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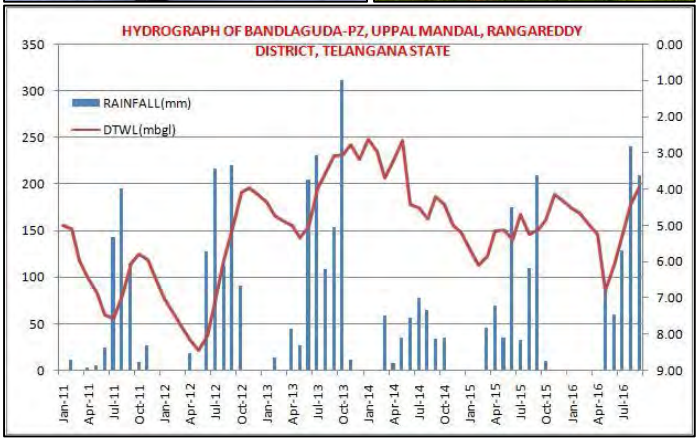
Central Ground Water Board

Ministry of Water Resources, River Development & Ganga Rejuvenation
Govt. of India

GROUND WATER YEAR BOOK
ANDHRA PRADESH
2015-16

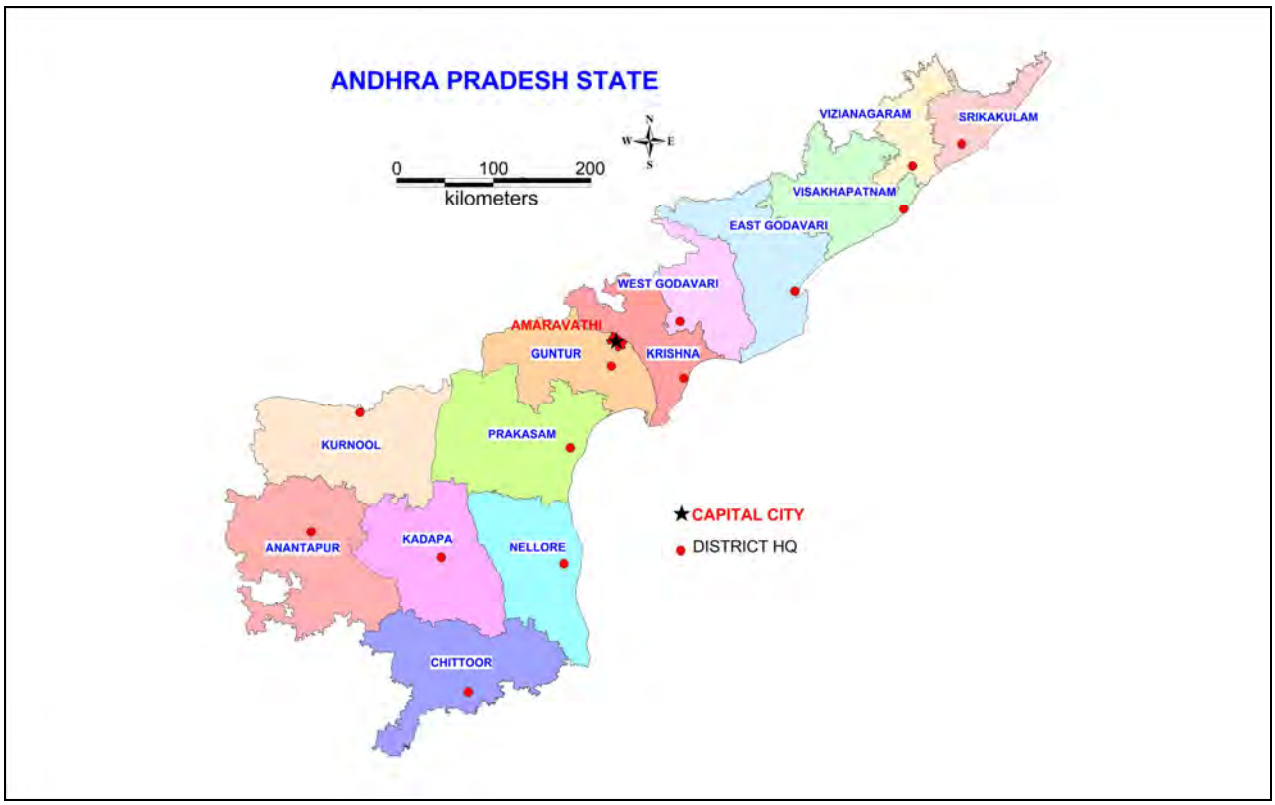


Southern Region, Hyderabad
November, 2016

GROUND WATER YEAR BOOK

Andhra Pradesh

2015-2016



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ANDHRA PRADESH
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CONTRIBUTORS

Principal Authors

Dr. Pandith Madhnure, Scientist-D (Sr. Hydrogeologist)
P. Sudhakar, Scientist-D (Hydrometeorologist)

Ground Water Quality

M. Bhaskar Reddy, Scientist-B
K.M. Prasad, Scientist-B
Y SatyaKumar, Asst.chemist

Report Scrutiny & Issuance

G.R.C. Reddy, Scientist-D
Smt. S. Renuka, Scientist-B (GP)
B.J. Madhusudhan, AHG

Overall Supervision and Guidance

A. D. Rao
Regional Director,
Southern Region, Hyderabad

GROUND WATER YEAR BOOK
ANDHRA PRADESH
2015-16

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FOREWORD

The historical ground water level monitoring data is very useful in understanding the dynamic changes in ground water regime in time and space and for preparation of sustainable development plan for the state. Central Ground Water Board has been monitoring ground water regime in the state of Andhra Pradesh (Residual Andhra Pradesh) since 1969. During the year 2015-16, 13 new ground water monitoring wells were established and 46 wells were abandoned due to various reasons. As on 31-3-2016, total 848 operational ground water monitoring stations (GWMS) (Dug wells: 745, Piezometer wells: 103) are in operation. These stations are being monitored four times a year viz., May, August, November and January to study the seasonal and long term changes. Total 496 ground water samples are collected during May 2015 (Pre-monsoon) for studying the major cation/anions, Iron and Arsenic and its suitability for various uses as per BIS standards.

The ground water level monitoring carried out by Central Ground Water Board, Southern Region, Hyderabad during 2015-16 is compiled in the form of Ground Water Year Book. It outlines the ground water level behavior in the current year, with reference to the corresponding periods of previous year, with last decadal mean and also with normals. It also elaborates the chemical quality of ground water.

The sincere efforts made by **Dr. Pandith Madhnure, Scientist-D, Sri. P.Sudhakar, Scientist-D (HM)** in preparation of the report is commendable. The efforts of officers of chemical laboratory namely Shri K. Bhaskar Reddy, Shri K. Maruthi Prasad and Shri Y. Satyakumar who analyzed the samples and their contributions are note worthy**.** Shri G.R.C Reddy, Scientist-D, Smt.S.Renuka, Scientist-B (GP) and Sri B.J.Madhusudhan AHg of **r**eport processing section in scrutiny, processing and issuance of the report are also appreciated.

It is hoped that the Ground Water Year Book will be quite useful as baseline information for planners, administrators and researchers involved in ground water development and management in the state of Andhra Pradesh.

Hyderabad **(A. D. RAO)**
Dated: 18.11.2016 **REGIONAL DIRECTOR**

EXECUTIVE SUMMARY

Central Ground Water Board, Ministry of Water Resources, River Development & Ganga Rejuvenation, Government of India, has been carrying out ground water regime studies all over the country for generating historical data base in order to establish dynamics of ground water regime which plays a crucial role for estimation of ground water resource.

Andhra Pradesh covering ~1.63 lakh Km^2 lies between NL 12° 37 and 19° 09 and EL 76° 45 and 84° 47 and governed administratively by 13 districts. The total population of the state is ~4.96 crores and shown a decadal growth of 9.2 %. Physiographically the state can be divided into 3 distinct zones viz., Coastal plains, Eastern Ghats and Western pediplains and drained by 40 major, medium and minor rivers and covered by red soil, laterite, black cotton soil, deltaic alluvium soil, coastal soil and saline soils. Forests occupy ~22.5 % of the area and total cropped area is ~47.25% and out of ~32.2 % is under paddy (as high as 63.2% in Nellore to 5.1% in Anantapuramu). The gross area irrigated during 2014-15 is 38.85 lakh hectares (decreased by 5.1 % from 2013-14) and net area irrigated is 29.27 lakh hectares (increased by 2.9 % from previous year). The net area irrigated by tanks is 10 %, canals is 49 %, tube wells/bore wells/dug wells is 37 % and other sources it is 4.3 %.

During the year 2015, state received annual rainfall of in the range of 516 mm in Kurnool district to 1446 mm in Chittoor district with average of 966 mm, 1.5 % more than the normal rainfall (952 mm). South-west monsoon (June-Sept) contributes 58 % of rainfall, whereas, north-east monsoon (Oct-Dec) contributes 30 %, winter rainfall contributes 1% and summer contributes ~11% of rainfall in the state.

A major part of the state is underlain by gneissic complex with a structural fill of sedimentary formations and basin-fill of meta-sedimentary formations. The gneissic complex is intruded by several younger rocks namely granites, dolerites, pegmatite's and quartzite etc.

The annual replenishable ground water resources are 20387 MCM, natural discharge during non-monsoon period is 1913 MCM, net ground water availability is 18474 MCM, annual gross ground water draft is 8104 MCM, allocation for future domestic and industrial use is 1644 MCM and net ground water availability for future irrigation use is 10192 MCM. The average stage of ground water development is 44 % and 61 mandals categorized as over-exploited(OE), 17 mandals as critical, 54 mandals as semi-critical and remaining 538 under safe category (including 73 poor quality mandals (41 Fully and 32 partly)). More mandals

from Rayalseema region falls under OE, Critical and Semi-Critical category than coastal region mandals.

Ground water monitoring is carried out as part of National ground water monitoring programme 4 times a year (January, May, August and November) and ground water quality one time (May). As on 31/03/2016, total of 848 (DW: 745 and Pz: 103) Ground Water Monitoring Wells (GWMS) are in existence. There are total 164 parahydrogeologists are appointed to monitor GWMS on participatory mode (all dug wells).

Density of wells varies from one well for 100 Km^2 in East Godavari to 439 Km^2/well in YSR Kadapa district with an average of 189 Km^2/well. Alluvium have high number of monitoring wells (217 nos), followed by BGC (171 nos), khondalites (107 nos) etc.

In general, the water levels are deep during May and shallow during November months. During May (pre-monsoon season) water levels are in the range of 0.02 m bgl to 49.3 m bgl and water levels in the range of 5-10 m bgl are more predominant occupying ~47 % of the area followed by 2-5 m bgl (30 % of area). During August (mid-monsoon season) water levels are in the range of 0.05 m bgl to 47.6 m bgl and water levels in the range of 5-10 m bgl are more predominant occupying ~39 % of the area followed by 2-5 mbgl (27% area). Moderate deep water levels (10-20 mbgl) occupy ~19 % and deep water levels (>20 mbgl) occupy ~2 % of the area.

During November (post-monsoon season) water levels are in the range of 0.23 m bgl to 44.5 m bgl and water levels in the range of 2 to 5 m bgl are more predominant occupying ~37 % of the area followed by 5-10 mbgl (34 % area). Moderate deep water levels (10-20 mbgl) occupy ~6 % and deep water levels (>20 mbgl) occupy ~2 % of the area. During January-16, water levels are in the range of 0.02 m bgl to 43.5 m bgl and water levels in the range of 2-5 m bgl are more predominant occupying ~47 % of the area followed by 5-10 mbgl (32 % area). Deep water levels (>20 mbgl) occupy ~2 % of the area.

Annual water level fluctuation during May 2015 versus May14 have shown fall in water levels in 76 % of the area due to less rainfall (-28 %) than the previous year. Maximum rise of 6.7 m is observed in Chittoor district and maximum fall of 25.5 is observed in Prakasham district. Water level rise of more than 4 m is recorded maximum in Anantapuramu district, while water level fall of more than 4 m is recorded in Srikakulam and YSR Kadapa districts.

Annual water level fluctuation during August 2015 versus August 2014 have shown fall in water levels in 66 % of the area and rise in 33 % of the area. Water level rise of more

than 4 m is recorded maximum mainly in Chittoor, Southern parts of YSR Kadapa and East Godavari districts.

Annual water level fluctuation during November 2015 versus November 2014 have shown fall in water levels in 52 % of the area and in 48 % of the area rise is observed. The minimum and maximum rise in water level fluctuations is recorded as 0.01 m in Chittoor, Guntur and Visakhapatnam districts and 14.49 m in West Godavari district. The minimum fall in water level fluctuations is recorded in 0.01 m East Godavari and Kurnool districts and maximum fall of 32.6 m in Guntur district.

Annual water level fluctuation during January2016 versus January 2015 have shown fall in water levels in 48 % of the area. The minimum rise in water level fluctuation is recorded as 0.01 m in Anantapuramu, Guntur and Visakhapatnam districts and maximum rise of 16.55 m in Chittoor district. The minimum and maximum fall in water level fluctuations is recorded in 0.01 m Prakasam district and 28.57 m in Guntur district respectively.

Water levels during May-15, August-15, November-15 and January-16 as compared to decadal water levels of the same months, have shown fall in most of the wells as well as most of the area, due to less rainfall during these months.

Aquifer wise water level analysis shows that during pre and post-monsoon season shallowest water levels are observed in alluvial formations and deepest in shale formations.

A total of 26 hydrographs are generated (2 from each district) and out these wells, 9 shows rising trends and 8 shows falling trends in both seasons. The remaining shows mixed trends.

Ground water quality is assessed during pre-monsoon season of 2015 by collecting 496 samples from both dug wells and peizometers and 15 parameters namely pH, EC (in µS/cm at 25 ° C), TDS, TH, Ca, Mg, Na, K, CO_3, HCO_3, Cl, SO_4, NO_3, F and As were analyzed as per standard guidelines laid down in APHA and suitability of ground water for drinking purposes is assessed as per BIS guidelines and for irrigation as per USSL, Percent Na and RSC.

Groundwater from the state is mildly acidic to alkaline in nature with pH in the range of 5.1-9.3. Electrical conductivity varies from 62-10039 µ Siemens/cm**,** excluding one sample sample at Krishnapuram, Nellore district, it is 15570 µS/cm. Total dissolved solids (TDS) varies from 65-8103 mg/l and in 44 samples it is beyond 2000 mg/l (6.75 %). Total hardness varies from 25-6800 mg/l and in 20 % of samples it is beyond 600 mg/l. Calcium varies from 6-520 mg/l, except one sample at Krishnapuram, Nellore district, it is 1020 mg/l and it is

found that 7 % samples record Ca beyond permissible limits of BIS i.e., >200 mg/l). Magnesium varies from 0-477 mg/l, excluding one sample at Krishnapuram, Nellore district, where it is 1034mg/l and in 62 samples (12%), it is beyond permissible limits of BIS. Sodium and potassium varies from 0 to 1656 and BDL to 700 mg/l respectively.

In the ground waters of state, the concentrations of bicarbonate ranges from 12 to 1488 mg/l. Maximum concentration of 1488 mg/l is detected in Konakallu well (Krishna district). In 95 samples (19%) bicarbonate concentration is beyond permissible limts of BIS. Chloride concentration ranges from 7 to 5211 mg/l and found that 27 samples are unsuitable for drinking purposes. The maximum concentration of 5211 mg/l is detected in Krishnapuram well of Nellore district. Sulphate range from 0 to 1415 mg/l and found that 27 samples are unsuitable for drinking purposes and maximum concentration of 1415 is detected in Nadupur well of Krishna district. Nitrate ranges from 0 to 1331 mg/l and maximum concentration of 1331 is detected in Gulyan well of Kurnool district. It is found that in 199 samples (40 %) NO_3 is beyond permissible limits of human consumption. Fluoride ranges from 0.01 to 5.1 mg/l and maximum concentration of 5.1mg/l is detected in Alampur well of Anantapuramu district. Over all 39 samples (8%) are unfit for human consumption and higher concentration of F (>1.5 mg/l) are detected in Anantapuramu, Cuddapah, Prakasam and Nellore districts. Arsenic in ground water of state is within prescribed limits of BIS (< 50 ppb) and varies from below detectable limit to 10 ppb in 492 samples. Only in 4 samples (Kastampahad-Nellore, Ratana-Kurnool, Vadlamudi and Etukuru in Guntur district, it is 28, 22, 15 and 10 ppb respectively.

As for as irrigation suitability of ground water is concerned it is found that majority of samples fall in C_3-S_1 and C_4-S_1 type of water (high salinity low sodium hazard and very high salinity and low sodium hazard). As per RSC and percent Na classification of water 15 % and 14 % samples are unfit for irrigation respectively. Ground water from the area is mainly of Ca-HCO_3-Cl and Ca-Na-CHO_3-Cl type followed by Ca-Cl and Ca-Na-Cl type.

The correlation plot of F^- vs. Na (r^2=0.04) and F^- vs. HCO_3 (r^2=0.1) shows a weak degree of positive correlations and F^+ vs. pH^- show no relationship and F^- vs. Ca^{2+} shows weak negative correlation (r^2=0.005).

GROUND WATER YEAR BOOK
ANDHRA PRADESH
2015–2016

1. INTRODUCTION

Central Ground Water Board has taken up the task of complex issues of ground water development, management, augmentation, protection and regime monitoring both in terms of quality and quantity. In order to arrive at proper parametric indices of evaluation and judicious development of ground water resources, the Board is monitoring a National Network of Hydrograph Stations (NHS) on long term basis since 1969 through a network of wells (Dug wells and Piezometer wells) for studying its long term behavior due to influence of rainfall and ground water development. A historical database on the ground water levels and water quality has been developed over a period of time since 1969.

The monitoring mainly comprises measurement of water levels and temperature, four times in a year viz., in the months of May (pre-monsoon), August (mid-monsoon), November (post-monsoon) and January and collection of water samples during May every year, for chemical analysis. During the year (2015-16, 46 Ground water monitoring wells (40 Dug wells and 6 Piezometers) are abandoned and 13 new ground water monitoring wells (all dug wells) are established. As on 31-03-.2016, there were 848 operational Ground Water Monitoring Stations (GWMS) (745 dug wells and 103 piezometers).

The dug wells tapping unconfined aquifers are mostly confined to village limits, which are used for domestic purpose. Some of these are community wells and the remaining belongs to private individuals. The piezometers tapping unconfined and confined aquifers are constructed under various projects and exploration programmes by the department and are monitored manually four times a year. The location of network of monitoring wells is presented in the **Fig.1.1.**

1.1 Location and extent

Andhra Pradesh state is the 8th largest state in India covering geographical area of 1, 62,970 Km^2. It lies between NL 12° 37□ and 19° 09□ and EL 76° 45 □ and 84° 47□. The state is bordered on east by Bay of Bengal (~970 km), on south by 2016)Tamilnadu and Karnataka, on west by Karnataka and Telangana and on north by Telangana, Chattisgarh and Orissa states. Administratively, the state is divided into 13 districts (Srikakulam, Vizianagaram, Vishakhapatnam, East Godavari, West Godavari, Krishna, Guntur, Prakasam,

SPS Nellore, YSR Cuddapah, Kurnool, Ananthapuramu and Chittoor) and governed by 670 revenue mandals (blocks/tahsils) with 17,398 revenue villages. Total population of the state (2011 census) is ~4.96 crores with sex ratio of 997, of which 70 % lives in rural area and 30% in urban area. The density of population varies from 188 persons/km^2 in YSR Kadapa to 518 persons/km^2 in Krishna district (average density: 304 persons/km^2). The overall growth in total population during Decade is ~9.2 % (2001 to 2011).The present ground water year book (2015–16) depicts the ground water level scenario in the state and describes the behaviour of water levels during the period. The observation wells are distributed more or less uniformly over the State.

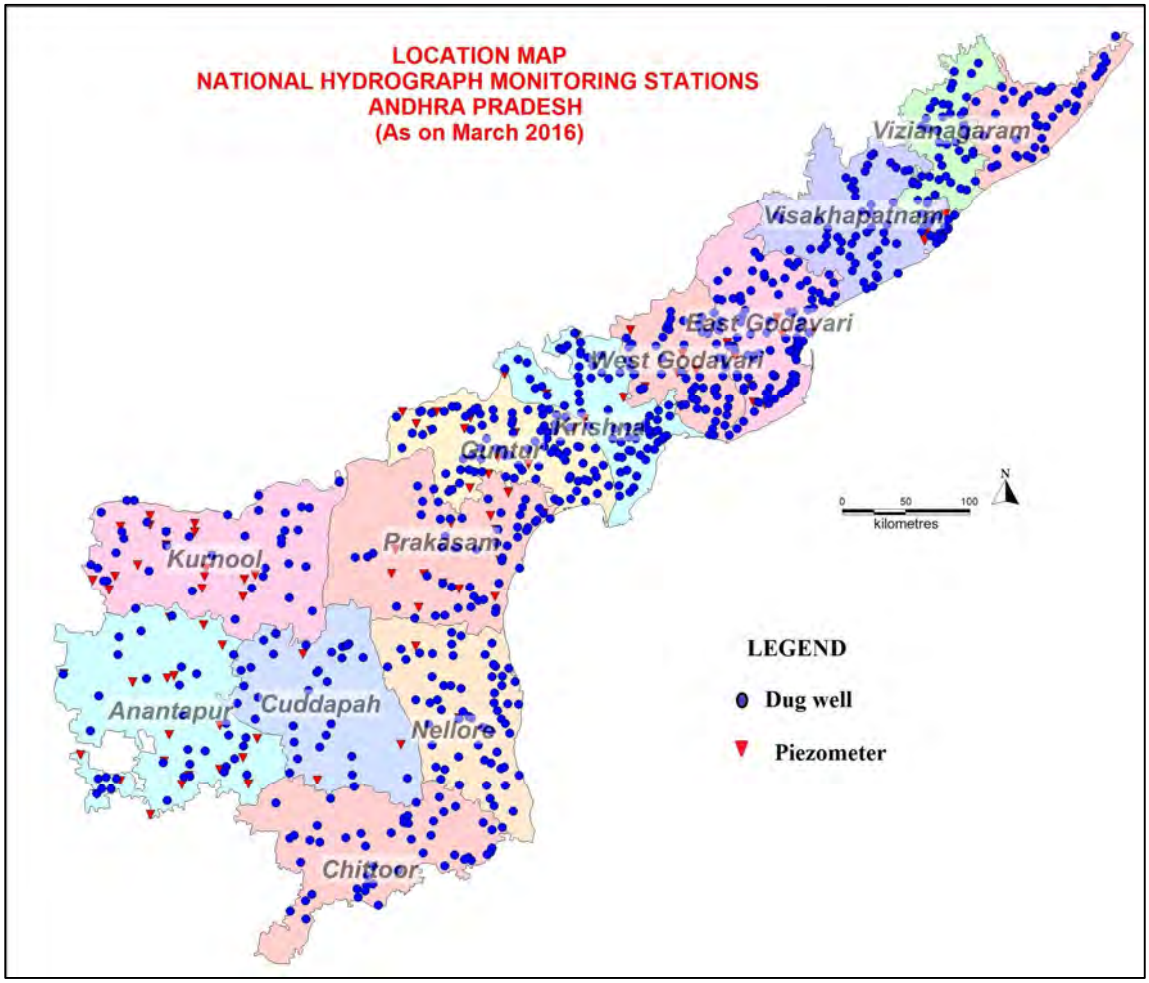


Fig 1.1 Location of GWMS in Andhra Pradesh

2. PHYSIOGRAPHY, DRAINAGE, SOIL, AGRICULTURE, LAND UTILIZATION AND IRRIGATION

2.1 Physiography

Physiographically, Andhra Pradesh state can be divided into 3 distinct zones, viz., Coastal plains, Eastern Ghats and Western pediplains. The first two zones stretch from north-east to south-west in a narrow strip while 3rd zone occupy rest of the area. The elevation ranges from 0 to > 600 m above mean sea level (amsl) (**Fig.2.1**).

2.1.1 Coastal Plains

The coastal plains stretch from Kalingapatnam (Srikakulam district) in north to Pulicat (Nellore district) in south along a narrow strip, which broadens in the middle along Godavari-Krishna deltas (up to 80 km). The altitude of coastal plains ranges from sea level at the coast to 150-200 m amsl on the west. The area has rich agricultural land owing to two deltas.

2.1.2 Eastern Ghats

The Eastern Ghats follow the coastal plains stretching closely from one end to other end except in area between the Godavari and Krishna rivers. The hill ranges trend in NE - SW direction in the north and in N-S direction in the south and attain an elevation of 600 to 1200 m amsl. The Nallamala, Erramala, Seshachalam, Velikonda and Palakonda hills falling in Rayalaseema region, cover southern section of Eastern Ghats.

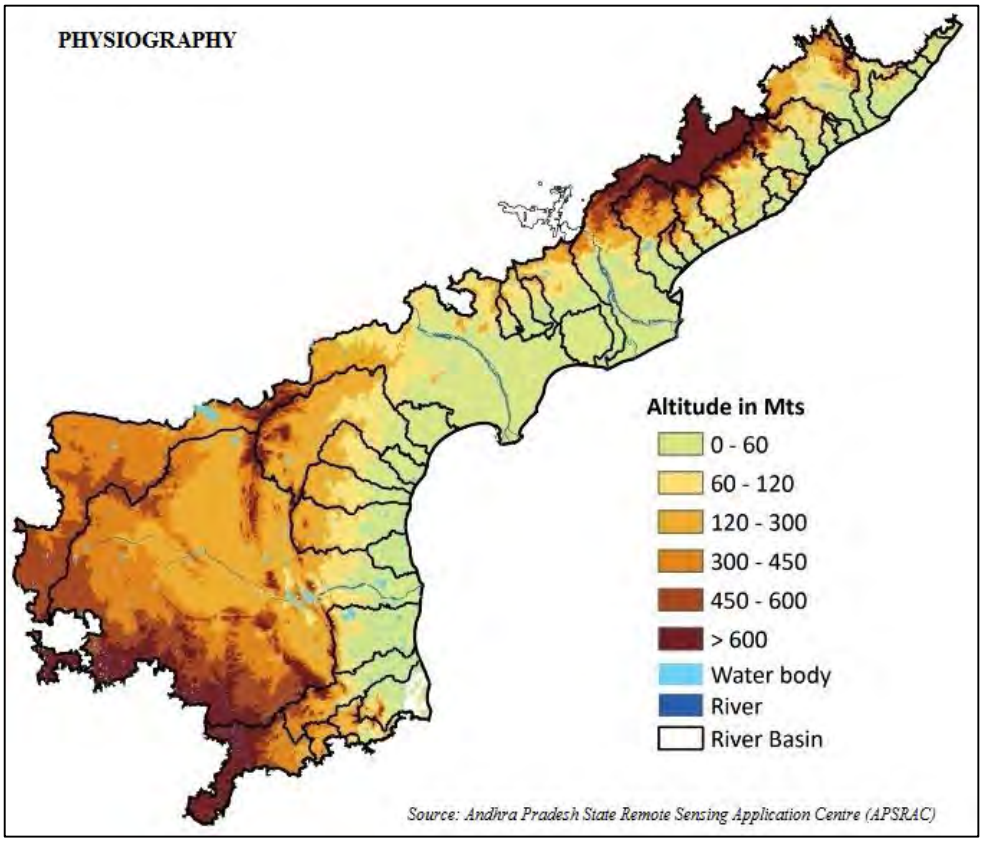


Fig.2.1: Physiography map of AP

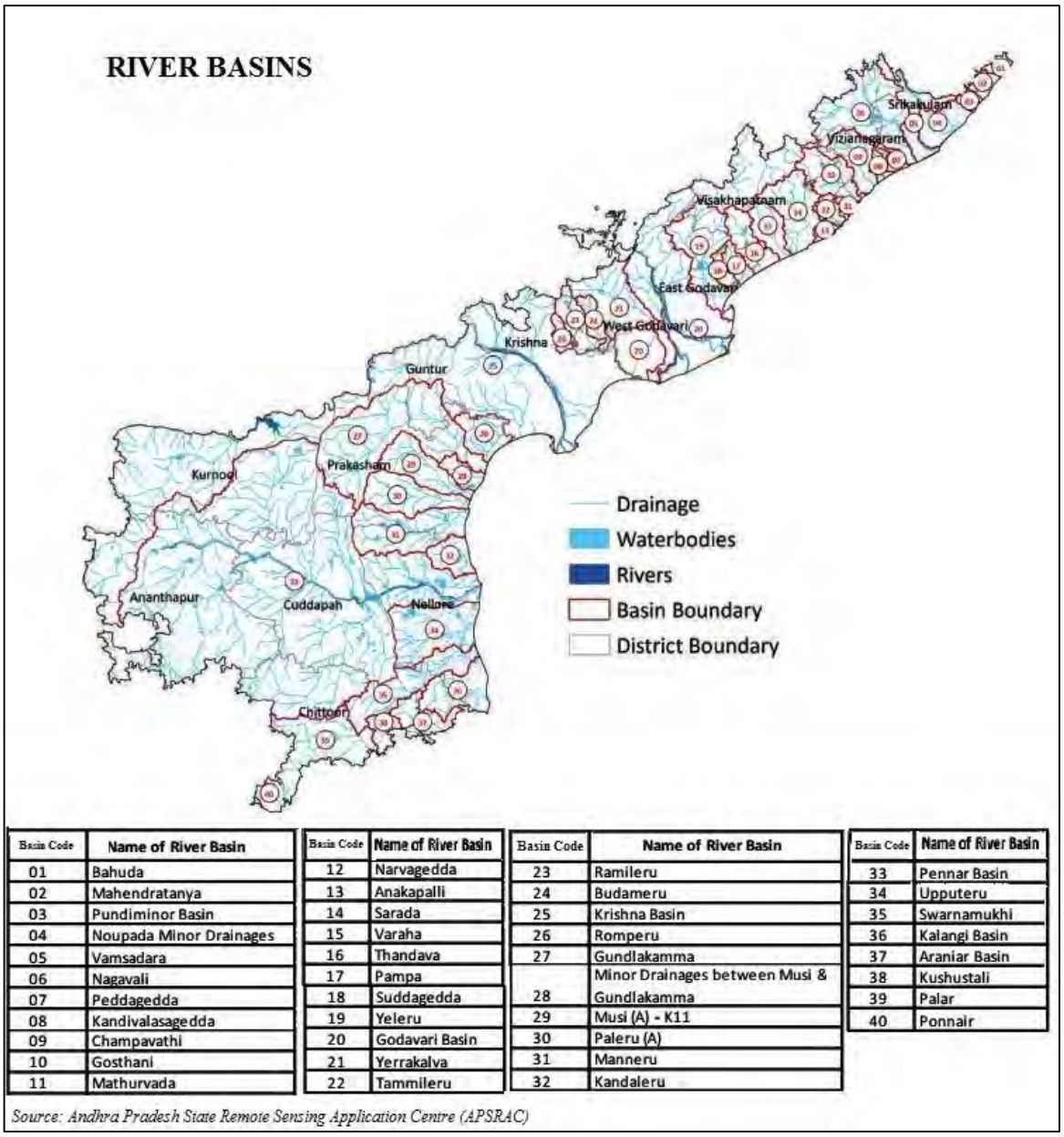
2.1.3 Western Pedeplains

A major part of state covering parts of Rayalaseema region (Kurnool and Anantapuramu districts), fall in this category. The pedeplains show rolling topography with flat to undulating tracts. This plateau in the interior of the state extends largely between elevation of 150 to 600 m amsl except at places where it is overlain by Basaltic Lava flows, the elevation of which ranges from 600 to 900 m amsl.

2.2 Drainage

The state is drained by 40 major, medium and minor rivers. The important rivers are Godavari, Krishna, Pennar, Palar, Vamsadhara, and Nagavalli (**Fig. 2.2**). Godavari and Krishna rivers and their tributaries drain the northern and central part and Pennar river drains in southern part of state before joining Bay of Bengal. There are 3 major basins and 11 medium river basins in the state. The major river basins are Godavari, Krishna and Pennar and medium basins are Vamsadhara, Nagavali, Sarada, Yeleru, Gundlakamma, Paleru (A), Manneru, Uppateru, Swarnamukhi, Palar and minor drainages between Musi and Gundlakamma. The drainage pattern is generally dendritic with wide valleys in western pediplain. The drainage in Eastern Ghat is coarse and dendritic with steep and narrow valleys. Youthful streams and valleys mark the eastern coastal tract intersected by innumerable feeder and distributory canal system. The mature river courses of Godavari, Krishna and Pennar meanders through the vast areas covered by deltas as well as coastal plains. Most of the smaller streams feed innumerable tanks.

The Tungabhadra, Vedavati, Hindri and Paleru rivers drain the southern part of the state. River Penna flows across the southern part of the state with its tributaries Chitravati, Papaghni and Cheyyeru and drains major part of Rayalaseema region and Nellore district of coastal region. The drainage basins are charecterised by undulating topography comprising a series of ridges and valleys intersperse by hill ranges. The deltas of rivers are very extensive and charecterised by considerable thickness of alluvial material. Vamsadhara and Nagavalli rivers with their distributaries drain the northeastern part of the state in Srikakulam district. Visakhapatnam district is mostly drained by local rivulets like Sarada. River Yeleru drains most of the East Godavari district while Yerrakalava, Tammileru drain West Godavari district. Nellore district is drained by Pennar, Swarnamukhi and Araniar rivers.



Basin Code	Name of River Basin
01	Bahuda
02	Mahendratanya
03	Pundiminor Basin
04	Noupada Minor Drainages
05	Vamsadara
06	Nagavali
07	Peddagedda
08	Kandivalasagedda
09	Champavathi
10	Gosthani
11	Mathurvada

Basin Code	Name of River Basin
12	Narvagedda
13	Anakapalli
14	Sarada
15	Varaha
16	Thandava
17	Pampa
18	Suddagedda
19	Yeleru
20	Godavari Basin
21	Yerrakalva
22	Tammileru

Basin Code	Name of River Basin
23	Ramileru
24	Budameru
25	Krishna Basin
26	Romperu
27	Gundlakamma
28	Minor Drainages between Musi & Gundlakamma
29	Musi (A) - K11
30	Paleru (A)
31	Manneru
32	Kandaleru

Basin Code	Name of River Basin
33	Pennar Basin
34	Upputeru
35	Swarnamukhi
36	Kalangi Basin
37	Araniar Basin
38	Kushustali
39	Palar
40	Ponnair

Source: Andhra Pradesh State Remote Sensing Application Centre (APSRAC)

Fig.2.2: Drainage and River sub-basin map of Andhra Pradesh State.

