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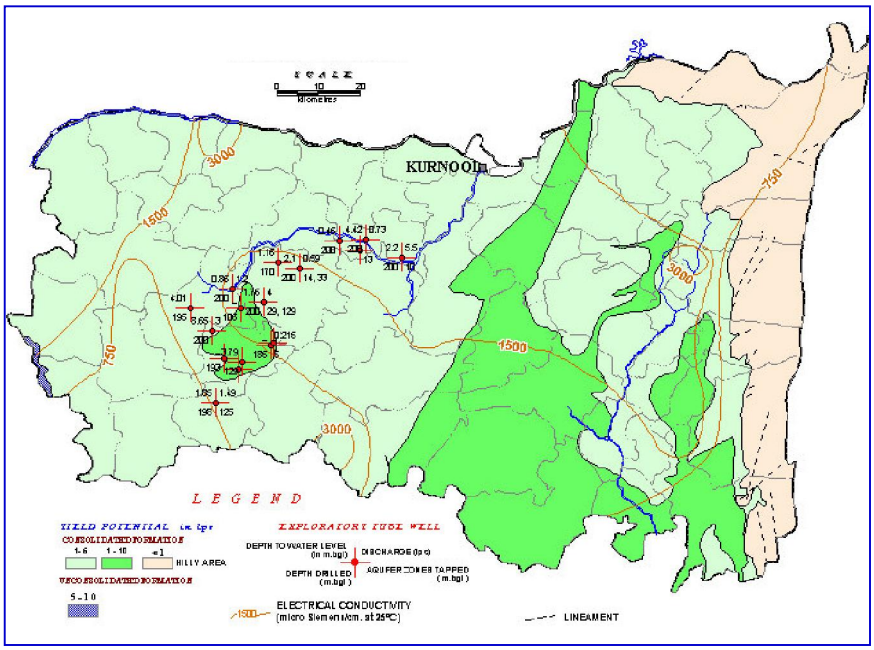
CENTRAL GROUND WATER BOARD
MINISTRY OF WATER RESOURCES
GOVERNMENT OF INDIA

GROUND WATER BROCHURE
KURNOOL DISTRICT, ANDHRA PRADESH



SOUTHERN REGION
HYDERABAD
September 2013

CENTRAL GROUND WATER BOARD

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GROUND WATER BROCHURE

KURNOOL DISTRICT, ANDHRA PRADESH
(AAP-2012-13)

BY

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GROUND WATER BROCHURE
KURNOOL DISTRICT, ANDHRA PRADESH

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DISTRICT AT A GLANCE

1. GENERAL

Location	North Latitude	14^0 35' 35" - 16^0 09' 36"
	East Longitude	75^0 58' 42" - 78^0 56' 06"
Geographical area		17600 sq.km
Headquarters		Kurnool
No. of revenue mandals		54
No. of revenue villages		926
Population (2011)	Urban	11,43,724
	Rural	29,02,877
	Total	40,46,601
Population density		229 per sq.km
Major rivers	Krishna, Tungabhadra,Vedavati, Middle Pennar	
Soils	Red earths and black cotton	
Agroclimatic zone	Scarce rainfall zone	

2. RAINFALL

Normal annual rainfall	Total	665 mm
Annual Rainfall during 2012		615 mm

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

Forest	3,40,669
Barren and uncultivated	1,27,313
Cultivable waste	48,260
Current fallows	1,55,935
Net area sown	8,75,431

4. IRRIGATION (2012) (Area in ha.)

Source of irrigation	
Canals	1,30156
Tanks	8,264
Dug wells	26,400
Bore / Tube wells	86,379
Others	13,239
Net area irrigated	2,64,438
Gross area irrigated	2,98,842

Major irrigation projects	4
	Tungabhadra low level canal Tungabhadra high level canal K.C. canal, Gajula dinne Telugu Ganga Project

5. GEOLOGY

Major rock types	Shales, limestones Granite gneisses quartzites

6. GROUND WATER

Exploration by CGWB

No. of wells drilled	:	33
Major aquifer zones	:	9.5 to 102 m
Depth to water level		
Pre-monsoon (min-max)	:	2.20 to 12.67 m bgl
Post monsoon (min-max)	:	0.47 to 22.0 m bgl

Aquifer parametres

Transmissivity (sq.m/day)	Hard rock	:	2.4 sq.m/d to 120.12 sq.m/d
Storage Co-efficient	Hard rock	:	2.36 x 10^{-2} to 1x10^{-6}

Monitoring
No. of observation wells

Dug wells	23
Piezometers Manual	19
Range of water levels (May 2011)	
Minimum (m below ground level):	0.85
Maximum (m bgl) :	27.4
General range (m bgl) :	5 to 12

7. GROUND WATER RESOURCES (HAM)

Net annual ground water availability	120856
Net annual draft	41185
Balance resource	70873
Stage of ground water development	34%

8. GROUND WATER DEVELOPMENT CATEGORY

No. of mandals categorised as	
Safe (<70 % of net available resource)	52
Semi Critical (70 - 90 %)	0
Critical (90 - 100 %)	0
Over exploited (> 100 %)	0

