Total hardness as CaCO3 is calculated from Ca2+ and Mg2+ and TDS are calculated utilizing EC (Hem, 1989).

RESULTS AND DISCUSSION

To portray groundwater potential zones

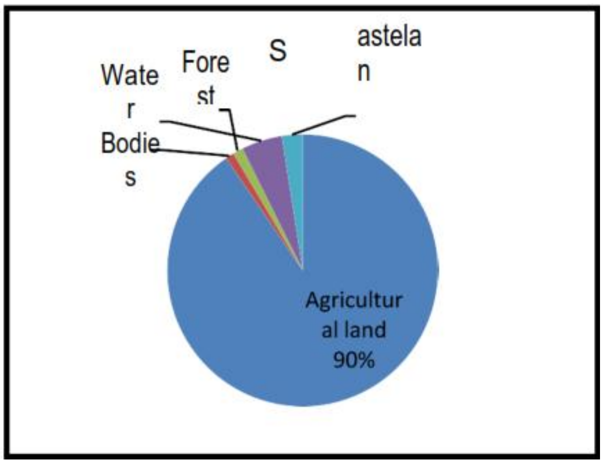
GROUNDWATER POTENTIAL ZONES

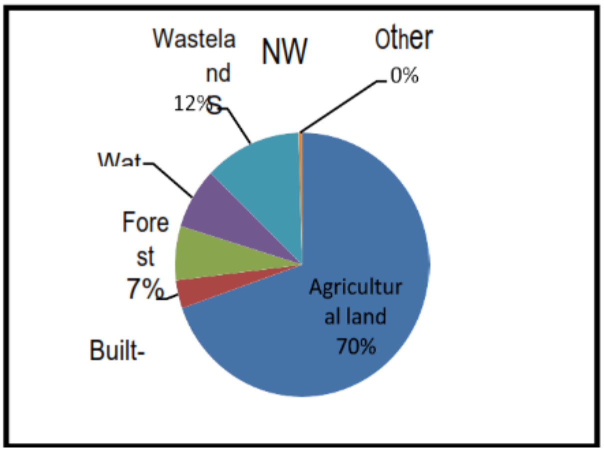
Based on overlay analysis, a groundwater imminent zone maps have been arranged and are classified into four districts viz, poor to nill, moderate to poor, moderate and great groundwater potential zones The low potential zones are found in the northern, western and southeastern pieces of the investigation region, though the gneissic rocks are at shallow profundities. Significant part of the examination territory is portrayed by medium potential zone. High potential areas are seen along the course of the stream in all the watersheds that are northwestern, southeastern and a few locations where the thickness of the overburden is relatively high. The high and medium potential zones are promising imminent territories for future exploration and development of groundwater in the investigation region.

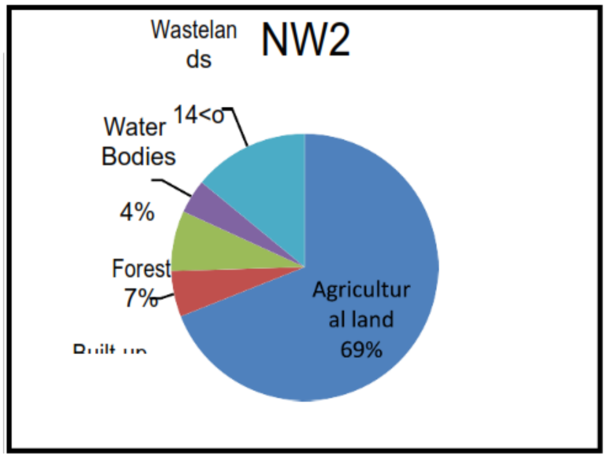
Table 4.1 Slope Category of Godavari Watersheds