2.3 Soils

The state has a wide variety of soils viz., Red soil, Laterite soil, Black cotton soil, Deltaic Alluvium soil, Coastal soil and saline soil. Red clayey soil occurs predominantly in Srikakulam, Visakhapatnam, East Godavari and West Godavari districts in coastal region. Black cotton soil commonly occurs in Krishna Kadapa, Kurnool, Anantapuramuamu and Guntur districts. Red earths with loamy sub-soil and red sandy loamy soil occur in Prakasam and Nellore districts. Laterite soils occur in Nellore and Prakasam districts. Red loamy soils occur in parts of Chittoor and Kadapa districts. Red earths are predominant in Anantapuramu district. Soil map of AP is given in **Fig. 2.3.**

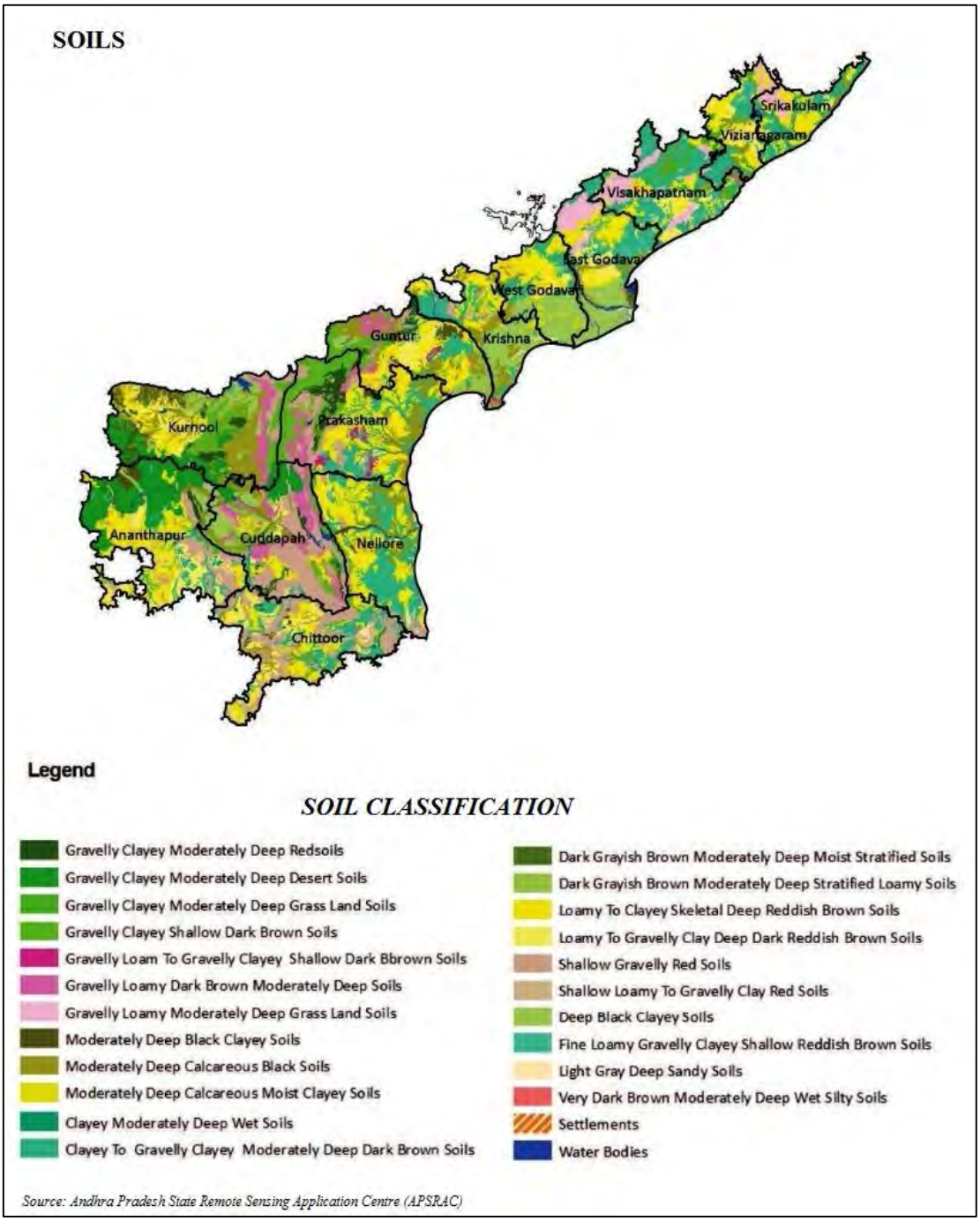


Fig.2.3: Soil Map of Andhra Pradesh

2.4 Agriculture and land utilization

Agriculture plays an important role in the economy of state and sustainable growth in agriculture continues to be core agenda of the Government and occupies center stage with three thrust areas viz, i) to promote inclusive growth ii) to enhance rural income and iii) to sustain food security.

Forests occupy ~22.5 % of states geographical area and total cropped area is ~47.25% and net cropped area is 38.3 % of total area. Current fallow lands is 8.6 %, land put to non-

agricultural uses is 12.3 %, barren and uncultivable land is 8.3 % and rest falls under other fallow lands and remaining under culturable waste etc. (**Fig.2.2**) . During the year 2014-15, ~32.2% of the area with gross cropped area is under paddy in the state and it is as high as 63.2 % in Nellore to 5.1% in Anantapuramu district. The other districts where > 50 % paddy is grown are West Godavari and East Godavari.

2.5 Irrigation

The gross area irrigated in the state during 2014-15 is 38.85 lakh hectares which Decreased by 5.1 % from 2013-14. The net area irrigated is 29.27 lakh hectares during the 2014-15 which increased by 2.9 % from previous year. The net area irrigated by tanks is 10%, by canals is 49%, under tube wells/bore wells/dug wells is 37 % and under other sources it is 4.3 %..The year wise net area irrigated by different sources is given in Fig 2.4

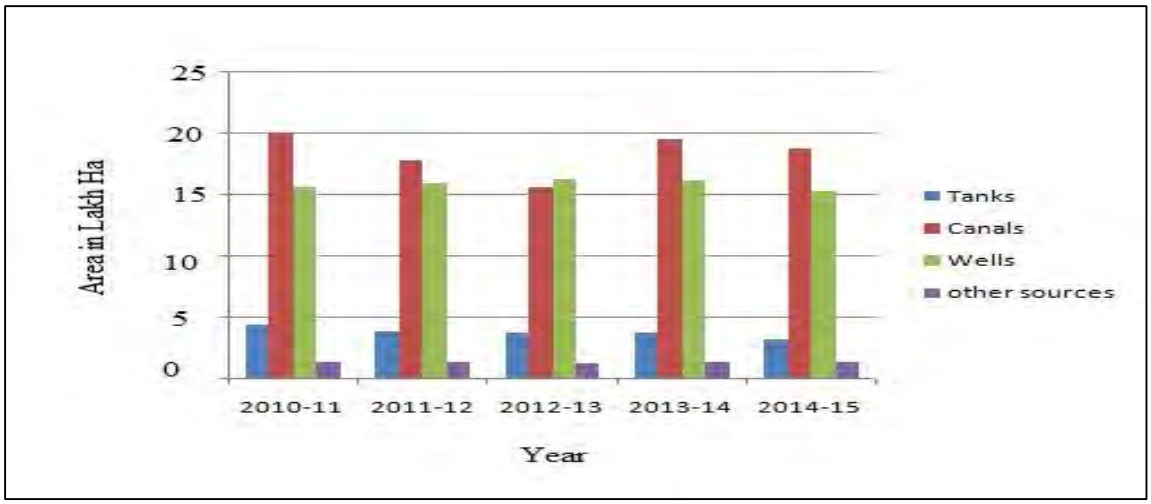


Fig.2.4: Year wise net area irrigated by different sources.

3. HYDROMETEOROLOGY

3.1 Climate

The climate of the state is tropical in nature and is influenced by the topographical variations and maritime influence. The Deccan Plateau has more of a temperate climate than the coastal belt. The Eastern Ghats in Vishakhapatnam and its neighborhood play a significant role, which acts as a barrier to easterly winds in association with depression from Bay of Bengal during the southwestern monsoon.

The Agro-climatic classification (Agricultural Department) of the state is given in the **Table-3.1**.

Table-3.1: Agro-climatic classification (Agricultural department).

Region	Classification
Rayalaseema Plateau	Scarce rainfall zone
	Southern zone
Coastal Andhra Pradesh	Krishna – Godavari Zone
	North Coastal zone
	South Coastal zone
	High Altitude
	Tribal Zone
	Scarce Rainfall Zone

3.2 Rainfall Analysis-2015

District-wise monthly, seasonal and annual rainfall of both normal and actual for the year 2015 is compiled from daily and weekly weather reports of India Meteorological Department (IMD) and presented in **Table-3.2** and depicted in **Fig.3.1.** The salient features are given below.

- The normal annual rainfall of the state is 952 mm of which SW monsoon (June-September) contributes 58 % (555 mm), NE monsoon (Oct-Dec) contributes 30 % (285 mm), winter contributes 1 % (10 mm) and summer contributes 11 % (96.3 mm) of the rainfall. Annual normal rainfall ranges from 574 mm in Anantapuramu district to 1166 mm in Srikakulam district **(Fig.3.2).**
- During the year 2015, state received 1.5 % more rainfall (966 mm) than normal rainfall of which SW monsoon (June-September) contributed 60 % (579.2 mm), NE monsoon (Oct-Dec) contributed 30.8 % (297.3 mm), winter contributed < 1 % (8.8 mm) and summer contributed 8 % (81 mm) of the rainfall.

- Annual rainfall in 2015 ranges from 516 mm (Deficit by 24 %) in Kurnool district to 1446 mm (excess by 61 %) in Chittoor district.
- Monthly mean rainfall ranges from 1.9 mm in January to 200 mm in November.

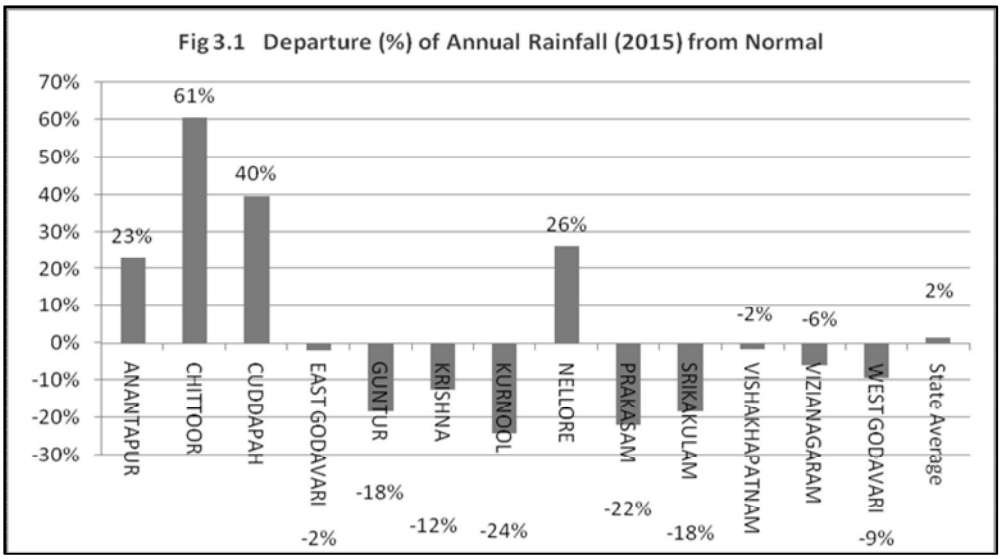


Fig.3.1: Annual departure of rainfall (2015) from normal rainfall (%).

The rainfall received during the period January 2005 to December 2015 is compiled and analysed for correlating with water levels monitored during the period May 2015 to January 2016. The data is presented in **Table-3.2 to 3.5** and depicted in the **Fig. 3.3 to 3.10.**

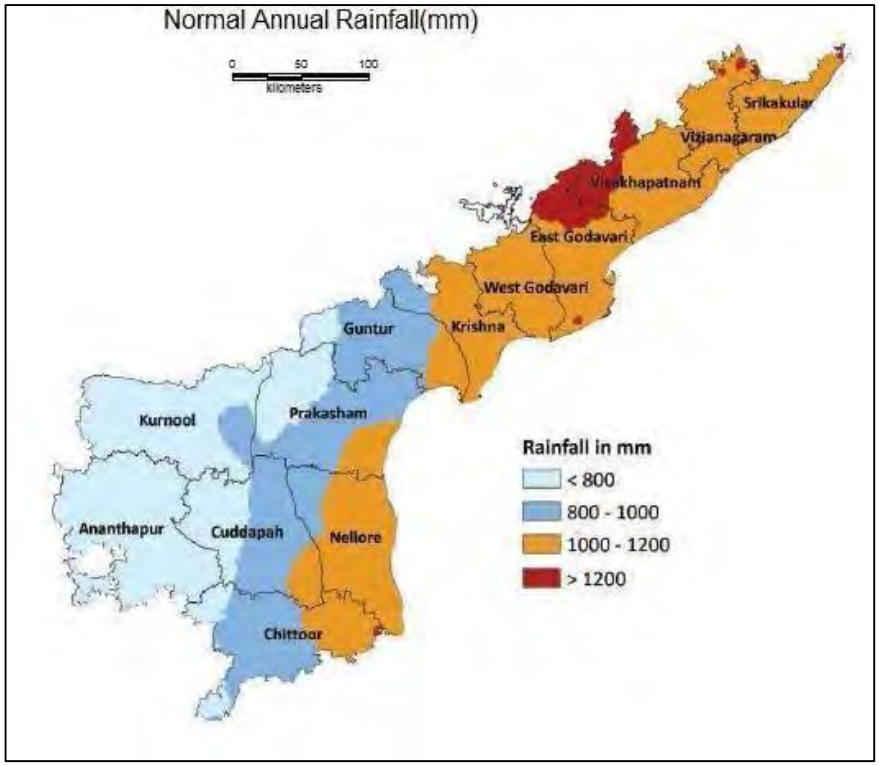


Fig.3.2: Isohytel map of Andhra Pradesh State (Normal annual rainfall in mm).

Table-3.2: Monthly normal and actual rainfall 2015 (mm) in Andhra Pradesh State.

District	Jan		Feb		Mar		Apr		May		Jun		Jul		Aug		Sep		Oct		Nov		Dec		Annual		
	A	N	A	N	A	N	A	N	A	N	A	N	A	N	A	N	A	N	A	N	A	N	A	N	A	N	%
Anantapuramu	0	2.4	0	3.6	6.1	5.2	72	21	70	56.7	64	55	19	64	95	75	153	129	96	115	124	35	5.3	12	706	574	**23**
Chittoor	0.9	7.5	45.5	7.4	19	8.4	77	29.8	63	67.2	91	67	46	100	132	110	124	140	160	167	590	137	96	58	1446	900	**61**
Cuddapah	3.6	1.9	0	2.3	8.2	4.2	66	19.2	24	47.6	76	70	38	101	144	109	130	125	91	137	390	77	34	24	1004	718	**40**
East Godavari	0.1	5.9	0	9	0.4	11	27	25.4	24	75.3	323	132	139	206	196	188	168	177	85	199	122	70	1.1	7.8	1085	1107	**-2**
Guntur	1.3	5.3	0	7.9	0.7	6.7	19	16.7	17	58.4	183	90	94	147	145	155	142	150	32	144	79	76	0.9	15	714	872	**-18**
Krishna	5.9	4.6	0	6.2	2.3	7.8	22	18.5	23	46.8	267	121	105	217	175	194	140	170	64	164	96	66	2	12	901	1028	**-12**
Kurnool	1.3	1.1	37	1.9	11	4.9	43	19.9	22	51.7	44	81	44	116	82	124	170	140	39	106	22	28	2.4	6.6	516	680	**-24**
Nellore	0.6	15.6	0	11	9.3	5.6	44	17.4	30	51.4	59	53	29	91	149	95	112	113	79	248	747	284	119	107	1379	1093	**26**
Prakasam	0.6	7.9	0	8.8	3.1	8.6	23	17.6	15	52.3	79	64	54	99	129	96	123	123	58	182	120	115	26	32	629	807	**-22**
Srikakulam	6.5	7.4	4.1	18	1.4	15	39	29.4	21	63.9	209	145	136	190	195	202	212	208	57	211	57	70	16	4.9	953	1166	**-18**
Vishakhapatnam	1.4	8.3	1.5	11	18	15	69	50.5	38	96.6	209	133	130	178	205	178	261	185	48	204	123	59	2.9	4.3	1105	1123	**-2**
Vizianagaram	2.4	8.2	1.2	15	8	15	22	37.3	56	90.7	297	141	107	182	215	195	264	209	57	188	39	56	2.5	6.1	1072	1142	**-6**
West Godavari	0.6	6	0.1	10	1.3	8.4	6.7	20.8	33	55.8	279	136	126	240	244	228	180	180	91	198	93	67	0.2	12	1054	1162	**-9**
State Avg	**1.9**	**6.3**	**6.9**	**8.7**	**6.8**	**8.8**	**41**	**24.9**	**34**	**63**	**168**	**99**	**82**	**149**	**162**	**150**	**168**	**158**	**74**	**174**	**200**	**88**	**24**	**23**	**966**	**952**	**2**

A- Actual *N- Normal* *% Deviation*

Table-3.3: Rainfall and its variability in Andhra Pradesh State.

District	Rainfall (mm)				Rainfall departure of June 14 to May2015 with		
	June-14 to May-15	June-13 to May-14	Decadal mean (2006-15)	Normal	June-13 to May-14	Decadal mean (June-May)	Normal (June-May)
Anantapuramu	487	542	608	573	-10.2%	-20.0%	-15.0%
Chittor	721	793	933	898	-9.0%	-22.7%	-19.7%
Cuddapah	499	654	658	717	-23.7%	-24.2%	-30.4%
East Godavari	563	1141	1126	1106	-50.7%	-50.0%	-49.1%
Guntur	651	1098	919	872	-40.7%	-29.2%	-25.3%
Krishna	576	1251	1120	1027	-54.0%	-48.6%	-43.9%
Kurnool	664	686	723	680	-3.1%	-8.1%	-2.3%
Nellore	751	802	1046	1092	-6.5%	-28.2%	-31.2%
Prakasam	499	932	835	806	-46.4%	-40.2%	-38.1%
Srikakulam	1104	1578	1201	1165	-30.1%	-8.1%	-5.3%
Vishakhapatnam	1056	1237	1125	1121	-14.7%	-6.2%	-5.8%
Vizianagaram	1105	1116	1175	1140	-1.0%	-5.9%	-3.1%
West Godavari	765	1256	1153	1160	-39.1%	-33.6%	-34.1%
STATE MEAN	**726**	**1007**	**971**	**950**	**-27.9%**	**-25.2%**	**-23.6%**
Source: IMD, Govt of India							

3.2.1 May-2015

3.2.1.1 Rainfall Analysis (June2014 toMay2015 from June2013 to May2014 rainfall)

The thematic map depicting departure of rainfall during June 2014 to May 2015 from June2013to May 2014 rainfall is given in **Fig. 3.3**. Water level fluctuation during May, 2015 is correlated with departure of rainfall. The rainfall recorded during June 2014 to May2015 is 726 mm (Table 3.3) which is 28 % less than normal rainfall received during the same period of previous year. The departure ranges from -54 % in Krishna district to -1 % in Vizianagaram district.

3.2.1.2 Departure of rainfall during June 2014 to May 2015 from Decadal mean rainfall 2006-2015 (June-May)

Rainfall departure of June 2014 to May 2015 with decadal mean rainfall (June-May) is prepared to correlate with water level fluctuation map of May 2015 with decadal mean (May) (**Fig-3.4**). Decadal mean rainfall (June-May) of the state is 971 mm and it ranges from -50 % (East Godavari district) to -6 % (Vizianagaram district).

3.2.1.3 Departure of rainfall during June 2014 to May 2015 from normal rainfall of same period

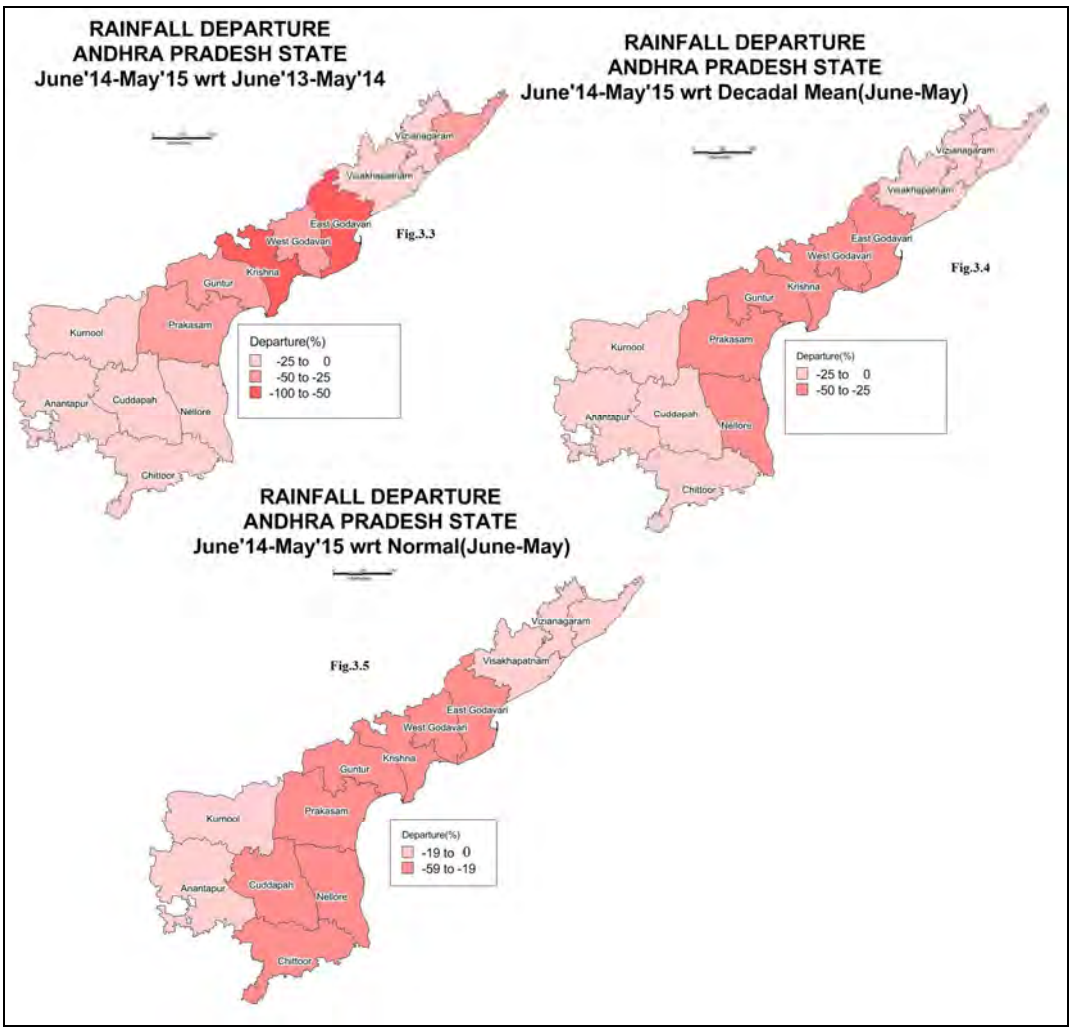
Rainfall departure of June 2014 to May 2015 rainfall with normals of the same period is prepared to correlate with water level fluctuation map of May 2015 (**Fig-3.5**). During this period state received -24% rainfall than normal rainfall and it ranges from-49 % (East Godavari district) to -2.3 % (Kurnool district) and deficient rainfall is observed in Chittoor, Cuddapah, East Godavari, Guntur, Krishna, Nellore, Prakasam and West Godavari districts. Remaining area of the state received normal rainfall.

3.2.2 August, 2015

The district wise rainfall for the period June to August 2015, June to August2014, Decadal mean and normal rainfall for the same period is given in **Table-3.4** and different thematic maps are presented in **Fig.3.6, 3.7 and 3.8**.

3.2.2.1 Departure of rainfall during June 2015 to August 2015 from June 2014 to August2014

Departure of June 2015 to August 2015 rainfall from June 2014 to August 2014 rainfall is depicted in the **Fig.3.6.** During June 2015 to August 2015, State received rainfall of 420 mm (Table-3.4) which is 32.5 % more than the rainfall during the same period previous year (317 mm). The departure ranges from -44 % in Kurnool district to 141 % in East Godavari district.



3.2.2.2 Departure of rainfall during June 2015 to August, 2015 from Decadal mean of same period (2006-2015)

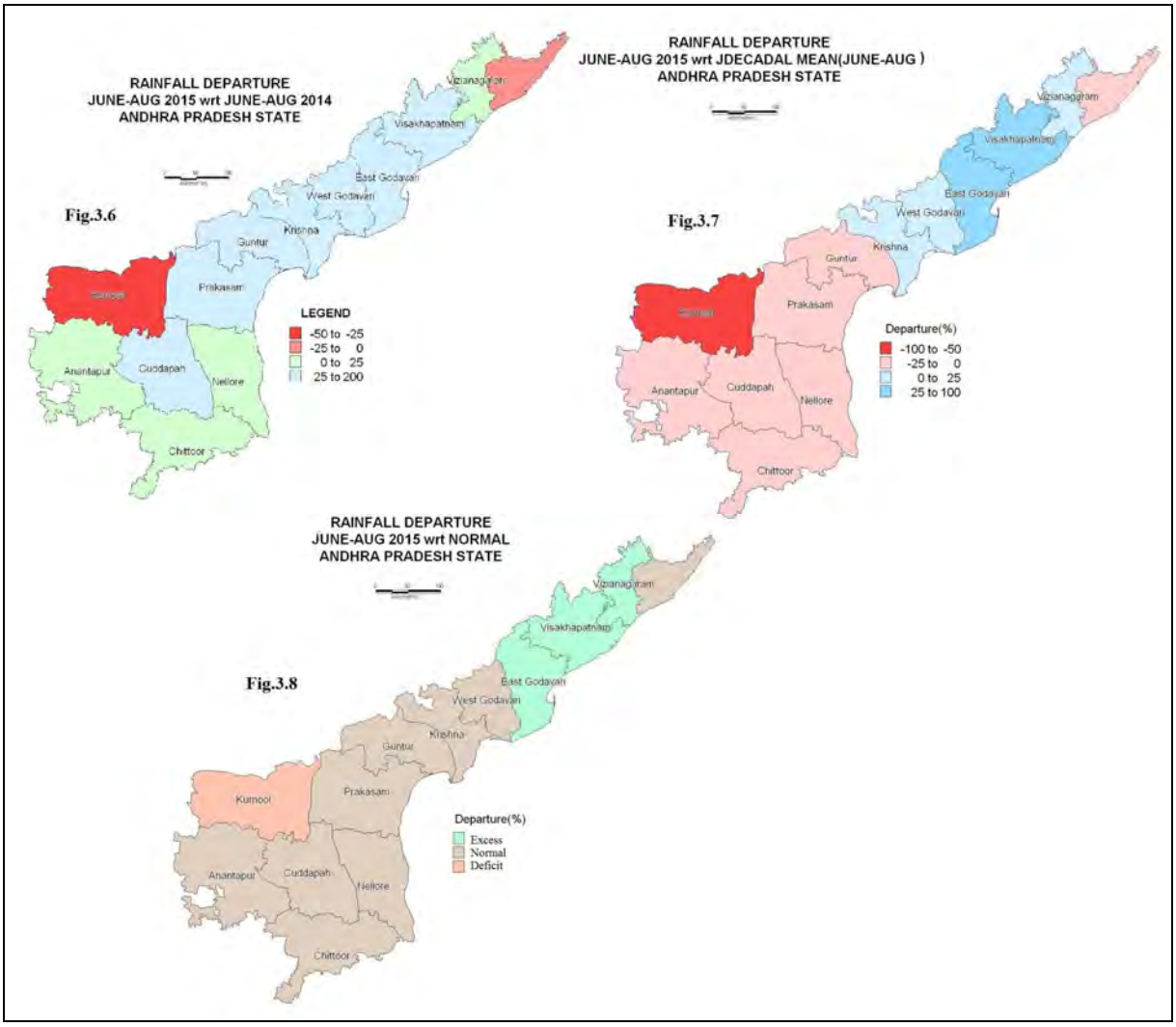
Departure of June 2015 to August 2015 rainfall from Decadal mean (June-May) is depicted in the **Fig.3.7**. Water level fluctuation map of August 2015 with Decadal mean (August) is correlated with departure of rainfall. Decadal mean rainfall (June-May) of the state is 410 mm (Table-3.4) and it ranges from -52 % in Kurnool district to 42 % in Vishakhapattanam district.

3.2.2.3 Departure of rainfall during June to August, 2015 from normal rainfall of the same period

Departure of June 2015 to August 2015 rainfall from normals of the same period is depicted in the **Fig.3.8** and correlated with depth to water levels of August-2015. It ranges from -47 % in Kurnool district to 32.5 % in Vishkahapattanam district. Deficit is observed Kurnool district and excess rainfall in Vishkhapattanam, East Godavari, Vizianagaram districts and in other districts it received normal rainfall.

Table-3.4: Rainfall and its variability in Andhra Pradesh.

District	Rainfall (mm)				Departure of June15 to Aug15 with		
	Jun-15 to Aug-15	Jun-14 to Aug-14	Decadal mean (June-Aug) (2006-15)	Normal (Jun-Aug)	June-14-Aug-14	Decadal mean (Jun-Aug)	Normal (June-Aug)
Anantapuramu	179	168	237	194	6.9%	-24.5%	-7.7%
Chittoor	269	242	317	277	11.1%	-15.1%	-2.9%
Cuddapah	258	186	269	280	38.9%	-4.1%	-7.7%
East Godavari	657	273	490	527	140.7%	34.1%	24.7%
Guntur	422	267	425	393	58.3%	-0.7%	7.4%
Krishna	546	267	544	532	104.6%	0.4%	2.7%
Kurnool	170	303	351	321	-43.9%	-51.6%	-47.0%
Nellore	237	227	249	240	4.2%	-4.8%	-1.1%
Prakasam	262	185	276	260	41.9%	-5.1%	1.0%
Srikakulam	539	576	567	538	-6.4%	-4.9%	0.3%
Vishakhapatnam	648	441	456	489	46.8%	42.1%	32.5%
Vizianagaram	619	546	548	517	13.5%	13.0%	19.7%
West Godavari	648	435	598	604	48.9%	8.4%	7.3%
STATE MEAN	**420**	**317**	**410**	**398**	**32.5%**	**2.4%**	**5.5%**
Source: IMD, Govt of India							



3.2.3 November, 2015

The district wise rainfall for the period June to October-2015, June to October-2014, Decadal mean and normal rainfall for the same period is given in **Table 3.5** and different thematic maps are presented in **Fig.3.9, 3.10 and 3.11**.

3.2.3.1 Departure of rainfall during June 2015 to October 2015 from June2014 to October 2014

Departure of June 2015-October'15 rainfall from June'14-October'14 rainfall is depicted in the **Fig.3.9.** Water level fluctuation during November, 2015 Vs November 2014 is correlated with departure of rainfall. During this period the state received 652 mm rainfall, which is ~11 % more than the rainfall of same period of previous year (587 mm). It ranges from -21.2 % in Srikakulam district to 87 % in East Godavari district.

Table-3.5: Rainfall and its variability in Andhra Pradesh State- (Source: IMD, Govt of India).

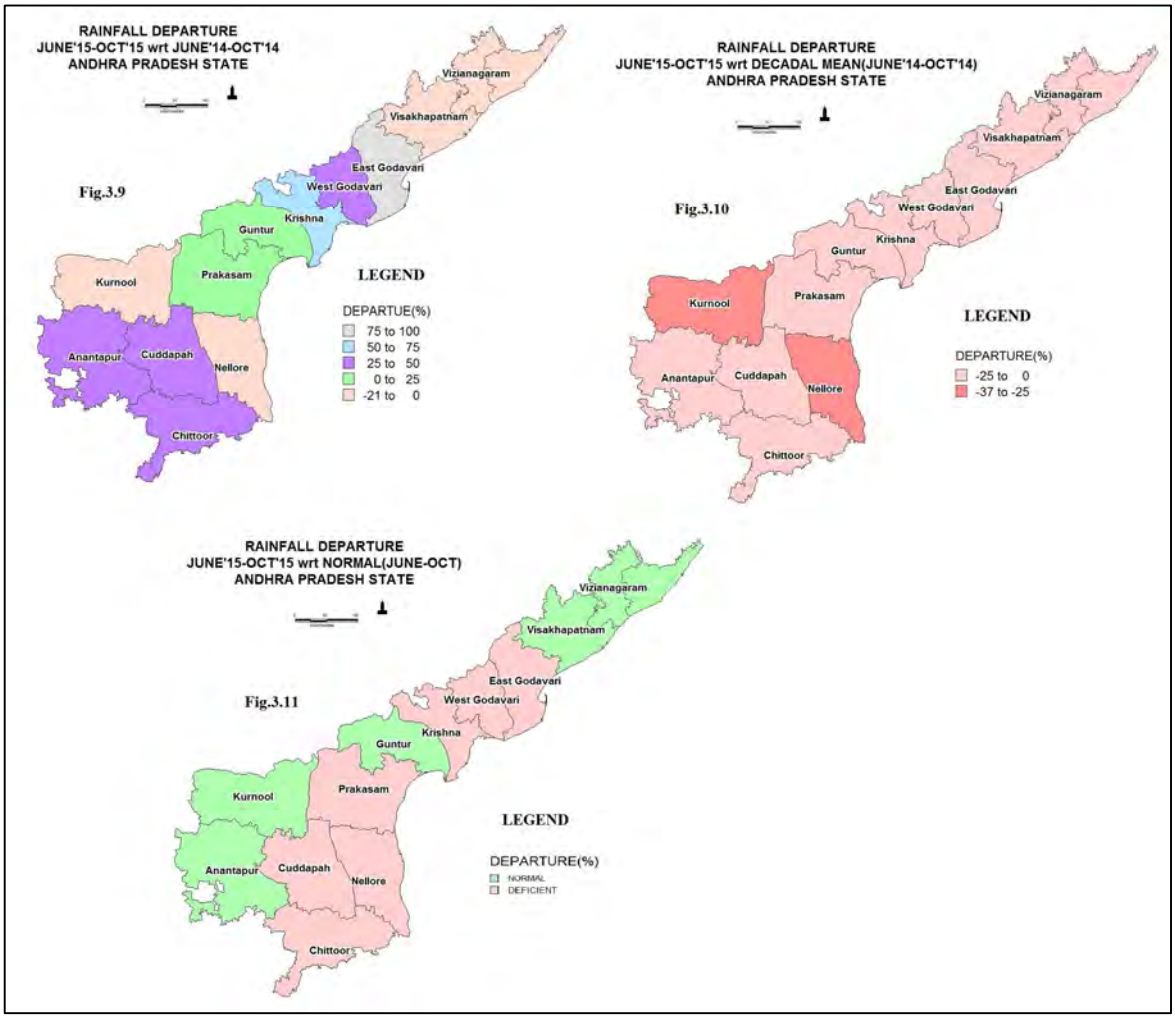
District	Rainfall (mm)				Departure of Jun-15 to Oct15 with		
	Jun-15 to Oct-15	Jun-14 to Oct-14	Decadal mean (Jun-Oct) (2006-15)	Normal (Jun-Oct)	Jun-14 to Oct-14	Decadal mean (June-Oct)	Normal (Jun-Oct)
Anantapuramu	428	321	461	438	33.3%	-7.2%	-2.2%
Chittor	553	440	618	584	25.8%	-10.5%	-5.4%
Cuddapah	479	365	498	541	31.2%	-3.8%	-11.5%
East Godavari	910	487	918	903	87.0%	-0.9%	0.8%
Guntur	596	561	744	687	6.3%	-19.9%	-13.2%
Krishna	751	491	921	866	52.9%	-18.5%	-13.2%
Kurnool	378	479	604	566	-21.0%	-37.4%	-33.2%
Nellore	421	455	607	601	-7.6%	-30.6%	-29.9%
Prakasam	443	366	591	564	21.1%	-25.0%	-21.5%
Srikakulam	808	1025	998	957	-21.2%	-19.0%	-15.6%
Vishakhapatnam	852	919	900	879	-7.3%	-5.3%	-3.0%
Vizianagaram	941	1006	956	914	-6.5%	-1.6%	2.9%
West Godavari	918	710	985	982	29.2%	-6.8%	-6.5%
STATE MEAN	**652**	**587**	**754**	**729**	**11.2%**	**-13.5%**	**-10.6%**

3.2.3.2 Departure of rainfall during June-15 to October-2015 from Decadal mean of same period

Departure of June 2015 to October 2015 rainfall from Decadal mean (June-October) is depicted in the **Fig.3.10**. Water level fluctuation map of November-2015 with decadal mean (June-October) is correlated with departure of rainfall. Overall it is 652 mm (Table-3.5) which is -13.5 % less than the decadal normal (754 mm) and it ranges from -37.4 % in Kurnool district to -1 % in East Godavari district.