9. CHEMICAL QUALITY

Electrical Conductivity (micro Siemens / cm at 25 deg. C) 565-4343

Chloride	(mg/l)	32-780
Fluoride	(mg/l)	0.23-2.27
Nitrate	(mg/l)	2.0-531

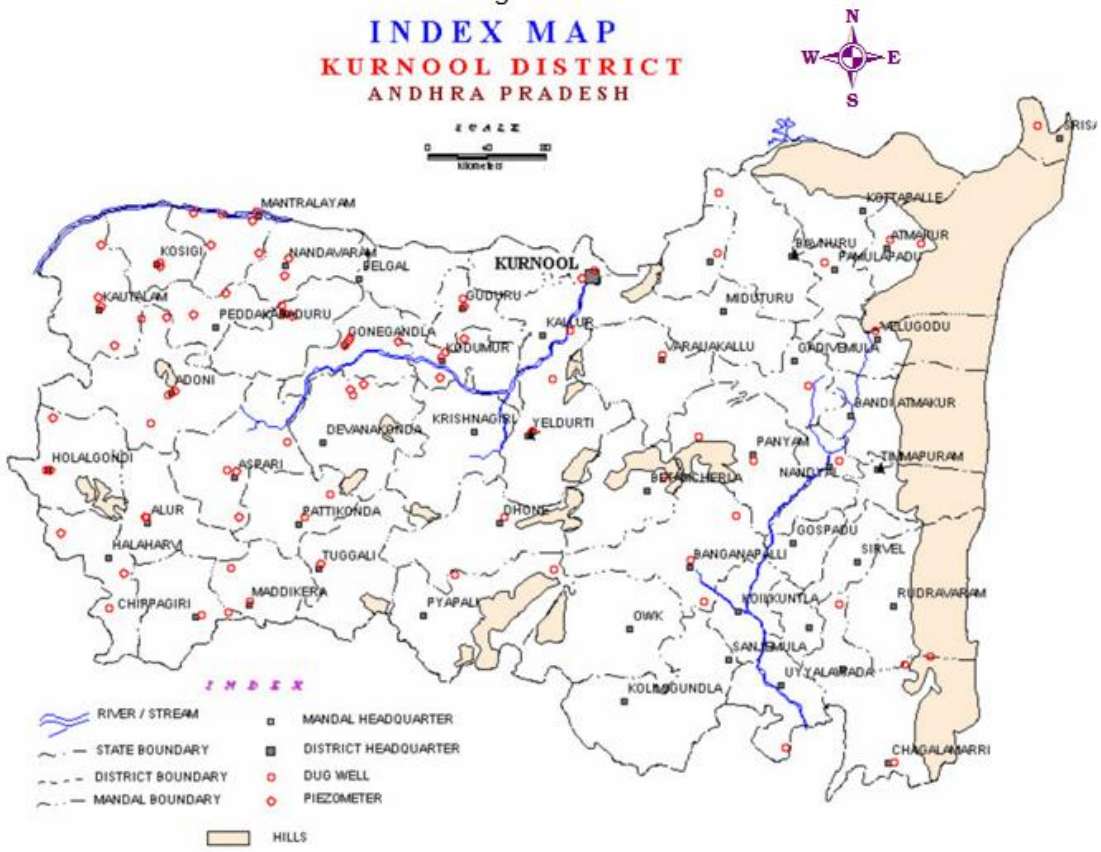
GROUND WATER BROCHURE
KURNOOL DISTRICT, ANDHRA PRADESH

1.0 INTRODUCTION

Kurnool district is the third largest district in Andhra Pradesh situated between North latitudes 14°35′35″:16°09′36″ and East longitudes 75°58′42″:78°56′06″. It is bounded by Tungabhadra and Krishna rivers and Mahabubnagar district in the north and Prakasam district in the East, Bellary district of Karnataka State in the west and Anantapur and Kadapa districts in the South. The total geographical area of the district is 17600 sq.km with headquarters at Kurnool and divided into 54 revenue mandals (Fig.1). Major crops grown in the district are paddy, jowar, bajra, cotton, sunflower, groundnut and chillies. The population density, which was 66 persons per sq.km during 1901, has increased to 200 persons as per 2001census and 229 persons sq.km as per 2011 census.

Failure of monsoon leads to depletion of ground water levels and reduction in well yields, which ultimately resulted crop failure. The Krishna river enters the district at Kudali Sangam. The river Thungabhadra forms boundary between Kurnool district of Andhra Pradesh and Raichur district of Karnataka. Hundri river joins Tungabhadra river at

Fig.1



Kurnool town and the Thungabhadra river joins at Kudali Sangam about 29 km from Kurnool. The district is divided into 80 minor basins. Surface water irrigation is from Tungabhadra project-low level canal and high level canal, KC canal, Telugu Ganga project and Gazuladinne project.

1.1 Irrigation

As per 2011-2012, the canal irrigation accounts for 1,30,156 ha., tank irrigation accounts for 8,264 ha whereas an area of 1,20,053 ha is irrigated by ground water. Out of gross irrigated area of 2,98,842 ha, about 1,38,420ha (47%) is being irrigated by surface water and the remaining area of 1,12,779ha (38%) by ground water and remaining from other sources. There are 26,000 dug wells and 86,379 bore wells in the district. The main crops raised are paddy, groundnut, jowar, cotton, bajra, tobacco and sugarcane. The source wise area irrigated is given in Table-1.

Table-1 Source-wise area irrigated (in ha)

Sl. No	Source of Irrigation	Year					
		2005-2006	2006-2007	2007-2008	2008-2009	2009-2010	2011-2012
1	Canals	88000	N/A	N/A	112170	118552	130156
2	Tanks	17000	N/A	N/A	11920	14465	8264
3	Tube wells/Filter wells	80000	N/A	N/A	81593	89259	86379
4	Other wells	34000	N/A	N/A	35248	31194	26400
5	Other sources	12000	N/A	N/A	932	1196	13239
6	Net area irrigated	189941	175707	206447	207788	209022	264438
7	Area irrigated more than once	41301	36891	47350	45561	62612	34404
8	Gross area irrigated	231242	212598	253797	253349	271634	298842

2.0 RAINFALL

The average annual rainfall of the district is 665.5mm, which ranges from nil rainfall in January and December to 139.6 mm in September. August and September are the wettest months. The mean seasonal rainfall distribution is 459.1mm in southwest monsoon (June-September), 133.7mm in northeast monsoon (Oct-Dec), 1.9 mm rainfall in Winter (Jan-Feb) and 70.8 mm in summer (March–May). The percentage distribution of rainfall, season-wise, is 69% in southwest monsoon, 20.1 % in northeast monsoon, 0.3 percentage in winter and 10.6 % in summer. The annual and seasonal rainfall distribution with its departure from mean along with percentage distribution is given in Table-2. The monthly rainfall distribution is presented in the Fig.2. The annual rainfall ranges from 482 mm in 2011 to 1082.2 mm in 2007. The annual rainfall departure ranges from -28 % in 2011 to 62% in 2007. The southwest monsoon rainfall contributes about 69 % of annual rainfall. It ranges from 338.5 mm in 2002 to 939.5 mm in 2007. The year 1999 and 2011 experienced drought conditions in the district as the annual rainfall recorded in these two years is 27 % and 28% less than the long period average (LPA) respectively. The cumulative departure of annual rainfall from LPA is presented in Fig.3. It indicates that, the rainfall departure as on 2011 is positive i.e. 81%, showing rainfall excess. The annual rainfall during 2012 is 615 mm.

Table-2 Annual and seasonal rainfall with departure from mean with percentage distribution

Sl No	Year	Annual	SW	NE	WINTER	Sum-mer	SW (%)	NE (%)	Winter (%)	Summer (%)	Dep From LPA(%)
1	1999	483.0	366.0	47.0	2.0	68.0	75.78%	9.73%	0.41 %	14.08%	-27%
2	2000	922.0	731.0	120. 0	14.0	57.0	79.28%	13.02%	1.52 %	6.18%	38%
3	2001	718.2	384.0	283. 2	3.0	48.0	53.47%	39.43%	0.42 %	6.68%	8%
4	2002	558.5	338.5	139. 0	5.0	76.0	60.61%	24.89%	0.90 %	13.61%	-16%
5	2003	570.9	425.7	117. 2	0.0	28.0	74.57%	20.53%	0.00 %	4.90%	-14%
6	2004	643.5	386.8	101. 4	4.9	150.4	60.11%	15.76%	0.76 %	23.37%	-3%
7	2005	838.2	479.4	278. 3	6.3	74.2	57.19%	33.20%	0.75 %	8.85%	26%
8	2006	600.8	411.5	84.4	0.0	104.9	68.49%	14.05%	0.00 %	17.46%	-10%
9	2007	1082.2	939.5	74.8	3.0	64.9	86.81%	6.91%	0.28 %	6.00%	62%
10	2008	708.6	409.2	152. 5	12.8	134.1	57.75%	21.52%	1.81 %	18.92%	6%
11	2009	767.9	429.1	258. 4	0.1	80.3	55.88%	33.65%	0.01 %	10.46%	15%
12	2010	823.2	618.7	140. 2	4.1	60.2	75.16%	17.03%	0.50 %	7.31%	24%
13	2011	482.1	356.2	76.0	3.7	46.2	73.89%	15.76%	0.77 %	9.58%	-28%
		665.5	459.1	133. 7	1.9	70.8	68.99%	20.09%	0.29 %	10.64%	

