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Perspective Study on Ground Water in East Godavari District of Andhra Pradesh

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Abstract: *This article is a deal with the study of East Godavari District There is a need for study the ground water in the district. The information helps the planners, hydrologists, Geologists, Geographers and researchers for better planning and management of underground water data whenever it is required. So for this a study is made on the basis of secondary data form internet and water board survey reports from three decades, This helps in decision making based on the information of ground water as a resource in East Godavari District. A series of information has been considered and highlighted for the uses.*
Key words: *Hydrologists, Management, Planners, Survey.*

I. Introduction:

Water is needed in all aspects of life. Difficult to purify, expensive to transport and impossible to substitute, water is an indispensable element of life. Renewable fresh water is an increasingly scarce commodity and the amount of fresh water actually available to people is finite. The general objective is to make certain, that adequate supplies of water of good quality are maintained, for the entire population of this planet, while preserving the hydrologic, biological, and chemical functions of the ecosystems, adapting human activities within the capacity limits of nature and combating vectors of water related diseases. Without sufficient water, economic development becomes virtually impossible and conflict over scarce resources virtually inevitable. Regional and local water shortages have always existed because of the inequalities of the hydrological cycle, but a global view also indicates that the entire hydrologic cycle is nearing the limits of use and therefore, even the water surplus countries will very soon start experiencing water shortages. United Nation Organization has given top priority to the problem of water scarcity and sanitation. Nearly 70 % of the fresh water is used for irrigating the agricultural fields which has raised water conflict between the urban and rural areas. If all this continues, then very soon i.e. by 2032, nearly half of the world's population will be facing water shortage problem. In the ground water point of view 85 per cent groundwater is being used for irrigation purposes. Groundwater is also the main source of urban water supply in India. The number of power pumps in Andhra Pradesh increased from less than one million in 1990 to almost 2.8 million in 2008. The continuously increased use of groundwater for irrigation has severely impacted drinking-water sources in rural areas and is becoming a great concern. The installation of over 3.5 million India Mark II hand pumps and over 0.12 million piped water supply schemes for drinking water purposes and 2.8 million power-driven pumps for irrigation purposes and industrial needs has resulted in depletion of groundwater and consequently decreased well yields.

II. Objectives of the study:

1. Access the geological factors of the Andhra Pradesh
2. Climatic conditions of the Andhra Pradesh
3. Trace out the ground water levels of east Godavari district.
4. Trace out the water bodies and rainfall in the east Godavari District.

III. Methodology

Secondary data has been collected from other available studies that have been conducted related to the topic-mainly magazines and journals of sanitation and water supply scheme, Internet, e-journals some text books and related to the ground water resources and quality of water and drilling costs ---etc. In a similar way I have consulted the assistant secretary, assistant programming officer, project development division, Geologists, Engineers, Zilla panchayat. East godavari District who are having the data on different themes pertaining.

IV. Relevant Reviews

The Deltaic Regional Centre of NIH has been monitoring groundwater levels and its quality in and around Kakinada town since 1994. In continuation of this program the spatial analysis of groundwater levels and its quality for the year 1998 is discussed in the report. Total 164 groundwater samples were collected from 41 observation well during the monts of Feb98, May 98 and Nov 98. The area covered by these observation