3.2.3.3 Departure of rainfall during June 2015 to October-2015 from normal rainfall of same period (June-October)

Departure of June 2015 to October 2015 rainfall from normal of the same period is depicted in the **Fig.3.11** and correlated with depth to water levels of November 2015. Overall the state received 652 mm which is -10.6 than the normal rainfall during the same period. It ranges from -33.2 % in Kurnool district to 3 % in Vizianagaram district.



3.3.4 January, 2016

The district wise rainfall for the period January 2015 to Decemebr2015,January 2014 to December 2014, Decadal mean of January-December (2006-15) and normals of same period is given in **Table-3.6** and different thematic maps are presented in **Fig.3.12, 3.13 and 3.14**.

3.3.4.1 Departure of rainfall during January 2015 to December2015 from January 2014 to December 2014

Departure of January-15 to Dec-2015 from January-14 to Dec-14 rainfall is depicted in the **Fig.3.12.** During this period the State received 966 mm rainfall, which is 31 % more than the rainfall of same period in last year (737 mm). It ranges from -25 % in Srikakulam district to 143 % in Chittoor district.

Table-3.6: Rainfall and its variability in Andhra Pradesh State- (Source: IMD, Govt of India).

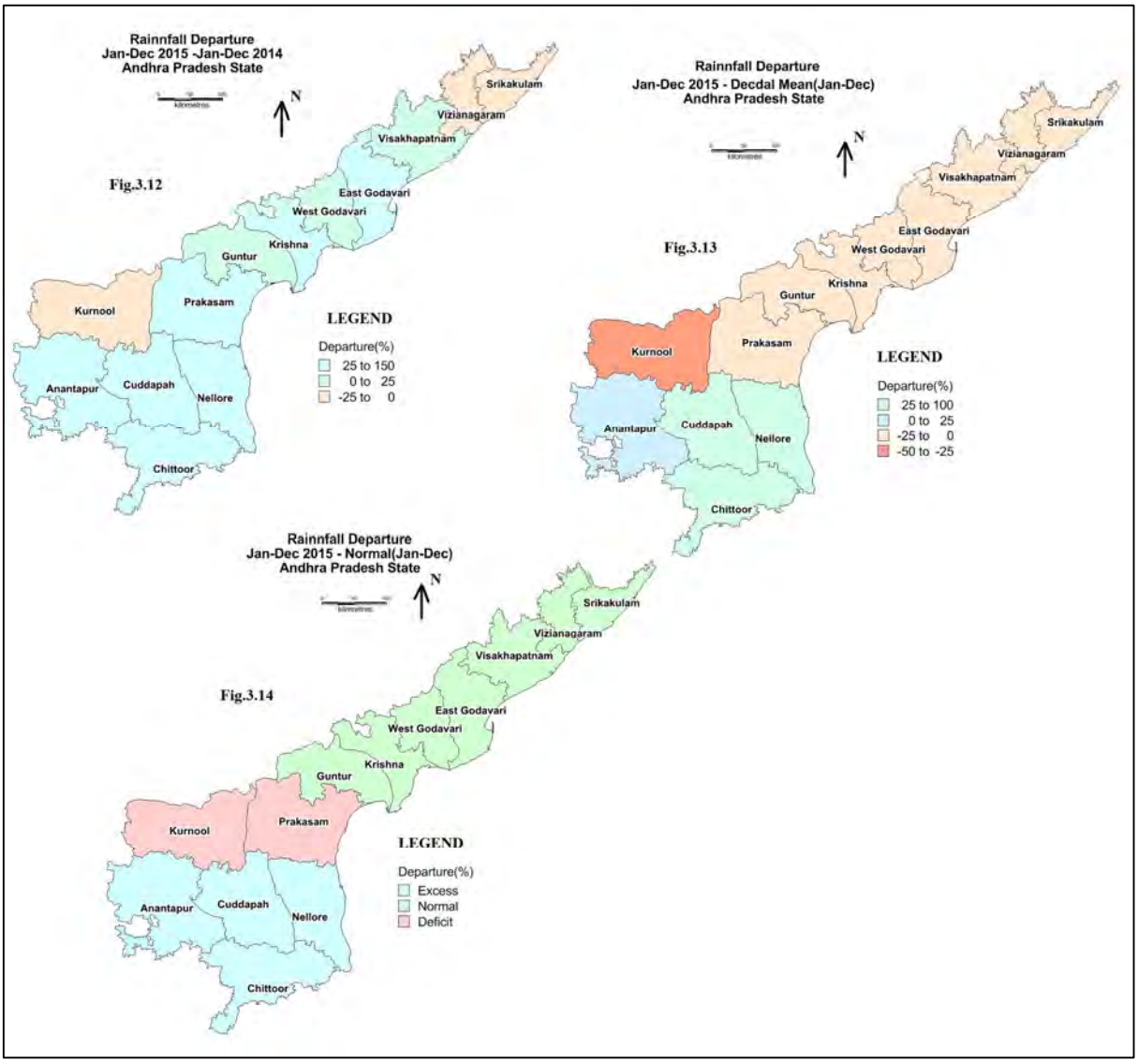
District	Rainfall (mm)				Departure of January 15 to Dec-15 with			Remarks
	Jan-15 to Dec-15	Jan-14 to Dec-14	Decadal mean (2006-15)	Normal (Jan-Dec)	Jan 14 to Dec-14 %	Decadal mean (Jan-Dec) %	Normal (Jan-Dec) %	
Anantapuramu	706	438	618	573	61	14	23	Excess
Chittor	1446	596	958	898	143	51	61	Excess
Cuddapah	1004	434	692	717	131	45	40	Excess
East Godavari	1085	632	1116	1106	72	-3	-2	Normal
Guntur	714	681	919	872	5	-22	-18	Normal
Krishna	901	615	1130	1027	47	-20	-12	Normal
Kurnool	516	581	714	680	-11	-28	-24	Deficit
Nellore	1379	702	1039	1092	96	33	26	Excess
Prakasam	629	497	831	806	27	-24	-22	Deficit
Srikakulam	953	1268	1211	1165	-25	-21	-18	Normal
Vishakhapatnam	1105	1082	1119	1121	2	-1	-1	Normal
Vizianagaram	1072	1195	1186	1140	-10	-10	-6	Normal
West Godavari	1054	860	1176	1160	23	-10	-9	Normal
STATE MEAN	**966**	**737**	**978**	**950**	**31**	**-1**	**2**	Normal

3.3.4.2 Departure of rainfall during January 2015 to December 2015 from Decadal mean of January2006-Dec-15

Departure of January 2015 to December 2015 rainfall from Decadal mean (January2006-December 2015) is depicted in the **Fig.3.13**. Water level fluctuation map of January 2016 with Decadal mean is correlated with departure of rainfall. Overall it is 966 mm (**Table-3.6**) which is -1% less than decadal mean (978 mm)and it ranges from -28 % in Kurnool district to 51 % in Chittoor district.

3.3.4.3 Departure of rainfall during January 20 15 to December 2015 with normal rainfall of the same period

Departure of January-15 to December-15 from normals of the same period is depicted in the **Fig.3.14** and correlated with depth to water levels of January 16. It ranges from -24 % in Kurnool district to 61 % in Chittoor district.


Rainnfall Departure
Jan-Dec 2015 -Jan-Dec 2014
Andhra Pradesh State
N
Fig.3.12
Srikakulam
Vizianagaram
Visakhapatnam
East Godavari
West Godavari
Krishna
Guntur
Prakasam
Kurnool
Cuddapah
Anantapur
Nellore
Chittoor
LEGEND
Departure(%)
25 to 150
0 to 25
-25 to 0
Rainnfall Departure
Jan-Dec 2015 - Decdal Mean(Jan-Dec)
Andhra Pradesh State
N
Fig.3.13
Srikakulam
Vizianagaram
Visakhapatnam
East Godavari
West Godavari
Krishna
Guntur
Prakasam
Kurnool
Cuddapah
Anantapur
Nellore
Chittoor
LEGEND
Departure(%)
25 to 100
0 to 25
-25 to 0
-50 to -25
Rainnfall Departure
Jan-Dec 2015 - Normal(Jan-Dec)
Andhra Pradesh State
N
Fig.3.14
Srikakulam
Vizianagaram
Visakhapatnam
East Godavari
West Godavari
Krishna
Guntur
Prakasam
Kurnool
Cuddapah
Anantapur
Nellore
Chittoor
LEGEND
Departure(%)
Excess
Normal
Deficit

4. GEOLOGY

A wide variety of geological formations occur in Andhra Pradesh State, ranging from the oldest Archaean crystalline formations to recent Alluvium. The geological set up and hydrogeological map is presented in the **Fig.4.1** and **4.2** respectively. A major part of the area is underlain by gneissic complex with a structural fill of sedimentary formations and basin-fill of meta-sedimentary formations. The gneissic complex is intruded by several younger rocks namely granites, dolerites, pegmatites and quartzite etc.

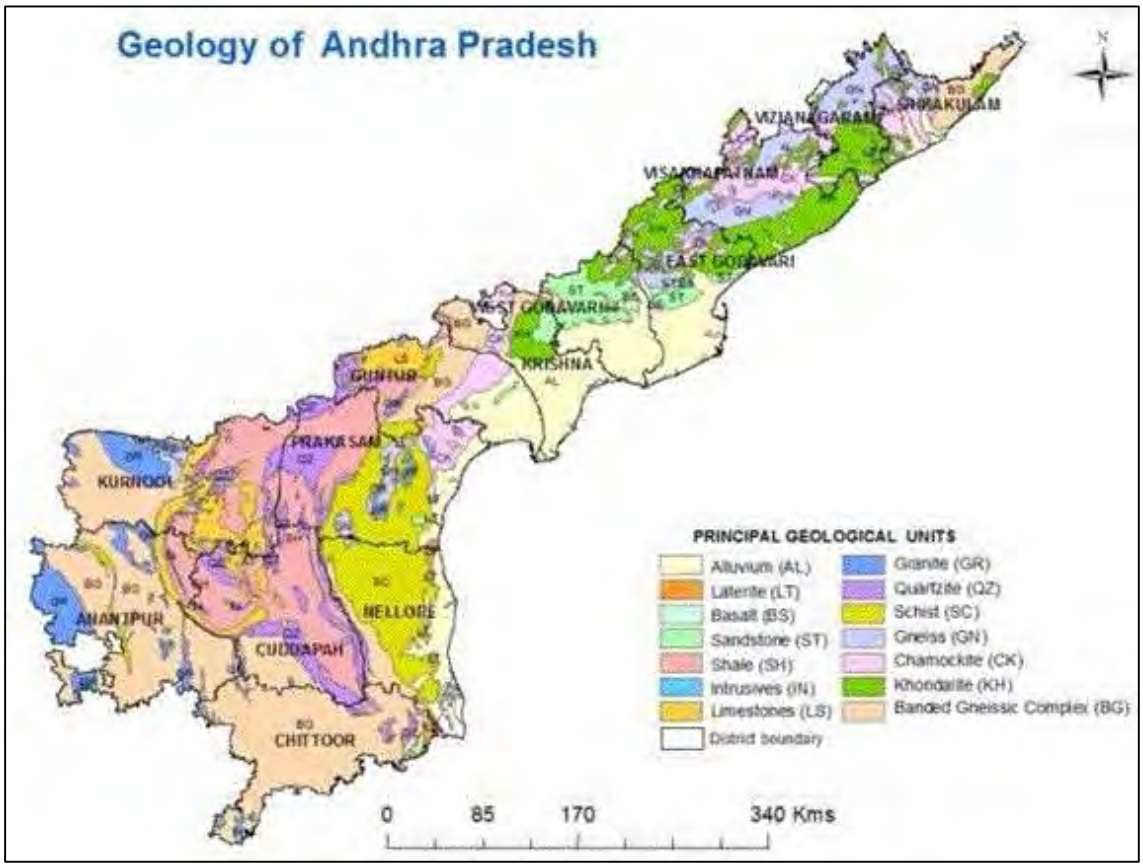


Fig.4.1: Geology of Andhra Pradesh State.

4.1 Archaeans and Lower Pre-Cambrians

Peninsular gneisses of Archaean age are dominant rock types in Rayalseema region of the state. Dharwars, comprising amphibolites, gneisses, schists, and quartzites occur as narrow isolated bands within granites in Chittoor, Anantapuramu, Kurnool, Kadapa, Nellore and Prakasam districts.

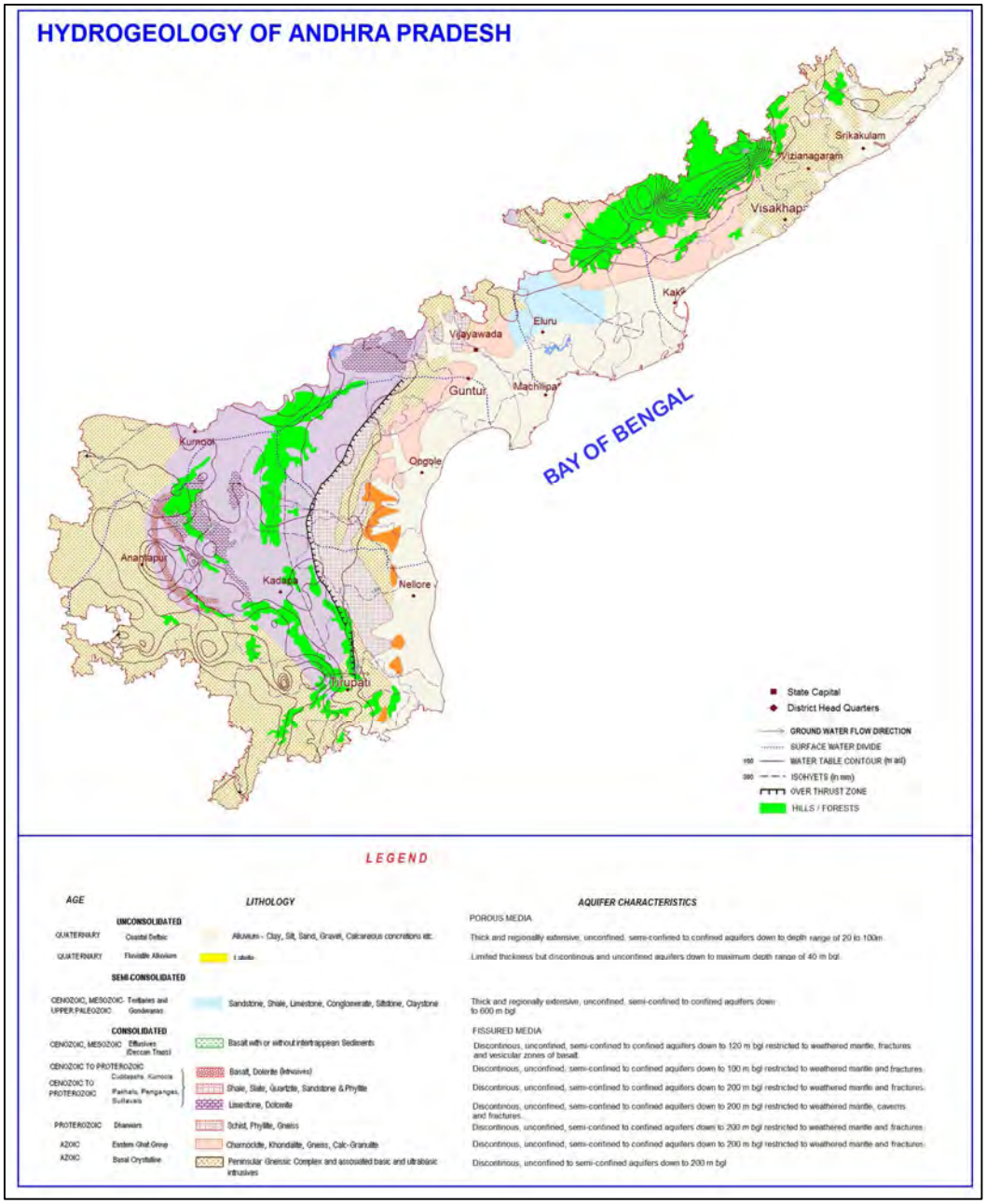


Fig.4.2: Hydrogeology map of Andhra Pradesh state.

The Charnockites and Khondalites occur in an extensive belt in Srikakulam, Vizianagaram, and Visakhapatnam districts and in upland areas of East Godavari and West Godavari districts. The Charnockite bands also occur as narrow patches adjoining coastal alluvium in Krishna, Guntur and Prakasam districts.

4.2 Upper Pre-Cambrian to Early Pre-Cambrian

The group includes Cuddapahs, Pakhals, Pengangas, Kurnools and Sullavais comprising shales, limestones, dolomites, sandstones and conglomerates. The crescent shaped Cuddapah

Super Group covering ~42,100 Km^2 occur in parts of Krishna, Kurnool, Prakasam, Guntur, Nellore, Kadapa, Chittoor and Anantapuramu districts. Kurnools occur in Kundair valley and Palnad tract. Sullavais are exposed in Godavari valley. Gondwana Formations, comprising lower group of rocks, the Talchirs, Barakars and Kamthis and upper group of rocks, the Maleris, Kotas and Chikialas, occupy parts of West Godavari district. The Gondwana formations, of alluvial and lacustrine sediments, are exposed in lower reaches of Godavari valley. Gondwanas also occur as disconnected outcrops along the coast from Tuni in East Godavari district to Satyavedu in Chittoor district.

4.3 Deccan Traps (Basalt) and Associated Rocks

Deccan traps, the horizontally disposed lava flows are confined to Minor outcrops near Rajahmundry on either banks of the river Godavari. The thickness of individual flow varies between few metres to as much as 30 m. Inter-trappean beds comprising limestones, cherts and sandstones occur between trap flows near Rajahmundry. Infra-trappean beds, comprising deposits of limestones and sandstones, underlie the trap flows. These are exposed in an area covering a stretch of 6 km from Pangidi in West Godavari district to Kateru in East Godavari district.

4.4 Tertiary Formations (Miocene-Pliocene)

The formation of this group is locally known as Rajahmundry formation. It constitutes mainly Sandstones occurring from Eluru to Rajahmundry as isolated out crops dipping gently towards the coast. Sandstones of equivalent age occur along the southern coast in Chittoor, Prakasam and Nellore districts. They are highly potential from ground water point of view.

4.5 Quaternary Formations

Alluvium, beach sands, Laterite soils etc. belong to this group. Beds of clay, sand, gravel and boulders stretch along the coast except near Visakhapatnam. This distribution is not only confined to deltas but also extends deep inland in narrow patches along river courses of Godavari, Krishna, Pennar and Vamsadhara. The alluvial deposits attain a thickness of more than 600 m in East and West Godavari districts sloping towards the coast. In Srikakulam and Visakhapatnam districts, the thickness varies between 60 m and 100 m.

5. GROUND WATER RESOURCES (2012-2013)

The dynamic ground water resource potential of the state has been estimated as per the methodology given by the Ground Water Estimation Committee 1997 (GEC 1997).

As per the latest estimates (March 2013), the annual replenishable ground water resources are 20387 MCM, natural discharge during non-monsoon period is 1913 MCM, net ground water availability is 18474 MCM, annual gross ground water draft is 8104 MCM, allocation for future domestic and industrial use is 1644 MCM and net ground water availability for future irrigation use is 10192 MCM. The average stage of ground water development is 44 %.

Out of 670 mandals, 61 fall under over-exploited category, 17 falls under critical, 54 under semi-critical and remaining 538 under safe category (this includes 73 poor quality mandsls (41 Fully and 32 partly). More mandals from Rayalseema regions falls under OE, Critical and Semi Critical category than coastal region mandals. The categorization of mandals is depicted in **Fig.5.1**.

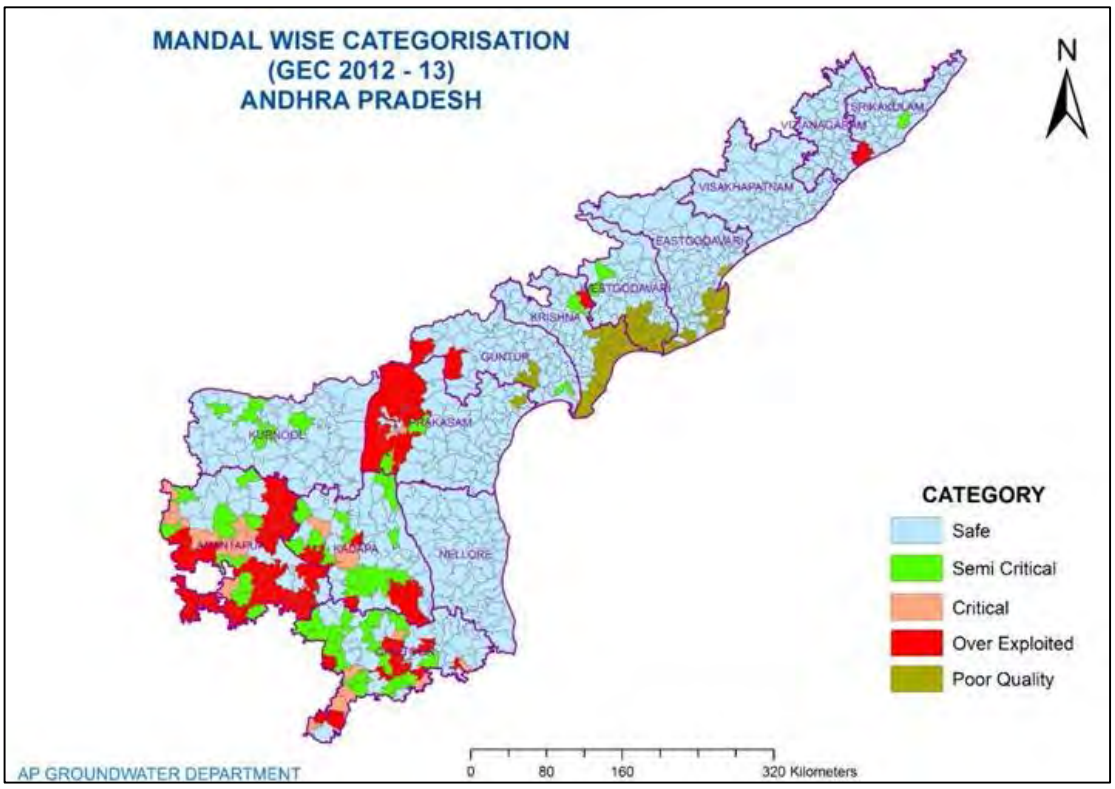


Fig.5.1: Categorization of mandals (as on 2013), Andhra Pradesh state.

6. GROUND WATER REGIME MONITORING

Ground water level monitoring is a scientific surveillance system to establish the periodic and long-term changes in ground water regime. The water level data over a period of time provides information on changes in ground water levels with progressive ground water development by natural and artificial recharge/surface water irrigation system.

Monitoring of a network of ground water monitoring wells provides periodical information on ground water regime scenario with a fair degree of accuracy in different hydrogeological environments in the area.

Ground water occurrence point of view State litho units are grouped in to following 3 groups.

i) Consolidated Formations
ii) Semi-consolidated Formations
iii) Unconsolidated Formations

6.1 Consolidated formations: Crystalline rocks of Archaean age, metasedimentary rocks of Cuddapah and Kurnools and basalts lava flows of Deccan traps are included in these formations occupying ~83% of the area. These rocks generally lack primary porosity and secondary porosity is developed due to weathering, fracturing, development of solution cavities and channels and interconnection of vesicles. In these rocks depth of weathering varies from 5 to 10 m bgl (occassionaly up to 20 m) and majority of fractures occur with in 100 m depth. In these rocks dug wells/ dug cum bore wells and bore wells are the most prevalent abstraction structures. Ground water yield from these rocks varies from 0.1 lps to 3 lps.

In Khondalite formations, depth of weathering varies from 10-40 mbgl with yields of 0.5-2 lps.Consolidated meta-sedimentary formations (Cuddapah and Kurnool rocks and equivalents) has undergone great deal of compaction, metamorphism, thereby reducing primary porosity. Occurrence of ground water in these formations is restricted to structural features like folds, faults, lineaments, fractures, fissures, solution cavities and channels etc. Depth of weathering in these formation ranges from 5-10 m bgl and yield varies from 0.01-19 lps (general 1-5 lps). Relatively Kurnool group of rocks are more potential than other Cuddapahs (general yield 5-10 lps).

6.2 Semi-consolidated formations: Semi-consolidated formations are represented by rocks belonging to Gondwana formations (sandstones) and Rajahmundry sandstones. The yield from these formations ranges from 5-50 lps.

6.3 Unconsolidated formations: Un-consolidated formations are represented by coastal alluvium, deltaic alluvium and inland river alluvium. Ground water occurs under water table and confined conditions in coastal areas and it is shallow and brackish or saline in nature. Water quality in deeper aquifers from Nellore and Krishna district is of poor quality.In deltaic areas of Godavari, Krishna and Pennar, yield varies from 0.7-30 lps and Godavari deltas yields are relatively better than Krishna and Pennar. Ground water quality is of potable nature in paleochannels.

6.4 Monitoring Methodology

Ground water regime is monitored through a network of dug wells and piezometers known as Ground Water Monitoring Station (GWMS). The dug wells, which are owned by government, non-government agencies and individual users, are tapped in the shallow aquifer system. Piezometers (basically bore wells/tube wells) constructed exclusively for ground water regime monitoring under Hydrology Projected. Some of the exploratory wells/ observatory wells drilled under exploratory drilling programme of Central Ground Water Board are converted to piezometers for regular monitoring.

The network of observation wells are monitored 4 times a year by the officials of Central Ground Water Board during the following periods.

Period	**Date**
January	1st to 10th of the month
May (Pre-monsoon)	21st to 30th of the month
August (Mid-monsoon)	21st to 30th of the month
November (Post-monsoon)	1st to 10th of the month

6.4.1 Participatory Ground water Monitoring

Weekly water level measurements are initiated in phases involving local people as observers under participatory ground water monitoring programme, to observe micro-level changes in ground water regime. Participatory observers from the local area where GWMS is there are engaged since May, 2005 and as on 31st March **164** nos of GWMS are monitored though participatory approach (**Table-6.1**).

6.4.2 Chemical Quality Monitoring

The chemical quality of ground water is monitored (dug wells/Piezometers) once in the month of May (pre-monsoon season) to observe the effect of geogenic, anthropogenic contamination on ground water in different hydrogeological environments over a period of time.

6.5 Maintenance of Database on Ground Water Monitoring Wells

The database on water levels and chemical quality is entered in the software, developed over a period of time since 1969. The database is maintained in Oracle using GEMS (Ground water Estimation and Management System) software, which is adopted by all ground water agencies in the country.

6.6 Distribution of Ground Water Monitoring Wells

The distribution and density of monitoring wells in the State; distribution in river basins, aquifer systems and canal command areas are summarized in the the following session.

6.6.1 District-Wise Distribution of Ground Water Monitoring Wells

Total 848 GWMS are monitored in the state (DW: 745 (88 %) and Pz: 103 (12%)) and district wise density varies from 100 Km^2/well (East Godavari) to 439 Km^2/well in Cuddaph district (**Table-6.1** and **Fig.1.1**).

6.6.2 Aquifer-Wise Distribution of Ground Water Monitoring Wells

Out of 848 GWMS, 727 wells are located in hard rocks, 121 wells in soft rocks. District wise and aquifer wise distribution of GWMS is given in **Table-6.2.** Majority of GWMS (25 %) are located in Alluvium rocks followed by Banded Gneissic complex (20 %), followed by Khondalite rocks (13 %) etc.

Table-6.1: Distribution of GWMS, Andhra Pradesh State (As on March, 2016).

S. No.	District	Area (Km^2)	No of GWMS			No of Participatory observers	Density of Net work
			DW	Pz	Total	Nos	Km^2/well
1	Anantapuramu	19130	35	20	55	18	348
2	Chittoor	15152	47	0	47	15	322
3	Cuddapah	15359	32	3	35	11	439
4	East Godavari	10807	95	13	108	12	100
5	Guntur	11391	90	13	103	18	111
6	Krishna	8727	70	7	77	12	113
7	Kurnool	17658	39	18	57	18	310
8	Nellore	13076	61	2	63	7	208
9	Prakasam	17626	53	14	67	13	263
10	Srikakulam	5837	45	0	45	4	130
11	Vishakhapatnam	**11161**	**69**	**4**	**73**	**25**	153
12	Vizianagaram	**6539**	**47**	**0**	**47**	**3**	139
13	West Godavari	**7742**	**62**	**9**	**71**	**8**	109
	Total	**160205**	**745**	**103**	**848**	**164**	**189 (avg)**

Table-6.2: Principal Aquifer-wise distribution of monitoring stations (as on March, 2016).

District	Principal Aquifer Systems												
	All	**BGC**	**CK**	**Gn**	**Gr**	**Kh**	**Qz**	**SC**	**LS**	**LT**	**SH**	**ST**	**Total**
Anantapuramu		37			15						3		55
Chittor	1	41					1			4			47
Cuddapah		8					3	2	1		21		35
East Godavari	63		5	9		22						9	108
Guntur	26	21	19		1		3	8	18		3	4	103
Krishna	41	13	7			12			1		1	2	77
Kurnool		18		3	11		3		13		9		57
Nellore	17	7						34		5			63
Prakasam	16	3	9	6	7		2	13		1	7	3	67
Srikakulam	7	22	8	6		2							45
Vishakhapatnam	1		8	23		41							73
Vizianagaram			11	15		20						1	47
West Godavari	45	1				10				1		14	71
Total	**217**	**171**	**67**	**62**	**34**	**107**	**12**	**57**	**33**	**11**	**44**	**33**	**848**
Percentage	**25.58**	**20.10**	**8**	**7**	**4**	**12.6**	**1.4**	**6.7**	**3.8**	**1.3**	**5**	**4**	

(Note:All: Alluvium, BGC-Banded Gneissic complex, CK-Charnokite, Gn-Gneiss, Gr-Granite, Kh-Kondalite, LS-Limestone, LT-Laterite, Qz-Quartzite,SC-Schists, SH-Shale, ST-Sandstone).

7. ANALYSIS OF WATER LEVELS

The ground water levels observed over a period of time provides valuable information on behaviour of the ground water regime, which is constantly subjected to changes due to recharge and discharge phenomena. A balance between these two factors results in the decline or rise in the ground water storage. When the recharge exceeds discharge there will be a rise in the ground water storage and vice versa. The Decline in water level may be due to increase in draft (for different purposes) or Decrease in precipitation (less recharge to ground water). On the other hand a rise in water level may be due to an increase in rainfall and/or due to changes in irrigation practices. The dug wells are tapping the phreatic aquifer which is mostly limited to a depth of 20 m. The depth of piezometers which are tapping both the phreatic and deeper aquifers varies from 20 to 100 m. Hence the water level recorded in the piezometers may not be the same as that of dug wells for a particular period though both the structures are in the same place. In this report the water level data collected from un-confined aquifers (shallow depth) is presented. The data from GWMS for the year 2015-16 was analysed and for every set of measurements, write up and maps were prepared and are presented here under various paragraphs. The purpose of water level data analysis is

i) Four measurements of depth to water level give an overall idea regarding the ground water level in the state during the year of measurement.
ii) The fluctuation in comparison to the same month of the previous year gives an idea about the change in the ground water level for a particular period with respect to that of the water level during the same month in the previous year. This gives an idea about the change in the amount of draft and rainfall between the two years.
iii) The water level fluctuation during the pre-monsoon period in comparison to post monsoon period gives an idea about the seasonal fluctuation, which ultimately reflects the change in dynamic ground water resources.
iv) The water level fluctuation during a particular month of measurement with reference to the Decadal mean for the same months gives an idea of the behaviour of the ground water level on long-term basis.

7.1 Depth to Water Levels, May-2015 (Pre- monsoon season)

- An analysis of depth to water level data of 787 wells **(Annexure-1**) shows, water levels in the range of 0.02 (Krishna district) to 49.3 m bgl (Prakasam district) (**Fig.7.1**).
- Shallow water level in the range of 0 to 2 m bgl covers an area of about 4374 Km^2 (3% of state area) and mostly observed in Guntur, East and West Godavari districts.

- Water levels in the range of 2 to 5 m occupies about 48600 Km^2 area (30% of the total geographical area of the state), occupying mostly coastal region of the state.
- Majority of the water levels are in the range of 5 to 10 m bgl occupying about 75,580 Km^2 area (47%) and represented by 33 % wells.
- Water levels between 10-20 m bgl covers about 27520 Km^2 (17%) representing 11.8% wells.
- Deep water levels in the range of 20-40 m bgl and > 40 m bgl covers about 1% and <0.1% of the total geographical area respectively, representing < 1% of total wells covering mostly Cuddapah and Chittoor districts.

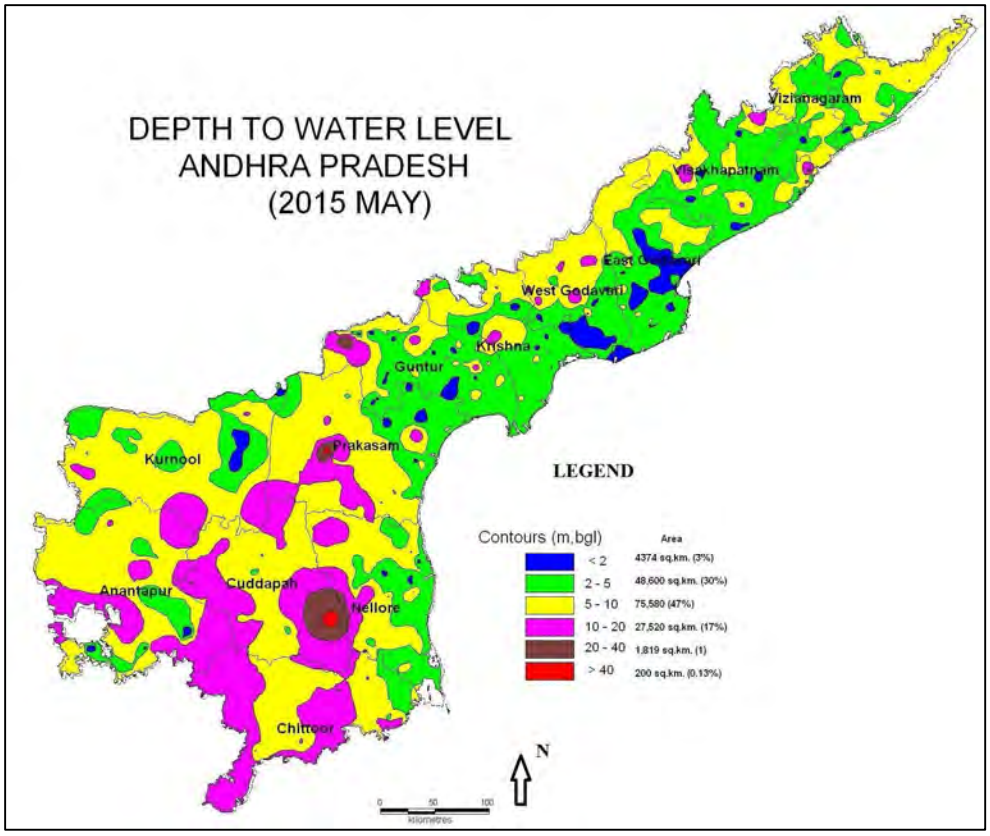


Fig.7.1: Distribution of water levels, Premonsoon season-2015 (May).

