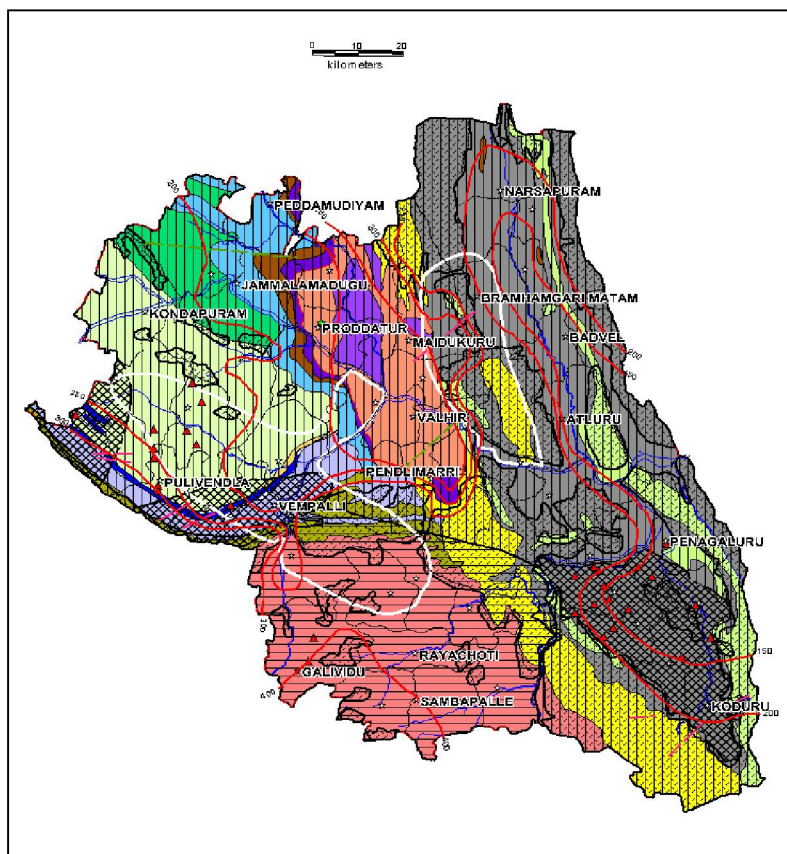




CENTRAL GROUND WATER BOARD
MINISTRY OF WATER RESOURCES
GOVERNMENT OF INDIA

GROUND WATER BROCHURE
YSR DISTRICT (KADAPA), ANDHRA PRADESH



SOUTHERN REGION
HYDERABAD
September 2013



CENTRAL GROUND WATER BOARD
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YSR DISTRICT (KADAPA), ANDHRA PRADESH
(AAP-2012-13)

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**GROUND WATER BROCHURE
YSR DISTRICT (KADAPA), ANDHRA PRADESH**

CONTENTS

DISTRICT AT A GLANCE

1.0 INTRODUCTION

2.0 CLIMATE

3.0 GEOMORPHOLOGY, DRAINAGE & IRRIGATION

4.0 GEOLOGY

5.0 HYDROGEOLOGY

6.0 DEPTH TO WATER LEVEL

7.0 GROUND WATER RESOURCES

8.0 GROUND WATER QUALITY

9.0 GROUND WATER DEVELOPMENT

10.0 GROUND WATER RELATED ISSUES & PROBLEMS

11.0 CONCLUSIONS

DISTRICT AT A GLANCE

1. GENERAL

Location	: North Latitudes 13° 43' and 15°14' East Longitudes 77°55' and 79° 29'
Geographical area (sq.km)	:15,379 Sq.km
Headquarters	:Kadapa
No. of revenue mandals	:51
No. of revenue villages	:965
Population (2011)	:28,84,524 (Male:14,54,136 and Female: 14,30,388)
Urban	:9,83,736
Rural	:19,00,788
Population density	:188 (persons/sq.km)
Decadal Growth Rate (1991-2001)	:10.87%
Major rivers	:Pennar and its tributaries viz. Papagni, Papagni, Cheyyair, Chitravati, Sagileru, Kundu
Soil	:Red loamy, Red sandy, Red earths and Black
cotton soils	

2. CLIMATE

Actual rainfall (2012)	: 550 mm
Average Annual Rainfall (1999-2011)	: 709.6 mm

3. LAND USE (2012) (Area in ha)

Forest	: 5,00,961
Barren and uncultivated	: 2,22,099
Cultivable waste	: 46,013
Current fallows	: 1,35,935
Net area sown	: 3,52,762

4. IRRIGATION -2012 (area in ha)

Canals	: 21,758
Tanks	: 3,892
Dug wells	: 4,168
Bore/Tube wells	: 1,29,983
Others	: 887
Net area irrigated	: 1,60,688
Gross area irrigated	: 1,96,386
Major irrigation projects	: K.C.Canal, TBP-HLC Stage-I &II and Pulivendula Branch Canal
Medium irrigation projects	: Lower Sagileru, Upper Sagileru, Pincha, Buggavanka and Annamayya Projects

5. PRINCIPAL CROPS GROWN 2010-11 (Area in Ha.)

Paddy	: 70,382
Ground Nuts	: 1,60,595
Total Pulses	: 1,01,627
Cotton	: 15,021
Jawar	: 5,384
Bajra	: 4,940
Turmaric	: 5,518
Total Oil Seeds	: 2,42,231

6. GEOLOGY

Major rock types : Granite-gneisses, schist, phyllite, dolomite, quartzite, limestone, sandstone, shale and alluvium.

7. GROUND WATER

Exploration by CGWB

No. of wells drilled : 81 (EW:43, OW:28,PZ: 4 and WT:6)
Major aquifer zones : 8.0-196.5 m bgl
Depth to Water Level (Pre-monsoon 2012)
(Min – Max) : 3.13 to 17.35 m bgl
Depth to Water Level (Post monsoon-2012)
(Min – Max) : 2.09 to 14.57 m bgl

Aquifer parameters

Transmissivity (sq.m/day) : 1.51 to 884.7 sq.m/day
Storage Co-efficient : 1.3×10^{-5} to 0.59×10^{-3}
Number of Monitoring Wells : 29 (Dug wells-26 & Pz-3)

7. GROUND WATER RESOURCES (MCM) As on March, 2009

Net ground water availability : 1,05,039 ham
Gross annual draft : 65,194 ham
Net GW availability for future irrigation : 39,845 ham
Stage of ground water development : 62 %

8. CHEMICAL QUALITY

	Shallow	Deeper
Electrical Conductivity (micro Siemens/cm at 25°C)	: 472-3891	444-2240
Chloride (mg/l)	: 27-773	8-262
Fluoride (mg/l)	: 0.34-3.60	0.360-2.890
Nitrate (mg/l)	: 0-340	1-148