Fig.2 Monthly rainfall distribution – Kurnool district

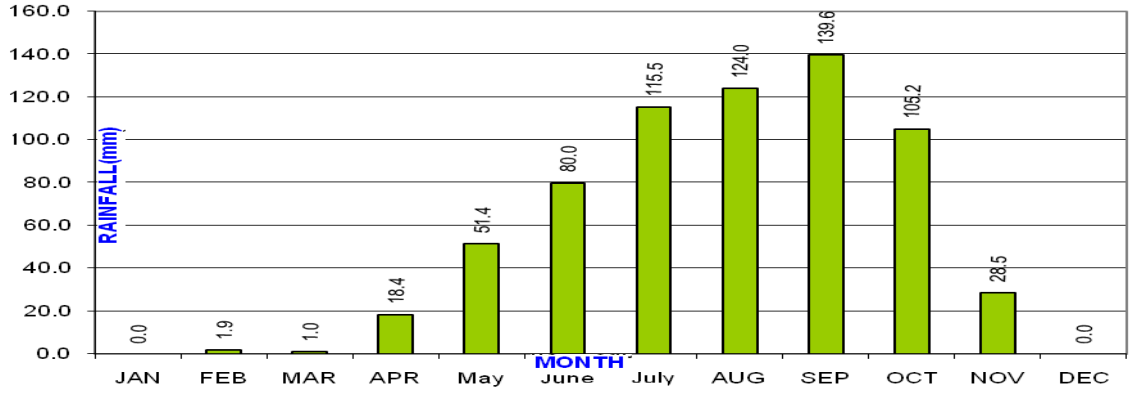
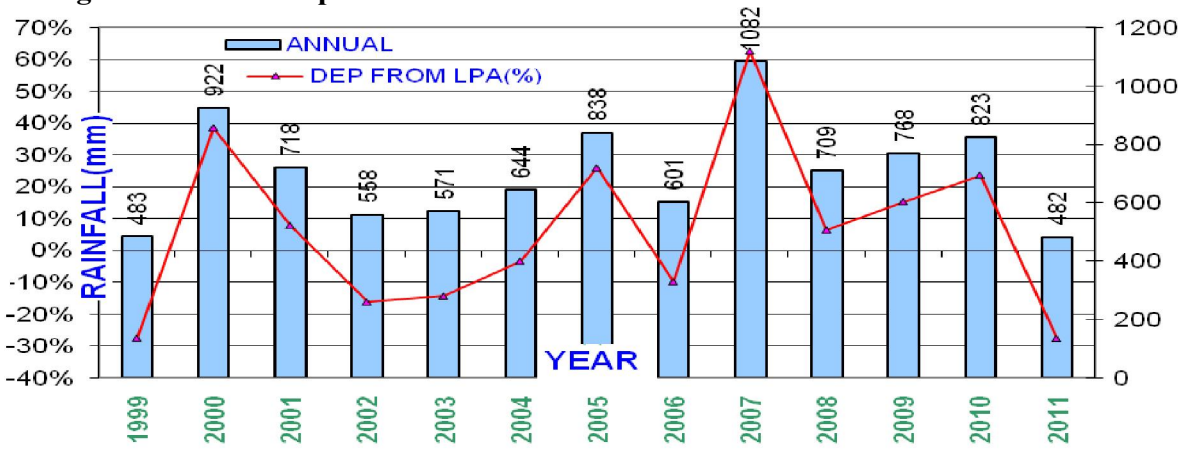


Fig.3 Cumulative departure of annual rainfall from LPA – Kurnool District



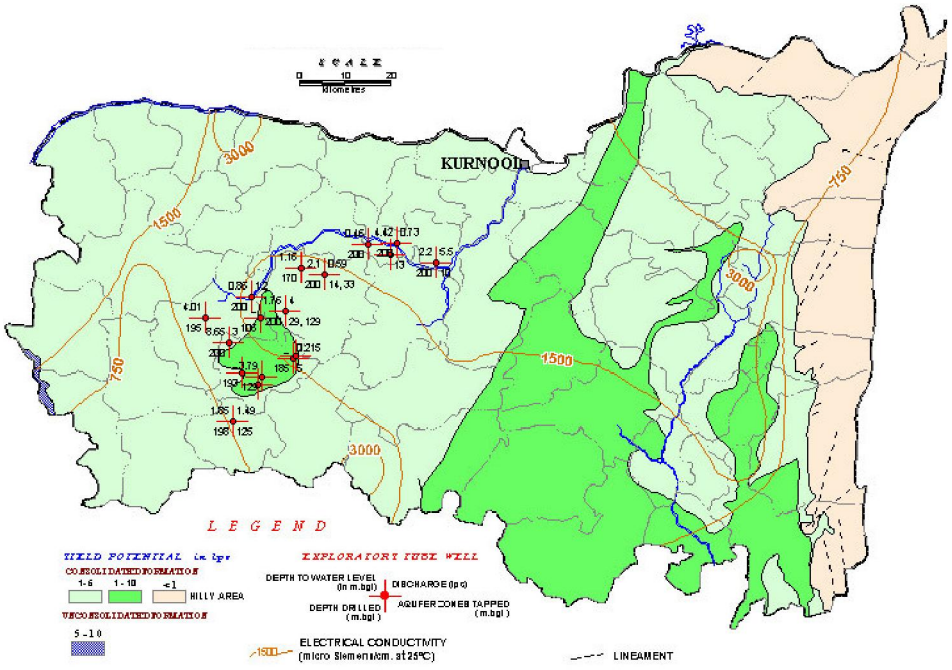
3.0 GEOLOGY

The district is underlain by different geological formations ranging in age from Archaean to recent. The major part of the district in west is occupied by granite gneisses, while the eastern part is underlain by quartzites, shales and limestones of cuddapah and kurnool group. The recent alluvium is confined to the major stream and river courses like Krishna, Tungabhadra, Gundlakamma and Kuderu.

4.0 HYDROGEOLOGY

Ground water occurs in all the geological formations in Kurnool district. Hydrogeological conditions in the district are presented in Fig.3.

Fig.3 Hydrogeology of Kurnool District



4.1Crystalline aquifers

The crystalline rocks develop secondary porosity through fracturing and subsequent weathering over ages and become water bearing. Movement of ground water is controlled by degree of inter-connection of secondary porosity and voids. The depth of weathered zone ranges from few centimeters to 18 m bgl. Ground water occurs under unconfined conditions in shallow weathered zones and under semi-confined conditions in joints, fissures and fractures. Occurrence of joints and fissures extends down to depth ranging from 20 to 100 m bgl. The shallow aquifers are developed through large diameter irrigation wells and domestic wells. The depth of irrigation wells ranges from 4 to 26m bgl. Irrigation wells sustain pumping of 2 to 4 hrs. per day during summer.