7.2 Depth to Water Levels, August-2015,(Mid-monsoon season)

The depth to water levels are summarized below and presented in **Fig. 7.2.** An analysis of depth to water level data of 785 wells **(Annexure-2**) shows, water levels in the range of 0.05 (Vishakhapattanam district) to 47.45 mbgl (Cuddapah district).

- One well located at in Krishna district shown artesian conditions (-0.2 m).
- Shallow water level in the range of 0 to 2 m bgl covers an area of about 20,700 Km^2 (13 % of state area) and mostly observed in eastern part of north coastal districts.

- Water levels in the range of 2 to 5 m occupies about 43,730 Km^2 areas (27 % of the total geographical area of the state), occupying mostly eastern and northern part of the State.
- Majority of the water levels are in the range of 5 to 10 m bgl occupying about 62,020 Km^2 areas (39 %) and represented by 24 % of wells.
- Water levels between 10-20 m bgl cover about 29,820 Km^2 of state area (19 %) represented by 12 % of wells.
- Deep water levels in the range of 20-40 m bgl and > 40 m bgl covers about 1631 Km^2 and 1999 Km^2 area (1 % and 1.2 % respectively) of the total geographical area respectively, covering south eastern part of YSR Cuddapah district.

7.3 Depth to Water Levels, November 2015 (Post-monsoon Season)

The depth to water levels are summarized below and presented in **Fig.7.3.** An analysis of depth to water level data of 762 wells **(Annexure-3**) shows, water levels in the range of 0.23 m (Vishakapatanam district) to 44.5 mbgl (Prakasam district).

- One well located at in East Godavari district and one in Nellore district shown artesian conditions (- 0.04 and -0.5 m) respectively.
- Shallow water level in the range of 0 to 2 m bgl covers an area of about 33,610 Km^2 (21% of state area) (coastal area and parts of Kadapa and Kurnool districts).
- Water levels in the range of 2 to 5 m occupies about 59,400 Km^2 (37% of the total geographical area of the state).
- Water levels in the range of 5 to 10 m occupies about 54,200 Km^2 (34% of the total geographical area of the state).
- Water levels between 10-20 m bgl cover about 9,947 Km^2 of state area (6 %).
- Deep water levels in the range of 20-40 mbgl and > 40 mbgl covers about 870 Km^2 and 1873 Km^2 area (0.54 % and 1.2 % respectively) of the total geographical area respectively.

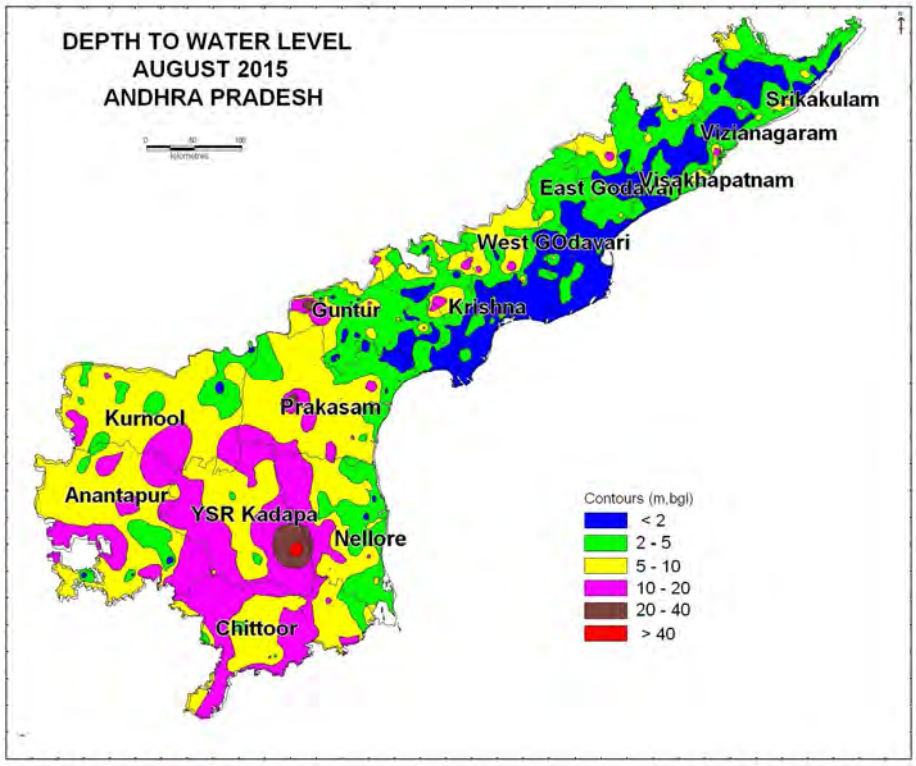


Fig.7.2: Depth to water levels-August 2015.

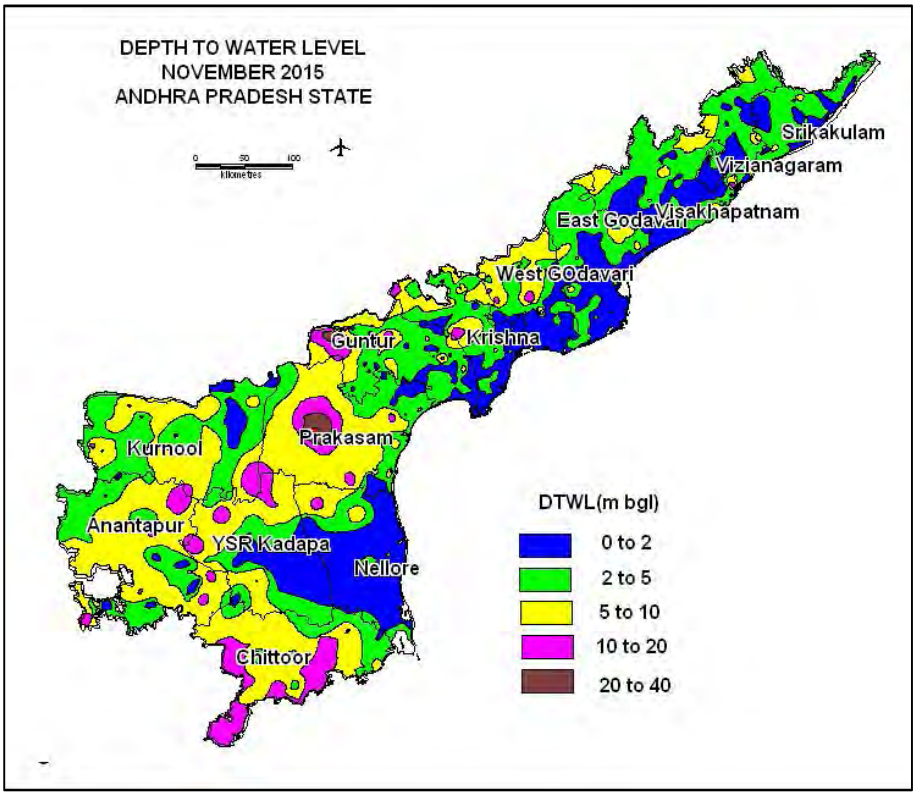


Fig.7.3: Depth to water levels-November 2015.

7.4 Depth to water levels, January2016

The depth to water levels during January-16 are summarized below and presented in **Fig.7.4.** An analysis of depth to water level data of 755 wells **(Annexure-4**) shows, water levels in the range of 0.02 m (Chittor district) to 43.5 m bgl (Prakasam district).

- Shallow water level in the range of 0 to 2 m bgl covers an area of about 21190 Km^2 (13 % of state area) and mostly observed in coastal area and parts of Chittoor district.
- Water levels in the range of 2 to 5 m are more predominant occupying ~75200 Km^2 (47% of area).
- Water levels in the range of 5 to 10 m occupy about 51010 Km^2 (32% of area).
- Water levels between 10-20 m bgl cover about 9849 Km^2 of state area (6 %).
- Deep water levels in the range of 20-40 mbgl and > 40 mbgl covers about 796 Km^2 and 1855 Km^2 (0.5 % and 1.2 % respectively) of the total geographical area respectively.

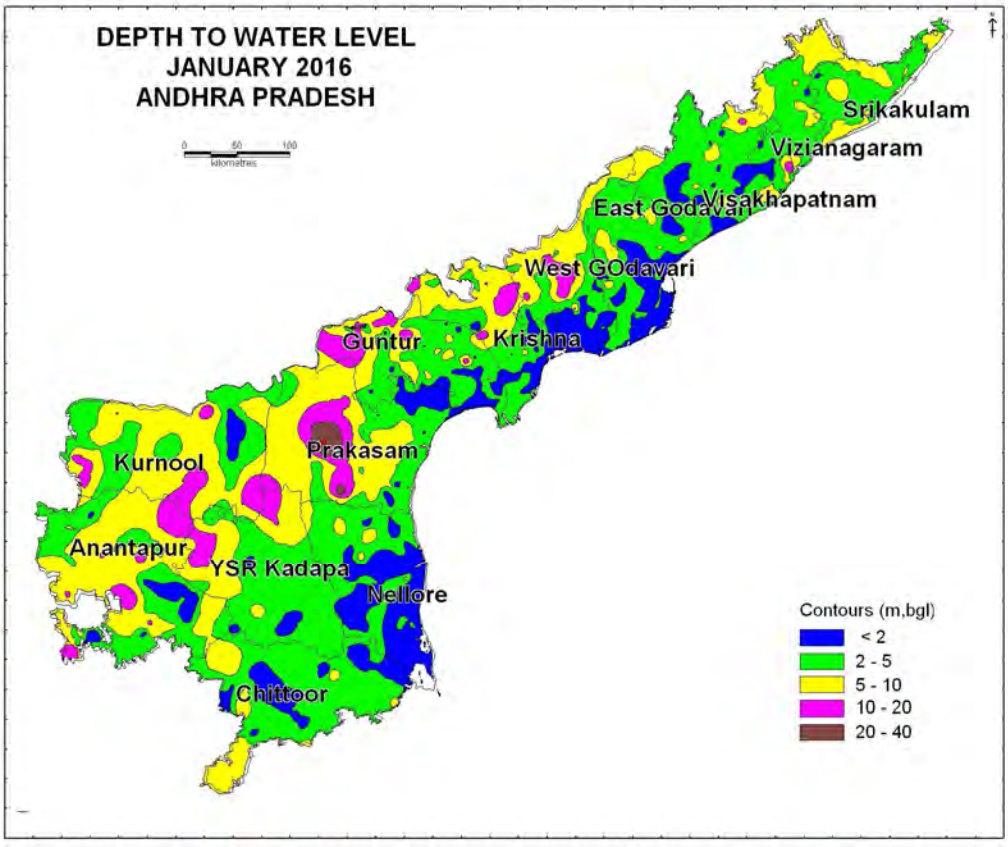


Fig.7.4: Depth to water levels-January 2016.

7.5 Annual water level fluctuations

7.5.1 Water level fluctuation-May2015 with respect to May2014)

Water level fluctuation data of May 2015 with respect to May 2014 is presented in **Annexure-5.** Areal distribution of fluctuation map is presented in **Fig.7.5.** An analysis of 724 wells shows that water level rise is recorded in 30 % wells (220) covering an area of about 23 %. ~76 % of the area has shown a fall in water level representing 64 % wells (463), while in the remaining 41 wells, no fluctuation is recorded. Fall in water levels is mainly due to less rainfall (-28%) than the previous year.

Rise in water levels:

- During May 2015, the minimum rise in water level of 0.01 m is noticed in East Godavari,chittor and maximum rise of 6.7 m is noticed in Chittoor district.
- Prakasam district have shown a very negligible rise in water levels as compared to other district (Min 0.02 and Max 2.56 m).
- Water level rise of <2 m is recorded in 27.2% wells covering about 22 % of total geographical area, covering mostly Vishakhapattanam.
- 2 to 4 m and > 4 m rise in water levels is observed in 2.2 % and 1% of wells, covering about 1% and < 1% geographical area respectively.
- Water level rise of more than 4 m is recorded maximum in Anantapuramu district (2 wells)

Fall in water levels:

- During the period an appreciable fall in water levels is observed with minimum 0.01 m in Nellore,Guntur ,Vishakapatnam and west Godavari districts and maximum 25.5 m in Prakasam district covering about 1,21,134 Km^2 area (76% of the total geographical area).
- Fall in water levels of less than 2 m is observed in all districts of the state covering an area about 97760 km^2 (61%). This range is observed in 48.75% of wells.
- Water level fall between 2 to 4 m is noticed in all districts of the state covering an area about 18620 km^2 (12%). This range is observed in 10.5% of wells.
- More than 4 m water level fall is observed in all districts except Vizainagaram covering an area about 4754 km^2 (3 %) (~5 % of wells).

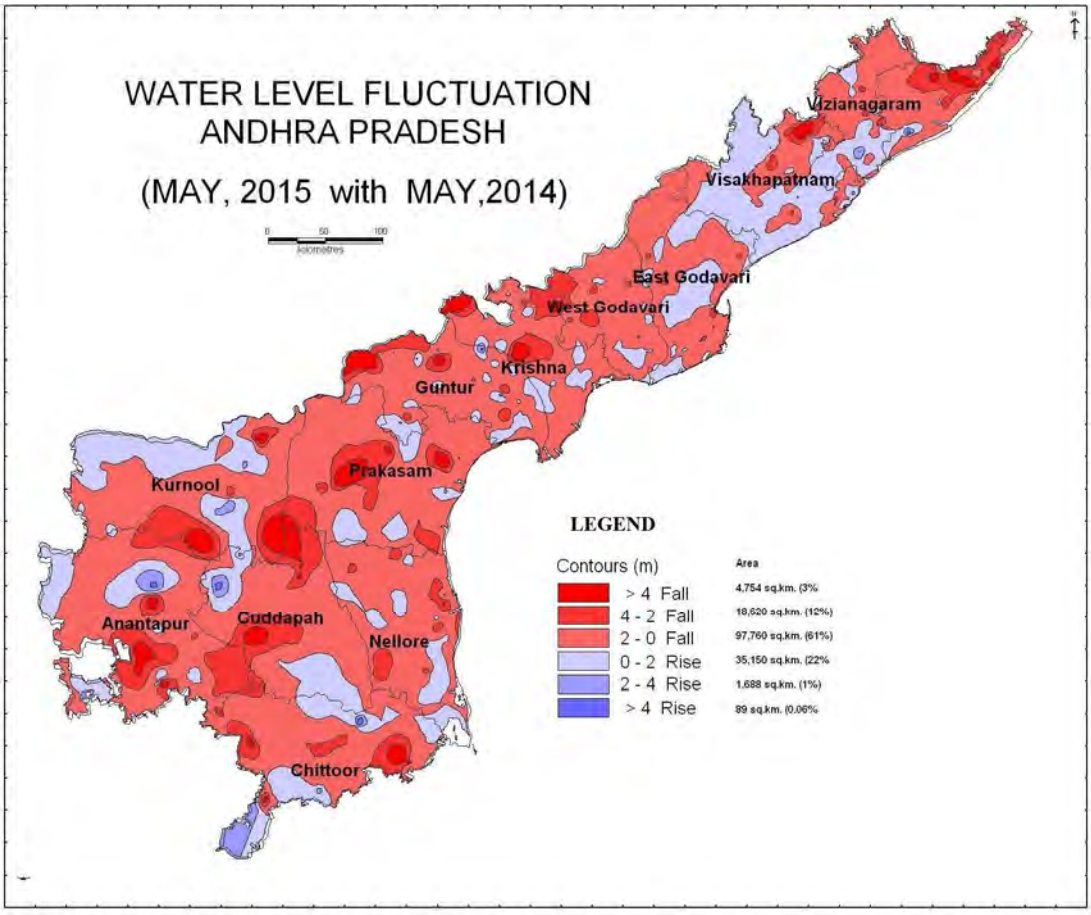


Fig.7.5: Water level fluctuation- May 2015 Vs May 2014.

7.5.2 Water level fluctuation -August2015 with respect to August2014

Water level fluctuation data of August 2015 with respect to August 2014 is presented in **Annexure-6** and areal distribution of fluctualtion map is presented in **Fig.7.6.**

- An analysis of 718 wells shows that water level rise is recorded in 43.5 % wells (312) covering an area of about 33 % of the total geographical area.
- About 66 % of the areas have shown a fall in water level representing 49.4 % wells (355). In 51 wells there is neither rise nor fall in water levels.
- Water level rise of more than 4 m is recorded maximum mainly in Chittor, southern parts of Cuddapah and East Godavari districts.

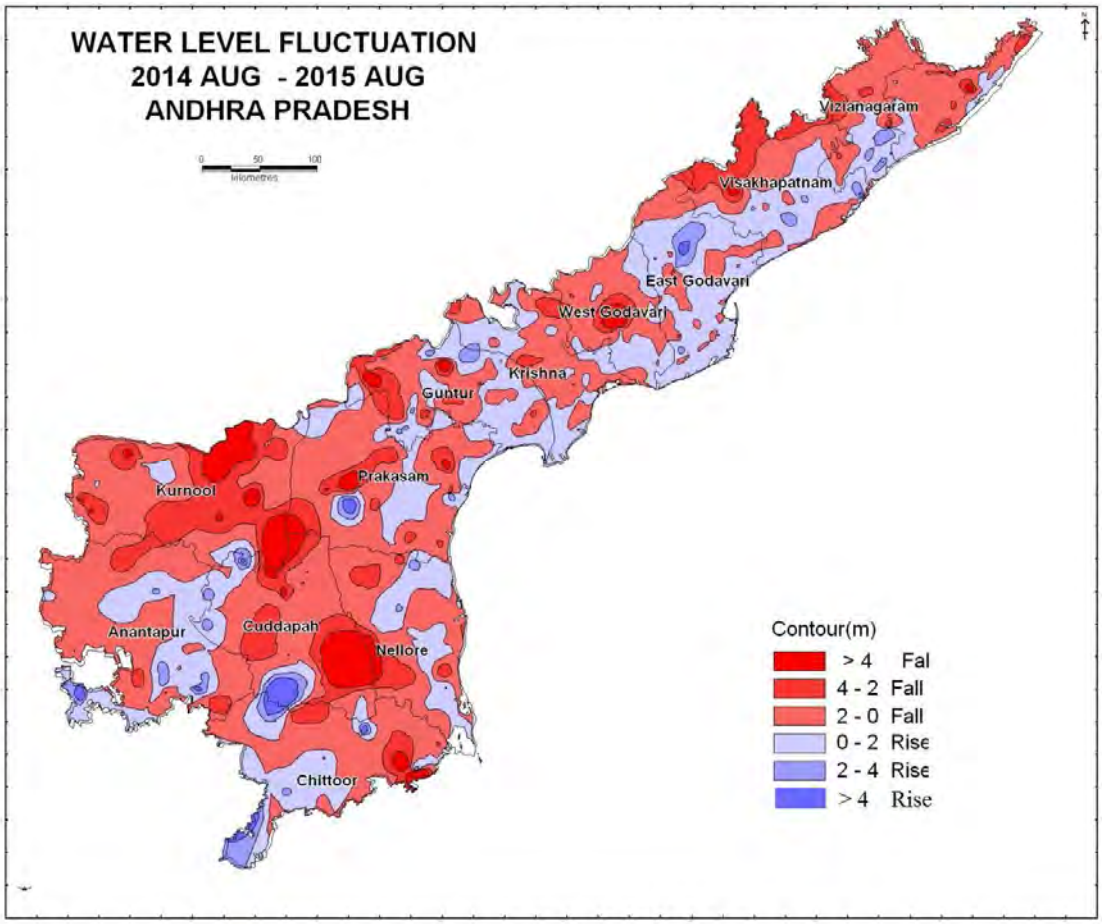


Fig. 7.6: Water level fluctuation- August 2015 Vs August 2014.

7.5.3 Water level fluctuation-November2015 with respect to November2014

Water level fluctuation data of November 2015 with respect to November 2014 is presented in **Annexure-7** and areal distribution of fluctualtion map is presented in **Fig.7.7.** An analysis of 730 wells shows that water level rise is recorded in 297 wells covering an area of about 48 % of the total geographical area. About 52% of the areas have shown a fall in water level representing 414 wells. About 19 wells have shown neither rise nor fall in water levels.

- The minimum and maximum rise in water level fluctuations is recorded as 0.01 m in Chittoor, Guntur and Visakhapatnam districts and 14.49 m in West Godavari district.
- The minimum and maximum fall in water level fluctuations is recorded in 0.01 m East Godavari and Kurnool districts and 32.6 m in Guntur district respectively.

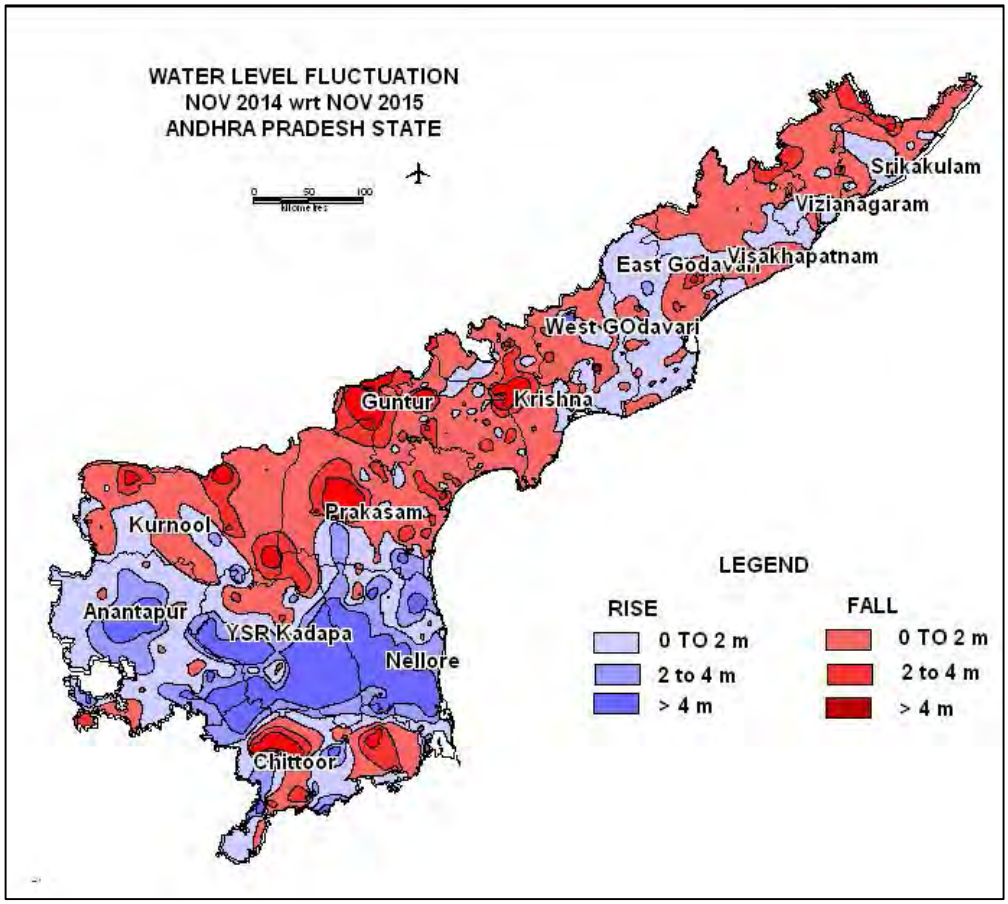


Fig. 7.7: Water Level Fluctuation-November2015 Vs November 2014.

- In the state about 76480 km^{2}area shown a rise in water levels in the range of < 2 to > 4 m and in about 83420 of the area, water level fluctuations have shown a fall in the range of < 2 to > 4 m.
- Water level fall of more than 4 m is recorded as small patches in throughout the state except in Anantapuramu, Nellore and Visakhapatnam districts.

7.5.4 Water level fluctuation-January 2016 with respect to January 2015

Water level fluctuation data of January 2016 with respect to January 2015 is presented in **Annexure-8** and areal distribution of fluctuation map is presented in **Fig.7.8.** An analysis of 740 wells shows that about 48 % of the areas have shown a fall in water level representing 413 wells, rise is recorded in 309 wells covering an area of ~51 % and 18 wells shown neither rise nor fall in water levels during the period.

- The minimum and maximum rise in water level fluctuations is recorded as 0.01 m in Anantapuramu, Guntur and Visakhapatnam districts and 16.55 m in Chittoor district.
- The minimum and maximum fall in water level fluctuations is recorded as 0.01 m in Prakasam district and 28.57 m in Guntur district respectively.
- In the state about 76296 km^2 areas covering mostly southern part has shown a rise in water levels in the range of < 2 m, 2-4 m and > 4 m.
- About 83604 km^2 of the area covering mostly northern parts of the state water level fluctuations have shown a fall in the range of < 2, 2-4 and > 4 m.
- Water level fall of more than 4 m is recorded in YSR Kadapa, Kurnool, Prakasam, Srikakulam, Krishna, West Godavari, Vizianagaram and Guntur districts.

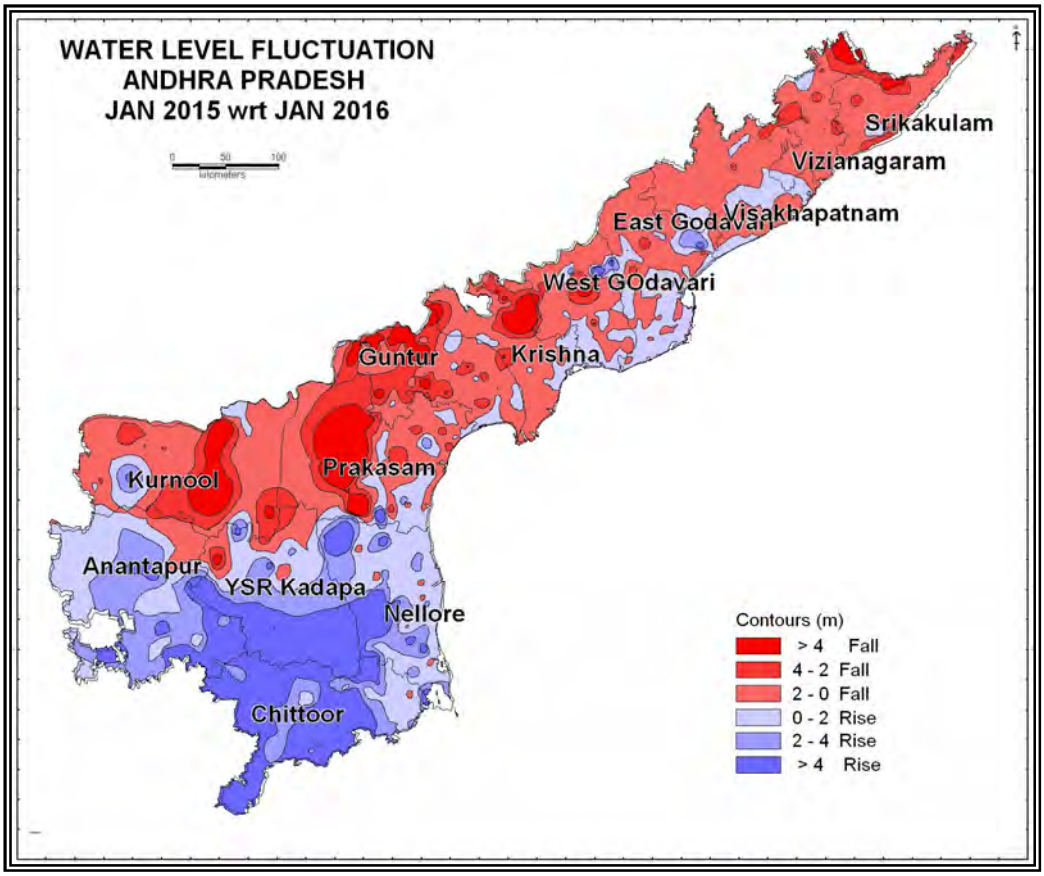


Fig. 7.8: Water Level Fluctuation-January2016 Vs January 2015.

7.6 Decadal Water Level Fluctuation

7.6.1 Water level fluctuation -May 2015 with Decadal mean of May

Water level fluctuation of May, 2015 with reference to decadal mean of May, (2006-2015) is presented in **Annexure-9.** Decadal fluctuation map is presented in **Fig.7.9.**

An analysis of 734 wells data shows a rise in water levels in 265 wells (36.1%) and fall in 458 wells (62.4%) covering an area of 41,388 km^2 (26%) and 1,16,693 km^2 (73%) respectively. This fall in water levels with respect to Decadal mean is mainly due to less rainfall (-25.2%) during the same period.

Perusal of the map shows a general fall in water levels. Water level rise of more than 4 m is recorded in East Godavari, Krishna, Prakasam and Vizianagaram districts, while water level fall of more than 4 m is recorded in most of the districts except Vizianagaram district.

Decadal rise in water levels:

- During May 2015, the minimum rise in water level of 0.01 m in East Godavari district and maximum of 4.92 m in Krishna district is observed.
- West Godavari district have shown a very negligible rise in water levels as compared to other district (Min 0.04 and Max 1.75 m).
- Water level rise of < 2 m is recorded in 32.1 % wells covering about 25% of total geographical area (39740 Km^2) and it is mainly observed in East Godavri Vishakapatanam and Vizianagaram districts.
- 2 to 4 m and > 4 m rise in water levels is observed in 3.4 % and 0.5% wells, covering about 1% area.

Decadal fall in water levels:

- During the period an appreciable fall in water levels is observed with minimum 0.01 m (West Godavari) and maximum 29.55 m (Cuddapah district) covering about 1,16,693 Km^2 area (73%).
- Fall in water levels of less than 2 m is observed in all districts covering an area about 85,200 km^2 (53%). This range is observed in 46.7% of wells.
- Water level fall between 2 to 4 m is noticed in all districts covering an area about 23,370 km^2 (15%). This range is observed in 10.5% of wells.
- More than 4 m water level fall is observed in all districts except Vizianagaram district covering an area about 8123 km^2 (5%). This range is observed in 5.2% of wells.

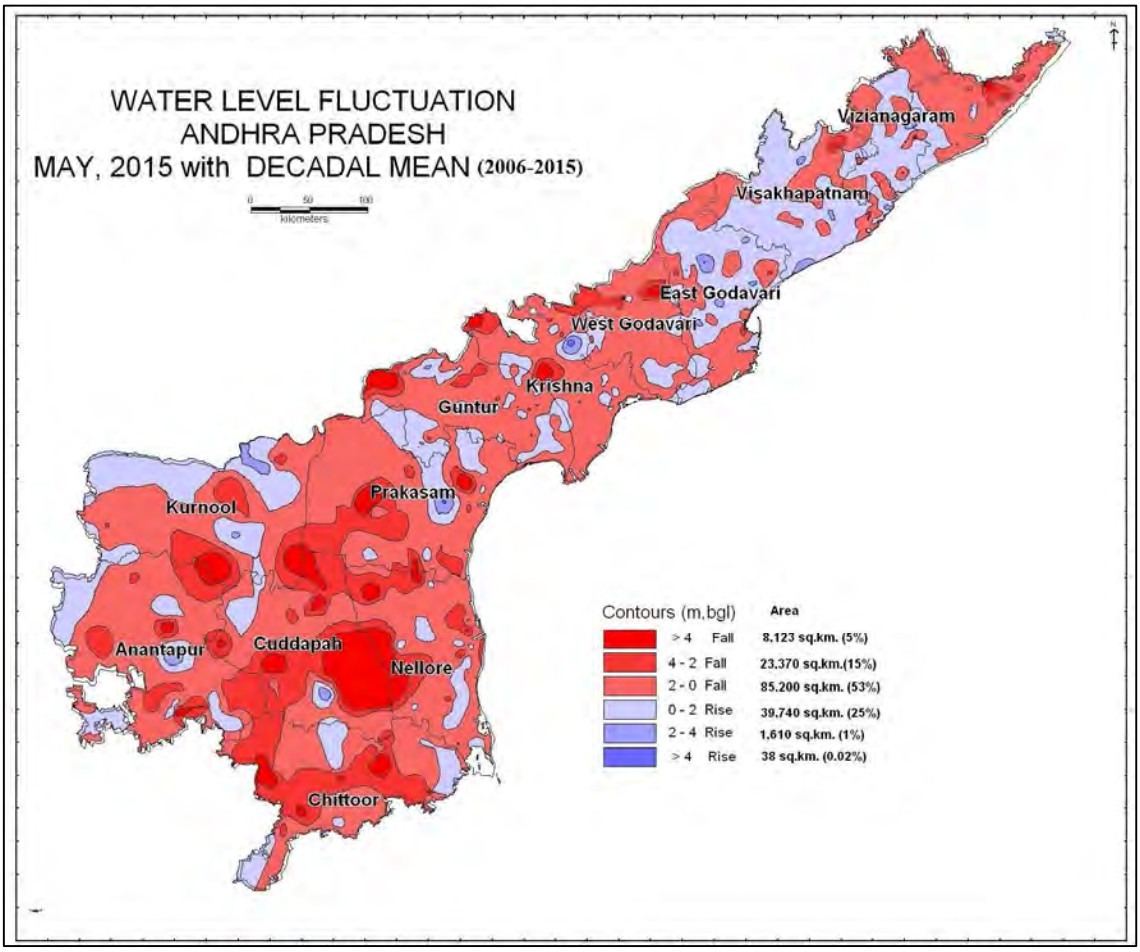


Fig.7.9: Water level fluctuation-May 2015 Vs decadal mean of May- 2005 to2014).

7.6.2 Water level f luctuation-August-2015 with decadal mean of August

Water level fluctuation of August, 2015 with reference to decadal mean of August, (2005-2014) is presented in **Annexure-10 and Fig.7.10.**

An analysis of 725 wells data shows a rise in water levels in 288 wells (40 %) and fall in 412 wells (57 %) covering an area of 36,586 km^2 (23 %) and 1,23,314 km^2 (77 %) respectively. This fall in water levels with respect to Decal mean is mainly due to less rainfall in Rayalaseema region of the state.

Perusal of the map shows a general fall in water levels in major part of the state. Water level fall of more than 4 m is recorded in Rayalaseema region of the state.