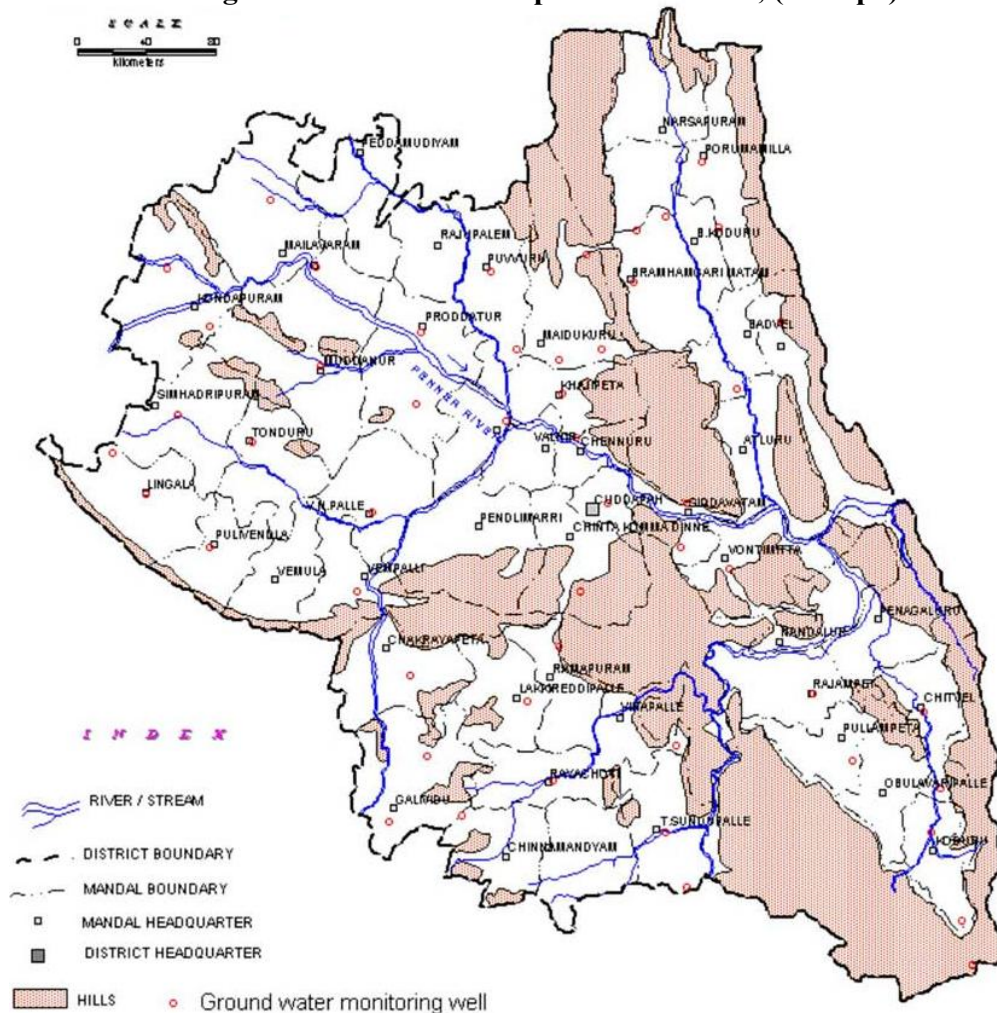
GROUND WATER BROCHURE

YSR DISTRICT (KADAPA), ANDHRA PRADESH

1. INTRODUCTION

YSR District (Kadapa) is one of the chronically drought affected districts of Rayalseema Region of Andhra Pradesh. It has a total geographical area of 15,379 sq.km with 3 Revenue divisions, 51 mandals, 831 gram panchayats, 965 revenue villages and 4533 habitations and lies between the 13° 43' and 15°14' North latitudes and 77° 55' and 79° 29' of the East longitude. **(Fig-1).** The annual normal rainfall received by the district is 709.6 mm. Southwest and northeast monsoon contributes 55% and 30% respectively. The YSR District (Kadapa) is drained by Pennar river and its chief tributaries are cheyyair, Papaghni, Chitravati, Sagileru and Kunderu. Pincha and Mandavi are minor streams. About 21,758 ha area is irrigated by canals while 4,168 ha. and 1,29,983 ha. are irrigated through dug wells and bore wells respectively. It has ground water resources of 1.05 lakh ham.

Fig.1: Administrative Map of YSR district, (Kadapa)



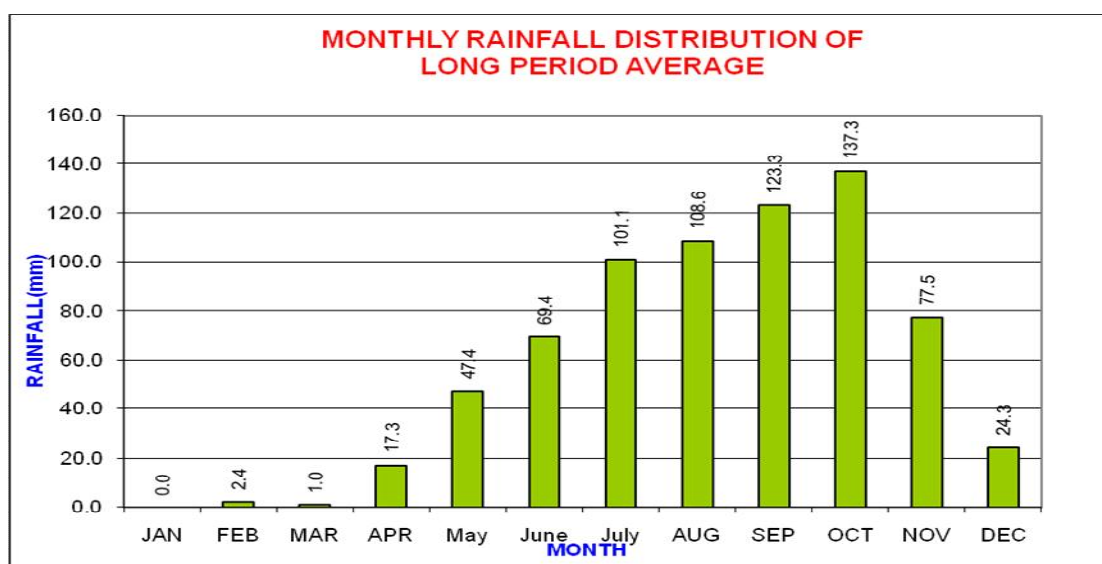
Out of the total geographical area of 5,00,961 ha (32.57%) of the area is covered by forests. Similarly, barren and uncultivable land is 14.4% and cultivable waste and current fallows put together is 9.1%. The net area sown is 8.6% to the total geographical area.

The important crops harvested in the district are paddy (70,382 ha), Cotton (15,021 ha), Total pulses (1,01,627 ha), Ground Nuts (1,60,595 ha), Mango (22,283 ha.) and Banana (8,706 ha). Ground nut is the major crop that grown in the district ground nut followed by Pulses and Paddy and Mangoes respectively.

2. CLIMATE

The average annual rainfall of the YSR District (Kadapa) is 710 mm, which ranges from nil rainfall in January to 137 mm in October. October is the wettest month of the year. The mean seasonal rainfall distribution is 402.4 mm in southwest monsoon (June-September), 239.1 mm in northeast monsoon (Oct-Dec), 2.4 mm rainfall in Winter (Jan-Feb) and 65.7 mm in summer (March – May). The percentage distribution of rainfall, season-wise, is 56.7% in southwest monsoon, 33.7 % in northeast monsoon, 0.34 % in winter and 9.3 % in summer. The mean monthly rainfall distribution is given in **Fig- 2**.

Fig.2: Mean Monthly Rainfall Distribution



The annual and seasonal rainfall distribution with its departure from mean along with percentage distribution year-wise is given in **Table 1**. The annual rainfall ranges from 460 mm in 1999 to 910.8 mm in 2007. The annual rainfall departure ranges from -35 % in 1999 to 28 % in 2007. The southwest monsoon rainfall contributes about 56.7 % of annual rainfall. It ranges from 200.6 mm in 2002 to 630.5 mm in 2007. The years 1999, 2002 and 2006 experienced drought conditions in the district as the annual rainfall recorded is 35%, 34% and 26% less than the long period average (LPA) respectively. The departure of annual rainfall from LPA is presented in **Fig-3**. It indicates that, the rainfall departure as on 2011 is negative i.e. -35%, showing rainfall deficiency.