4.2 Consolidated Sedimentary Formation

Ground water occurs in the aquifers of Kurnool formations in Panyam Quartzites under unconfined and semi- confined conditions in weathered zone, sheared zones, joint planes and bedding contacts. The depth of dug wells varies from 7-13 m bgl., with extension bores down to a maximum depth of 15 m. The yield of wells ranges from 30 to 100 cu.m/day. In Koilkuntla limestone, ground water occurs under unconfined conditions in the top weathered zones and karstified horizons. Ground water occurs under unconfined condition in Nandyal shales down to a limited depth of 30 m bgl. The thickness alluvial aquifers varies from less <1 to 8.0m and depth to water ranges between 1.0 and 5.3 m bgl.

4.3 Aquifer Parameters

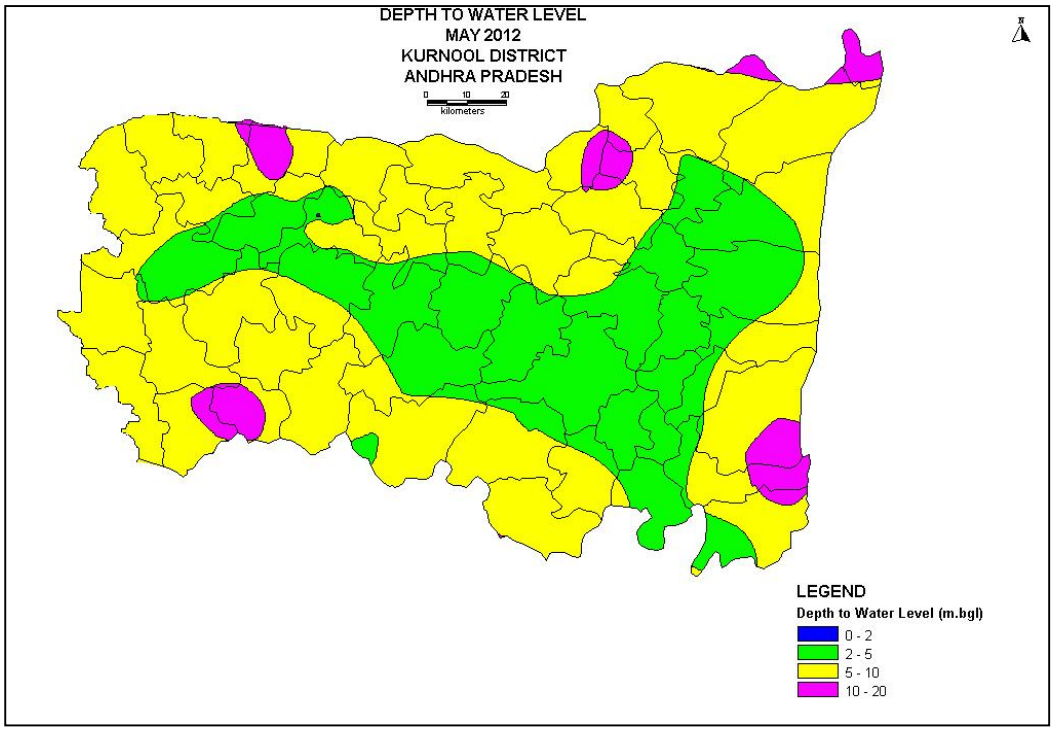
Transmissivity of the aquifers in granitic gneisses in western part of the district in Vedavati River Basin ranging from 585 to 1370 sq.m/day and in Tungabhdra canal command area it is varing from 1 to 210 sq.m/day. The storativity is in the order of 2.76 x 10^{-2} to 1 x 10^{-6}. The specific capacity of wells varied from 5.92 to 49.78 lpm/m of draw down. Transmissivity values range from 67 and 1910 sq.m/day in Cuddapah and Kurnool formations.

5.0 Depth to water level

5.1 Pre-monsoon

The depth to water levels range from 2.20 to 12.67 m bgl during May, 2012. Deeper water levels of more than 10 m bgl are observed as scattered patches in the district. However, water levels between 0-5 are observed in central and southern parts of the district. The depth to water level during pre-monsoon (May 2012) is presented in Fig. 4.

Fig.4 Depth to water level during pre-monsoon(May 2012) Kurnool District



5.2 Post-monsoon

The depth to water levels ranges from 0.47 to 22.0 m bgl during post-monsoon (Nov.2011). The shallow water levels of less than 2 m are observed in north east and south east part of the district during post monsoon period. The area with water levels of 5 to 10 m bgl range in pre-monsoon period has come up to 2-5 m in post monsoon period. The depth to water levels of 5 to 10 m was observed in the western part of the district and in isolated patches. The depth to water level scenario during post-monsoon is presented in Fig.5.