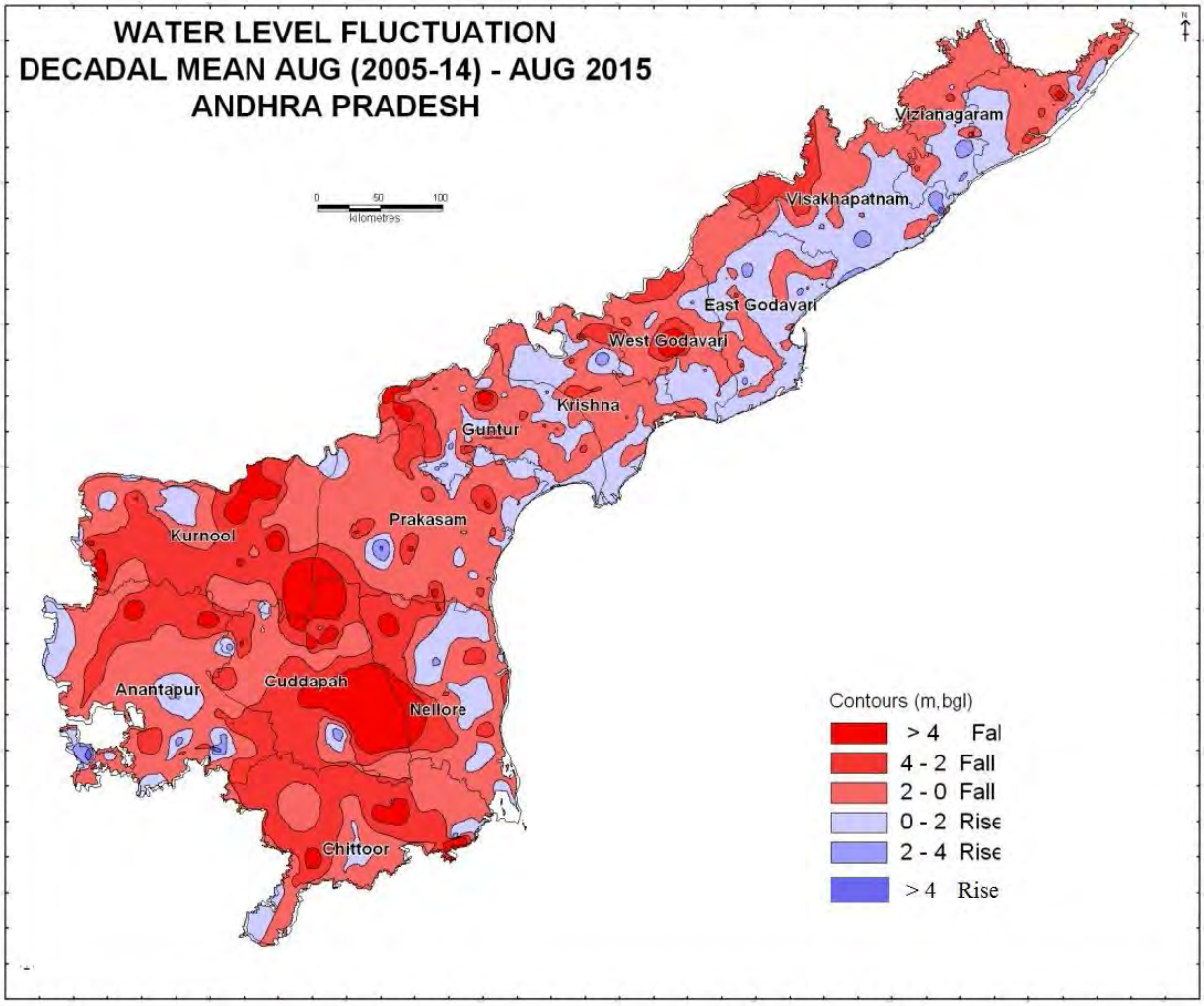


Fig. 7.10: Water level fluctuation-August 2015 with decadal mean of August.

7.6.3 Water level fluctuation- November2015 with Decadal mean of November

Water level fluctuation of November, 2015 with reference to decadal mean of November, (2005-2014) is presented in **Annexure-11** and **Fig.7.11.** An analysis of 749 wells data shows a rise in water levels in 251 wells and fall in 495 wells covering an area of 50,280 km^2 (31%) and 1,09,620 km^2 (69%) respectively. This fall in water levels with respect to Decal mean is mainly due to less rainfall in Rayalaseema region of the state. Perusal of the map shows a general fall in water levels in major part of the state.

- The minimum rise in water level fluctuations is recorded as 0.01 m in Krishna, Visakhapatnam, Vizianagaram East Godavari and West Godavari districts and and maximum rise in 13.91 in Nellore district.
- The minimum and maximum fall in water level fluctuations is recorded in 0.01 m Prakasam district and 35.83 m in Guntur district respectively.

- In the state about 1,09,620 km^2area shown a fall in water levels in the range of < 2 to > 4 m and in about 50,280 of the area, water level fluctuations have shown a rise in the range of < 2 to > 4 m.
- In general fall in water levels is observed in 69 % of part of the state and > 4 m water level fall is recorded in all districts except and Srikakulam and Nellore districts.

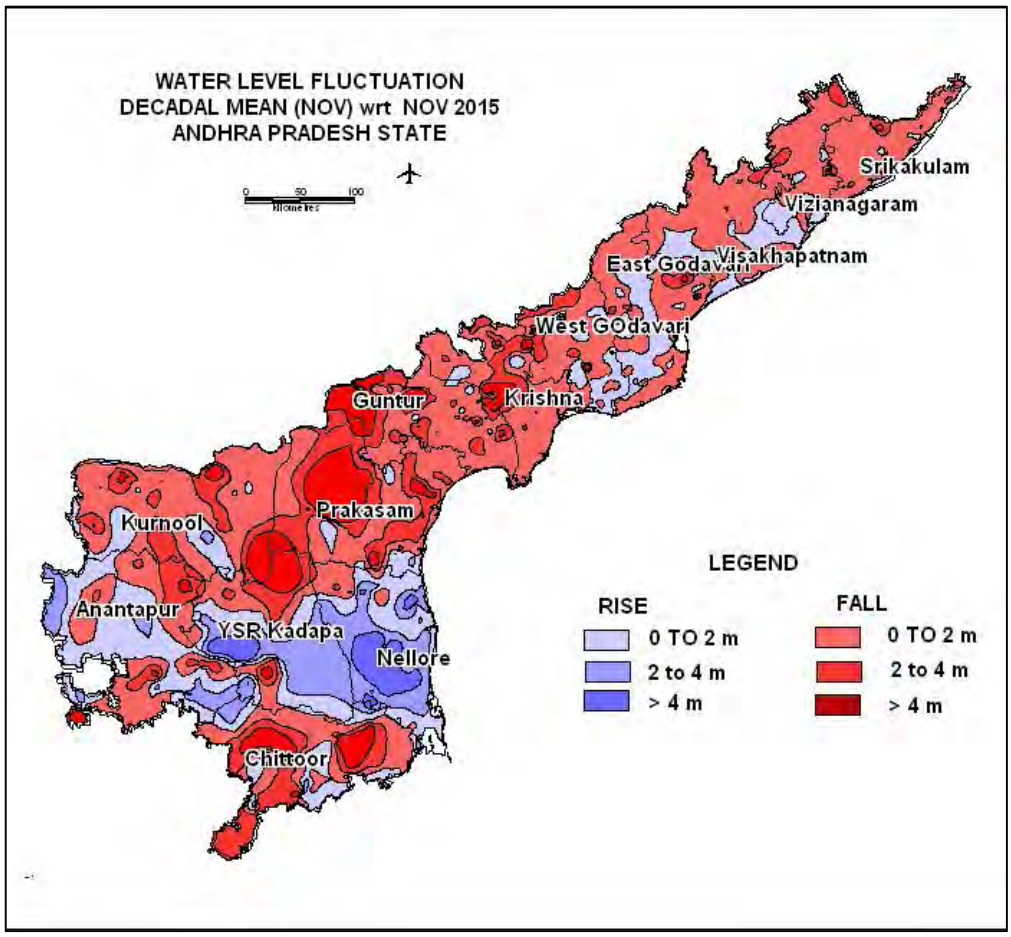


Fig. 7.11: Water level fluctuation- Decadal mean of November Vs November 2015

7.6.4 Water Level Fluctuation- January 2016 with Decadal mean of January

Water level fluctuation of January-2016 with reference to Decadal mean of **January (2006-2015)** is presented in **Annexure-12 and Fig.7.12.**

An analysis of 764 wells data shows fall in 460 wells (60% of the area); a rise in water levels in 300 wells (40 % of the area). This fall in water levels with respect to Decadal mean is mainly due to less rainfall (-25%) during this period.

- The minimum rise in water level fluctuations is recorded as 0.01 m in Guntur and Visakhapatnam districts and maximum rise of 11.1 in Chittoor district.

- The minimum and maximum fall in water level fluctuations is recorded in 0.01 m Chittoor, Cuddapah, Krishna and Visakhapatnam districts and 27.23 m in Guntur district.
- About 64010 $km^2$of the area covering Chittoor, Nellore and Kadapa district, water level fluctuations have shown a rise in the range of < 2 m, 2-4 m and > 4 m.
    - In the state about 95890 km^2 area covering northern and eastern districts of the state shown a fall in water levels in the range of < 2 m, 2-4 m and > 4 m.

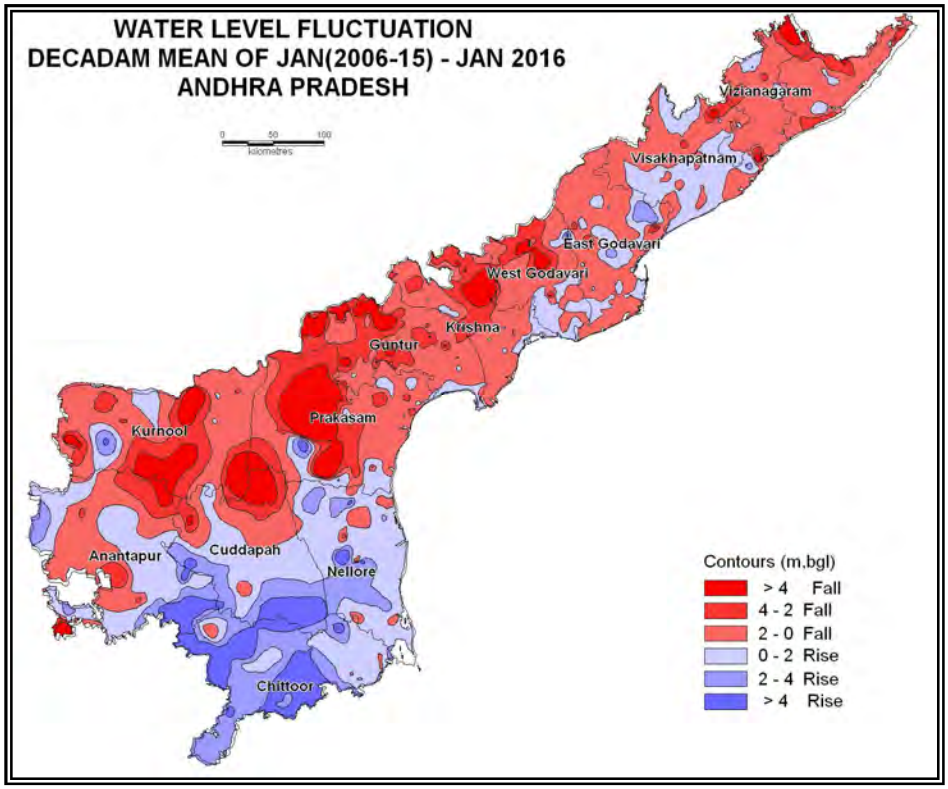


Fig. 7.12: Water level fluctuation- Decadal mean of January 2006-15 Vs January2016.

7.7 Aquifer wise water levels

Aquifer wise water level analysis shows that during pre and post-monsoon season shallowest water levels are observed in alluvial formations. The deepest water levels are observed in shale formation in both seasons (49.3 mbgl and 44.5 mbgl respectively). Aquifer wise water level scenario is presented in **Table-7.1.**

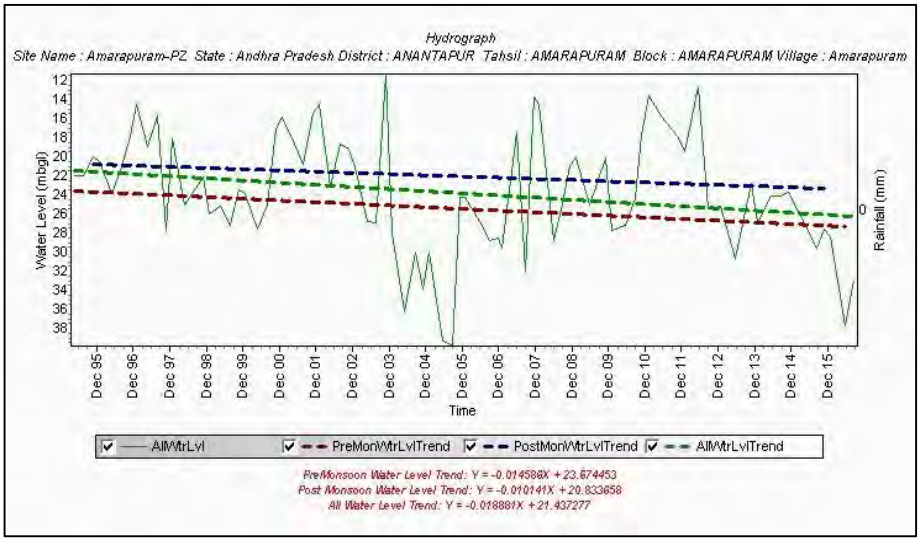
7.8 Long-term water level trends: Total 26 hydrographs are are generated (2 from each district) (**Table-7.2 and Fig. 7.13**). Out of 26, 9 wells show rising trends in both seasons, 8 shows falling trends in both season and remaining shows mixed trends (**Table-7.2**).

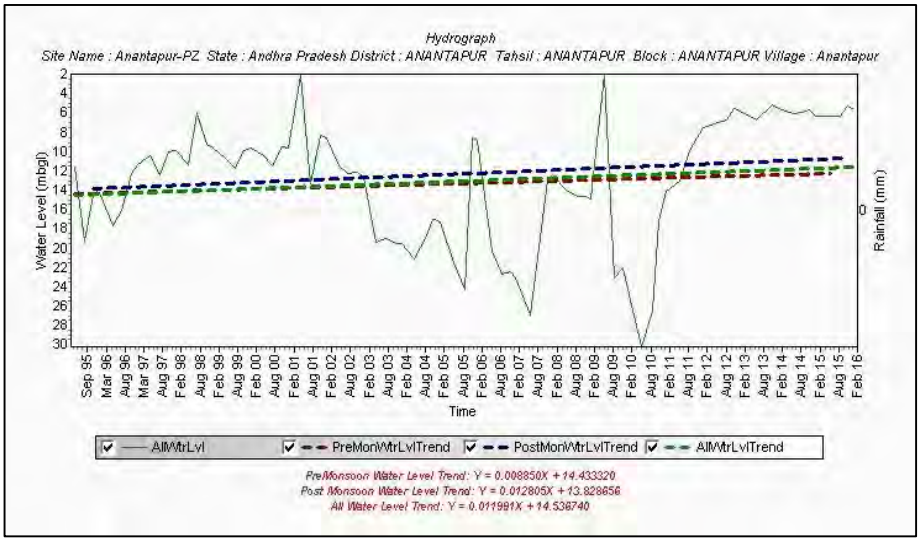
Table-7.1: Aquifer wise distribution of water levels, Andhra Pradesh State.

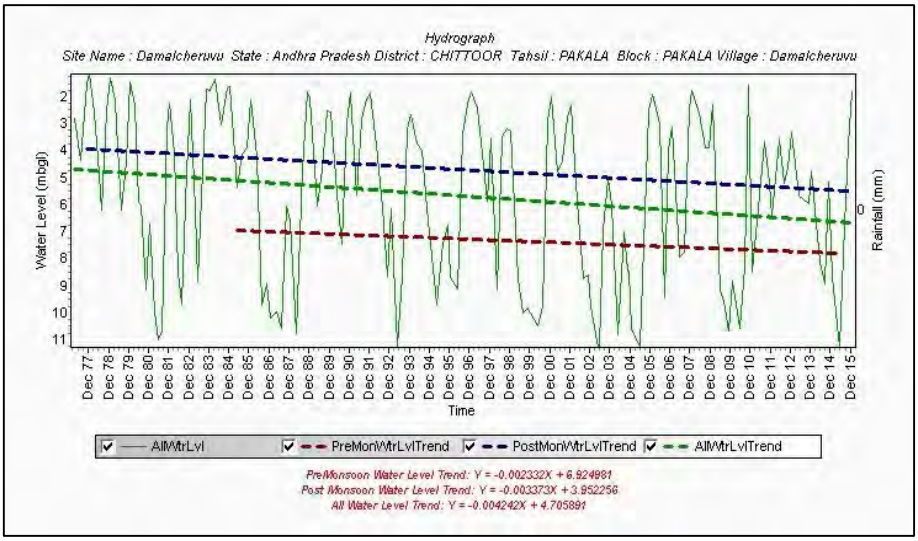
Aquifer Type	May-15				Nov-15			
	Min	**Max**	**Avg**	**Nos**	**Min**	**Max**	**Avg**	**Nos**
All	-	17.7	**3.5**	197	-0.4	17.9	**2.5**	191
BGC	0.2	21.3	**7.6**	148	-0.2	19.4	**5.6**	146
CK	0.7	15.3	**4.3**	65	0.5	13.2	**3.1**	65
Gn	0.9	11.6	**4.9**	63	-	9.9	**3.3**	63
Gr	0.5	14.7	**6.8**	25	0.5	10.5	**5.3**	22
Kh	0.4	23.6	**5.5**	97	0.2	14.4	**3.3**	96
Qz	1.4	12.9	**8.1**	8	0.5	11.3	**4**	9
SC	1.1	17	**7.2**	57	-0.5	13.6	**4.4**	48
LS	0.6	39.5	**6.8**	31	0.5	39.5	**6.7**	32
LT	1.3	13.3	**6.3**	12	-	13.3	**3.1**	11
SH	1	49.3	**10.1**	42	0.6	44.5	**7.7**	34
ST	0.4	12	**5**	26	0.5	11.3	**3.6**	27
Total				**771**				**744**

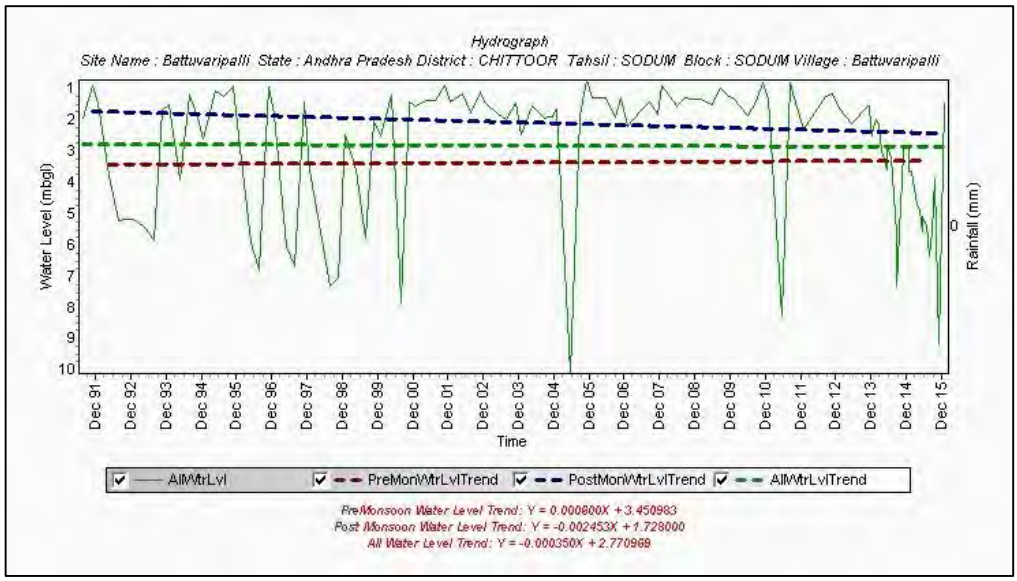
Table-7.2: Representative hydrographs showing rising and falling trends in Andhra Pradesh

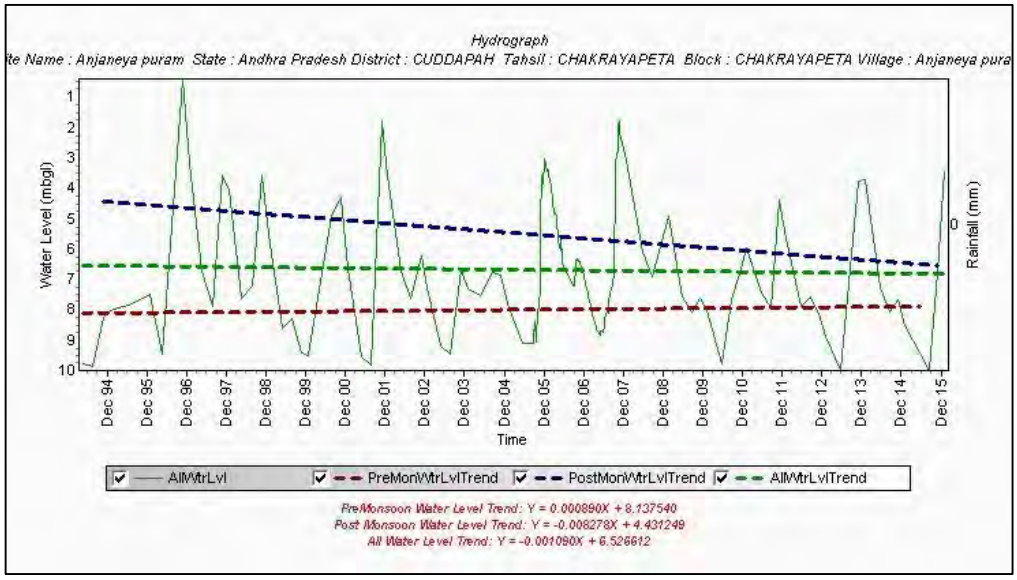
S. No.	Location	District	Pre (m/yr)		Post (m/yr)	
			Rise	**Fall**	**Rise**	**Fall**
1	Amarapurama	Anantapuramu		0.175		0.122
2	Anatapur	Anantapuramu	0.11		0.15	
3	Damalcheruvu	Chittoor		0.03		0.04
4	Battuvaripalli	Chittoor	0.01			0.03
5	Muddireddipalli	Cuddapah		0.10		0.21
6	Anjanuaryeyapuram	Cuddapah	0.01			0.10
7	Jaggampet	East Godavari	0.150		0.054	
8	Gollaprolu	East Godavari	0.018			0.002
9	Ipur	Guntur	0.009			0.017
10	Guntur	Guntur	0.051		0.004	
11	Nuziveedu	Krishna	0.074		0.094	
12	Gudivada	Krishna	0.0135		0.0003	
13	Gonegandla	Kurnool	0.057			0.019
14	Ahobilam	Kurnool		0.102		0.132
15	Kadanothola	Nellore		0.050	0.026	
16	Bata	Nellore		0.01		0.07
17	Chirala	Prakasam		0.003	0.001	
18	Chandalur	Prakasam		0.11	0.01	
19	Ichapuram	Srikakulam		0.01266	0.042336	
20	Barua	Srikakulam	0.08		0.11	
21	Narsipattanam	Vishakhapattanam	0.005		0.002	
22	Araku	Vishakhapattanam		0.03		0.01
23	Agraharam	Vizianagaram	0.1		0.11	
24	Garbham	Vizianagaram		0.008		0.016
25	Kovvur	West Godavari	0.025		0.05	
26	Eluru	West Godavari		1.02		0.89

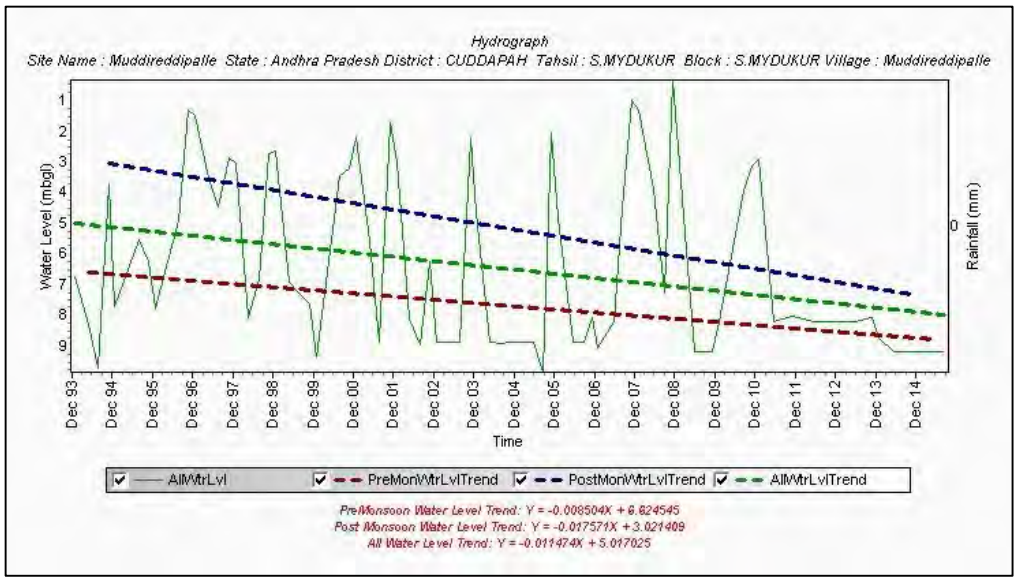

Hydrograph
Site Name : Amarapuram-PZ State : Andhra Pradesh District : ANANTAPUR Tahsil : AMARAPURAM Block : AMARAPURAM Village : Amarapuram
Water Level (mbgl)
Rainfall (mm)
Time
AllWtrLvl
PreMonWtrLvlTrend
PostMonWtrLvlTrend
AllWtrLvlTrend
PreMonsoon Water Level Trend: Y = -0.014586X + 23.674453
Post Monsoon Water Level Trend: Y = -0.010141X + 20.833658
All Water Level Trend: Y = -0.018881X + 21.437277

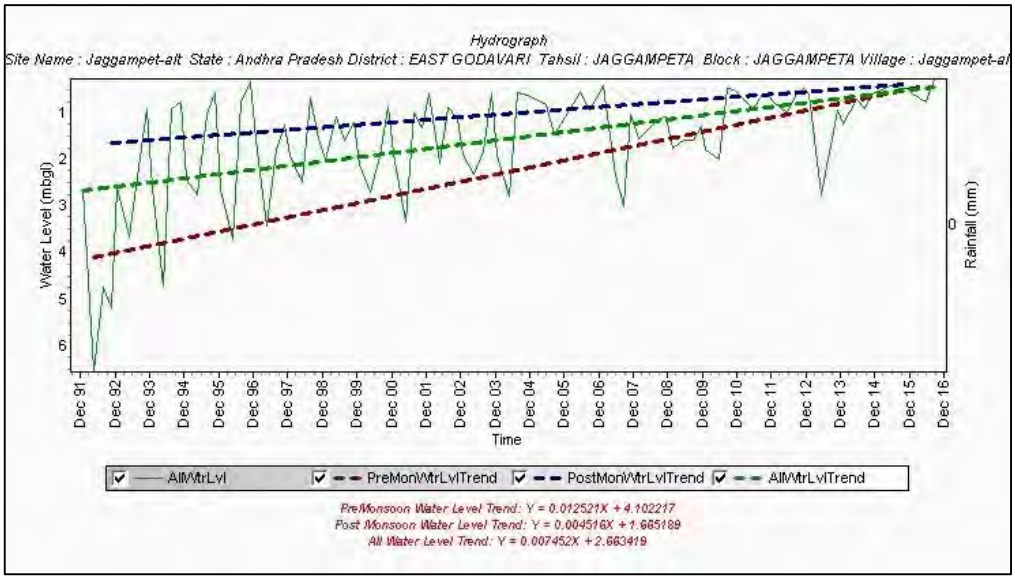

Hydrograph
Site Name : Anantapur-PZ State : Andhra Pradesh District : ANANTAPUR Tahsil : ANANTAPUR Block : ANANTAPUR Village : Anantapur
Water Level (mbgl)
Rainfall (mm)
Time
AllWtrLvl
PreMonWtrLvlTrend
PostMonWtrLvlTrend
AllWtrLvlTrend
PreMonsoon Water Level Trend: Y = 0.008850X + 14.433320
Post Monsoon Water Level Trend: Y = 0.012805X + 13.828656
All Water Level Trend: Y = 0.011991X + 14.536740

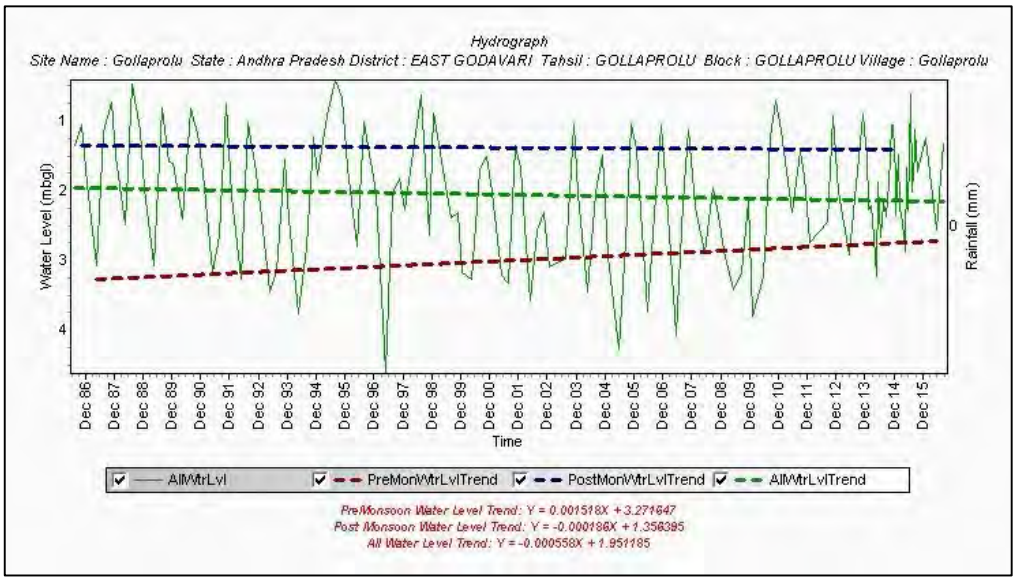

Hydrograph
Site Name : Damalcheruvu State : Andhra Pradesh District : CHITTOOR Tahsil : PAKALA Block : PAKALA Village : Damalcheruvu
Water Level (mbgl)
Rainfall (mm)
Time
AllWtrLvl
PreMonWtrLvlTrend
PostMonWtrLvlTrend
AllWtrLvlTrend
PreMonsoon Water Level Trend: Y = -0.002332X + 6.924981
Post Monsoon Water Level Trend: Y = -0.003373X + 3.952256
All Water Level Trend: Y = -0.004242X + 4.705891

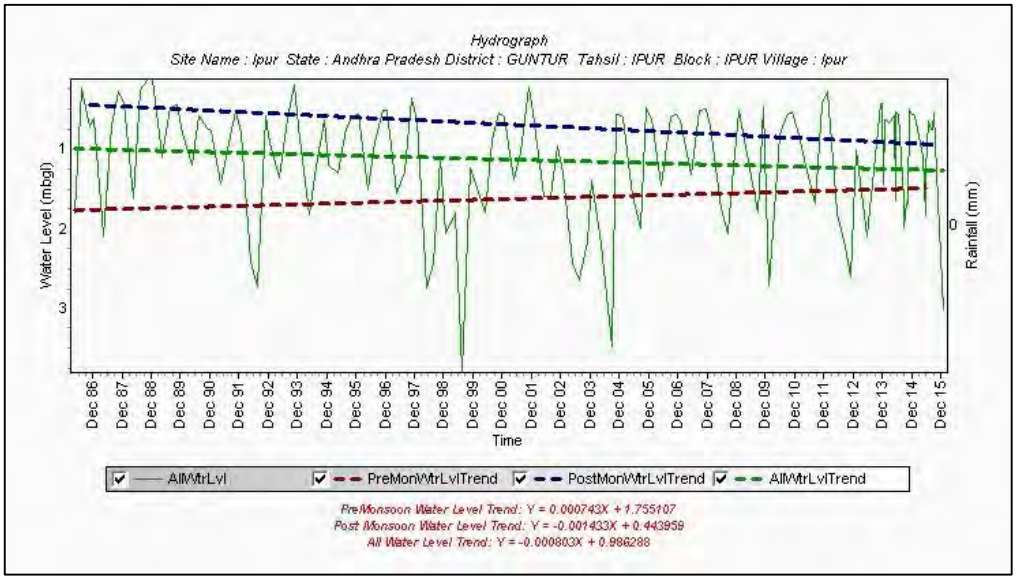

Hydrograph
Site Name : Battuvaripalli State : Andhra Pradesh District : CHITTOOR Tahsil : SODUM Block : SODUM Village : Battuvaripalli
Water Level (mbgl)
Rainfall (mm)
Time
AllWtrLvl
PreMonWtrLvlTrend
PostMonWtrLvlTrend
AllWtrLvlTrend
PreMonsoon Water Level Trend: Y = 0.000600X + 3.450983
Post Monsoon Water Level Trend: Y = -0.002453X + 1.728000
All Water Level Trend: Y = -0.000350X + 2.770968

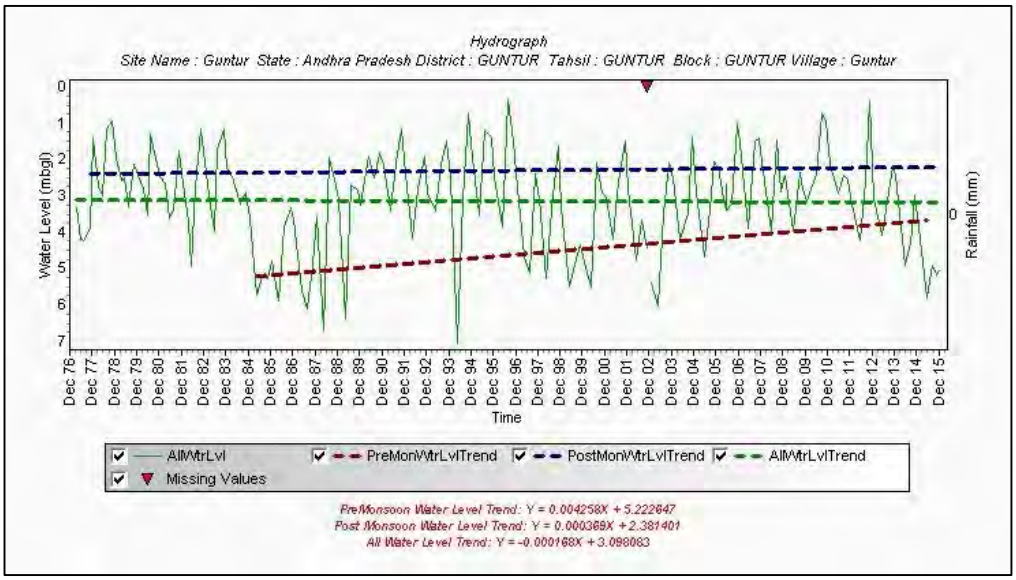

Hydrograph
te Name : Anjaneya puram State : Andhra Pradesh District : CUDDAPAH Tahsil : CHAKRAYAPETA Block : CHAKRAYAPETA Village : Anjaneya pura
Water Level (mbgl)
Rainfall (mm)
Time
AllWtrLvl
PreMonWtrLvlTrend
PostMonWtrLvlTrend
AllWtrLvlTrend
PreMonsoon Water Level Trend: Y = 0.000890X + 8.137540
Post Monsoon Water Level Trend: Y = -0.008278X + 4.431249
All Water Level Trend: Y = -0.001090X + 6.526612