Fig.3: Departure of Annual Rainfall From LPA

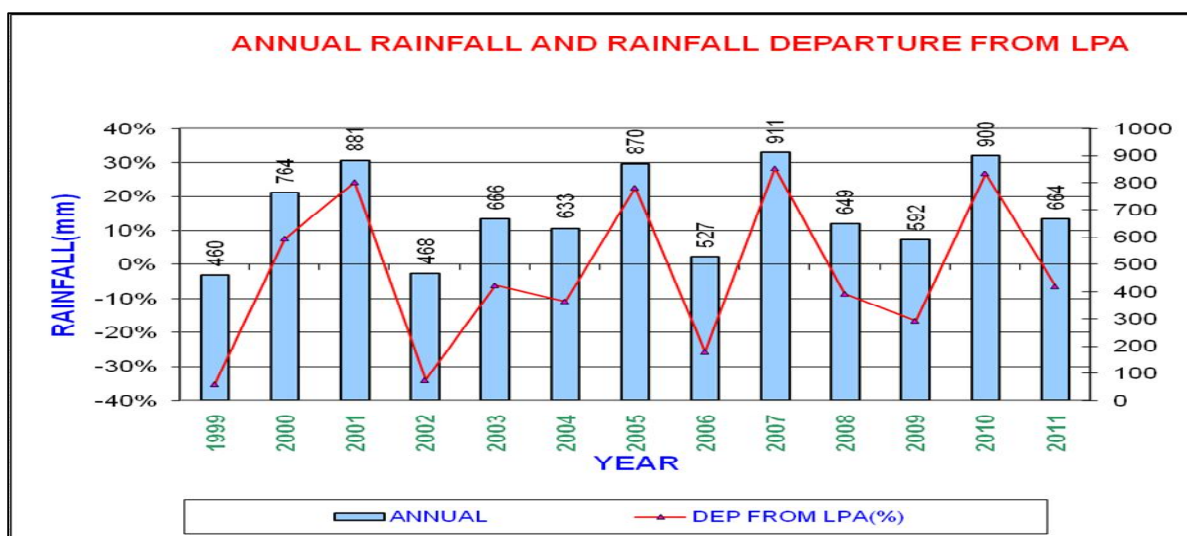


Table-1: MONTHLY RAINFALL DISTRIBUTION OF YSR DISTRICT (KADAPA) DISTRICT (1999-2011)

Sl No	Year	Annual	SWM	NEM	Winter	Summer	SW(%)	NEM (%)	Winter %	Summer (%)	Dep from(%)
1	1999	460.0	265.0	149.0	2.0	44.0	57.61	32.39	0.43	9.57	-35%
2	2000	764.0	480.0	169.0	17.0	98.0	62.83	22.12	2.23	12.83	8%
3	2001	881.2	355.0	445.2	0.0	81.0	40.29	50.52	0.00	9.19	24%
4	2002	468.2	200.6	202.6	6.0	59.0	42.85	43.27	1.28	12.60	-34%
5	2003	666.2	410.3	242.0	0.0	13.9	61.59	36.33	0.00	2.09	-6%
6	2004	632.5	351.4	99.8	0.2	181.1	55.56	15.78	0.03	28.63	-11%
7	2005	869.6	328.9	465.3	4.4	71.0	37.82	53.51	0.51	8.16	22%
8	2006	527.4	308.9	111.6	0.0	106.9	58.57	21.16	0.00	20.27	-26%
9	2007	910.8	630.5	240.4	0.0	39.9	69.22	26.39	0.00	4.38	28%
10	2008	648.7	259.0	281.7	33.7	74.3	39.93	43.43	5.20	11.45	-9%
11	2009	591.6	368.8	167.1	0.1	55.6	62.34	28.25	0.02	9.40	-17%
12	2010	899.7	504.5	327.1	2.3	65.8	56.07	36.36	0.26	7.31	27%
13	2011	664.3	392.0	209.6	1.8	60.9	59.01	31.55	0.27	9.17	-6%
Long Period Average		709.5	402.4	239.1	2.4	65.7	56.72	33.69	0.34	9.25	

Source: India Meteorological Department and Directorate of Economics and Statistics

3. GEOMORPHOLOGY, DRAINAGE & IRRIGATION

PHYSIOGRAPHY:

The district has an irregular landscape with a number of hill ranges and hills with intervening valleys and high lands. The highest elevation is 1108 m amsl. The important hill ranges are Velikonda, Nallamalais, Yerramalai, Palakonda and Lankamalai are trending in NW-SE or E-W direction.

DRAINAGE:

The important rivers that drains through the district is Pennar which is perennial and flows in NW-SE direction. Its tributaries Chitravathi, Cheyyair, Papagni, Kundair and Sagileru are intermittant in nature. The drainage pattern in general is dendritic to sub-dendritic and parallel. The drainage is often parallel to sub parallel indicating structural control.

GEOMORPHOLOGY:

Geomorphologically, YSR District (Kadapa) has been classified into three units based on relief, slope factor and soil. The three groups are (i) Structural land forms (ii) Denudational land forms and (iii) fluvial land forms.

- i) **The structural landforms:** These include structural hills, structural valleys, cuesta hills, Mesa/Buttee, linear ridges, intermontane valleys etc. These landforms occupy in considerable part and are mostly developed in eastern part. The structural hills, cuesta hills, Mesa/Buttee are generally not suitable for ground water development. The structural valleys and intermontane valleys are generally suitable for ground water development with good recharge.
- ii) **Denudational land forms:** These include pediplain, pediment- inselberg complex. Piedmont zone and residual hills. The ground water prospects are limited in shallow weathered pedipline and pediment inselberg complex, where as ground water prospects are moderate in moderately weathered pediplain.
- iii) **Fluvial land forms:** These include alluvial plains along major rivers and Bazada zones. Flood plains form highly productive zones, while Bazada forms along foot hills and form shallow aquifers with good yields.

IRRIGATION:

Irrigation in the district is through major, medium and minor irrigation projects. There are 4 major, 5 medium irrigation projects in the district. The major irrigation projects are 1) Kurnool- canal 2) TBP HLC Stage-I, 3) TBP HLC Stage-II (Mylavaram) and 4) Pulivendula Branch canal with a total ayacut of 2,27,896 acres. The five medium irrigation projects are 1) Lower Sagileru Project 2) Upper Sagileru Project 3) Pincha Project 4) Buggavanka Project and 5) Annamayya Project with a total ayacut of 55,625 acres. The area irrigated during the year 2010-11 through these canals is 27,305 Ha., and through ground water is 1,22,781 Ha., Irrigation from the other sources (1,125 ha.) and through tanks 8,042 Ha.

4. GEOLOGY

The YSR District (Kadapa) is underlain by various rock types belong to Late Archaean or Early Proterozoic era which are succeeded by rocks of Dharwarian Age and both are traversed by dolerite dykes. The older rocks are overlain by rocks of Cuddapah Super group and Kurnool Group belonging to Middle and Upper Proterozoic Age. The Cuddapah Sedimentary Basin, which is a huge depression formed over the denuded surfaces of older rocks extending into neighbouring districts occupies the major part of the district. The major rock types are quartzites, shales, limestones, phyllites, granites, granodiorites and granite gneiss. The Archaean comprises the Peninsular Gneissic Complex, represented by granite, granodiorite, granite-gneiss and migmatite. These rock types occur in the southwestern part of the district. Both the Archaean and Dharwar are traversed by dolerite dykes and quartz reefs. Alluvium consisting of gravel, sand, silt and clay occur along the river courses in the district.