wells is around 82 sq.kms. the groundwater table contours were plotted for pre monsoon(May 98) and post monsoon (Nov 98) periods and the approximate flow direction had been demarcated. Groundwater Samples have been analysed for physical and chemical parameters. The variation in each parameter is discussed in the report . further samples have been classified according to stiff, piper's and U.S salinity laboratory classifications and observed their seasonal changes . the groundwater quality parameter are also compared with WIIO (1984) and ISI (1983) drinking water standards. The groundwater quality maps of TDS, total hardness, chloride and SAR have been prepared for pre monsoon (May 98) and post monsoon (Nov 98) periods and observed the change in spatial distribution. More studies are necessary to understand the vertical variation of groundwater quality in the study area. Before taking up any water resources project such as reservoir construction, anicut regulation canal project to augment it's judicial management of water surrounding other waterbodies and its behavior in different seasons is required. Remote sensing methods admirably suits over conventional methods to collect such information because of its capability to provide broad synoptic and repetitive coverage if the area in multispectral mode, Andhra Pradesh coastal area has been selected to study the pre-and post –monsoon surface variations of the water d\bodies using 1:250,000 scale false colour composite(FCC) in this task a total of forty FCC's has been delineated for both the pre-and post-monsoon seasons. Along the coast twenty four medium to major reservoirs/anicuts. Two major reservoirs Yeluru and Kanigiri are located in East Godavari and Nellore districts and the later districts is commissioned with more number of reservoirs and tanks. The minimum area 0.25 sq.km which is measurable using the digital planimeter has been kept has the threshold to map the tanks/lakes. Kolleru a fresh water lake which serves as bird sanctuary covering an area of 853.8 sq.km and pulicat lake fully brackish waterbody measuring 508.1 sq.km are the special features among tanks and lakes. During monsoon season 904.8 sq.km coastal area get waterlogged which lies between west Godavari and Krishna districts. Due to the involvement of small scale satellite data minor reservoir's /anicut's pre and post monsoon variations could not be analysed. Usage of 1:50,000 scale topographic and remote sensing data would give better results on minor reservoirs and tanks. Groundwater is the most precious gift of nature to living beings, particularly to the mankind and is essential for life. In recent years, rapid development has created an increased demand for drinking water, which is increasingly being fulfilled by groundwater abstraction. Groundwater constitutes one of the principal sources of fresh water. Hence it assumes enormous importance in domestic as well as Industrial activities. In view of the groundwater being used for potable purpose, its quality remains one of the issues of concern. The present study was undertaken to assess major ion chemistry of ground water to understand geochemical evolution of groundwater and water quality for promoting sustainable development and effective management of groundwater resources. Sampling procedures and chemical analysis were carried out as per the standard methods. A total of 19 water samples were collected and the water chemistry of various parameters viz. pH, EC, Total Hardness (TH), Total Dissolved Solids (TDS), calcium (Ca++), sodium (Na+), potassium (K+), carbonate (CO3-), bicarbonate (HCO3-),chloride (Cl-), nitrate (NO3-), and fluoride (F-) are carried out. A comparison of groundwater quality in relation to drinking water quality standards revealed that most of the samples are suitable for drinking purpose. Commensurate with the growth of industrial and allied activities in and around Visakhapatnam city, its area grew from $30km^2$ in 1960 to over 80 km^2 to date. The city's population according to 2001 census is about 1.33 million. Water supply has always been inadequate in this city with the crisis growing along with cities progress. Today's water requirement is 360 million gallons per day. The existing Thatipudi, Gossthani, Meghadrigadda and Mudasarlova can hardly meet 50% of the need. Raiwada water scheme can add a little more, therefore the supply capacity needs to be augmented. The only viable solution is to transport water from Godhavari. A part from the municipal supply the population also depends upon the ground water reservoirs. ground water quality of southern India is strongly dependent on bedrock geology and climate but may also be impacted in parts by pollution, particularly from agricultural and industrial sources. In this study the water level and quality data collected in all the 15 obsevation wells is analysed on the water year basis from June to May for three years 1996-97, 1997-98, and 1998-99 as part of hydrogeological and geochemistry studies of the ground water flow in the suddagadda basin. The study resulted in understanding the ground water level variation in different parts of the basin and to identify places where fluctuations is very high. Also the geochemical analysis has classified the ground water into 6 groups in the study area. The data and analysis of the hydrogeology and geochemistry of the basin will be useful and will give a direction for undertaking ground water balance and modeling studies of the study area in future. Groundwater samples collected at different locations in and around Namakkal were analyzed for their physicochemical characteristics. Ten locations of groundwater samples were collected and studied for every two month for the period June-2007 to December-2007. The present investigation is focused on the determination of physicochemical parameters such as temperature, taste, turbidity, electrical conductivity, pH, hardness, total solids, total dissolved solids, total suspended solids, chlorides, sulphate, nitrate, fluorides, dissolved oxygen, sodium, potassium and E.coli bacterium. Groundwater suitability for domestic and irrigation purposes was examined by using WHO and BIS standards, which indicate the groundwater in a few areas, were not much suitable for domestic and agriculture purposes. Thus the objective of this study is to identify the