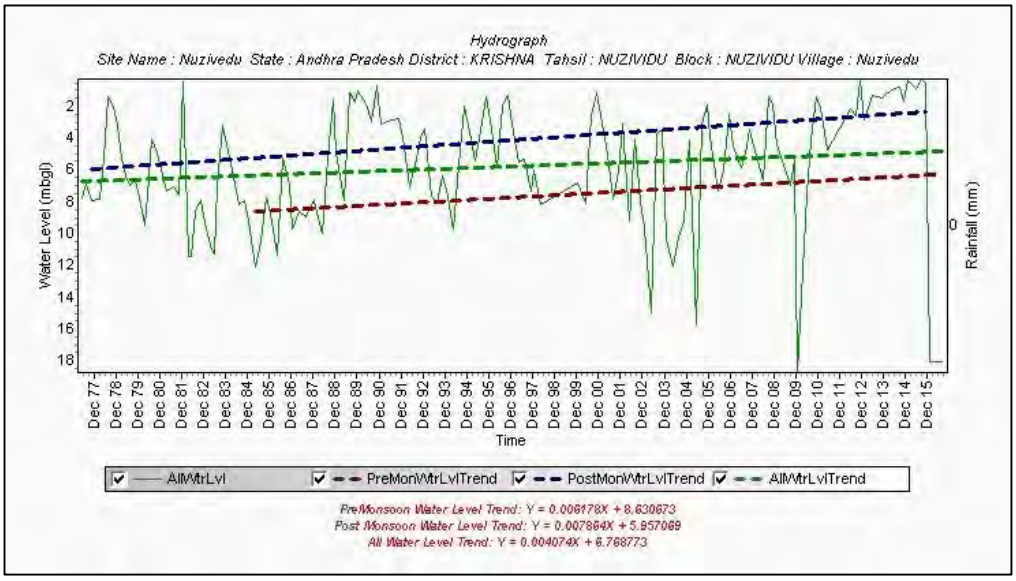

Hydrograph
Site Name : Muddireddipalle State : Andhra Pradesh District : CUDDAPAH Tahsil : S.MYDUKUR Block : S.MYDUKUR Village : Muddireddipalle
Water Level (mbgl)
Rainfall (mm)
Time
AllWtrLvl
PreMonWtrLvlTrend
PostMonWtrLvlTrend
AllWtrLvlTrend
PreMonsoon Water Level Trend: Y = -0.008504X + 6.624545
Post Monsoon Water Level Trend: Y = -0.017571X + 3.021409
All Water Level Trend: Y = -0.011474X + 5.017025

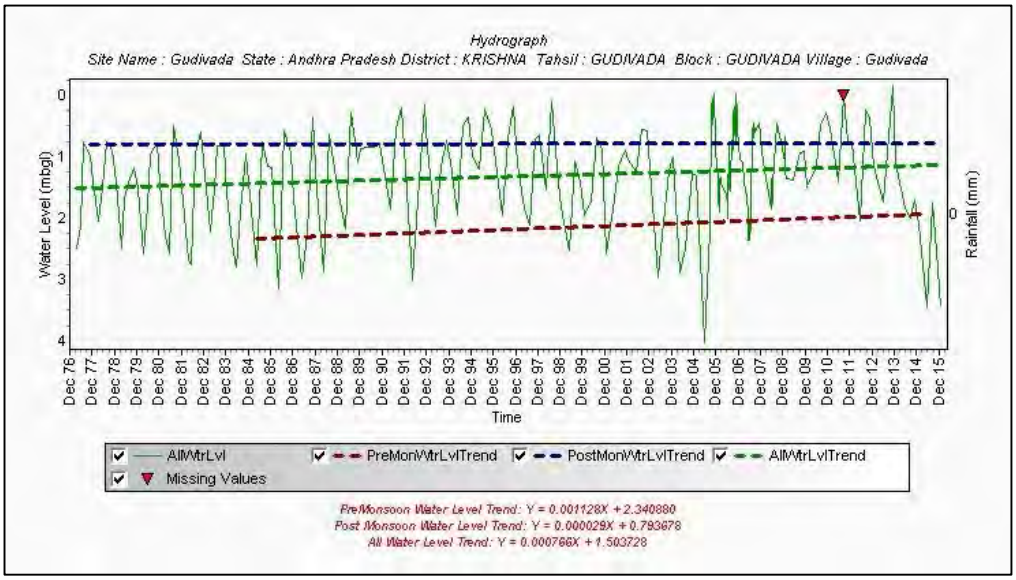

Hydrograph
Site Name : Jaggampet-alt State : Andhra Pradesh District : EAST GODAVARI Tahsil : JAGGAMPETA Block : JAGGAMPETA Village : Jaggampet-alt
Water Level (mbgl)
Rainfall (mm)
Time
AllWtrLvl
PreMonWtrLvlTrend
PostMonWtrLvlTrend
AllWtrLvlTrend
PreMonsoon Water Level Trend: Y = 0.012521X + 4.102217
Post Monsoon Water Level Trend: Y = 0.004516X + 1.665189
All Water Level Trend: Y = 0.007452X + 2.663419

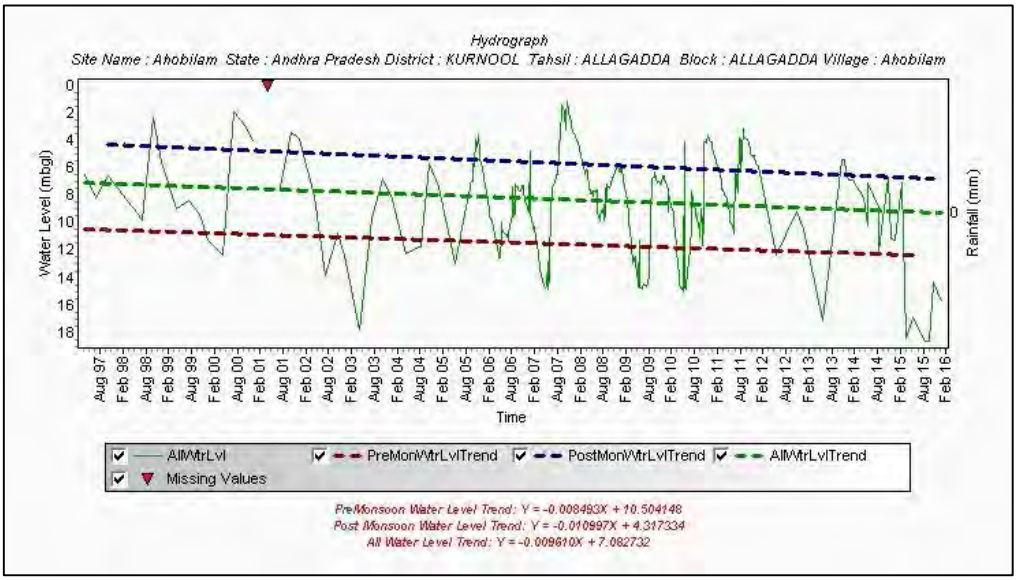

Hydrograph
Site Name : Gollaprolu State : Andhra Pradesh District : EAST GODAVARI Tahsil : GOLLAPROLU Block : GOLLAPROLU Village : Gollaprolu
Water Level (mbgl)
Rainfall (mm)
Time
AllWtrLvl
PreMonWtrLvlTrend
PostMonWtrLvlTrend
AllWtrLvlTrend
PreMonsoon Water Level Trend: Y = 0.001518X + 3.271647
Post Monsoon Water Level Trend: Y = -0.000186X + 1.356395
All Water Level Trend: Y = -0.000558X + 1.951185

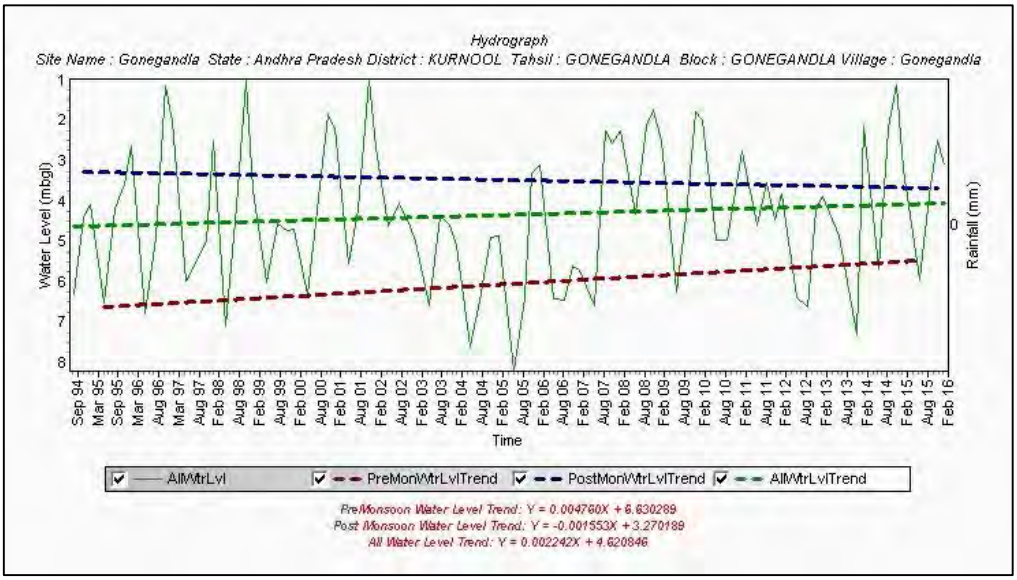

Hydrograph
Site Name : Ipur State : Andhra Pradesh District : GUNTUR Tahsil : IPUR Block : IPUR Village : Ipur
Water Level (mbgl)
Rainfall (mm)
Time
AllWtrLvl
PreMonWtrLvlTrend
PostMonWtrLvlTrend
AllWtrLvlTrend
PreMonsoon Water Level Trend: Y = 0.000743X + 1.755107
Post Monsoon Water Level Trend: Y = -0.001433X + 0.443959
All Water Level Trend: Y = -0.000803X + 0.986288

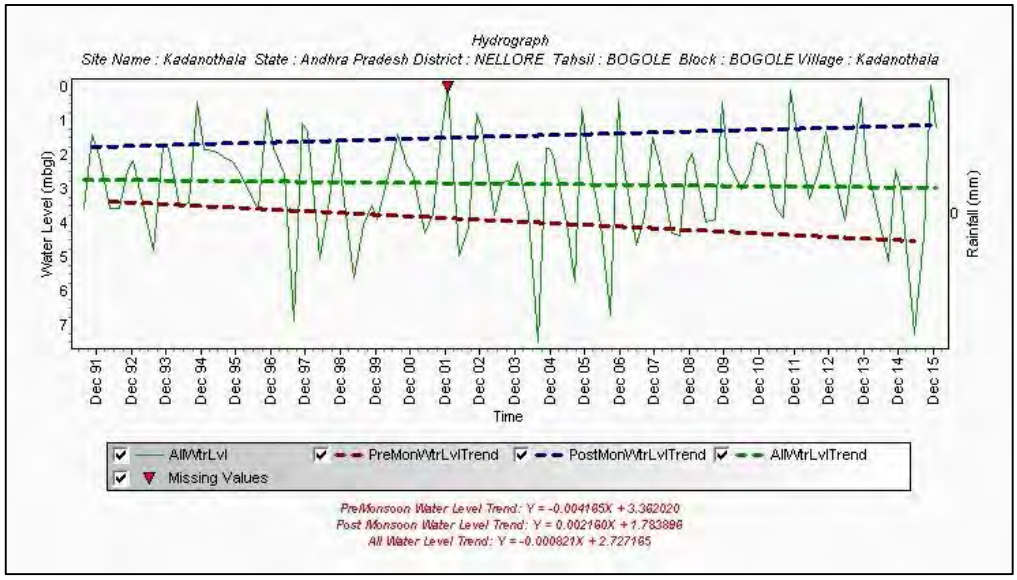

Hydrograph
Site Name : Guntur State : Andhra Pradesh District : GUNTUR Tahsil : GUNTUR Block : GUNTUR Village : Guntur
Water Level (mbgl)
Rainfall (mm)
Time
AllWtrLvl
PreMonWtrLvlTrend
PostMonWtrLvlTrend
AllWtrLvlTrend
Missing Values
PreMonsoon Water Level Trend: Y = 0.004258X + 5.222647
Post Monsoon Water Level Trend: Y = 0.000389X + 2.381401
All Water Level Trend: Y = -0.000168X + 3.098063

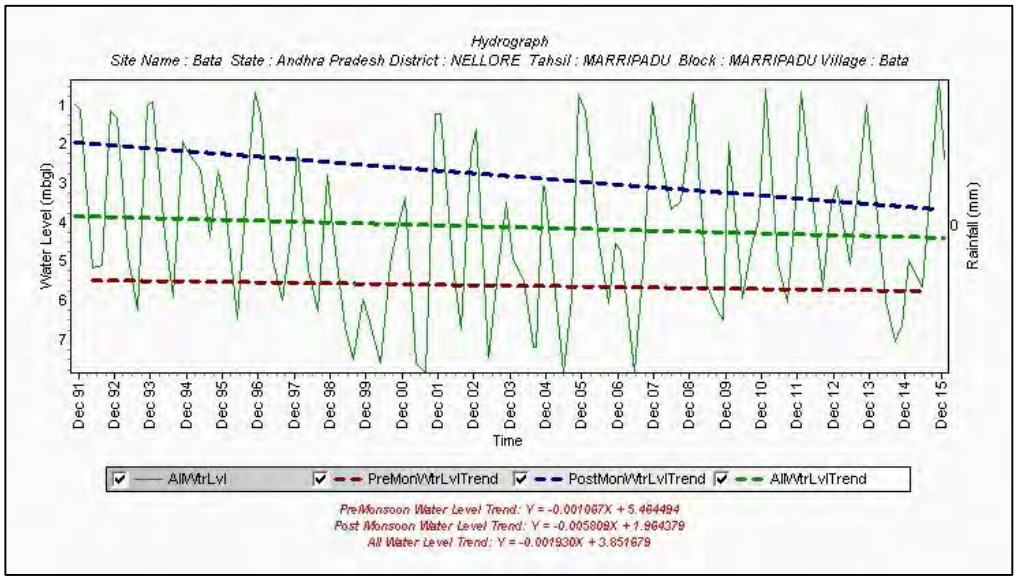

Hydrograph
Site Name : Nuzivedu State : Andhra Pradesh District : KRISHNA Tahsil : NUZIVIDU Block : NUZIVIDU Village : Nuzivedu
Water Level (mbgl)
Rainfall (mm)
Time
AllWtrLvl
PreMonWtrLvlTrend
PostMonWtrLvlTrend
AllWtrLvlTrend
PreMonsoon Water Level Trend: Y = 0.006178X + 8.630673
Post Monsoon Water Level Trend: Y = 0.007864X + 5.957069
All Water Level Trend: Y = 0.004074X + 6.768773

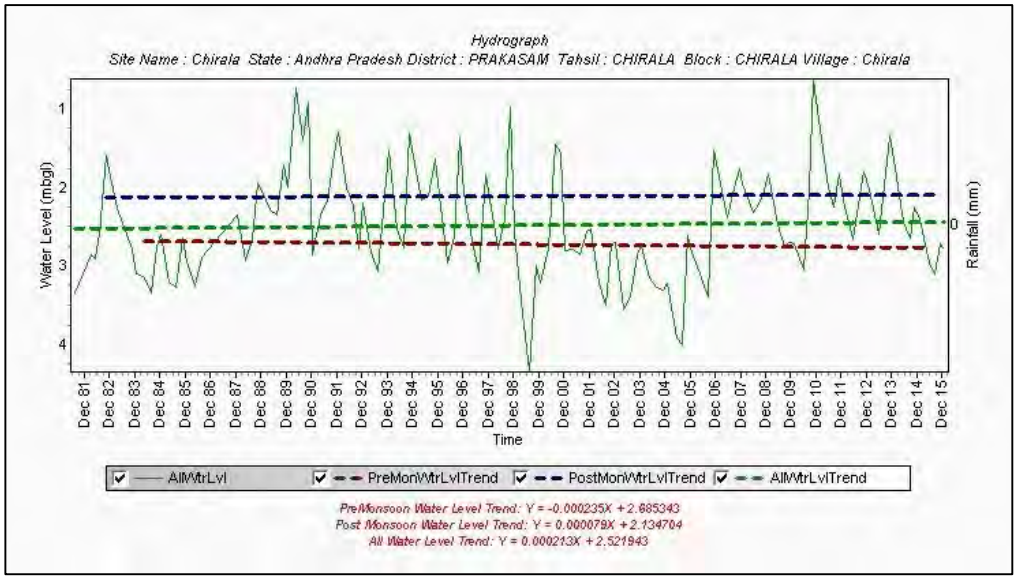

Hydrograph
Site Name : Gudivada State : Andhra Pradesh District : KRISHNA Tahsil : GUDIVADA Block : GUDIVADA Village : Gudivada
Water Level (mbgl)
Rainfall (mm)
Time
AllWtrLvl
PreMonWtrLvlTrend
PostMonWtrLvlTrend
AllWtrLvlTrend
Missing Values
PreMonsoon Water Level Trend: Y = 0.001128X + 2.340880
Post Monsoon Water Level Trend: Y = 0.000029X + 0.793678
All Water Level Trend: Y = 0.000766X + 1.503728

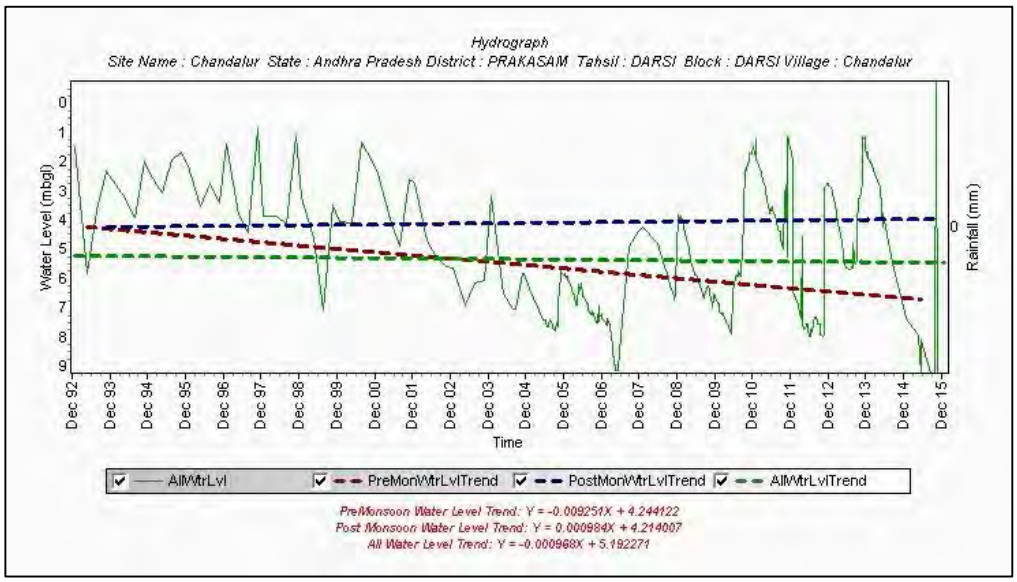

Hydrograph
Site Name : Ahobilam State : Andhra Pradesh District : KURNOOL Tahsil : ALLAGADDA Block : ALLAGADDA Village : Ahobilam
Water Level (mbgl)
Rainfall (mm)
Time
AllMtrLvl
PreMonWtrLvlTrend
PostMonWtrLvlTrend
AllWtrLvlTrend
Missing Values
PreMonsoon Water Level Trend: Y = -0.008493X + 10.504148
Post Monsoon Water Level Trend: Y = -0.010997X + 4.317334
All Water Level Trend: Y = -0.009610X + 7.082732

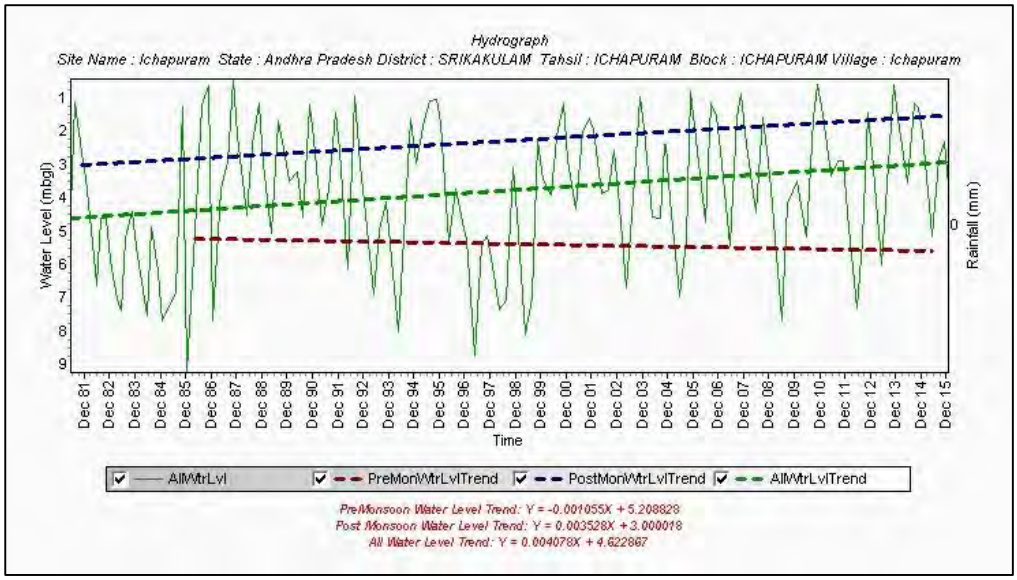

Hydrograph
Site Name : Gonegandla State : Andhra Pradesh District : KURNOOL Tahsil : GONEGANDLA Block : GONEGANDLA Village : Gonegandla
Water Level (mbgl)
Rainfall (mm)
Time
AllMtrLvl
PreMonWtrLvlTrend
PostMonWtrLvlTrend
AllWtrLvlTrend
PreMonsoon Water Level Trend: Y = 0.004760X + 6.630289
Post Monsoon Water Level Trend: Y = -0.001553X + 3.270189
All Water Level Trend: Y = 0.002242X + 4.620846

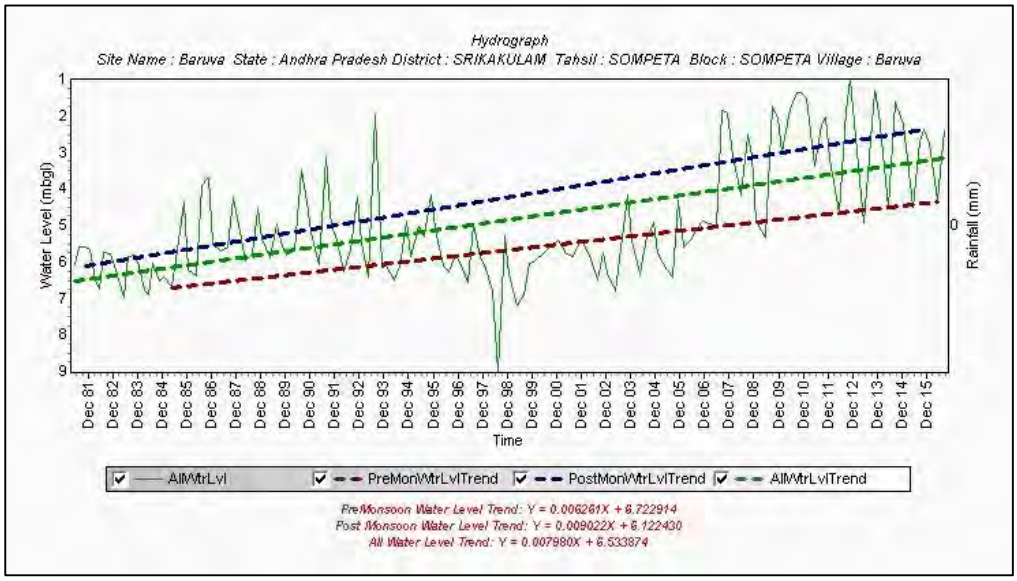

Hydrograph
Site Name : Kadanothala State : Andhra Pradesh District : NELLORE Tahsil : BOGOLE Block : BOGOLE Village : Kadanothala
Water Level (mbgl)
Rainfall (mm)
Time
AllMtrLvl
PreMonWtrLvlTrend
PostMonWtrLvlTrend
AllWtrLvlTrend
Missing Values
PreMonsoon Water Level Trend: Y = -0.004165X + 3.362020
Post Monsoon Water Level Trend: Y = 0.002160X + 1.783896
All Water Level Trend: Y = -0.000821X + 2.727165

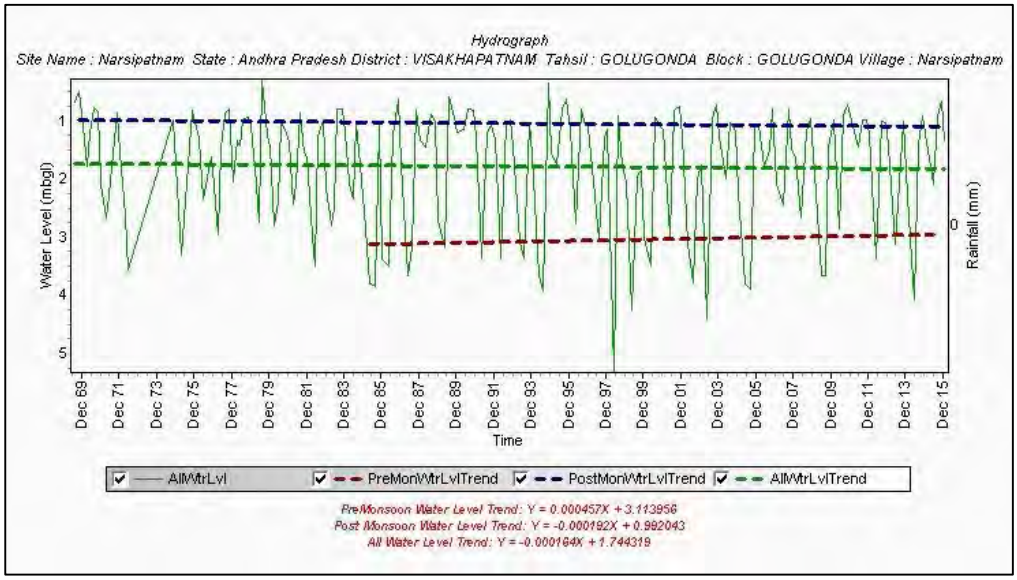

Hydrograph
Site Name : Bata State : Andhra Pradesh District : NELLORE Tahsil : MARRIPADU Block : MARRIPADU Village : Bata
Water Level (mbgl)
Rainfall (mm)
Time
AllWtrLvl
PreMonWtrLvlTrend
PostMonWtrLvlTrend
AllWtrLvlTrend
PreMonsoon Water Level Trend: Y = -0.001067X + 5.464494
Post Monsoon Water Level Trend: Y = -0.005809X + 1.964379
All Water Level Trend: Y = -0.001930X + 3.851679

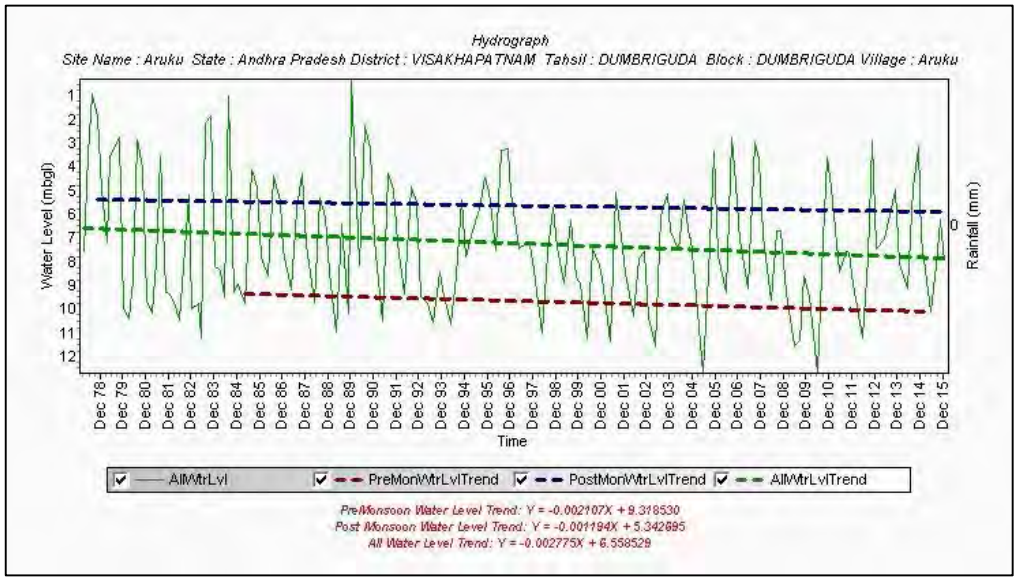

Hydrograph
Site Name : Chirala State : Andhra Pradesh District : PRAKASAM Tahsil : CHIRALA Block : CHIRALA Village : Chirala
Water Level (mbgl)
Rainfall (mm)
Time
AllWtrLvl
PreMonWtrLvlTrend
PostMonWtrLvlTrend
AllWtrLvlTrend
PreMonsoon Water Level Trend: Y = -0.000235X + 2.685343
Post Monsoon Water Level Trend: Y = 0.000079X + 2.134704
All Water Level Trend: Y = 0.000213X + 2.521943

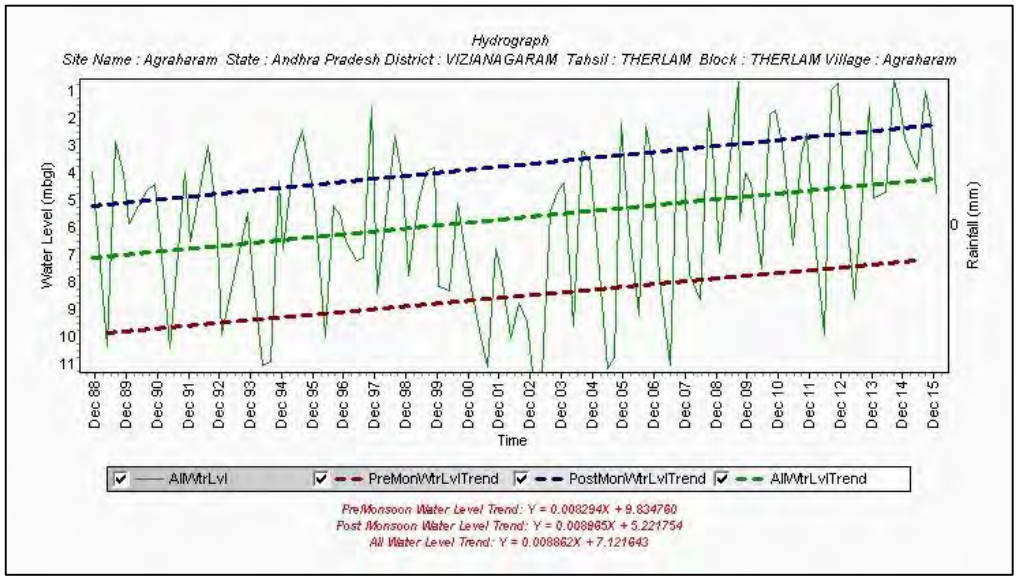

Hydrograph
Site Name : Chandalur State : Andhra Pradesh District : PRAKASAM Tahsil : DARSI Block : DARSI Village : Chandalur
Water Level (mbgl)
Rainfall (mm)
Time
AllWtrLvl
PreMonWtrLvlTrend
PostMonWtrLvlTrend
AllWtrLvlTrend
PreMonsoon Water Level Trend: Y = -0.009251X + 4.244122
Post Monsoon Water Level Trend: Y = 0.000984X + 4.214007
All Water Level Trend: Y = -0.000968X + 5.192271

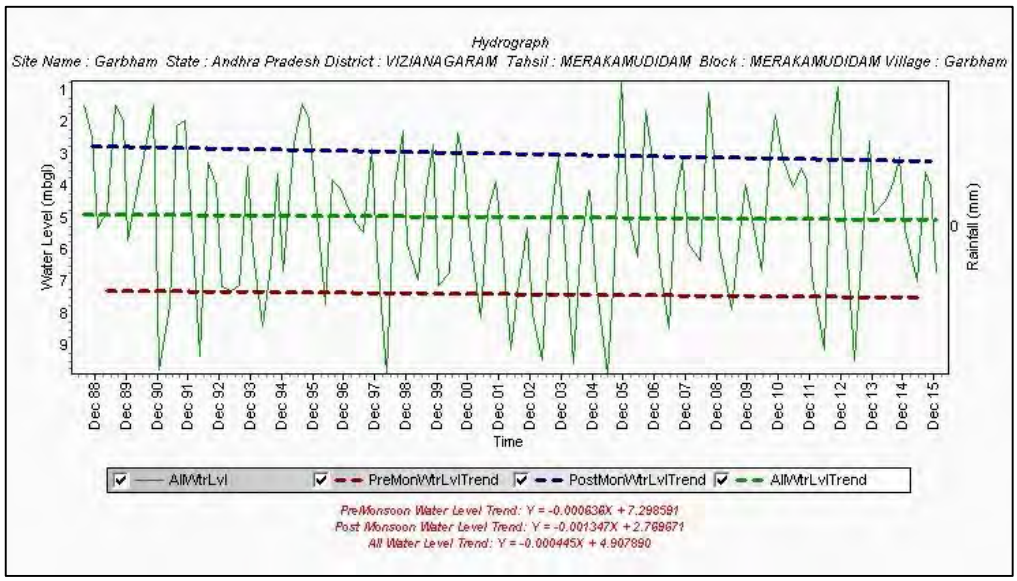

Hydrograph
Site Name : Ichapuram State : Andhra Pradesh District : SRIKAKULAM Tahsil : ICHAPURAM Block : ICHAPURAM Village : Ichapuram
Water Level (mbgl)
Rainfall (mm)
Time
AllMtrLvl
PreMonMtrLvlTrend
PostMonMtrLvlTrend
AllMtrLvlTrend
PreMonsoon Water Level Trend: Y = -0.001055X + 5.208828
Post Monsoon Water Level Trend: Y = 0.003528X + 3.000018
All Water Level Trend: Y = 0.004078X + 4.622867


Hydrograph
Site Name : Baruva State : Andhra Pradesh District : SRIKAKULAM Tahsil : SOMPETA Block : SOMPETA Village : Baruva
Water Level (mbgl)
Rainfall (mm)
Time
AllMtrLvl
PreMonMtrLvlTrend
PostMonMtrLvlTrend
AllMtrLvlTrend
PreMonsoon Water Level Trend: Y = 0.006261X + 6.722914
Post Monsoon Water Level Trend: Y = 0.009022X + 6.122430
All Water Level Trend: Y = 0.007980X + 6.533874