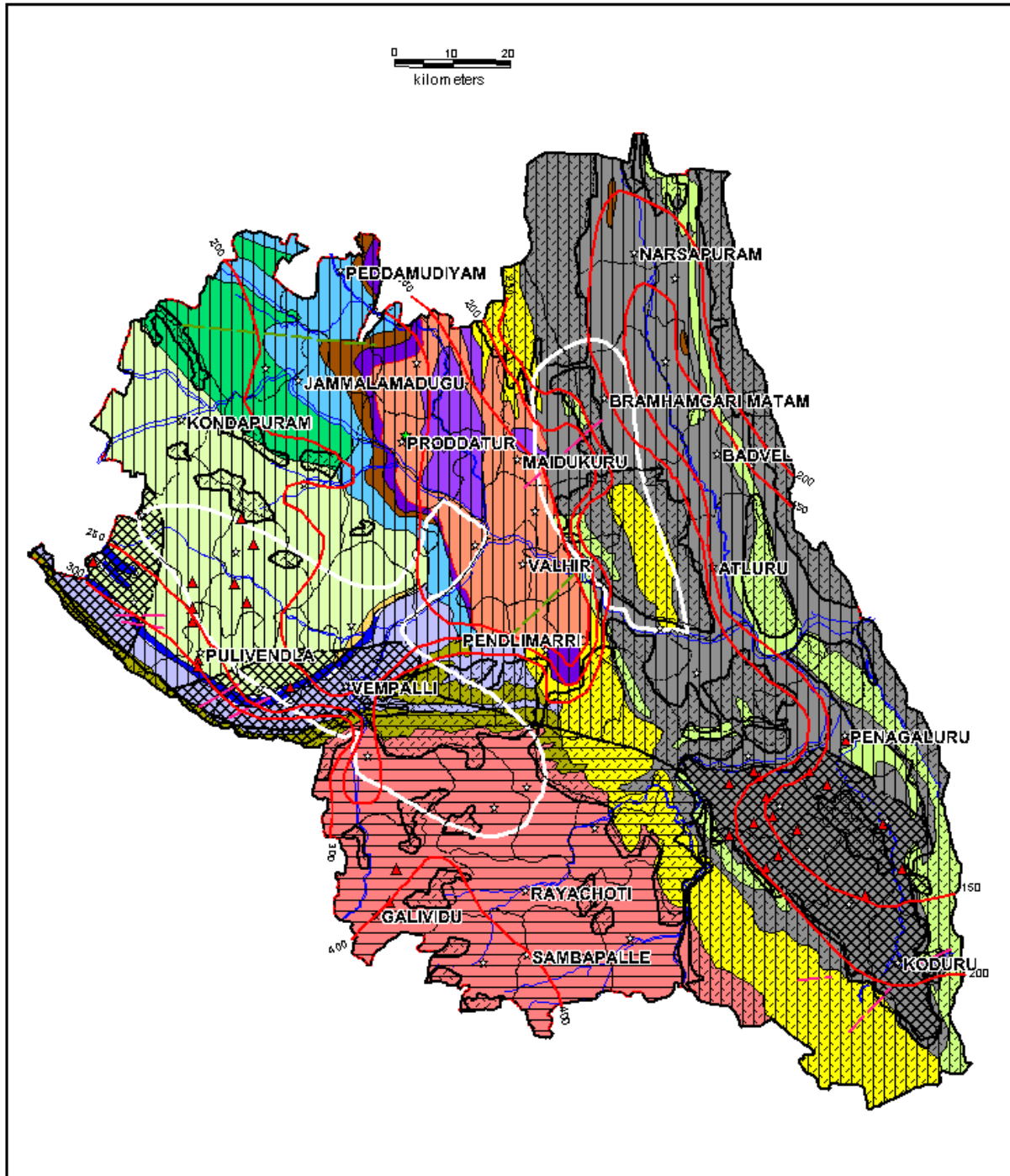
5. HYDROGEOLOGY

The YSR District (Kadapa) is underlain by various rock types of different age groups ranging from Archaean to Recent.

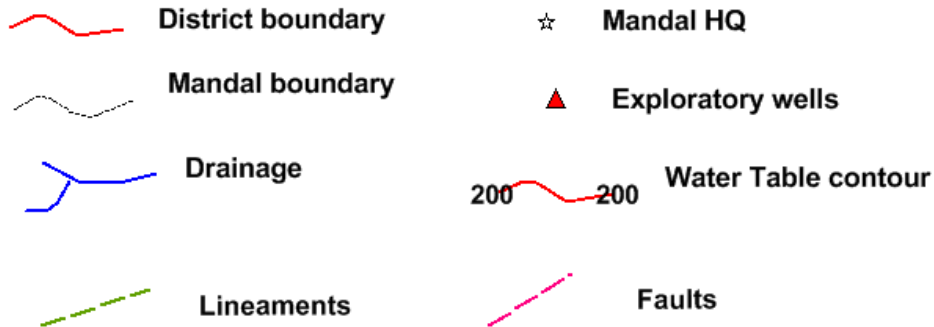
Ground water in Archaean Crystalline rocks: These rocks consists mostly granite gneisses, migmatites and generally lack primary porosity. However, development of secondary porosity through weathering and fracturing gives scope for occurrence of ground water. Ground water occurs under unconfined conditions in weathered portion and under semi-confined conditions in joints and fractures. The ground water in weathered zone is developed by large diameter (6 m) dug wells and dug-cum-bore wells. The thickness of the weathered zone is generally upto 10 m in most of the area. During the rainy season, these wells sustain pumping around 4 hrs. in a day in two spells and yields 20 to 60 cu.m/day in rainy season. However, during the Rabi season, most of the wells are likely to yield less i.e., 5 to 20 cu.m/day and in drought years, likely to be dried up.

The ground water in fractured portion is developed through construction of shallow/deep bore wells. Central Ground Water Board has carried out ground water exploration at the locations from depth ranging 107.20 to 200 m bgl. The drilling data reveals that fracture zones were encountered at various depths ranging from 8.00 to 145.80 m bgl. However, generally, the potential fractures were encountered between 20 and 100 m bgl. The cumulative yield of fracture zones varies from 0.1 to 4.9 lps. However, general yield of bore wells was found to be between 1 to 3 lps sometimes even more depending upon the fractured zone encountered in the bore well. The hydrogeological conditions in the district are presented in Fig.4.