quality of groundwater especially in the town and nearby town where groundwater is used for domestic and agriculture purposes is discussed. study of hydrochemical processes in the capital of Andhr.a Pradesh was carried out with an objective of identifying the geochemical processes and their relationship with ground water quality as well as to get an insight into hydrochemical evaluation of ground water. Various graphical plots and other parameters of groundwater were compared with different water standards and other conventional methods of data analysis were also used to evaluate the quality of ground water for utilitarian purposes based on the ionic constituents, water type and hydrochemical facies. A study [Mohammed Saidu, 2011] was conducted to evaluate the effect of solid waste dumps on ground waterquality. Water samples collected dry and wet seasons from hand dug wells were characterized for the parameters pH, TDS, EC, Hardness, chloride, Ca, P, DO and BOD. The study results reveal that the hand dug water around the refused dump sited are not safe for human consumption. A study [Sayyed Juned A. etal., 2011] was carried out in the Nanded city area, Marathwada, India to identify the quality of ground water where ground water used for domestic and agricultural purposes. Water samples collected during pre and post monsoon periods from different borewells were analysed for parameters Cl, Na and K. The study revealed that the quality of ground water was controlled the agricultural activities, geological formations and local environmental conditions. The tudy further revealed that ground water in few sampling sites were unsuitable for domestic and irrigation purposes. The studies [Moscow, S. et al., 2011] on the impact of agricultural activities on ground water of Cauvery belt in Papanasanam taluk, Tamilnadu, India revealed that the quality of ground water has been altered due to modern agriculture practice. Water quality assessment has been carried out for parameters pH, TDS, EC, Cl, Na, k, Ca, Mg, Fe, and Cu. The study results suggested that the overall quality of ground water of this area is safe for drinking, domestic purposes and also suitable for irrigation purposes. And Keeping in view the fact that clean water is absolutely essential for healthy living, it is proposed to take up the present research work to evaluate the quality of ground water and to assess the impact of sea water intrusion on the quality of ground water in the Kakinada coastal aquifer and to suggest accordingly the seriousness of the problem of contamination of ground waters. Studies on Characterization of twenty ground water samples Collected from various open wells around Kakinada city have been carried out The parameters considered for characterization include pH, EC, TDS, Total Hardness, Cl- , F-, No3 -, Ca+2, Mg+2, Na, K , Percent Sodium and SAR. Higher concentrations of Na, K, Ca, and Mg are due to intensive Agriculture and industrial activities while higher concentration of Calcium may be contributed to the excessive utilization of Nitrogenous fertilizers. The parametric studies also indicate the influence of sea water intrusion on the quality of ground water in various locations The results of the study further revealed the unsuitability of the water for domestic uses. The present study intended to calculate Water Quality Index (WQI) of industrial areas of well water samples in Kakinada, Andhra Pradesh, India were monitored. The quality of bore waters was assessed by comparing with existing standards for important parameters. Water Quality Index calculated from thirteen parameters of physico-chemical parameters taken together varied from 49.52 - 123.54 ppm indicating level of nutrient load and pollution in the bore waters. Results of this study indicate that all the bore well waters of the study area are Permissible limit except S3, S4 and S6 (Valasapakala, Vakalapudi, and Nagarjuna nagar). The water was not conforming to drinking standards, and hence it is suggested to take all the necessary precautions before the waters are sent into public distribution system. It is concluded that WQI can be used as a tool in comparing the water quality of different source. Quality of groundwater is controlled by many factors amongst which the interaction of river water with adjacent groundwater and mixing/non-mixing of different types of groundwater may be important. An attempt has been made to study these processes using multivariate statistical techniques such as factor and cluster analyses. The Nethravathi catchment (India) which is a tropical river basin draining the Precambrian crystalline province of peninsular India, has been selected for this study. Hydrogeochemical data for 56 groundwater samples were subjected to Q- and R- mode factor and cluster analysis. R-mode analysis reveals the inter-relations among the variables studied and the Q-mode analysis reveals the inter-relations among the samples studied. The R-mode factor analysis shows that Na and CI with HCO3 account for most of the electrical conductivity and total dissolved solids of the groundwater. The 'single dominance' nature of the majority of the factors in the R-mode analysis indicates non-mixing or partial mixing of different types of groundwater. Both Q-mode factor and Q-mode cluster analyses shows that there is an exchange between the river water and the adjacent groundwater. r 2002 Elsevier Science Ltd. All rights reserved. The small portion of available fresh water for human consumption is being contaminated by various anthropogenic sources at a very alarming rate. With this view an attempt was made to assess the quality of groundwater in rural areas of Vijayawada by examining various physico – chemical parameters such as colour, turbidity, odour, pH, electrical conductivity, total dissolved solids, alkalinity, hardness, nitrate, sulphate, chloride, fluoride, iron and magnesium, to check the suitability of water for human consumption. Except hardness all most all parameters in the collected ground water samples are within the permissible limits given by WHO, ISI ICMR. According to the Urban Development Ministry, 22 out of the 32 big cities in India are facing severe water crisis With 70% gap between demand and supply, Jamshedpur faces the worst situation. In Kanpur,