Fig.5 Depth to water level during Post-monsoon(Nov 2011) - Kurnool District

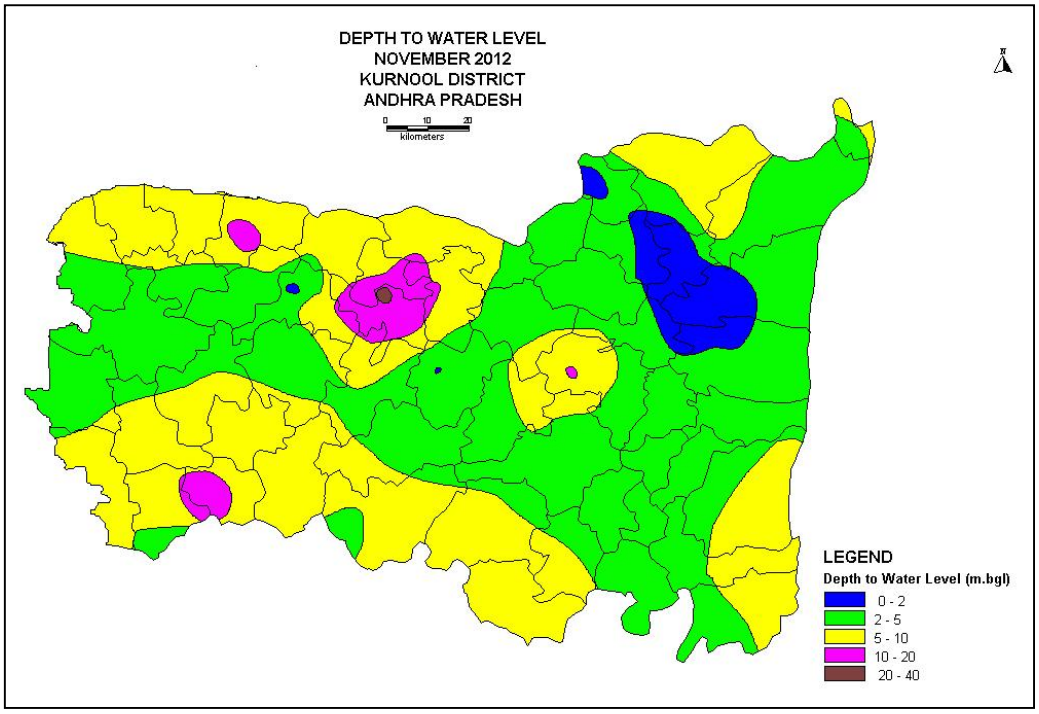
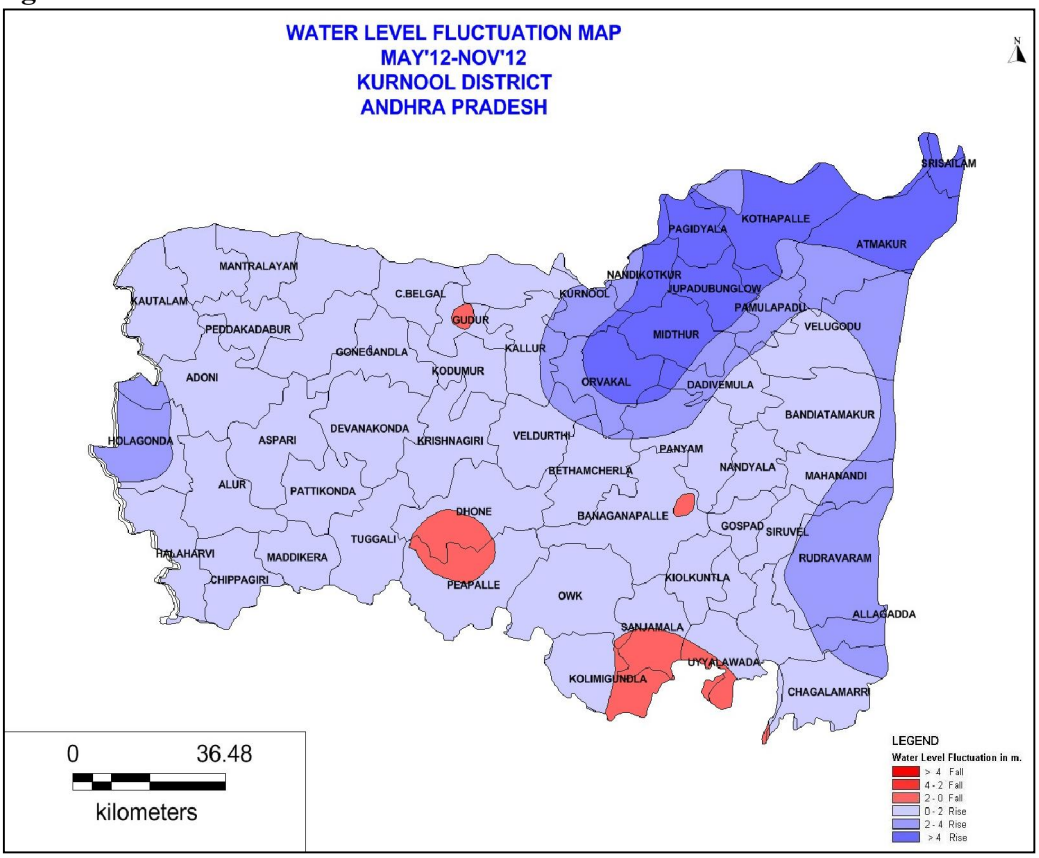


Fig.6 Water level Fluctuation - Kurnool District



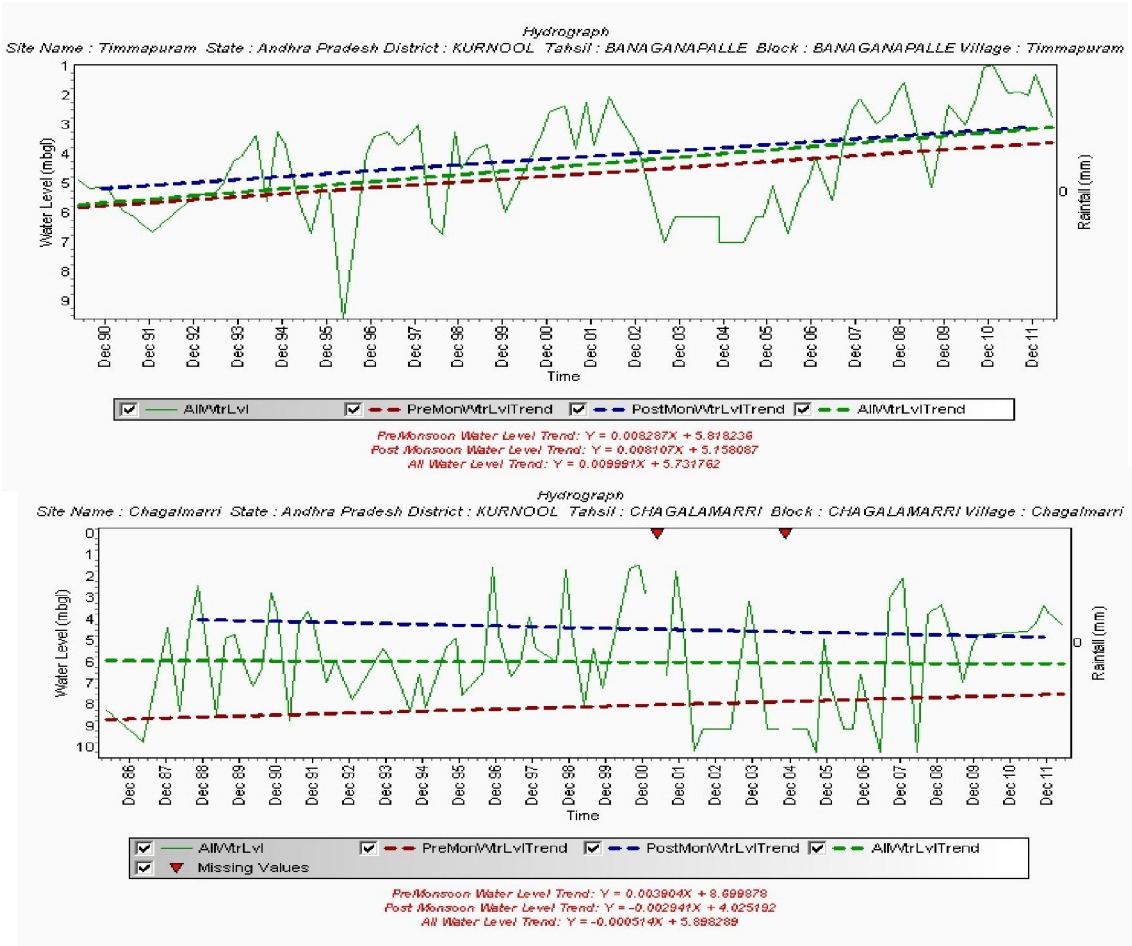
5.3. Water level fluctuation

The rise of water levels 2 - 4m was observed in north, south and eastern parts of the district and it is between 2-4 m in the remaining part of the district. However, the negative water level fluctuations in the range of 2 to 4 m were noticed in the south and western part of the district. The map depicting water level fluctuation during 2012 is presented in the Fig.6.

5.4. Long Term Water levels

Analysis of water level data shows annual rising trend varying from 0.008 to 0.87 m/year and falling trend from 0.001to 0.62 m/year. Hydrographs of select wells are presented in Fig.7. Rising trend of 0.006 to 0.648 m/year and declining trend varying from 0.038 to 0.85 m/year have been observed during pre-monsoon. Post-monsoon trend analysis indicate rising trend ranging from 0.006 to 1.13 m/year and declining trend ranging from 0.1 to 0.62 m/year .