Fig4. Hydrogeology map-YSR District (Kadapa), A.P



LEGEND

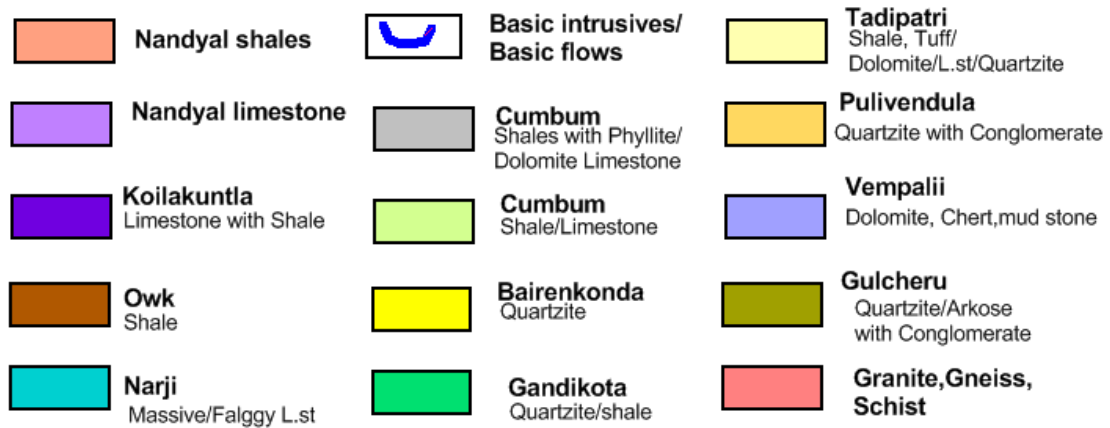


Yield Potential in Ips



No Window

GEOLOGY



Ground Water in Cuddapah and Kurnool formations:

Kadapa/Kurnool formations consist of mostly shales, quartzites, limestones/dolomites. Ground water occurs under water table conditions in weathered portion of the formation and the thickness of the weathered portion is around 10 m bgl. Ground water is developed in weathered portion through large diameter dug wells (6m). As the pressure on ground water increases, the water levels were lowered and the yields from dug wells decreased and occasionally dried up in the drought years.

Central Ground Water Board has carried out ground water exploration at the locations from depth ranging 30 to 200 m bgl. The drilling data reveals that fracture zones were encountered at various depths ranging from 8.00 to 196.90 m bgl. However, generally, the potential fractures were encountered between 25 and 120 m bgl. The cumulative yield of fracture zones varies from 0.08 to 21 lps. However, general yield of bore wells was found to be between 1 to 7 lps sometimes even more depending upon the fractured zone encountered in the bore well.

Ground Water in Alluvium formation:

Alluvium occurs along the river courses in the district. The thickness of the alluvium varies from 1 m to 20 m bgl. Ground water development in alluvium is through filter point wells upto 15 m depths. The yields vary from 2 to 12 lps, depending upon the thickness of the alluvium. Infiltration wells are also constructed at suitable locations for village water supply and lift irrigation schemes in these formations.

Aquifer parameters

Central Ground Water Board has carried out pumping tests in bore wells to know the aquifer parameters. In Archaean formations, the dug wells sustain pumping for 3 to 7 hrs. per day and capable of yielding of 101 to 217 cu.m/day. The Kadapa/Kurnool formations sustain intermittent pumping for 5 to 8 hrs./day and capable of yielding 198 to 290 cu.m/day. The wells in alluvium sustain pumping for 5 to 7 hrs./day and can yield 136 to 237 cu.m/day. The transmissivity determined from the aquifer performance tests is highly variable from 1.13 to 884.7 sq.m/day. Higher values are noticed in Cheyyeru basin, comparable to the Papagni basin. The storativity values of the aquifers range from 1.0×10^{-5} to 5.19×10^{-2} . The transmissivity low yielding wells range from 0.5 to 3.7 sq.m/day.

Deep Aquifers

The deep fractured rocks form potential aquifers in the Archaean crystallines. These are exploited by constructing bore wells. The depth of bore wells generally ranges from 25 to 80 m with yields varying from 0.1 to 15 liters per second (lps). The Central Ground Water Board and State Ground Water Department (SGWD) and Andhra Pradesh State Irrigation Development Corporation (APSIDC) drilled several borewells in Archaeans. The perusal of data indicates that the total depth of the wells is shallow, ranging from 30 to 80 m bgl. With yields generally ranging from 0.5 to 10 lps.

The Central Ground Water Board has carried out the exploration between 1992- 98 and 43 exploratory wells and 32 observation wells down to a depth of 200 m. The drilling discharges are highly variable from meagre 0.01 lps to as high as 21 lps in meta sediments and from traces to 3 lps in granites. The most of the potential fractures were encountered between 20 and 100 m. However the potential fractures also occur rarely between 100 and 196 m. Highly cavernous limestones occur both in Cheyair and Papaghni basins.

The transmissivity determined from the aquifer performance tests is highly variable from 1.13 to 884.7 sq.m/day. Higher values are noticed in Cheyyeru basin, comparable to the Papagni basin. The storativity values of the aquifers range from 1.0×10^{-5} to 5.19×10^{-2} . The transmissivity low yielding wells range from 0.5 to 3.7 sq.m/day.

6.0 DEPTH TO WATER LEVEL

Ground water levels are monitored from a network of 29 hydrograph stations in the district which are being monitored four times in a year i.e. in the months of January, May, August and November. These observation wells, tapping the phreatic aquifer, include dug wells (26) and 3 Piezometer wells. The historical water levels highlight the areas extent of ground water behavior and over exploitation and fluctuations of water levels and quality changes with time and in space, effects of surface water on ground water, rainfall (Pre-and post-monsoon) recharge, chemical and other anthropogenic activities on the ground water regime. The depth to water level distribution maps prepared for May,2012 (Pre-monsoon) and Nov,2012 (Post monsoon) were shown in **Fig. 5,6**.

Pre-monsoon water levels: The depth to water level during pre-monsoon (2012) range from 3.13 m to 17.35 m bgl. The shallow water levels of 2 to 5 m are observed in north east and north western part of the district. The depth to water levels between 5-10 m are observed in majority of the area. Deeper water levels of more than 10 m bgl are observed in the northwestern and south eastern parts of the district.

Post-monsoon water levels: The depth to Water level range from 0.85 to 12.27 m bgl during the post monsoon period (2012). The shallow water levels of less than 5 m are observed in northern and southern part of the district. The depth to water levels between 5-10 m are observed in major part of the area. The depth to water levels 10 -20 m are observed in north western and south eastern part of the district (Fig-6).

Fig.5: Depth to Water Level Map of YSR District (Kadapa), A.P (May 2012)