Asansol, Dhanbad, Meerut, Faridabad, Visakhapatnam, Madurai and Hyderabad, the gap between demand and supply is 30%. The shortfall in Delhi and Mumbai is 24% and 17% respectively.

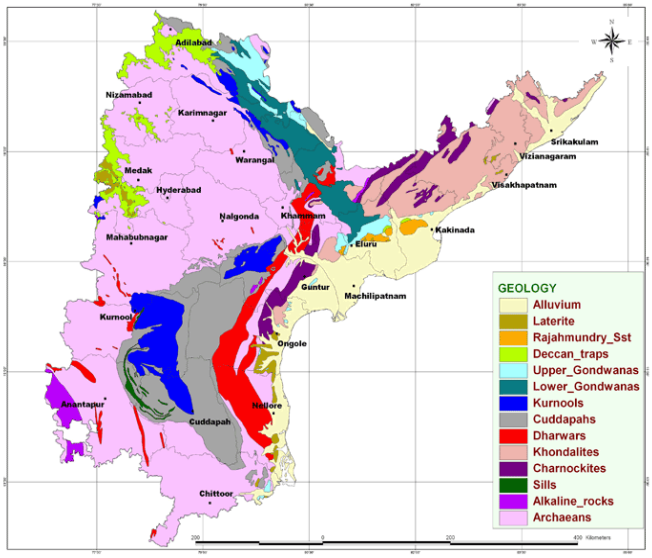
V. Description of the study as a state (Both Telugu States).

5.1. Demography of Andhra Pradesh

Andhra Pradesh, the third largest State of the country with a geographical area of 2.75 lakh Sq Kms. has a forest Cover of 23 %. The State shares its boundaries with Orissa, Tamil Nadu, Chattishgarh, Maharashtra and Karnataka, and on the eastern side is the Bay of Bengal. Total population of about 7.00 crores, which depends mainly on agriculture. Out of the total geographical area of 2.744 lakh sq.kms. about 53 per cent is cultivable land. The growth rate of population as per the previous census (1991) records is 21 per cent per decade on an average. Assuming the same growth rate, the total population of A.P. State by the year 2020 AD will increase to 11.39 Crores. The urban population in Andhra Pradesh has increased to 178.87 lakhs from 62.74 lakhs during the last three decades. Due to rapid industrialization and considering the previous average decadal growth the Urban population may increase to 603 lakhs by 2020 AD.

5.2. Geography of (Telugu States)

From the groundwater point of view, rock formations in the State can be classified into three distinct categories of (a) hard rocks, (b) soft rocks and (c) alluvial formations. Groundwater in these rocks occurs under water table, semi-confined or confined conditions. Groundwater is present in secondary porosity of the host rocks limited to the weathered and fractured zones; joints and bedding planes etc., In the soft rocks and alluvium, the inter granular porosity contributes towards occurrence and movement of groundwater.



Source:http://www.aponline.gov.in/apportal/departments/departments

5.3. Rainfall

Rainfall is the source of recharge to groundwater and during the last decade this source has become erratic and sometimes very low. The number of rainy days has also come down. Thus the recharge to groundwater bodies has come down. Apart from this people are resorting to use groundwater more often because, it is economical, easily available and consumes less time to ground a project, in view of the limited surface water resources and their uneven distribution. Thus the strain on groundwater aquifers mostly in upland areas is increasing day by day.