Fig.7 Hydrographs of select wells – Kurnool district



6.0 GROUND WATER RESOURCES

Based on the Ground Water Estimation Committee (GEC-97) recommendations, ground water assessment was done for the year 2008- 2009. Mandal wise ground water availability and stage of development is presented in Table-3. Ground water resource available in the district is 37024 Ham in command area and 33849 Ham in non-command area. Ground water utilization is 19799 and 21386 Ham in command and non-command areas respectively. The available balance ground water resource for future use is 37024 Ham in command area and 33849 Ham in non-command area. Thus the total resource available in the district for future use is 70873 Ham. Over all, the district falls under safe category with a stage of development at 34%. The stage of development in command area is 33% and in non-command area it is 35%, showing both command and non-command areas falling in safe category. Based on the stage of development, all the 54 mandals are categorized as safe. The Mandal wise categorisation in Kurnool district is shown in the Fig-8. The minimum stage of development of 2% is seen in Srisailam mandal. The maximum stage of development is in Betamcherla-81% and Oravakal 72%.

Fig.8 Categorisation of Mandals in Kurnool District

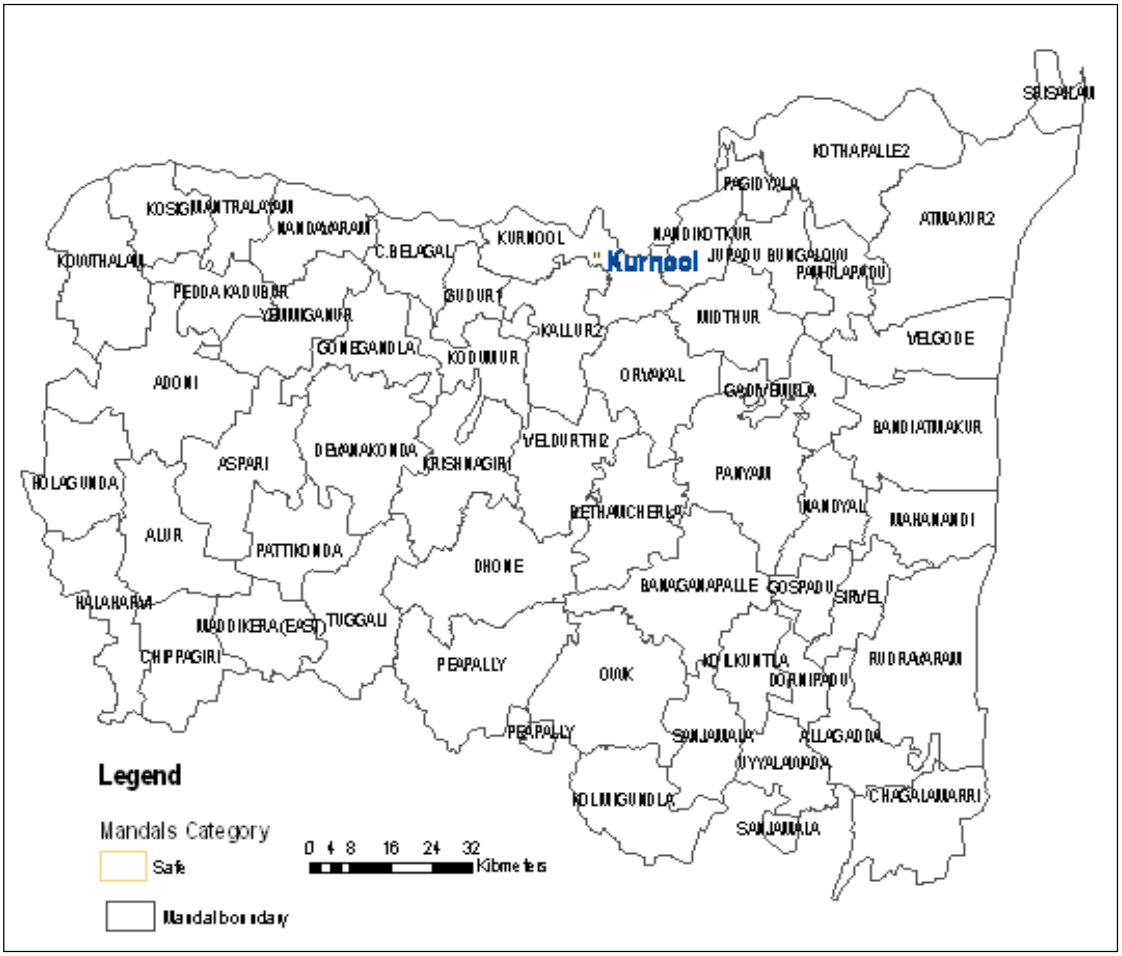


Table 3 MANDAL WISE GROUND WATER RESOURCE 2008-2009
KURNOOL DISTRICT, ANDHRA PRADESH

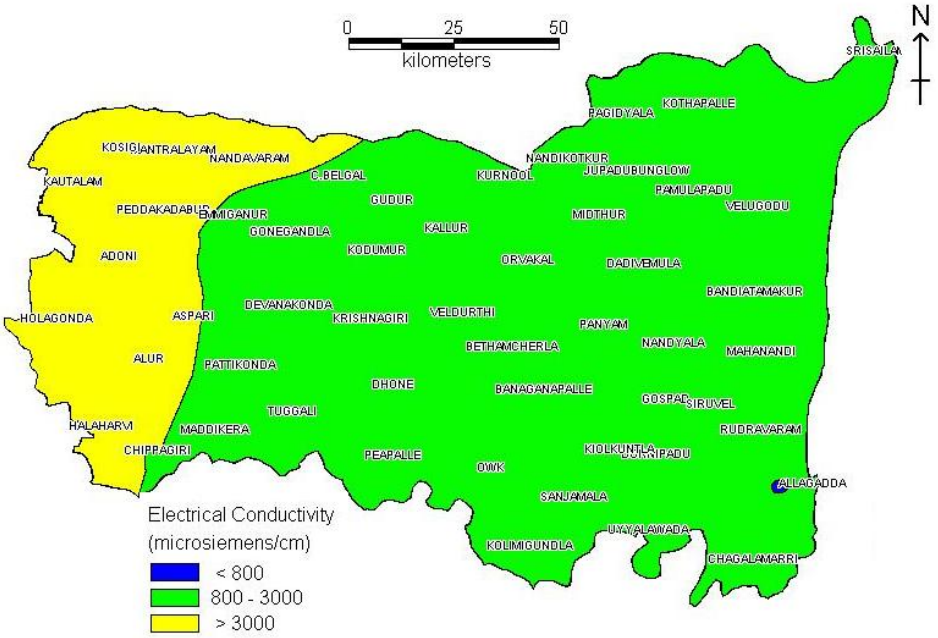
SL No	Mandal Name	Groundwater Availability ha.m			Groundwater Uti lisation ha. m			Groundwater Balance ha. m			Stage of Development %			Category		
		C	NC	T	C	NC	T	C	NC	T	C	NC	T	C	NC	T
1	Adoni	1509	2745	4254	72	1806	1878	1357	772	2129	5	66	44	Safe	Safe	Safe
2	Allagadda	2725	0	2725	1297	0	1297	1219	0	1219	48	0	48	Safe	NA	Safe
3	Aluru	0	2383	2383	0	513	513	0	1361	1661	0	22	22	NA	Safe	Safe
4	Aspari	0	2886	2886	0	611	611	0	2078	2078	0	21	21	NA	Safe	Safe
5	Atmakuru	0	1784	1784	0	557	557	0	1056	1056	0	31	31	NA	Safe	Safe
6	B.Atmakuru	4514	0	4514	764	0	764	3750	0	3750	17	0	17	Safe	NA	Safe
7	Banaganapalli	1730	1149	2879	593	770	1363	958	288	1246	34	67	47	safe	Safe	Safe
8	Bethamcherla	0	1402	1402	0	1140	1140	0	0	0	0	81	81	NA	Safe	Safe
9	C.Belagal	1059	894	1953	432	592	1024	550	221	771	41	66	52	Safe	Safe	Safe
10	Chagalamarri	1944	589	2533	1522	0	1522	295	589	884	78	0	60	safe	NA	Safe
11	Chippagiri	1520	994	2514	104	55	159	1372	873	2245	7	6	6	Safe	Safe	Safe
12	Devanakonda	0	2533	2533	0	1072	1072	0	2242	2242	0	30	30	Safe	Safe	Safe
13	Dhone	0	2480	2480	0	702	702	0	1398	1398	0	28	28	NA	Safe	Safe
14	Dornipadu	921	0	921	112	0	112	757	0	757	12	0	12	Safe	NA	safe
15	Gadivemula	1471	240	1711	723	101	824	637	109	746	49	42	48	Safe	Safe	Safe
16	Gonegandla	1788	898	2686	1038	408	1446	574	431	1005	58	45	54	Safe	Safe	Safe
17	Gospadu	751	0	751	316	0	316	332	0	332	42	0	42	safe	NA	Safe
18	Guduru	666	664	1330	184	169	353	389	438	827	28	25	27	Safe	Safe	Safe
19	Halaharvi	1479	1024	2503	144	151	295	1274	822	2096	10	15	12	Safe	Safe	Safe
20	Holagonda	1408	1319	2727	155	311	466	1159	939	2098	11	24	27	Safe	Safe	Safe