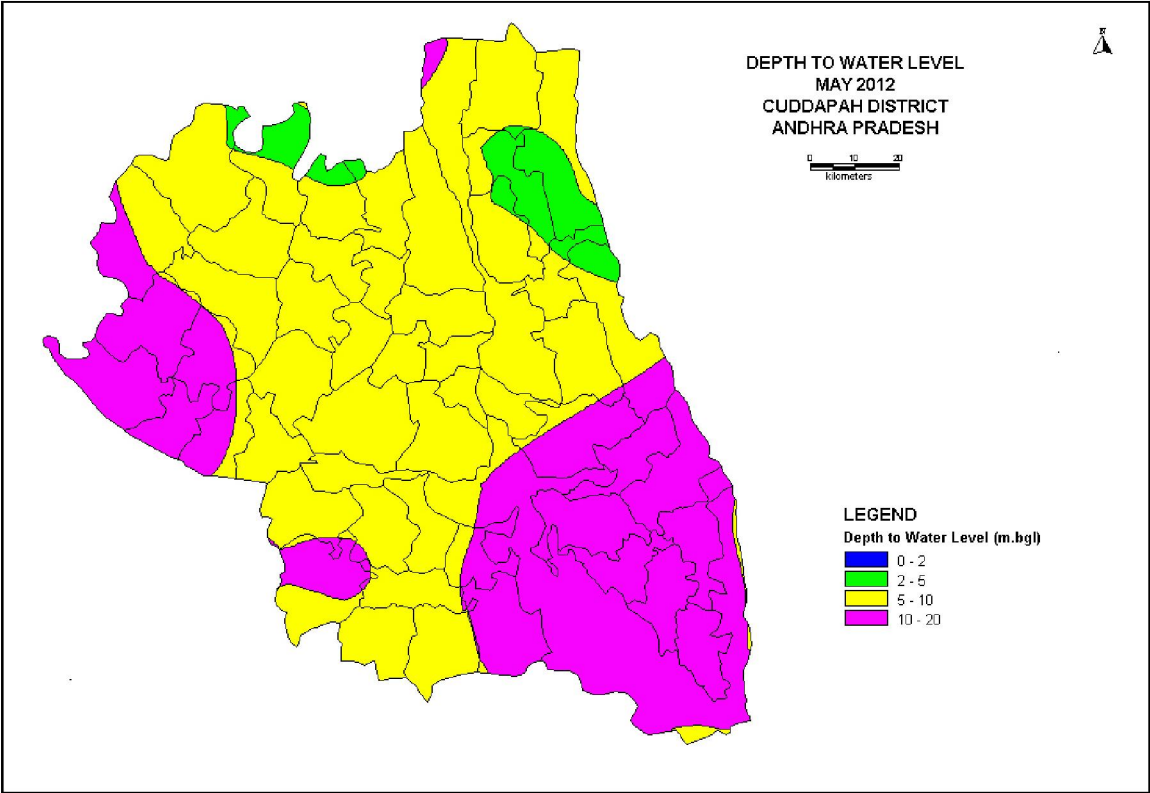
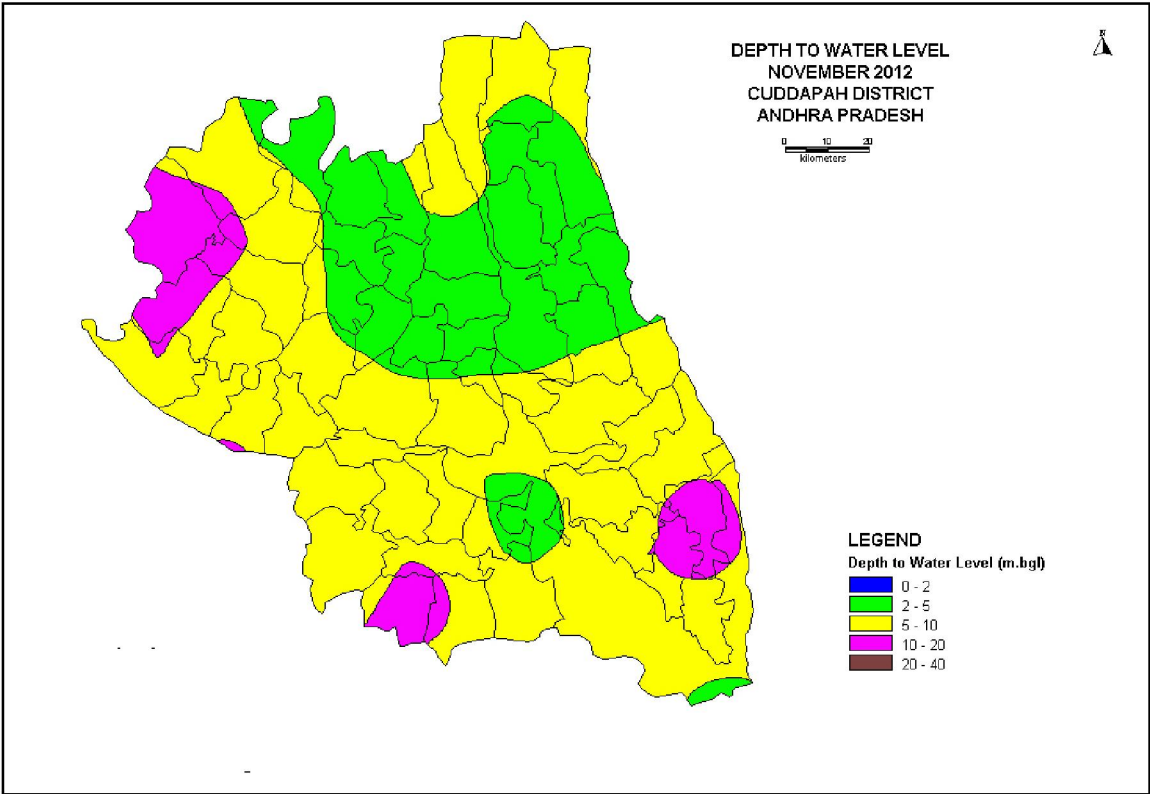
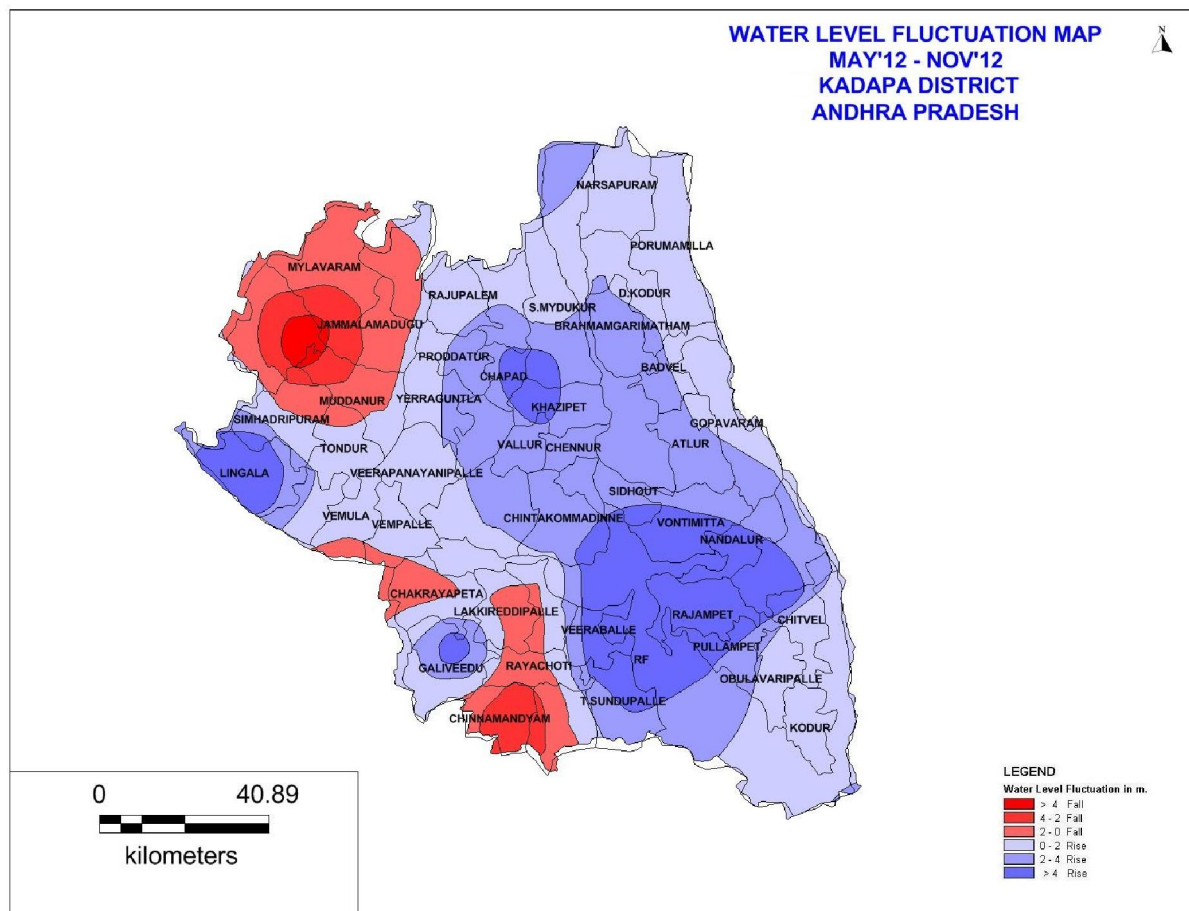