Hydrograph
Site Name : Narsipatnam State : Andhra Pradesh District : VISAKHAPATNAM Tahsil : GOLUGONDA Block : GOLUGONDA Village : Narsipatnam
Water Level (mbgl)
Rainfall (mm)
Time
AllMtrLvl
PreMonMtrLvlTrend
PostMonMtrLvlTrend
AllMtrLvlTrend
PreMonsoon Water Level Trend: Y = 0.000457X + 3.113956
Post Monsoon Water Level Trend: Y = -0.000192X + 0.992043
All Water Level Trend: Y = -0.000164X + 1.744319


Hydrograph
Site Name : Aruku State : Andhra Pradesh District : VISAKHAPATNAM Tahsil : DUMBRIGUDA Block : DUMBRIGUDA Village : Aruku
Water Level (mbgl)
Rainfall (mm)
Time
AllWtrLvl
PreMonWtrLvlTrend
PostMonWtrLvlTrend
AllWtrLvlTrend
PreMonsoon Water Level Trend: Y = -0.002107X + 9.318530
Post Monsoon Water Level Trend: Y = -0.001194X + 5.342695
All Water Level Trend: Y = -0.002775X + 6.558529


Hydrograph
Site Name : Agraharam State : Andhra Pradesh District : VIZIANAGARAM Tahsil : THERLAM Block : THERLAM Village : Agraharam
Water Level (mbgl)
Rainfall (mm)
Time
AllWtrLvl
PreMonWtrLvlTrend
PostMonWtrLvlTrend
AllWtrLvlTrend
PreMonsoon Water Level Trend: Y = 0.008294X + 9.834760
Post Monsoon Water Level Trend: Y = 0.008965X + 5.221754
All Water Level Trend: Y = 0.008862X + 7.121643


Hydrograph
Site Name : Garbham State : Andhra Pradesh District : VIZIANAGARAM Tahsil : MERAKAMUDIDAM Block : MERAKAMUDIDAM Village : Garbham
Water Level (mbgl)
Rainfall (mm)
Time
AllWtrLvl
PreMonWtrLvlTrend
PostMonWtrLvlTrend
AllWtrLvlTrend
PreMonsoon Water Level Trend: Y = -0.000636X + 7.298591
Post Monsoon Water Level Trend: Y = -0.001347X + 2.769671
All Water Level Trend: Y = -0.000445X + 4.907890

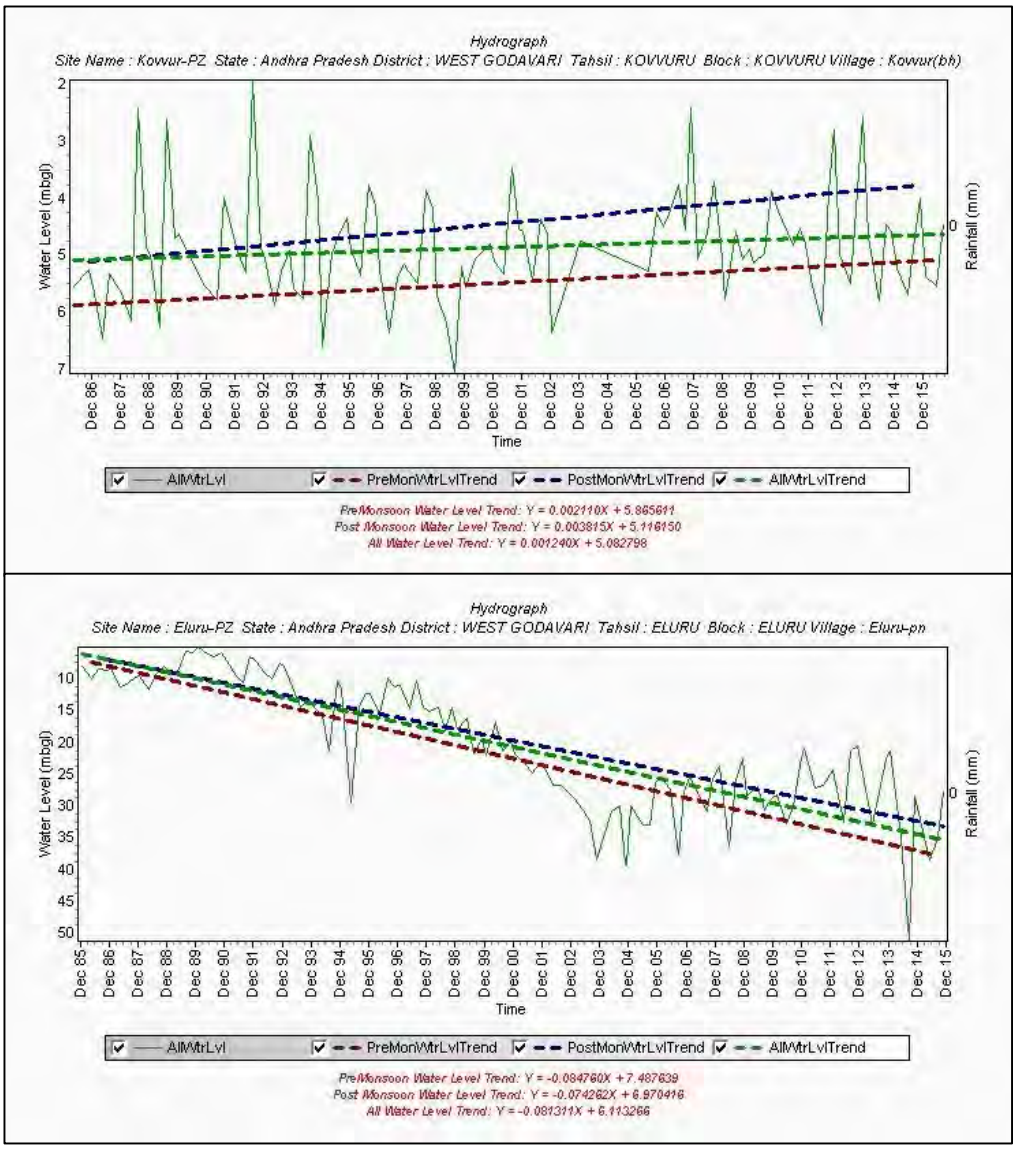


Fig.7.13: Representative hydrographs from Andhra Pradesh State.

8. GROUND WATER QUALITY

Water is a universal solvent and therefore, chemical nature of groundwater forms the basis of interpretations of quality in relation to source, geology, climate and use. Total 496 groundwater samples were collected for normal analysis , Iron and Arsenic analysis from shallow GWMS (both DW and Pz) during pre-monsoon season of 2015 (May) and district wise number of samples analysed is given in **Table-8.1.**The samples are analyzed in the Chemical Laboratory of CGWB (NABL Accredited). Sampling, preservation, and storage of groundwater have been carried out by following standard guidelines (**APHA 1998**). Fourteen major parameters such as pH, electrical conductivity (EC), total dissolved solids (TDS), total hardness (TH), calcium (Ca^{2+}), magnesium (Mg^{2+}), sodium (Na^{+}), potassium (K^{+}), carbonate (CO_3), bicarbonate (HCO_3^{-}), chloride (Cl), sulphate (SO_4^{2-}), nitrate (NO_3^{-}) ,fluoride (F^{-}) and also Iron and Arsenic were determined. The cation and anion balance are within acceptable limits of +/- 5% (**APHA, 1998**). District wise minimum, maximum and average data is given in **Annexure-13** and station wise details is given in **Annexure-14.**

Table-8.1: District wise collection of samples (May-2015).

S.No.	District	samples		S.No.	District	samples
1	Anantapuramu	27		8	Nellore	35
2	Chittor	17		9	Prakasam	46
3	Cuddapah	13		10	Srikakulam	39
4	East Godavari	34		11	Vishakhapatnam	72
5	Guntur	65		12	Vizianagaram	41
6	Krishna	49		13	West Godavari	24
7	Kurnool	34			**Total**	**496**

8.1 Distribution of physico-chemical parameters and suitability for drinking purpose (as per BIS, 2012)

8.1.1 Hydrogen Ion Concentration (pH)

The hydrogen ion activity is a main variable of groundwater system because the hydrogen ion participates in most of the chemical reactions that affect water composition. In most natural waters pH value is dependent on the carbon dioxide-carbonate-bicarbonate equilibrium. The pH value of a solution is the negative logarithm of concentration of hydrogen ions (H^{+}) in moles/liter. Pure water at 7 pH (at 25º C), contains equal proportion of H^{+} and OH^{-} (hydroxyl) ions. The pH value is less than 7 if the H^{+} ions exceed the OH^{-} ions, and it is more than 7 when OH^{-} ions exceed H^{+} ions.

In the ground waters of state, pH ranges from 5.1(Pedda Kanumalla-Prakasam district) to 9.3 (Rachuru-West Godavari district). In 5 samples (4 from Guntur district and 1 from West Godavari district) pH is beyond permissible limits of BIS (**Annexure-14**).

8.1.2 Electrical Conductivity (EC)

Specific conductance (EC) of an electrolyte is the reciprocal of specific resistance and is expressed in µ S/cm. Electrical conductivity normally, increases with flow and residence time in the aquifer and its determination shows, to what extent mineralization has taken place in the groundwater. In the study area, the EC values (µS/cm at 25 $^{\circ}$C) ranges from 62 to 10039 µS/cm excluding one sample (Krishnapuram-Nellore) where it is 15,570 µS/cm.

8.1.3 Total dissolved solids (TDS)

The concentration of TDS in groundwater depends upon nature of rock formation, depth through which water is passing, climate, geomorphology of the area at which water is moving, porosity and permeability of rocks. Contamination of water by human and animal activities including sewage disposal and agricultural practices and mixing of different types of water also affects TDS. In the state, concentration of TDS ranges from 65-8103 mg/l (avg: 1171) and it is found that in 44 samples, TDS is beyond drinking water standard limits (2000 mg/l) (**Fig.8.1**)

8.1.4 Total Hardness (TH)

Total hardness is the capacity of water to neutralize soap and is the sum of $Ca^{2+}$and Mg^{2+}. Hardness is of two types, namely primary and secondary. In the state, total hardness ranges from 25-6800 mg/l and it is found that in 102 samples (20%), TH is beyond drinking water standard limits of BIS (600 mg/l)

8.1.5 Calcium (Ca^{2+})

In most of the naturally occurring groundwater, calcium is the main cation due to its abundance in earth's crust and high mobility (**Hem, 1991**). The principal sources of calcium in groundwater are minerals present in igneous rock, especially silicates, like pyroxenes, amphiboles, feldspars and sedimentary rocks like limestone, dolomite and gypsum. It is also present in the form of adsorbed ions on negatively charged mineral surfaces in soils and rocks. The concentrations of calcium in the state range from 6-520 mg/l (except one sample i.e., Krishnapuram-Nellore where it is 1020 mg/l) and it is found that in 33 samples (~7%), Ca is beyond drinking water standard limits (200 mg/l).

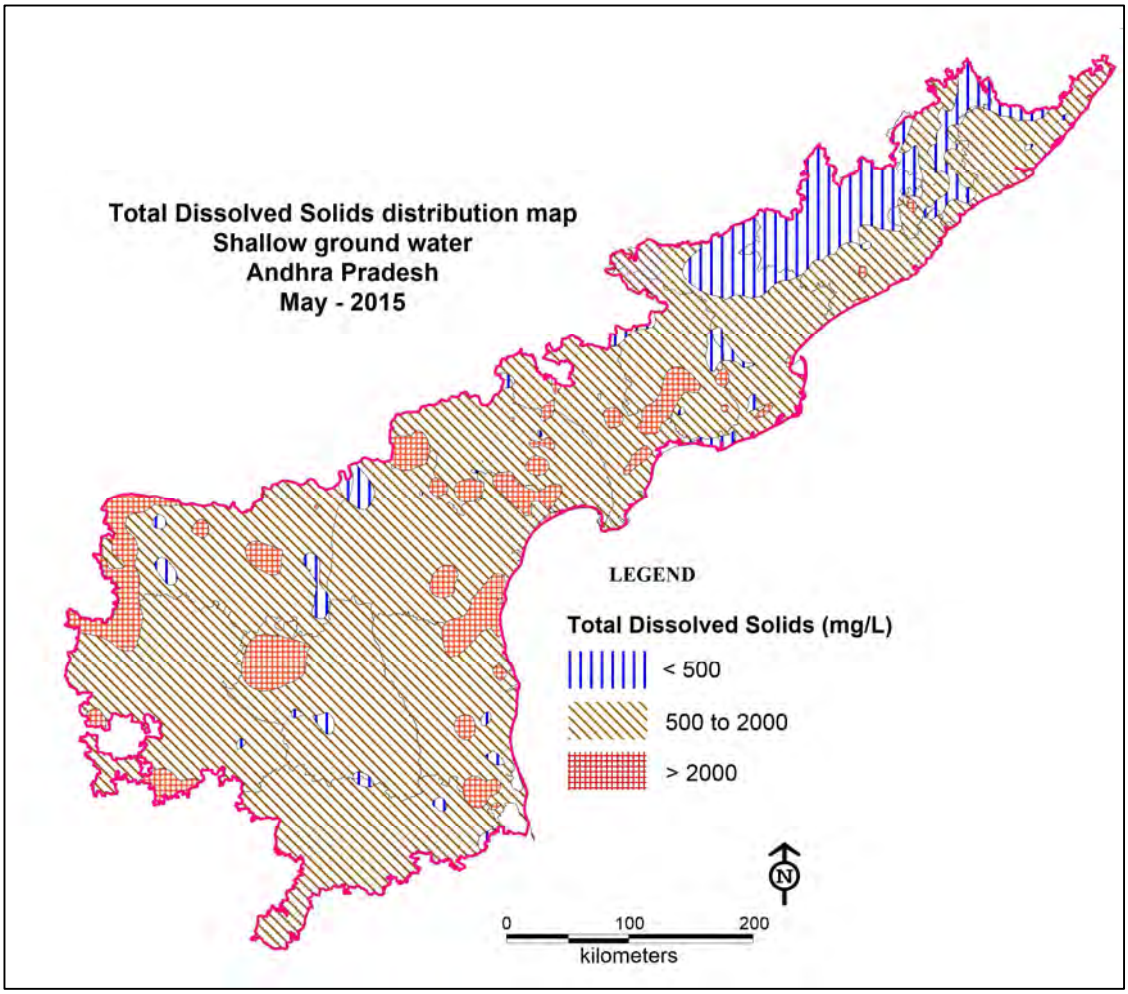


Fig.8.1: Distribution of TDS in Andhra Pradesh (May-2015).

8.1.6 Magnesium (Mg^{2+})

Weathering of basic igneous rocks such as dunites, pyroxenites; volcanic rocks such as basalts; metamorphic rocks like amphibolites, talc and tremolite-schists; sedimentary rocks such as dolomite, gypsum *etc* are the main sources of Mg^{2+} in the groundwater (**Karanth, 1987**) and use of surface water for irrigation is another source of Mg^{2+} in the groundwater (**Hem, 1991**). In the State, as in most natural water, the magnesium concentration is much lower than the calcium concentration (**Hem, 1991**). It ranges from 0-477 mg/l (excluding 1 i.e., Krishnapuram-Nellore, where it is 1034 mg/l). In total 62 samples (12%), Mg is beyond permissible limit of BIS.

8.1.7 Sodium (Na^{+})

Silicate minerals such as albite, nepheline, sodalite, glaucophane, aegerine and other Na^{+} bearing minerals present in rocks are the main source of Na^{+} in the groundwater. The other sources are rainwater, dissolution of evaporate minerals, sodium disposal through sewage and

industrial wastes (**Handa, 1975**). Certain clay minerals and zeolites can increase the sodium concentration in groundwater by base exchange reaction (**Karanth, 1987**). The concentration of Na^+ in the state ranges from 0 to 1656 mg/l. Maximum concentration of 2047 mg/l is detected in Konakallu well (Krishna district).

8.1.8 Potassium (K^+)

The common source of K^+ in groundwaters is weathering of silicate minerals like orthoclase, microcline, nepheline, biotite, leucite *etc*. Dissolution of evaporites containing highly soluble sylvite and nitre in sedimentary rocks are the other sources of K^+ in the ground waters (**Handa, 1975; Karanth, 1987**). Anthropogenic sources such as fertilizers, manure, human and animal wastes and intrusion of saline waters due to over pumping are some of the other sources of K^+ in ground waters.

The concentrations of K^+ in ground water ranges from below detectable limits to 700 mg/l. Maximum concentration of 700 mg/l is noticed in Rachuru well (West Godavari district).

8.1.9 Carbonate and Bicarbonate (CO_3^- and HCO_3)

The main sources of CO_3^- and HCO_3^- ion in the groundwater is dissolved CO_2 present in rainwater. When this rainwater enters soil, it dissolves more CO_2 from Decaying organic matter present in soil (**Karanth, 1987**). An increase in temperature or Decrease in pressure causes reduction in the solubility CO_2 in groundwater. Carbon dioxide mixed water, while passing through soil dissolves carbonate minerals and give bicarbonate.

The occurrence of carbonates in groundwater is mainly dependent on its pH. In groundwater, carbonates are generally present when pH of groundwater is above 8.3 and it is in traces or absent when pH of water is less than 8.3 (**Handa, 1975; Hem, 1991; Karanth, 1987**). Under normal conditions the bicarbonate concentration in groundwater ranges between 100 and 800 mg/l.

In the ground waters of State, the concentrations of bicarbonate ranges from 12 to 1488 mg/l. Maximum concentration of 1488 is detected in Konakallu well (Krishna district). In 95 samples (19%) bicarbonate concentration is beyond maximum permissible limits of BIS

8.1.10 Chloride (Cl^-)

Chloride in the form of chloride (Cl^-) is one of the major in-organic anion in water and wastewater (APHA, 1995). Hydrolysis of halite and related minerals, rainwater, irrigation and industrial effluents are the main sources of Cl^- in groundwater (**Handa, 1975**). Minerals like sodalite, mica, chloro-apatite, hornblende, *etc* are the other minor sources of chloride in groundwater (**Karanth, 1987**). Abnormal concentration of Cl^- in groundwater may results due to pollution of sewage wastes, planting of coconut trees (**Karanth, 1987**). In the ground waters of state, chloride concentration ranges from 7 to 5211 mg/l and found that 27 samples are

unsuitable for drinking purposes. Maximum concentration of 5211 mg/l is noticed in **Krishnapuram well (Nellore district). Areal distribution of chloride is depicted in Fig. 8.2.**

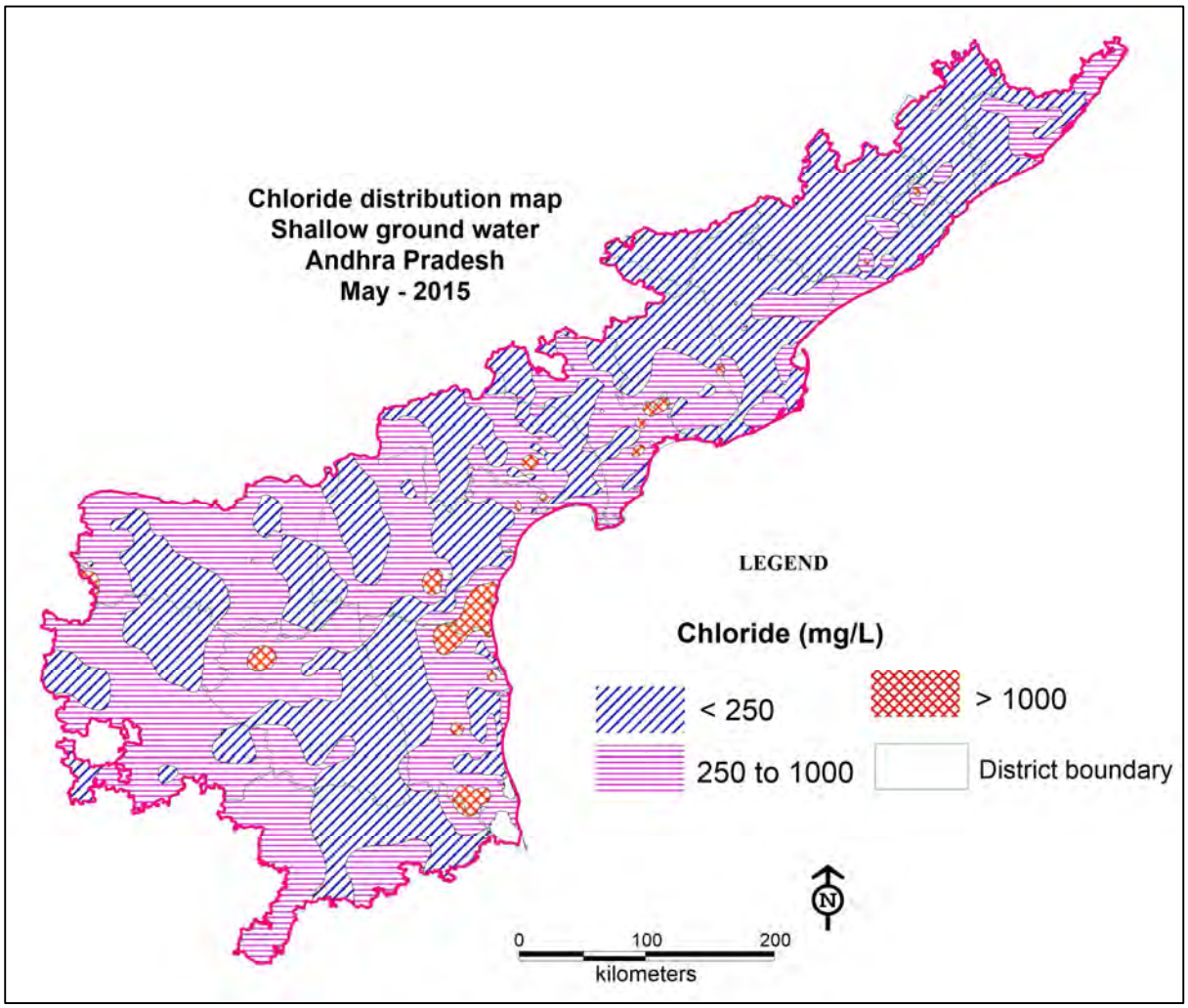


Fig.8.2: Distribution of Chloride in Andhra Pradesh (May-2015).

8.1.11 Sulphate (SO_4^{2-})

Sulphate (SO_4^{2-}) is widely distributed in native and may be present in natural waters in concentration ranging from a few to several thousand mg/l (**APHA, 1998**). The main sources of SO_4^{2-} in groundwater are sulphide minerals like pyrite, gypsum and anhydrite minerals found in sedimentary rocks and other sources of SO_4^{2-} in groundwater (**Karanth, 1987**).

In the ground waters of state, the concentrations of sulphate range from 0-1415 mg/l and found that 27 samples are unsuitable for drinking purposes. Maximum concentration of 1415 mg/l is noticed in Nadupur well (Krishna district).

8.1.12 Nitrate (NO_3^-)

Nitrogen is present in atmosphere reacts with rainwater and forms nitrate and ammonium ions. The incidence of high nitrate in groundwater has been observed due to pollution from

anthropogenic sources, specially leaching from sewage/septic tanks (**Walker, 1973; Dudley, 1990**).

In the ground waters of state, the concentrations of nitrate range from 0-1331 mg/l. Maximum concentration of 1331 mg/l is noticed in Gulyan well (Kurnool district). It is found that 199 samples (40%) are unfit for human consumptions. Distribution of nitrate is presented in **Fig.8.3**.

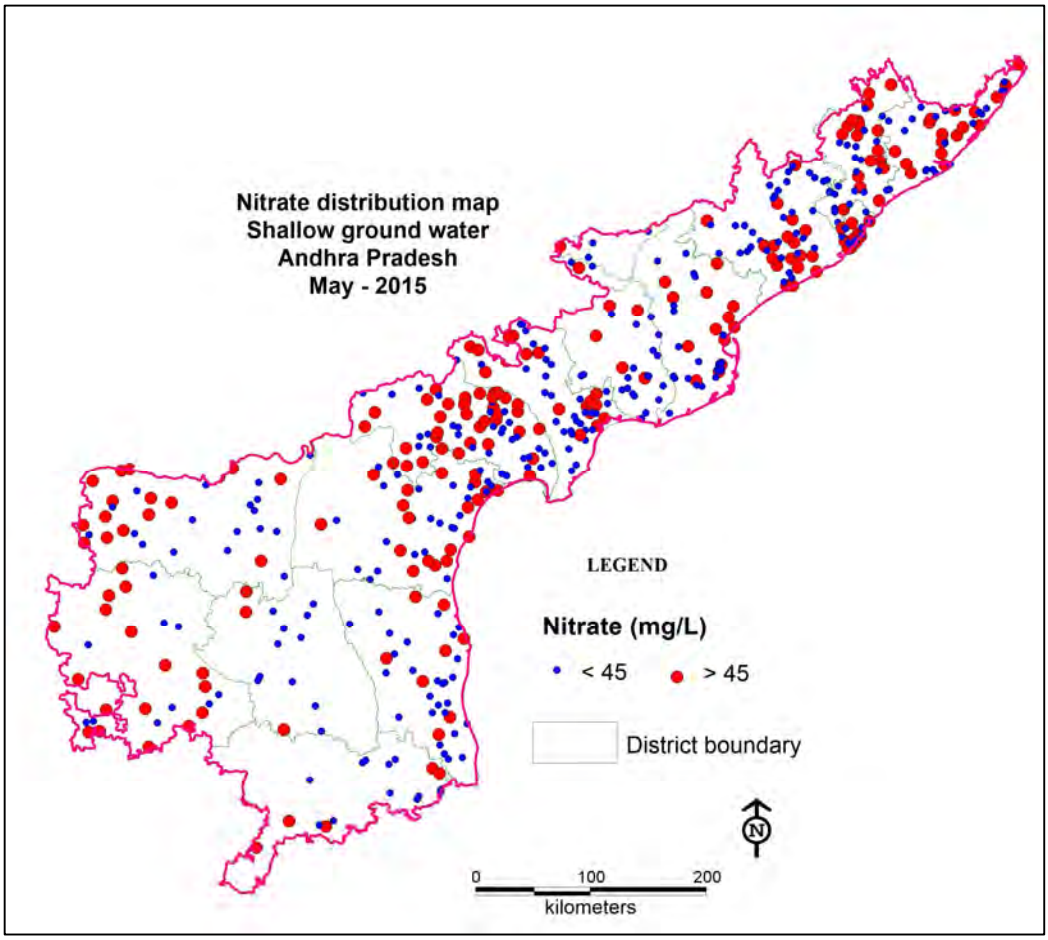


Fig.8.3: Distribution of nitrate in ground water-Andhra Pradesh (May-2015).

8.1.13 Fluoride (F^-)

The main sources of F^- in ground waters are F^- bearing minerals present in rocks like fluorite (CaF_2), apophyllite ($KFCa_4(Si_4O_{20})8H_2O$), fluoroapatite ($Ca_3(PO_4)_3F$), cryolite (Na_3AlF6), villuanite as well as F^- replacing hydroxyl ion in the ferromagnesium silicates (amphiboles, micas) and soil consisting of clay minerals. Dissolution of F^- bearing minerals, ion exchange and evaporative concentration can locally account for high F^- concentration in ground water. Weathering of rock and leachable F^- in an area are more important in Deciding the presence of F^- in groundwater rather than presence of F^- bearing minerals in bulk rocks/soils (**Ramesham**

and Rajagopalan 1985). Other causes of high F- in ground water are alkaline nature, high $HCO3^-$, high TDS and longer residence time in an aquifer (**Madhnure, et al., 2007**).

In the ground waters of state, the concentrations of fluoride range from 0.1 to 5.1 mg/l and maximum concentration of 5.1 is detected in Alampur well (Anantapuramu district). Over all 39 samples (8%) are unfit for human consumption. Higher concentration of F (>1.5 mg/l) are detected in Anantapuramu, Cuddapah, Prakasham and Nellore districts (**Fig.8.4)**.

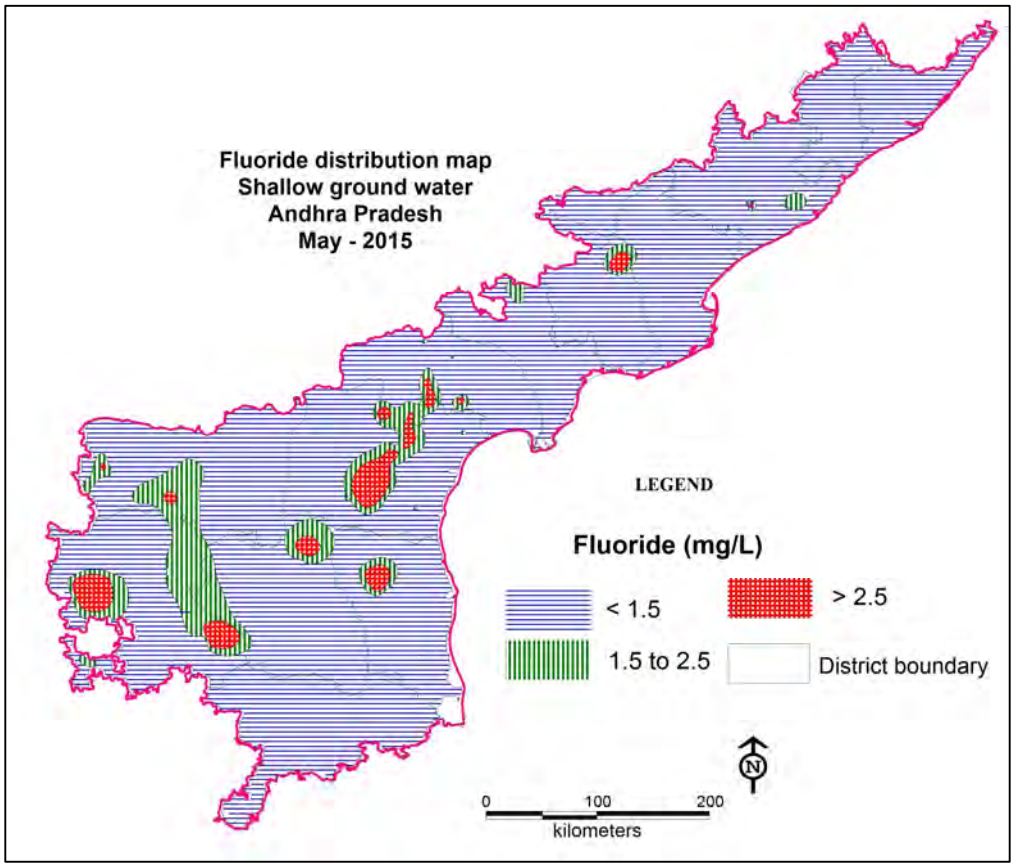


Fig.8.4: Distribution of Fluoride in ground water in Andhra Pradesh (May-2015).

8.1.14 Iron (Fe)

Iron concentration in ground water from the sate varies from < 0.3 to > 1.0 mg/l. Higher concentration (>1 mg/l) beyond maximum permissible limits of BIS (2003) is observed in, Chittoor, Cuddapah, Prakasham, West Godavari, Vishakhapattanam and Srikakulam districts (**Fig.8.5**).

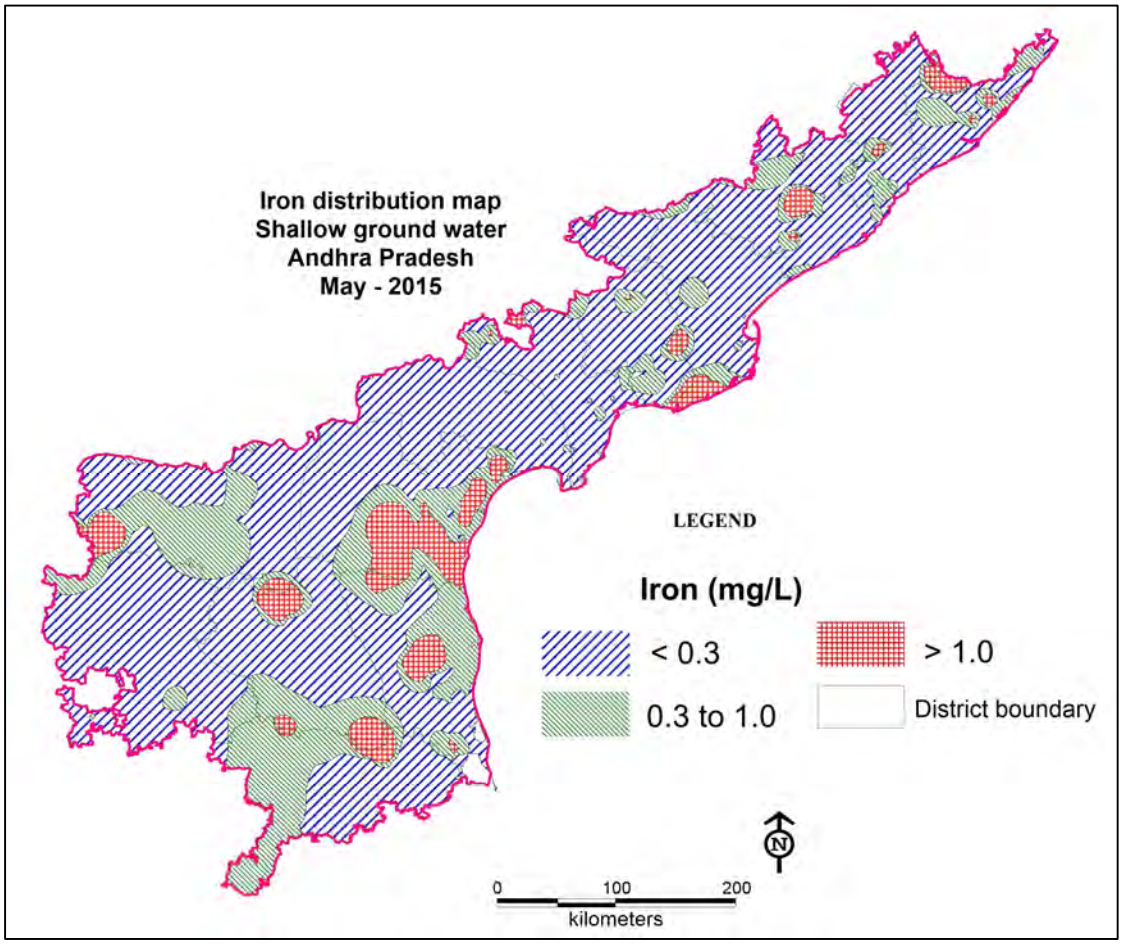


Fig.8.5: Distribution of Iron in ground water in Andhra Pradesh (May-2015).

8.1.15 Arsenic in ground waters

Arsenic is found naturally in rock's earth crust and is recognized as a cancer causing substance (carcinogen). It has not test or smell and can be detected through test and as per BIS; acceptable concentration of 0.01 mg/l (10 ppb) and maximum permissible limit is 0.05 mg/l (50 ppb).

Arsenic in ground water of state is within prescribed limits of BIS (< 50 ppb) and varies from below detectable limit to 10 ppb in 492 samples Only in 4 samples (Kastampahad-Nellore, Ratana-Kurnool, Vadlamudi and Etukuru in Guntur district it is 28, 22, 15 and 10 ppb respectively.