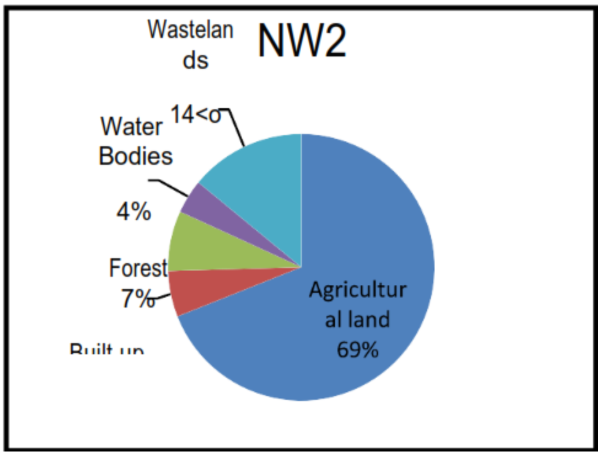
Watersheds	Nearly level (Km²) (0-1%)	Very Gentle Slope (Km²) (1—3%)	Gentle Slope (Km²) (3-5%)	Moderate Slope (Km²) (5-10%)	Slope (Km (10-15%)	Moderately Steep Slope (Km²) (15-35%)	Very steep slope (Km²) (>35%)
NW1	19.62 (38.66)	19.03 (37.48)	1.65 (3.25)	2.52 (4.96)	1.45 (2.85)	0.87 (1.71)	5.63 (11.09)
NW2	13.28 (36.40)	10.70 (29.32)	1.68 (4.60)	0.94 (2.59)	3.25 (8.92)	0.29 (0.78)	6.35 (17.39)
NW3	37.35 (37.41)	40.21 (40.28)	14.00 (14.03)	2.40 (2.40)	1.70 (1.70)	1.05 (1.05)	3.12 (3.13)
SW1	50.75 (35.40)	88.06 (61.42)	3.28 (2.29)	0.58 (0.40)	0.69(0.48)	—	—
SW2	89.39 (30.72)	192.7 (66.24)	7.17 (2.46)	1.70 (0.58)			
SW3	79.04 (28.87)	183.38 (66.9)	11.36 (4.15)	—			
SEW	57.74 (34.25)	108.5 (64.36)	2.16 (1.28)	0.18 (0.11)			
EW	62.36 (38.81)	76.22 (47.44)	19.10 (11.89)	3.00 (1.87)			

The values within the parentheses are percent of area.









Hydrochemistry

Total Dissolved Solids

The normal value of TDS is 523 and 589 ppm for premonsoon and postmonsoon. The values extend from 160 to 1400 ppm and 115 to 1662 ppm for premonsoon and postmonsoon seasons, respectively. The values are well inside the permissible range aside from in a couple of isolated cases. The iso-fixation maps of TDS show the anomalous zones around northern, central, eastern and southern pieces of the examination zone (Maps 8.11a and b).

Total Hardness

The carbonate hardness, or impermanent hardness, is brought about by Ca and Mg carbonates. The hardness is processed by multiplying the total of meq/ltr of Ca and Mg by 50 and communicated as equivalent measure of CaCO3.

On the off chance that the hardness surpasses alkalinity, the abundance is named as noncarbonate hardness. Sulfates and chlorides of Ca and Mg cause the noncarbonate hardness or changeless hardness. It tends to be calculated by the formula:

$$\mathbf{NCH = (Ca+Mg)}\ (CO_3 + HCO_3)\ 50$$

At the point when the focuses are in ppm. The thing that matters is negative, NCH is zero.

The calculated values of NCH are appeared in Table1

The total hardness of water samples as given below:

Quality of Water	Range (ppm)	No. of Samples	
		Premonsoon	Postmonsoon
Desirable	300	58	62
Permissible	301 600	33	31
Hard	>600	6	4

Residual Sodium Carbonate

The RSC values of the investigation region go from 5.7 to 1.8 in premonsoon and 12.92 to 0.71 in postmonsoon seasons. Based on above classification all the samples are protected in both the seasons aside from 1 sample, which is marginal, in premonsoon (Tables 2).

Range of RSC (meq/l)	Category	No. of Samples (Premon)	No. of Samples (Postmon)
<1.25	Safe	96	97
1.25< 2.50	Marginal	1	
>2.50	Not suitable	_	_

CONCLUSION

The present examination deals with the groundwater potential and environmental aspects of the watersheds. The available water should be judiciously utilized through appropriate development and the executive's procedures. The qualitative and quantitative geomorphic attributes of the various watersheds of Godavari have been contemplated. A near report on morphometric parameters evoluted by toposheets and ASTER data and their results are talked about and introduced for various watersheds. The geology of the examination region and soil types are talked about. The lithological and structural highlights and water-bearing properties of rocks are given in this part. The chemical quality of soil types with relation to groundwater is examined with the help of iso-variety maps.

The anomalous zones of Iso-CO3 map matches with zones of the third factor score map for the two seasons. The lithology of anomalous these anomalous zones are endured more youthful rocks, peninsular gneisses, amphibolitic schist and dolerite dykes. The anomalous zones of fourth factor score map harmonize with anomalous zones of Iso-pH for premonsoon season. The lithology of these anomalous zones are endured more youthful rocks and peninsular gneisses. The anomalous zones of fourth factor score map agrees with anomalous zones of Iso-K for postmosnoon season. The lithology of these anomalous zones is potash feldspar-rich rocks and the utilization of artificial fertilizers for cultivation influences these anomalous zones.

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