Fig.6: Depth to Water Level Map of YSR District (Kadapa), A.P (Nov-2012)



Water level fluctuation : Majority of the district shows rise in water level between pre and post monsoon period of 2012. Rise in water level between 0-2 m observed in north eastern, western and southern part of the district. Rise of water level between 2-4 m is observed in central and south western part of the district. Rise of water level of more than 4 m is observed in central and south eastern, southern and north western part of the district. Water level fall of 0-2 m is observed in very limited part of the district. Fall in the range of 2-4m is seen in north western and south western part of the district. (Fig.7).

Fig.7: Water Level Fluctuation Map (Pre-Post) of YSR District (Kadapa), A.P (2011)



Long Term Water Levels

Ground Water Regime Studies:

There is a perceptible rise in the water levels from June/July onwards till December every year. Then the water levels fall from December onwards till May. Just after the onset of monsoon. This is reflected in the hydrographs with a steep rise and decline. Based on the representative hydrograph data, hydrographs have been generated for the period since 1993-2012 and the same are given in Fig.8. On perusal of the hydrographs it is observed that out of the 81 hydrographs 45 are showing falling trends during the period.

To assess the long-term trends of water levels in the district, the National Hydrograph Network Stations data for 20 years (1993-2012) of Central Ground Water Board and State Ground Water Department were analyzed. About 44% of the wells are showing general rising trend of 0.0001 to 1.4219 m/year and the rest 56% of the wells are showing falling trend varying from 0.0005 to 1.9786 m/year.

7. GROUND WATER RESOURCES

Based on the Ground Water Estimation Committee (GEC 97) norms, ground water assessment was done in 2008-09. The mandal-wise details are presented in **Table-2**. The net ground water availability is 1,62,783 ha.m in command area and 9,634 ha.m in non-command area and total ground water resources available in the district 1,72,417 ha.m. The existing gross ground water draft for all uses in the district is 31,933 ha.m, which is 27,604 ha.m in command area and 4,329 ha.m in non command area. The net ground water availability for future irrigation is 1,28,445 ha.m and 4,137 ha.m in command and non-command areas respectively. The stage of ground water development in command area is 17%, while it is 45% in non command areas and 19% in the entire district. All the mandals and falls under safe category.

8. GROUND WATER QUALITY

The ground water in the district is in general suitable for both domestic and irrigation purposes. The Electrical Conductivity ranges from 472 to 3891 micro Siemens/cm at 25°C. Distribution of F ranges from 0.34 to 3.6 mg/l, while nitrates ranging from 0 to 340 mg/l.

The assessment of deep ground water is done based on 19 water samples collected from the bore wells during the exploratory drilling programme. The deeper ground water is generally alkaline with pH varies from 6.00 to 8.65. The electrical conductivity varies from 444 to 2240 micro Siemens/cm at 25°C. About 58% of the samples have Nitrate more than permissible limit of 45 mg/l. Fluoride content more than permissible limit of 1.5 mg/l have in 10% of samples of deeper ground water.

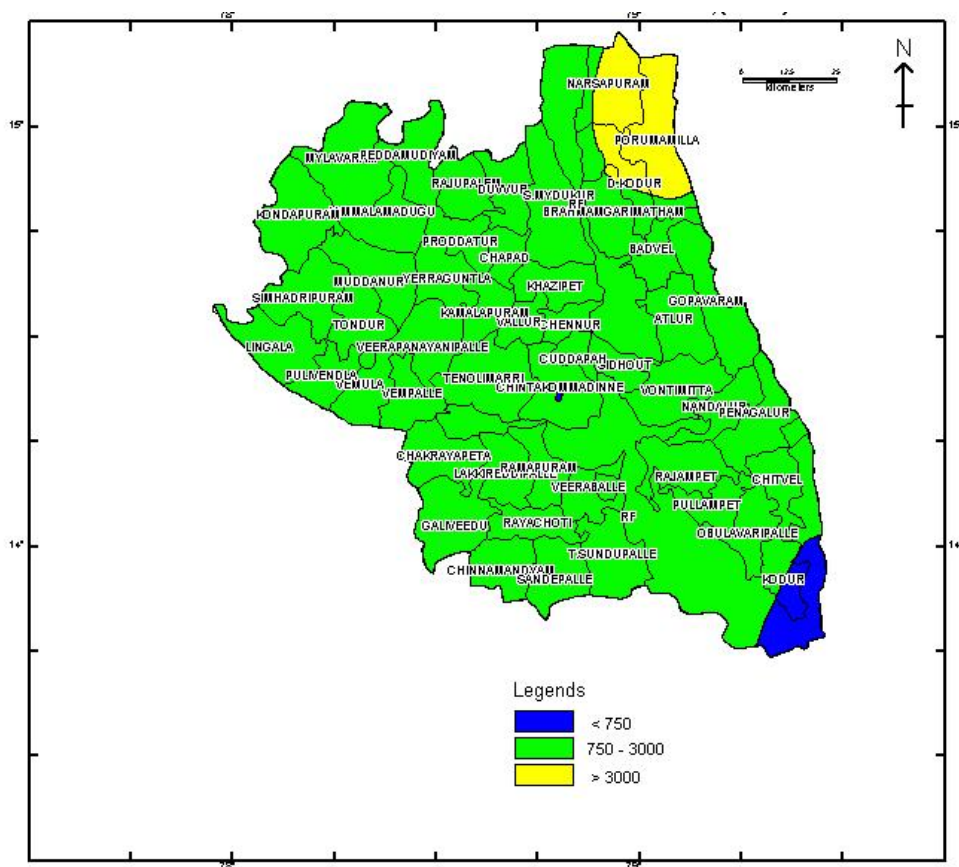
Table-2: Assessment of Mandal Wise Dynamic Groundwater Resources of the YSR District (Kadapa)
Andhra Pradesh [2008-2009] [In Ha.M.]