Table 1

Total Rainfall in Andhra Pradesh June-Aug 2000. (cm)					
Estimated Rainfall		Actual rainfall			
103.6		139.3			
Regional wise Rainfall (cm)					
Telangana		Rayalaseema		Costal Andhra	
Estimated Rainfall	Actual rainfall	Estimated Rainfall	Actual rainfall	Estimated Rainfall	Actual rainfall
48.7	61.7	19.1	32.7	35.8	44.9
Source: Weather Research Center, Visakhapatnam					

Table 1 shows the to weather research center at the time of monsoon season total rainfall reported in the 2011, given to the regional wise, Telangana, Rayalaseema, and coastal Andhra and noted 44.9 out of 35.8 cm rainfall fall in the district this is megar growth.

5.4. Ground water Status of Andhra Pradesh

Andhra Pradesh has 23 districts with 1108 blocks and 26,011 villages. In 2004, The Groundwater Department divided the state into 1229 micro-basins, having an average area of 220 sq. km and classified them according to stage of groundwater development. This classification was based on groundwater levels recorded from selected observation wells and secondary information available on the pumping intensities and cropping Patterns in each micro-basin. In the state 132 micro-basins were classified as overexploited (Groundwater development > 100%); 89 in critical condition (groundwater development 90–100%) and another 175 semi-critical (groundwater development 70– 90%) out of the total 1229 micro-basins.

5.5. Drilling methods and Depth of Ground Water

- During the last three decades:
- Well population increased from 8.0 to 25.0 lakhs.
- Average annual growth rate of well population in the state is about 50,000 wells per year.
- Area irrigated through groundwater increased from 10 to 28 lakh hectares.
- This constitutes about 50% of the total area irrigated.
- About 80% of the drinking water needs are met through groundwater.

Table 2

Average depth of water level (in meters)								
Andhra Pradesh								
Nov 10			Nov 11			Fluctuation		
5.97			8.5			2.53		
Regional wise data								
Telangana			Coastal Andhra			rayalaseema		
Nov 10	Nov 11	fluctuation	Nov 10	Nov 11	fluctuation	Nov 10	Nov 11	fluctuation
6.64	9.33	2.69	4.15	6.68	2.53	8.33	10.75	2.42
Source: Andhra Pradesh Ground Water Department								

Ground water is decreased due to water cycle is disturbing from global warming and deforestation above table 2 shows the average depth of water level in the regional wise in the selective state according to this table coastal average depth of water level (m) noted on November 2011. 6.68 (m) in the coastal Andhra districts.

VI. Geographical Scenario of Selective Area

6.1. Profile of the study Area

The district is a residuary portion of the old Godavari District after West Godavari District was separated in 1925. As the name of the district conveys, East Godavari District is closely associated with the river Godavari, occupying a major portion of the delta area. The headquarters of the district is located at Kakinada. East Godavari district is situated on north east of Andhra Pradesh in the geographical ordination of 16' 30 and 18' 20 of the northern latitude and 81' 30 and 82' 36 of the eastern longitude. East Godavari district covers a vast portion of the delta area of the Godavari River. This district is located on the north-east costal of Andhra Pradesh. The district is bounded on the north by Visakhapatnam district and the state of Orissa, on the east by Bay of Bengal on the south and on the west Godavari district and Khammam districts. It can be broadly classified into three natural zones the delta, upland and agency tracks. It has an area of 10807 Sq.Kms. The headquarters of East Godavari district is Kakinada, which is well connected by rail and road. Kakinada is a natural port with costal length of 144 Km.

6.2. Type of the soils

The main soils in the district are alluvial (clay loamy) red soils, sandy loams and sandy clay. The soils are the mostly alluvial in Godavari delta area and sandy clay at tail and portions of Godavari. There are red loamy soils in uplands and agency area of the district. The climate is comparatively equitable and although it is very warm in may with a maximum temperature of 38.6^0c and with a minimum temperature of 20.3^0c. The actual rainfall received is 1404.6 mm. as against the normal rainfall 1218 mm. from June , 2007 to may ,2008. The percentage of deviation over normal is 15.34 mm. more than half of the annual rainfall (959.5 mm). covered during south west monsoon period from June to September while the large portion of the rest i.e. 223.7 mm. received during the north east monsoon period i.e. October to December.