21	Jupadu Bunglow	1041	421	1462	205	275	480	788	105	893	20	65	33	Safe	Safe	Safe
22	Kalluru	227	1941	2168	114	1155	1269	102	300	402	50	60	59		Safe	Safe
23	Kodumuru	788	1182	1970	422	431	853	285	605	890	54	36	43	Safe	Safe	Safe
24	Koilakuntla	1120	0	1120	230	0	230	745	0	745	21	0	21	Safe	NA	Safe
25	Kolimigundla	0	1962	1962	0	752	752	0	1061	1061	0	38	38	NA	Safe	Safe
26	Kosigi	1122	938	2060	519	570	1089	523	187	710	46	61	53	Safe	Safe	Safe
27	Kothapalli	0	2712	2712	0	382	382	0	2777	2777	0	14	14	NA	Safe	Safe
28	Kowthalam	3473	515	3988	482	291	773	2812	188	3000	14	57	19	Safe	Safe	Safe
29	Krishnagiri	483	2092	2575	83	819	902	388	1140	1528	17	39	35	Safe	Safe	Safe
30	Kurnool	512	1711	2223	0	693	693	512	876	1388	0	41	31	NA	Safe	Safe
31	Maddikera	0	1642	1642	0	232	232	0	1296	1296	0	14	14	NA	Safe	Safe
32	Mahanandi	2114	1231	3345	1610	0	1610	504	1231	1735	76	0	48	Safe	NA	Safe
33	Mantralayam	1624	392	2016	350	163	513	1158	174	1332	22	42	25	Safe	Safe	Safe
34	Midthuru	0	1306	1306	0	560	560	0	637	637	0	43	43	NA	Safe	Safe
35	Nandavaram	2785	106	2891	496	28	524	2149	74	2223	18	26	18	Safe	Safe	Safe
36	Nandikotkuru	577	544	1121	135	373	508	411	92	503	23	69	45	Safe	Safe	Safe
37	Nandyala	2920	0	2920	364	0	364	2305	0	2305	12	0	12	Safe	NA	Safe
38	Orvakal	0	1985	1985	0	1434	1434	0	433	433	0	72	72	NA	Safe	Safe
39	Owk	2487	359	2846	900	128	1028	1467	215	1682	36	36	36	Safe	Safe	Safe
40	Pagidyala	1603	124	1727	98	109	207	1436	0	1436	6	88	12	Safe	Safe	Safe
41	Pamulapadu	868	385	1253	256	289	545	554	41	595	29	75	43	safe	Safe	Safe
42	Panyam	2158	727	2885	863	134	997	1146	578	1724	40	18	35	Safe	Safe	Safe
43	Pathikonda	0	2186	2186	0	510	510	0	1547	1547	0	23	23	NA	Safe	Safe
44	Peapully	0	2007	2007	0	978	978	0	809	809	0	49	49	NA	Safe	Safe
45	Peddakadabur	1441	533	1974	574	301	875	765	191	956	40	56	44	Safe	Safe	Safe
46	Rudravaram	2551	1019	3570	1635	0	1635	804	1019	1823	64	0	46	Safe	NA	Safe
47	Sanjamala	1066	280	1346	472	146	618	521	96	617	44	52	46	Safe	Safe	Safe
48	Sirivella	1999	0	1999	1246	0	1246	572	0	572	62	0	62	Safe	NA	Safe
49	Sri Sailam	0	123	123	0	2	2	0	108	108	0	2	2	NA	Safe	Safe
50	Tuggali	0	2635	2635	0	517	517	0	1965	1965	0	20	20	NA	Safe	Safe
51	Uyyalawada	226	615	841	3	80	83	223	433	656	1	13	10	Safe	Safe	Safe
52	Veldurthi	0	2102	2102	0	617	617	0	1262	1262	0	29	29	NA	Safe	Safe
53	Velugodu	2007	592	2599	193	30	223	1713	558	2271	10	5	9	Safe	Safe	Safe
54	Yemmiga Nur	1901	927	2828	1087	429	1516	518	434	952	57	46	54	Safe	Safe	Safe
District Total		60578	60278	120856	19799	21386	41185	37024	33849	70873	33	35	34	Safe	Safe	Safe

Note: OE = Over exploited; SC = Semi critical;C=Critical; C = Command; NC = Non command; NA = Not applicable

7.0 GROUND WATER QUALITY

The ground water in the district is in general suitable for both domestic and irrigation purposes. The electrical conductivity ranges from 565 to 4343 micro Siemens/cm at 25 C. The distribution of the EC is shown in the Fig.9. It is observed that EC values are more than 3000 micro Siemens/cm at 25 C in the western part of the district. Out of the 918 villages of the district, 72 villages are facing poor quality problem in ground water.