Sl. No	Mandal	Net annual ground water availability	Existing gross ground water draft for irrigation	Existing gross GW draft for domestic and industrial water supply	Existing gross ground water draft for all uses	Provision for domestic & industrial requirement supply to 2025	Net GW availability for future irrigation development	Stage of ground water development	Category
1	2	3	4	5	6	7	8	9	10
1	Atloor	1339	957	88	1045	88	294	78	SC
2	B.Koduru	1432	850	69	919	75	507	64	Safe
3	B.Mattam	3297	1371	109	1480	137	1789	45	Safe
4	Badvel	1741	695	116	811	116	930	47	Safe
5	Chakrayapeta	2314	1425	57	1482	57	832	64	Safe
6	Chapadu	2349	1176	133	1309	133	1040	56	Safe
7	Chennuru	1296	509	114	623	150	637	48	Safe
8	Chinna mandem	1280	1229	58	1287	58	0	101	OE
9	Chintakomma dinne	3188	1392	213	1605	213	1583	50	Safe
10	Chitvel	1962	1112	155	1267	155	695	65	Safe
11	Duvvur	3419	1027	329	1356	366	2026	40	Safe
12	Galiveedu	2928	1647	90	1737	90	1191	59	Safe
13	Gopavaram	1223	387	96	483	96	740	39	Safe
14	Jammala madugu	1946	842	67	909	67	1037	47	Safe
15	Kadapa	1170	46	313	359	313	811	31	Safe
16	Kalasapadu	2218	1815	70	1885	70	333	85	SC
17	Kamalapuram	1891	1443	94	1537	94	354	81	SC
18	Kasinayana	2949	1562	118	1680	144	1243	57	Safe
19	Khajipet	3602	1390	224	1614	293	2196	45	Safe
20	Koduru	1857	988	183	1171	183	686	63	Safe
21	Kondapuram	3304	2161	74	2235	74	1069	68	Safe
22	Lakkireddi palli	1839	1046	67	1113	67	726	61	Safe
23	Lingala	1563	1075	58	1133	58	430	72	SC
24	Muddanur	1860	1382	96	1478	96	382	79	SC
25	Mydukur	3239	1254	150	1404	194	1791	43	Safe
26	Mylavaram	2742	1105	69	1174	69	1568	43	Safe
27	Nandaluru	1158	585	96	681	96	477	59	Safe
28	Obulavari palli	1751	1208	195	1403	195	348	80	SC
29	Peddamudium	1866	636	83	719	83	1147	39	Safe
30	Penagaluru	1805	808	191	999	191	806	55	Safe
31	Pendlimarri	2382	1529	130	1659	130	723	70	Safe
32	Porumamilla	2544	1848	116	1964	116	580	77	SC
33	Proddatur	1913	842	159	1001	556	515	52	Safe
34	Pulivendula	970	1273	86	1359	86	0	140	OE
35	Pullampeta	1481	1502	175	1677	175	0	113	OE

1	2	3	4	5	6	7	8	9	10
36	Rajampeta	2504	1688	251	1939	251	565	77	SC
37	Rajupalem	2193	504	124	628	136	1553	29	Safe
38	Ramapuram	1821	1036	60	1096	60	725	60	Safe
39	Rayachoty	1742	1089	95	1184	95	558	68	Safe
40	Sambepalli	1964	978	67	1045	67	919	53	Safe
41	Sidhout	2073	1236	121	1357	121	716	65	Safe
42	Simhadripuram	1906	1416	62	1478	62	428	78	SC
43	T.Sundupalli	2909	1970	91	2061	91	848	71	SC
44	Thondur	1516	1045	48	1093	48	423	72	SC
45	Vallur	1187	921	70	991	81	279	83	SC
46	Veeraballi	2125	1291	86	1377	86	748	65	Safe
47	Vempalli	2012	1351	75	1426	75	586	71	SC
48	Vemula	1130	1369	57	1426	57	0	126	OE
49	VNPalli	1869	971	75	1046	75	823	56	Safe
50	Vontimitta	2613	1576	78	1654	78	959	63	Safe
51	Yerraguntla	1657	702	133	835	133	822	50	Safe
	District Total	105039	59260	5934	65194	6600	40438	62	

SC = Semi-critical, OE = Over exploited

Fig. 8: Distribution of EC in YSR District (Kadapa), A.P (2011)



9. GROUND WATER DEVELOPMENT

In the olden days, the ground water development is through dug wells. Over a period of time, due to increase in population, the stress on ground water has increased. Consequently, the water levels were lowered and the dug wells are replaced by dug-cum-bore wells, shallow bore wells and presently by deep bore wells. The dug wells are generally circular or rectangular in shape and generally down to 10 m depth. The shallow bore wells for hand pumps are generally down to 60 m. Deep bore wells with 162 mm diameter were drilled down to 300 m in non-command areas and down to 100 m in command areas. The dug wells are fitted with centrifugal pumps of 5 to 7.5 HP whereas the shallow bore wells where water levels are shallow are fitted with hand pumps for drinking and domestic purposes. The irrigation bore wells are fitted with submersible pumps ranging from 5 to 20 HP.

There are 1243 P.W.S. schemes, 5443 bore wells and 210 open wells for meeting the demands of domestic needs. Most of the open wells are in Atloor, Chapadu, B. Mattanur, Kalespadu, Tandur and Srihardipuram mandals. Most of the irrigation is through ground water in the district. Around 86% of the total irrigation is through ground water of which 81% is through bore wells and filter points and 5% through dug wells indicating the role of bore wells and filter points in the district.

10. GROUND WATER RELATED ISSUES AND PROBLEMS

Water Logged areas:

The prone to water logging conditions with water levels between 2-5 m bgl occur in major part of the district during post monsoon periods and water logging conditions occur in limited areas in the north eastern part of the area (Part of K.C canal command area).

Prone to water logging conditions occur in limited areas in the north eastern part of the district during pre-monsoon period.

Polluted areas:

Ground water pollution in YSR District (Kadapa) district is not conspicuous except but activities. About 58% of the samples show Nitrates beyond permissible limits in shallow ground water, while it is about 30% in deeper ground water. About 12% of the samples show Fluoride beyond permissible limits.

Water Table Depleted areas:

Due to increased ground water development there is depletion of water table and piezometric levels. Long term water level trends of last two decades (1993-2012) shows that, about 56% of the monitoring wells showing depleting water table mostly in the western part of the area and south eastern part of the area. The range of depletion of water table varies from 0.0005 to 1.9786 m/year in the area.

11. CONCLUSIONS

1. It is seen from the exploration data that most of the potential zones were encountered within the depth range of 20-150 m and beyond this depth, potential fractures through occur, but rare.
2. Conjunctive use practices have to be adopted in the command area by utilizing both surface and ground water resources. Ground water potential zones in the command area are to be identified and developed. Ground water development through bore wells can be restricted to 40-120 m.
3. Demonstrative Artificial Recharge Project taken up in Lingala, Pulivendula, Vemula and Vempalli mandals of the district proved that has good impact on improvement of water levels, increased the sustainability of pumping in addition to increase in productivity of form products. Construction of artificial recharge structures in similar environs may be replicated in large-scale in the non-command areas and over-exploited mandals and corpus fund has to be created to maintain those structures.
4. Exploring the possibilities of diversion of surface water through canals/pipes for filling up of existing dried up tanks in over-exploited mandals
5. Rainwater harvesting structures like contour bunding, check dams, percolation tanks, farm ponds are already in vogue. The construction of the artificial recharge structures should be taken up scientifically for 50% of non-committed run-off so as to not to deprive the down stream watersheds. A technical team consisting of Scientists, Engineers, Bureaucrats should be constituted for monitor the structures on regular basis.
6. In 'Safe' mandals, the artificial recharge to ground water should go hand-in-hand with ground water development further development of ground water should be restricted upto a depth of 150 m to avoid failures of bore wells.
7. Further ground water development through bore wells has to be avoided by strictly implementing APWALTA Act in the villages that are categorized as OE villages. However, ground water development in villages/mandals falling in safe to semi-critical/critical category can be developed on scientific lines.
8. Since the district is water scarce, land use system should place emphasis on cultivation of high value and low water requiring crops such as pulses, oilseeds. The suggestions of Agriculture Department have to be followed, according to seasons.
9. Modern irrigation systems using drip and sprinkler irrigation equipment have to be used for reducing the stress on ground water system and help in enhancing the availability of resource.

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