The general elevation of the district varies from a few feet near the sea to 1500 to the hills of the agency. It has rich alluvial soil accounting for 15% of the total area. There is a variety of geological formation, which includes deposits of graphite and pegmatite. An extent of 323244 hectares was covered with forest by producing valuable items like timber, bamboo and Minor Forest Products (MFP) i.e. tamarind soap nuts, honey, etc. Godavari, Yelaeru and Pampa are the important rivers and streams in the district.

6.3 Population 2011

In 2011, East Godavari had population of 5,154,296 of which male and female were 2,569,688 and 2,584,608 respectively. In 2001 census, East Godavari had a population of 4,901,420 of which males were 2,459,640 and remaining 2,441,780 were females. East Godavari District population constituted 6.09 percent of total Maharashtra population. In 2001 census, this figure for East Godavari District was at 6.43 percent of Maharashtra population.

Table 3

GEOGRAPHICAL INFORMATION OF THE DISTRICT		
Si.No	Description	Value(sq.km)
1	Total Geographical Area	210,818
2	**Physical area**	**26,73,283**
3	Forests	7,78,413
4	Dry & un-cultivable lands	2,04,395.
5	Lands other than agriculture	3,05,250
6	Cultivable dry lands	40,748
7	Permanent green lands	61,336
8	Un-cultivable lands like plants, bushes	20,046
9	Other badava lands	57,908
10	Present badava lands	1,81,281
11	Net cultivable area	10,03,911
Source:http://www.aponline.gov.in/apportal/departments/departments		

Table 4

Water bodies of East Godavari District								
Rivers	Godavari	Yeleru	Burada calva	Seethapalli vagu	Pampa	Sudda gedda	Thandava	Pamuleru
Available water in TMC	127.80	29.28	9.04	4.65	3.42	2.10	3.91	5.50
Water consumed in TMC	127.80	19.01	00	00	1.50	0.60	3.00	00
Ayacut in acres	5,06,415	57.415	00	00	12,005	9,900	18.776	00
Source:http://www.aponline.gov.in/apportal/departments/departments								

Table 5 Status of ground water levels in the east Godavari district.

Year	Month	Agency (M)	Metta(M)	Delta(M)
2010	Feb	7.73	16.19	3.70
2011	Feb	5.57	11.62	2.65
2013	Feb	7.40	14.91	3.49

Table 5 shows Status of ground water levels in the east Godavari district: the East godavari district most utilized ground water mandals (Gandepalli and Rangampeta). Noted in 2013 Feb major percentage Metta area occupies 14.91 (m) and least of Delta area 3.49(m).

VII. Conclusions

1. Ground Water table level is shrinking in all the continents of the world. Agricultural lands are becoming saline
2. The concentration of chemicalsin the groundwater is increasing making it unfit for consumption; wells may be expected to dry up ultimately leading to environmental degradation.

3. Agriculture is the single largest user of water with 70 % followed by industry and energy withdrawing 23 % of water, while household use is just 8 %.

4. However these patterns vary greatly from country to country depending upon the levels of development, climate and population size. In many of the developing countries river pollution from untreated sewage has crossed the limits of the recommended safe limits for drinking and bathing, for example; in India, cremated corpses and millions of tons of sewage is all found in the holy waters of the Ganges. This gives rise to spread of infectious diseases through water related diseases. Such diseases form single largest killers of infants in the third world countries.
5. This is because we lack in well-established practices and water development projects. Besides, much of the water is lost through leakages due to poor maintenance of thousands of tanks, wells, pipes and their fittings, and water reservoirs. Hence, while formulating any strategies for the country, the first priority has to be assigned to the issue of raising of water resources and its management.
6. Water cannot be withdrawn from reservoirs and other sources faster than it is replenished through the natural hydrologic cycle. Water must be drawn at a rate that permits water-table level to remain stable over time.

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