Fig.9 Distribution of EC in ground water in Kurnool district



8.0 STATUS OF GROUND WATER DEVELOPMENT

Half of the total irrigated area and most of the domestic needs of the district depend on ground water. There are about 53,375 ground water structures, which support the irrigation in the district. To meet the domestic water needs of the 918 villages, 12486 hand pumps and 580 seasonal bore wells and 1096-piped water supply schemes through bore wells schemes are constructed. The wells have 1-2 m of water column and sustain pumping by 5 HP motors for 2 to 5 hrs. in two spells, a day. The yield of wells varies from 40-150 cu.m/day during post-monsoon period. The fractured aquifers are tapped by bore wells of 100 to 159 m deep. In general, the discharge of bore wells varies from 1 to 18 cu.m/day for a draw down of 4 to 10 m.

9.0 GROUND WATER MANAGEMENT STRATEGY

9.1 Ground Water Development

All the mandals in the district are classified as Safe as per GEC 2008-2009. The ground water development should be through dug wells of 10 to 15 m depth and bore wells of 50-100 m depth, observing the spacing norms. In non-command areas, the spacing should be about 165 m between two dug wells and 250 m between two bore wells. The spacing norms are presented in Table-4 and the unit cost of different ground water abstraction structure is given in Table-5.

TABLE 4 SPACING NORMS FOR GROUND WATER ABSTRACTION STRUCTURES

S.N	Situation	Spacing between any two wells (m)			
		Piccota wells	Dug wells	Filter point or shallow borewells	Bore wells
1	Non-Ayacut	60	160	120	250-300
2	Ayacut	40	100	160	150-200
3	Near perennial source , river of tank(within 200m)	40	100	160	200-300
4	Non-perennial streams	50	150	180	200-500

Source: NABARD

TABLE 5 UNIT COST OF DIFFERENT TYPE OF WELLS

S. No.	Geological formation	Type of MI Structure	Dimensions		Staining Depth (m)	Dimensions of bore well		Unit Cost (Rs.)
			Dia (m)	Depth (m)		Dia (m)	Depth (m)	
1.	Granite Related Rocks	(a) DW	6	10	4	-	-	25000
		(b) DW	6	12	4	-	-	32500
		(c) DW	5	14	4	-	-	34400
		(d) DW	5	16	4	-	-	44500
		(e) DCB	6	10	4	100	30	31000
		(f) DCB	4	14	4	100	30	39400
2.	Lime Stones	(a)DW	4	12	4	-	-	17300
		(b)DW	6	12	4	-	-	32500
		(c) DCB	4	12	4	100	35/30	23300
3.	Sand Stones	(a)DW (b) DCB	3	12	4	-	-	11300
			3	12	4	100	30	17300
4.	Shale Formation	(a) DW (b) DCB	6	12	4	-		35000
			6	12	4	100		40000
5.	(i) Borewell in HardRocks	BW	-	-	-	150	40	12500
	(ii) –do– (iii)	BW	-	-	-	150–160	60	16000
	–do–	BW	-	-	-	150–160	80	20600
6.	In well bores in all geological formation	IWB	-	-	-	100	30	5000
7.	Alluvium	FP	-	-	-	100	15	4500
8.	Development of old well	DOW (Deepening 2 m from 10 to 12 m)						5000

The feasibility of bore wells and dug wells should be decided scientifically based on the depth of the weathering and fracture zones available. Potential fractures are encountered between the depth range of 50 and 100m. Success rate of bore wells beyond this depth is rare. Central Ground Water Board has carried out studies on conjunctive use of surface and ground water in Tungabhadra project irrigation command area. The studies indicate that there are few pockets waterlogged in head reaches of the canal system.

There are number of canal water shortage areas in the middle and tail end of the canal. There is a need to exploit ground water in conjunction with surface water for better management. The canal water shortage area was calculated to be 59,540 ha., out of the command area of 2,33,600 ha in Tungabhadra canal command area. This strategy suggested in the report should be taken into consideration. There are number of perennial and seasonal springs (Ahobilam, Kalvabugga, Mahananda etc.). The spring water should be harnessed for drinking purposes and the excess water should be diverted for artificial recharge.

9.2 Artificial Recharge

Ground water conservation and artificial recharge is being implemented on large scale in the district since 2002 under Neeru-Meeru, Watershed, RIDF and other programmes. So far, 1,45,024 number of artificial recharge structures have been constructed. The structures constructed under these schemes are percolation tanks, check dams, and farm ponds, etc. An additional volume of water of 2,79,16,183 cu.m/m is recharged by the artificial recharge structures constructed so far.

It is often seen that structures were constructed indiscriminately without considering the possible inflow (run off) and hydrogeological criteria, rendering the structure useless. Planning should be made for artificial recharge, taking into account the 50% of the available runoff. This will facilitate to allow the remaining run off to enter into the down stream watershed so as not to deprive the riparian rights and also the sustainability of the structures in the downstream.

Studies on hydrogeological, hydrological, geophysical should be taken up in order to estimate the storage space available in the aquifer before taking up any artificial recharge structures. Economic viability of the structure should also be decided.

Different artificial recharge structures like percolation tanks, check dams, sub-surface dykes, contour bunds should be constructed, based on the technical feasibility, deep water level, depth of weathering, declining water levels and stage of ground water development in the area.

10.0 RECOMMENDATIONS

1. Construction of artificial recharge structures may be intensified in all the developed Mandals viz., Allagadda-NC, B. Atmakur-NC, Banaganapally, Betamcherla, Chagalmarri-NC, Gadivemula-NC, Zupadubungalow-NC, Kothvalam-NC, Mahanandi, Nandyala-NC, Oravakal, Sirivella-NC.
2. Large scale artificial recharge structures constructed in non-command area and creation of a corpus fund for maintenance of the structures.
3. Rain water harvesting may be adopted to maintain the ground water use in safe mode.
4. Before taking any artificial recharge structures, detailed feasibility studies may be taken up by a multi-disciplinary group to look into the technical as well as socio-economic components, cost benefit ratio, ecological factors also to be worked out.

5. In command areas, Ground Water Development and Ground Water Conservation partial recharge must go hand in hand for sustainable development of the resource. Hence, the status of ground water development in the district has to be monitored periodically and suitable plans for artificial recharge may be prepared and executed accordingly in order to keep the wells sustained without further depletion of water levels.

6. Harnessing the springs for drinking water purposes, if excess for artificial recharge, should be worked out. Modern irrigation techniques like drip and sprinkler irrigation should be used for effective use of water resources in non-command areas particularly.

7. Farmers should consult the appropriate Government Department for scientific investigation. Farm models developed/suggested by the local Agriculture Department have to be introduced and explained to farmers in the local language for better management of the available ground water resources.

8. Mass awareness programmes must be widely conducted on regular basis to educate the farmers regarding the water management. Training programmes to be conducted for local government functionaries, NGOs, Voluntary Organisations engaged in watershed development activity in scientific techniques in the selection of sites, design of structures for construction of rain water harvesting and artificial recharge structures.

12. There should be a complete institutional credit cover to the small and marginal farmers for drilling deep bore wells identified by Hydrogeologists and also for procuring water saving equipment like drip and sprinkler systems, etc.
13. Small and marginal farmers are to be encouraged to look into the alternative sources of income generation by taking up dairy development and poultry industry with institutional financing to augment their income.
14. Insurance facilities to be provided to farmers, crops and bore wells

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