8.2 Suitability for Irrigation Purposes

Productivity and quality of agricultural crops is largely depends on quality of groundwater supplied for its irrigation (**US Salinity Laboratory Staff, 1973**). In order to find out suitability of groundwater for irrigation, EC along with Na^+ plays an important role. The salts present in soil affects the growth of plants, along with soil structure, permeability and aeration. Timely supply of water to crops helps is better yield but on other hand its excessive use results in

gradual accumulation of soluble salts in the soils, particularly when the soils has low permeability and less sufficient drainage facilities (**Handa, 1975**).

8.2.1 USSL Salinity Classification (USSL)

US Salinity Laboratory's diagram, which is based on EC and sodium adsorption ration (SAR), is widely used for assessing groundwater suitability for irrigational use.

Irrigation water classification based on US Salinity Laboratory Staff (**1954**) is given in **Table 8.2 and Fig.8.6.**

The sixteen classes in the diagram indicates the extent that water can affect the soil in terms of sodium hazard as low (S_1), medium (S_2), high (S_3) and very high (S_4) and similarly salinity hazard as a low (C_1), medium (C_2), high (C_3) and very high (C_4).

S_1 type can be used for irrigation on almost all soils with little danger of developing harmful levels of exchangeable sodium (KGS, 1998). S_2 type will present an appreciable sodium hazard in certain fine-textured soils especially poorly leached soils. Such water may be used safely on coarse-textured or organic soils having good permeability. S_3 type may produce harmful levels of exchangeable sodium in most soils and will require good drainage, leaching and addition of organic matter. S_4 type is generally unsatisfactory for irrigation unless special action is taken, such as addition of gypsum to the soil.

C_1 type can be used for irrigation of almost all crops on most soils with little likelihood that soil salinity will develop. C_2 type can be used if a moderate amount of leaching occurs. Crops of moderate salt tolerance can be irrigated with C_2 type water without special practices. C_3 type cannot be used on soils of restricted drainage. C_4 type is not suitable for irrigation water under ordinary circumstances. It can be used only on crops, which are tolerant to salt and when special practices are adopted (**US Salinity Laboratory Staff, 1954**).

Perusal of **Fig.8.6** indicates that groundwater falls in 4 classes' *viz*. C_1-S_1, C_2-S_1 and C_3-S_1 and C4-S_1 and majority of samples fall in C_3-S_1 and C_4-S_1 type of water.

Table 8.2: Classification of irrigation water based on EC and SAR (USSL, 1954).

S. NO.	Class	EC and SAR	Remarks
1	C_1S_1	< 250 µS/cm and SAR < 10	Low salinity and low sodium hazard
2	C_2S_2	< 250 – 750 µS/cm and SAR < 18	Medium salinity and medium sodium hazard
3	C_3S_3	< 750- 2250 µS/cm and SAR < 26	High salinity and high sodium hazard
4	C_4S_4	< 2250-5000 µS/cm and SAR > 26	Very high salinity and very high sodium hazard

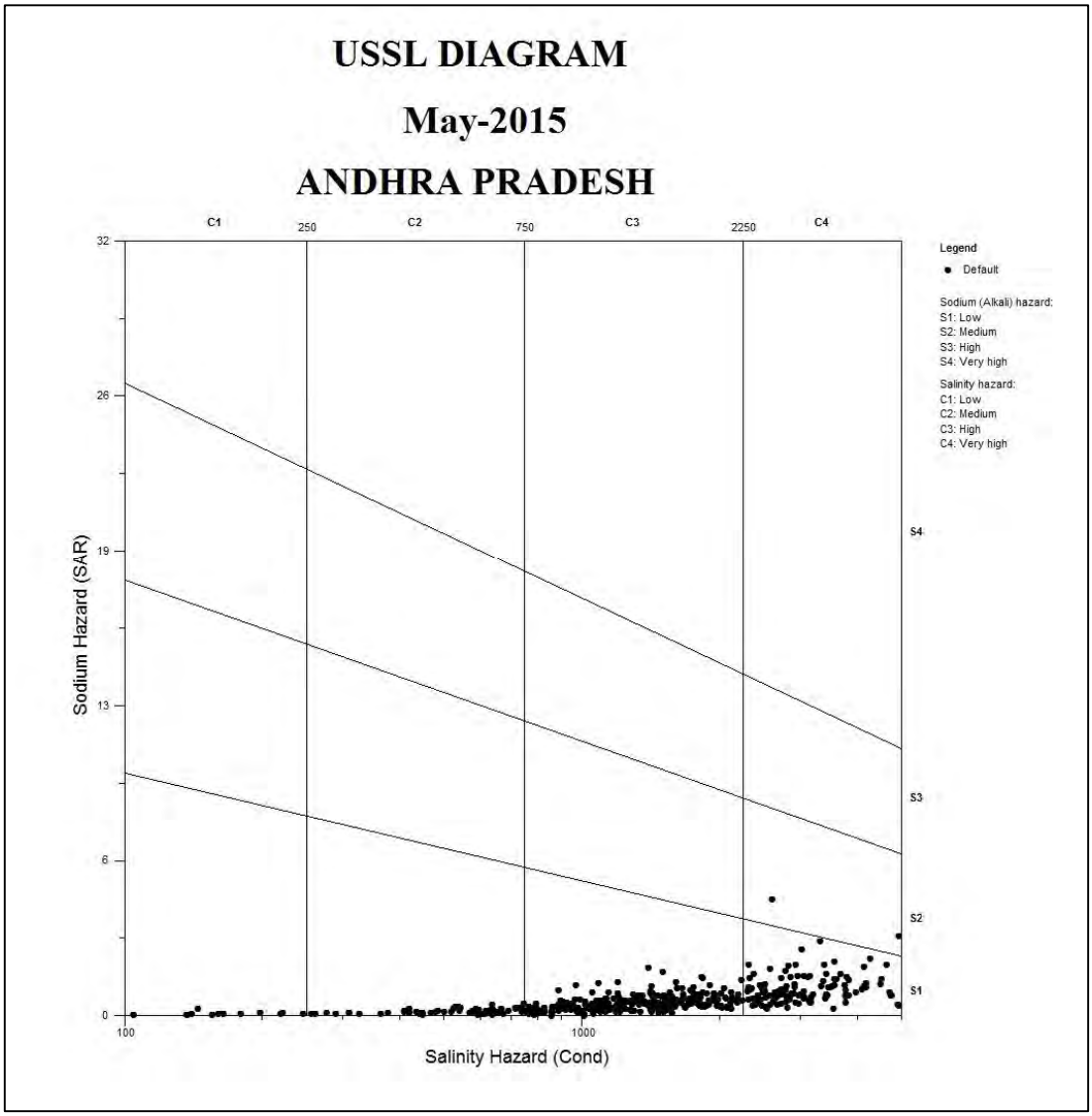


Fig.8.6: USSL Diagram, May-2015.

8.2.2 Residual Sodium Carbonate (RSC)

The RSC is defined as the excess of carbonate and bicarbonate amount over the alkaline earths (Ca^{2+} and Mg^{2+}). Use of RSC beyond permissible limit (>2.5) adversely affects irrigation. The tendency of Ca^{2+} and Mg^{2+} to precipitate, as the water in the soil becomes more concentrated, as a result of evaporation and plant transpiration, and gets fixed in the soil by the process of base exchange, thereby Decreasing the soil permeability.

Distribution of ground water from the State as per RSC given in **Table 8.3** and it reveals, majority of samples (78 %) fall in safe class (RSC < 1.25), 7 % in marginal category and remaining 15 % in not suitable category.

Table 8.3: Classification of ground water based on RSC.

Sl no	RSC	Category	No of samples	% of samples
1	<1.25	Safe	389	78
2	> 1.25 < 2.50	Marginal	35	7
3	> 2.50	Not Suitable	72	15

8.2.3 Percent of Sodium (% Na)

Suitability of groundwater for irrigation purposes is assessed by using the percent of sodium (% Na) in water (**Wilcox, 1948, 1955**). Excess of sodium combining with carbonate will lead to formation of alkaline soils, if combined with chloride the saline soils are formed and either of the soils will not support growth of crops. As per the Indian standards, maximum of 60 % sodium is permissible for irrigation water and it is found that ~14% of samples are unfit for irrigation.

8.3 Groundwater facies

For identification of different water facies of groundwater, Piper diagram is widely used as it gives best graphical representation (**Hill, 1940; Piper 1944**). Groundwater from the state can be grouped broadly into 9 types (**Fig.8.7**). Ground water from the area is mainly of Ca-HCO_3-Cl and Ca-Na-HCO_3-Cl type followed by Ca-Cl and Ca-Na-Cl type (**Fig.8.7**).

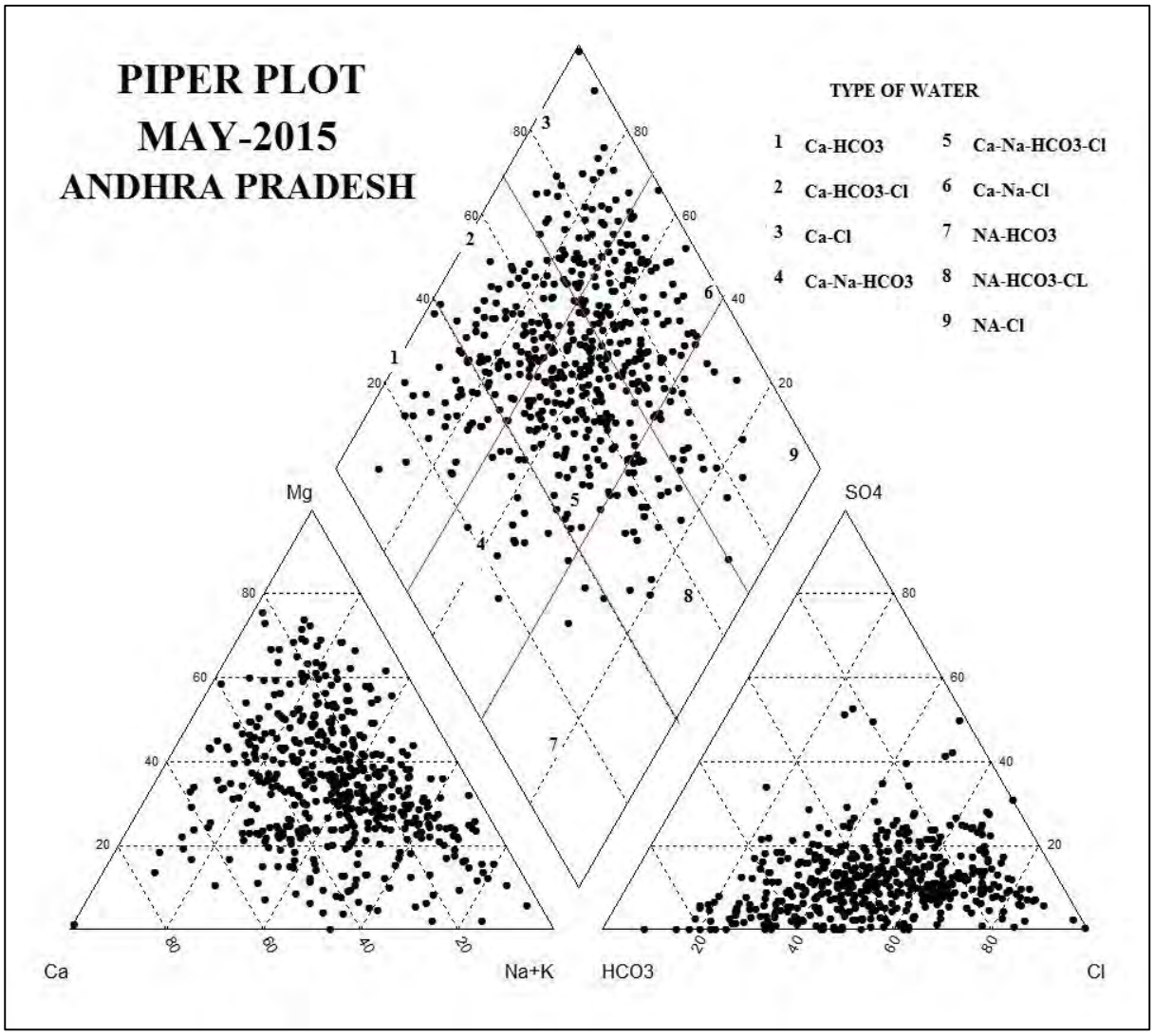


Fig.8.7: Ground water Facies (Piper Plot)-May-2015.

8.4 Interrelationships between variables (Correlation Matrix)

Correlation between F^- and four major ions (pH, Ca^{2+}, Na^+ and HCO_3^-), is studied (**Fig.8.8a-d)**. The correlation plot of F^- vs. Na (r^2=0.04) and F^- vs. HCO_3 (r^2=0.1) shows a weak degree of positive correlations and F^+ vs. pH^- show no relationship (F^+ vs. pH^- (r^2=0.000). **Apambire *et al.* (1997**) and **Madhnure *et al.*** (2007) have also observed that Na^+ concentration increases with F^-, thereby increasing the solubility of fluorite mineral in water. Plot between F^- vs. Ca^{2+} shows weak negative correlation (r^2=0.005), which is an accordance with the proven hypothesis of F^- enrichment being facilitated by removal of Ca^{2+} through precipitation of calcite during water rock interaction (**Reddy, 2014**).

0.005

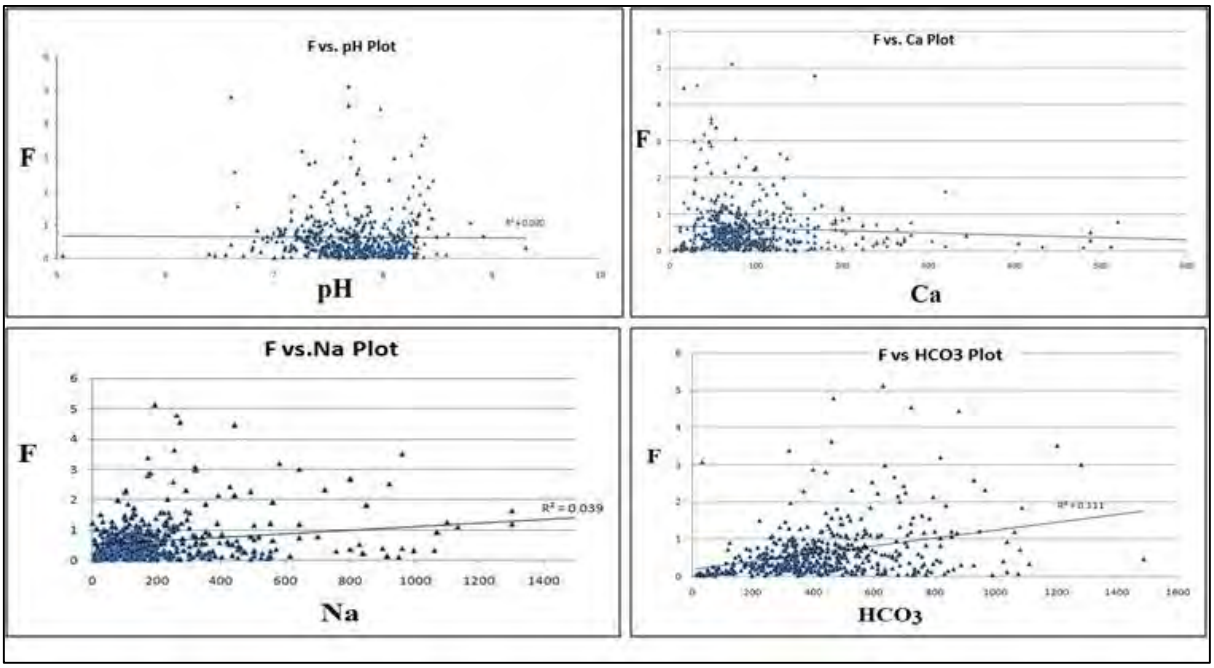


Fig.8.8 (a-d): Interrelationships between variables.

Acknowledgement

The authors thank Shri A.D. Rao, Regional Director for providing necessary guidance and condusive working atmosphere in the office and Dr. P. N. Rao, Suptdg. Hydrogeologist for constant encouragement and guidance from time to time. The authors sincerely thank the officers of CGWB, who have collected field data from GWMS in the stipulated time. Last but not least authors also thank the Report Processing section of CGWB for scrutinizing the report and bringing in proper shape.

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Annexure-1

Summarized results of depth to water level, Andhra Pradesh- May2015.

S. No.	District	No. of wells analyzed	Depth to water level (m bgl)		Number & Percentage of wells showing depth to water table (m bgl) in the range of											
			Min	Max	0 - 2	%	2 - 5	%	5 - 10	%	10 - 20	%	20- 40	%	> 40	%
1	Anantapur	39	0.25	18	6	15.38	7	17.95	14	35.9	12	30.8	0	0	0	0
2	Chittoor	48	1.26	21.25	1	2.08	7	14.58	18	37.5	21	43.8	1	2.1	0	0
3	Cuddapah	34	4.05	47.45	0	0	4	11.76	15	44.12	13	38.2	1	2.9	1	2.9
4	East Godavari	93	0.02	9.6	27	29.03	46	49.46	20	21.51	0	0	0	0	0	0
5	Guntur	101	0.47	39.5	15	14.85	54	53.47	24	23.76	7	6.9	1	1	0	0
6	Krishna	71	0.02	19.8	8	11.27	38	53.52	21	29.58	4	5.6	0	0	0	0
7	Kurnool	43	0.65	16.97	5	11.63	15	34.88	18	41.86	5	11.6	0	0	0	0
8	Nellore	61	1.37	17	4	6.56	26	42.62	22	36.07	9	14.7	0	0	0	0
9	Prakasam	71	0.91	49.3	5	7.04	26	36.62	32	45.07	7	9.9	0	0	1	1.4
10	Srikakulam	42	0.73	10.4	3	7.14	13	30.95	23	54.76	3	7.1	0	0	0	0
11	Visakhapatnam	76	0.4	23.65	14	18.42	34	44.74	22	28.95	5	6.6	1	1.3	0	0
12	Vizianagaram	48	0.66	9.64	3	6.25	28	58.53	17	35.42	0	0	0	0	0	0
13	West Godavari	60	0.34	16.99	14	23.33	25	41.67	14	23.33	7	11.7	0	0	0	0
	Total	**787**	**0.02**	**49.3**	**105**	**13.3**	**323**	**41**	**260**	**33**	**93**	**11.8**	**4**	**0.5**	**2**	**0.25**

Annexure-2

Summarized results of depth to water level, Andhra Pradesh- August 2015.

S. No.	District	No. of wells analyzed	Depth to water level (m bgl)		Number & Percentage of wells showing depth to water table (m bgl) in the range of											
			Min	Max	0 - 2	%	2 - 5	%	5 - 10	%	10 - 20	%	20- 40	%	> 40	%
1	Anantapur	40	0.48	18	3	7.5	6	15	19	47.5	12	30	0	0	0	0
2	Chittoor	50	1.4	21.3	1	2	6	12	21	42	21	42	1	2	0	0
3	Cuddapah	34	3.2	47.6	0	0	3	8.8	15	44.1	15	44.1	0	0	1	2.9
4	East Godavari	95	0.14	6.85	58	61	29	30.5	8	8.4	0	0	0	0	0	0
5	Guntur	102	0.14	39.5	36	35.3	46	45.1	13	12.7	6	5.9	1	1	0	0
6	Krishna	72	-0.2	17.7	30	41.7	25	34.7	12	16.7	5	6.9	0	0	0	0
7	Kurnool	45	1.18	18.63	4	8.9	12	26.7	21	46.7	8	17.8	0	0	0	0
8	Nellore	57	1.12	17.0	3	5.3	28	49.1	15	26.3	11	19.3	0	0	0	0
9	Prakasam	65	-0.2	32.3	7	10.8	16	24.6	34	52.3	7	10.8	1	1.5	0	0
10	Srikakulam	42	0.19	8.36	19	45.2	18	42.9	5	11.9	0	0	0	0	0	0
11	Visakhapatnam	74	0.05	18.05	38	51.3	22	29.7	11	14.9	3	4.05	0	0	0	0
12	Vizianagaram	48	0.48	9.9	26	54.2	17	35.4	5	10.4	0	0	0	0	0	0
13	West Godavari	61	0.3	13.3	36	59	9	14.8	12	19.7	4	6.6	0	0	0	0
	Total	**785**	**-0.2**	**47.6**	**261**	**33**	**237**	**30**	**191**	**24**	**92**	**12**	**3**	**0.4**	**1**	**0.12**

Annexure-3

Summarized results of depth to water level, Andhra Pradesh- November 2015.

Sl. No.	District	No. of wells analyzed	Depth to water Table (m bgl)		No of Wells/% of wells showing depth to water level (m bgl) in the range of											
			Min	Max	0 - 2	%	2-5	%	5-10	%	10-20	%	20-40	%	>40	%
1	Anantapur	41	0.30	14.60	9	21.95	9	21.95	17	41.46	6	14.63	0	0	0	0
2	Chittoor	48	0.68	19.35	4	8.33	10	20.83	19	39.58	15	31.25	0	0	0	0
3	Cuddapah	26	0.45	14.90	5	19.23	6	23.08	10	38.46	5	19.23	0	0	0	0
4	East Godavari	93	-0.04	9.05	48	51.61	35	37.63	10	10.75	0	0	0	0	0	0
5	Guntur	105	0.43	39.50	28	26.67	49	46.67	20	19.05	7	6.67	1	0.95	0	0
6	Krishna	72	0.39	17.91	25	34.72	31	43.06	12	16.67	4	5.56	0	0	0	0
7	Kurnool	43	0.56	14.33	11	25.58	14	32.56	14	32.56	4	9.30	0	0	0	0
8	Nellore	48	-0.49	11.33	37	77.08	7	14.58	3	6.25	1	2.08	0	0	0	0
9	Prakasam	64	0.49	44.50	9	14.06	21	32.81	29	45.31	4	6.25	0	0	1	2
10	Srikakulam	41	0.32	6.40	17	41.46	21	51.22	3	7.32	0	0	0	0	0	0
11	Visakhapatnam	73	0.23	14.44	40	54.79	22	30.14	10	13.70	1	1.37	0	0	0	0
12	Vizianagaram	47	0.65	8.12	22	46.81	20	42.55	5	10.64	0	0	0	0	0	0
13	West Godavari	61	0.39	13.30	30	49.18	15	24.59	12	19.67	4	6.56	0	0	0	0
	Total	762	-0.49	44.50	**285**	37.4	260	34	164	22	51	7	1	0.13	1	0.13

Annexure-4

Summarized results of depth to water level, Andhra Pradesh-January 2016.

S. No.	District	No. of wells analyzed	Depth to water Table (m bgl)		No of Wells/% of wells showing depth to water level (m bgl) in the range of											
			Min	Max	0 - 2	%	2-5	%	5-10	%	10-20	%	20-40	%	>40	%
1	Anantapur	41	0.35	14.95	10	24.39	14	34.15	10	24.39	7	17.07	0	0	0	0
2	Chittoor	47	0.02	10.03	16	34.04	23	48.94	7	14.89	1	2.13	0	0	0	0
3	Cuddapah	33	0.83	14.57	5	15.15	15	45.45	8	24.24	5	15.15	0	0	0	0
4	East Godavari	95	0.53	9.10	39	41.05	43	45.26	13	13.68	0		0	0	0	0
5	Guntur	99	0.55	33.80	21	21.21	45	45.45	24	24.24	8	8.08	1	1.01	0	0
6	Krishna	71	0.60	18.40	18	25.35	28	39.44	19	26.76	6	8.45	0	0	0	0
7	Kurnool	45	0.83	15.73	6	13.33	17	37.78	14	31.11	8	17.78	0	0	0	0
8	Nellore	61	0.06	7.30	35	57.38	21	34.43	5	8.20	0	0	0	0	0	0
9	Prakasam	62	0.74	43.50	13	20.97	23	37.10	21	33.87	3	4.84	1	1.61	1	2
10	Srikakulam	41	1.00	9.20	5	12.20	20	48.78	16	39.02	0	0	0	0	0	0
11	Visakhapatnam	73	0.30	18.53	21	28.77	35	47.95	15	20.55	2	2.74	0	0	0	0
12	Vizianagaram	46	1.45	9.19	6	13.04	30	65.22	10	21.74	0	0	0	0	0	0
13	West Godavari	61	0.42	17.50	24	39.34	20	32.79	10	16.39	7	11.48	0	0	0	0
	Total	**775**	**0.02**	**43.05**	**219**	**28.3**	**334**	**43**	**172**	**22.2**	**47**	**6**	**2**	**0.25**	**1**	**0.12**

Annexure-5

Summarized Results of Water level fluctuation-Rise and fall in percentage of wells A.P-- May 2015 Vs May 2014

S. No.	District	No of wells Analyzed	Range of Fluctuations (m)				No. of wells/Percentage showing fluctuation												Total no of wells	
			Rise		Fall		Rise						Fall						Rise	Fall
			Min	Max	Min	Max	0- 2	%	2-4	%	>4	%	0-2	%	2-4	%	>4	%	No	No
1	Anantapur	35	0.07	4.58	0.21	6	12	34.29	1	2.86	2	5.71	10	28.57	6	17.1	4	11.43	15	20
2	Chittoor	48	0.01	6.7	0.2	6.98	8	16.67	2	4.17	1	2.08	15	31.25	3	6.25	4	8.33	11	22
3	Cuddapah	32	0.12	4.9	0.35	6.16	3	9.38	0	0	1	3.13	10	31.25	4	12.5	4	12.5	4	18
4	East Godavari	83	0.01	2.05	0.05	4.89	25	30.12	1	1.2	0	0	50	60.24	4	4.82	1	1.2	26	55
5	Guntur	94	0.02	4.47	0.01	18.38	29	30.85	3	3.19	1	1.06	48	51.06	9	9.57	4	4.26	33	61
6	Krishna	63	0.03	1.82	0.03	6.68	11	17.46	0	0	0	0	43	68.25	4	6.35	3	4.76	11	50
7	Kurnool	38	0.17	3.12	0.13	6.82	12	31.58	4	10.5	0	0	16	42.11	2	5.26	3	7.89	16	21
8	Nellore	59	0.03	1.97	0.01	4.43	16	27.12	0	0	0	0	27	45.76	9	15.3	1	1.69	16	37
9	Prakasam	61	0.02	2.56	0.04	25.52	7	11.48	1	1.64	0	0	37	60.66	8	13.1	3	4.92	8	48
10	Srikakulam	40	0.02	4.95	0.1	8.16	5	12.5	0	0	1	2.5	20	50	9	22.5	5	12.5	6	34
11	Visakhapatnam	73	0.02	2.52	0.01	9.39	37	50.68	4	5.48	0	0	23	31.51	8	11	1	1.37	41	32
12	Vizianagaram	44	0.07	4.12	0.08	3.5	17	38.64	0	0	1	2.27	23	52.27	3	6.82	0	0	18	26
13	West Godavari	54	0.05	1.73	0.01	6.7	15	27.78	0	0	0	0	31	57.41	7	13	1	1.85	15	39
	Total	**724**	**0.01**	**6.7**	**0.01**	**25.52**	**197**	**27.2**	**16**	**2.2**	**7**	**0.96**	**353**	**48.75**	**76**	**10.5**	**34**	**4.7**	**220**	**463**

Annexure-6

Summarized Results of Water level fluctuation-Rise and fall in percentage of wells A.P-August 2015 Vs August 2014

S. No.	District Name	No. of wells analyzed	Range of Fluctuation (m)				No. of wells/Percentage Showing Fluctuation												Total No. of Wells	
			Rise		Fall		Rise						Fall						Rise	Fall
			Min	Max	Min	Max	0 to 2	%	2 to 4	%	> 4	%	0 to 2	%	2 to 4	%	> 4	%		
1	Anantapur	38	0.04	5.7	0.08	3.7	11	28.9	4	10.5	2	5.3	12	31.6	7	18.4	0	0	17	19
2	Chittoor	48	0.02	7.1	0.06	7.9	5	10.4	4	8.3	2	4.2	18	37.5	2	4.2	2	4.2	11	22
3	Cuddapah	34	0.11	13.14	0.42	19.2	2	5.9	2	5.9	1	2.9	6	17.6	5	17.4	4	11.7	5	15
4	East Godavari	90	0.07	5.1	0.02	3.13	53	58.9	5	5.56	1	1.1	29	32.2	2	2.2	0	0	59	31
5	Guntur	89	0.05	3.3	0.01	7.8	41	46.1	7	7.8	0	0	29	32.6	9	10.1	2	2.2	48	40
6	Krishna	62	0.02	1.8	0.02	4.5	27	43.6	0	0	0	0	30	48.4	3	4.8	1	1.6	27	34
7	Kurnool	39	0.08	4.8	0.01	9.8	4	10.3	0	0	1	2.6	15	38.6	7	17.9	11	28.2	5	33
8	Nellore	53	0.13	2.6	0.02	3.63	19	35.8	3	5.7	0	0	14	26.4	9	16.9	0	0	22	23
9	Prakasam	60	0.05	6.5	0.05	11.4	16	26.7	1	1.7	2	3.3	24	40.0	7	11.7	3	5.0	19	34
10	Srikakulam	41	0.03	0.99	0.04	6.13	12	29.3	0	0	0	0	22	53.7	6	14.6	1	2.4	12	29
11	Visakhapatnam	70	0.01	5.68	0.01	5.94	39	55.7	5	7.1	1	1.4	20	28.6	4	5.7	1	1.4	45	25
12	Vizianagaram	43	0.03	4.17	0.05	4.16	11	25.6	4	9.3	1	2.5	22	51.1	4	9.3	1	2.3	16	27
13	West Godavari	51	0.05	1.52	0.03	9.69	26	50.1	0	0	0	0	19	37.3	2	3.9	2	3.9	26	23
	Total	**718**	**0.01**	**13.14**	**0.01**	**19.2**	**266**	**37**	**35**	**5**	**11**	**1.5**	**260**	**36**	**67**	**9**	**28**	**4**	**312**	**355**

Annexure-7

Summarized Results of Water level fluctuation-Rise and fall in percentage of wells A.P- November 2015 Vs November 2014

Sl.No.	District Name	No. of wells analyzed	Range of Fluctuation (m)				No. of wells/Percentage Showing Fluctuation												Total No. of Wells	
			Rise		Fall		Rise						Fall						Rise	Fall
			Min	Max	Min	Max	0 to 2	%	2 to 4	%	> 4	%	0 to 2	%	2 to 4	%	> 4	%		
1	Anantapur	39	0.13	6.80	0.08	2.90	14	35.90	7	17.95	9	23.08	6	15.38	1	2.56	0	0	30	7
2	Chittoor	46	0.01	6.96	0.12	6.93	6	13.04	8	17.39	5	10.87	11	23.91	5	10.87	6	13.04	19	22
3	Cuddapah	26	0.09	10.13	0.62	4.71	5	19.23	3	11.54	9	34.62	3	11.54	3	11.54	1	3.85	17	7
4	East Godavari	93	0.02	3.02	0.01	5.00	55	59.14	3	3.23	0	0	28	31.11	4	4.30	2	2.15	58	34
5	Guntur	98	0.01	1.70	0.02	32.60	17	17.35	0	0	0	0	51	52.04	18	18.37	12	12.24	17	81
6	Krishna	67	0.03	1.56	0.02	9.97	15	22.39	0	0	0	0	42	62.69	6	8.96	4	5.97	15	52
7	Kurnool	42	0.10	3.63	0.01	6.89	5	11.90	3	7.14	0	0	24	57.14	5	11.90	5	11.90	8	34
8	Nellore	46	0.50	13.91	0.10	2.21	8	17.39	15	32.61	18	39.13	4	8.70	1	2.17	0	0	41	5
9	Prakasam	60	0.25	5.11	0.12	16.65	9	15.00	3	5.00	1	1.67	25	41.67	13	21.67	3	5	13	41
10	Srikakulam	40	0.03	1.10	0.09	5.93	13	32.50	0	0	0	0	23	57.50	3	7.50	1	2.50	13	27
11	Visakhapatnam	70	0.01	2.19	0.02	3.24	31	44.29	1	1.43	0	0	32	45.71	6	8.57	0	0	32	38
12	Vizianagaram	43	0.02	1.40	0.04	4.05	10	23.26	0	0	0	0	28	65.12	2	4.65	1	2.33	10	31
13	West Godavari	60	0.08	14.49	0.02	7.28	22	36.67	1	1.67	1	1.67	30	50.00	3	5.00	2	3.33	24	35
	Total	**730**	**0.01**	**14.49**	**0.01**	**32.60**	**210**	**29**	**44**	**6**	**43**	**6**	**307**	**42**	**70**	**10**	**37**	**5**	**297**	**414**

Annexure-8

Summarized Results of Water level fluctuation-Rise and fall in percentage of wells A.P- January 2016 Vs January 2015

Sl.No.	District Name	No. of wells analyzed	Range of Fluctuation (m)				No. of wells/Percentage Showing Fluctuation												Total No. of Wells	
			Rise		Fall		Rise						Fall						Rise	Fall
			Min	Max	Min	Max	0 to 2	%	2 to 4	%	> 4	%	0 to 2	%	2 to 4	%	> 4	%		
1	Anantapur	37	0.01	7.30	0.10	3.11	10	27.03	11	29.73	9	24.32	4	10.81	1	2.70	0	0	30	5
2	Chittoor	45	0.24	16.55	0.18	0.28	10	22.22	8	17.78	24	53.33	2	4.44	0	0	0	0	42	2
3	Cuddapah	32	0.36	11.50	0.36	5.65	6	18.75	4	12.50	14	43.75	3	9.38	1	3.13	1	3.13	24	5
4	East Godavari	92	0.02	5.25	0.05	3.20	36	39.13	5	5.46	1	1.09	43	46.74	3	3.26	0	0	42	46
5	Guntur	96	0.01	1.96	0.02	28.57	15	15.63	0	0	0	0	50	52.08	15	15.63	14	14.58	15	79
6	Krishna	69	0.06	1.41	0.05	17.69	15	21.74	0	0	0	0	40	57.97	8	11.59	6	8.70	15	54
7	Kurnool	39	0.12	4.66	0.07	8.60	5	12.82	0	0	2	5.13	20	51.28	5	12.82	6	15.38	7	31
8	Nellore	61	0.06	11.50	0.21	1.61	29	47.54	15	24.59	11	18.03	6	9.84	0	0	0	0	55	6
9	Prakasam	58	0.03	9.76	0.01	25.33	18	31.03	2	3.45	2	3.45	19	32.76	8	13.79	7	12.07	22	34
10	Srikakulam	40	0.59	1.19	0.10	8.28	3	7.50	0	0	0	0	30	75.00	2	5.00	4	10.00	3	36
11	Visakhapatnam	71	0.01	2.99	0.02	3.07	28	39.44	1	1.41	0	0	38	53.52	3	4.23	0	0	29	41
12	Vizianagaram	42	0.05	1.90	0.05	5.45	4	9.52	0	0	0	0	31	73.81	5	11.90	2	4.76	4	38
13	West Godavari	58	0.05	13.32	0.05	6.10	18	31.03	1	1.72	2	3.45	31	53.45	2	3.45	3	5.17	21	36
	Total	**740**	**0.01**	**16.55**	**0.01**	**28.57**	**197**	**27**	**47**	**6**	**65**	**9**	**317**	**43**	**53**	**7**	**43**	**6**	**309**	**413**

Annexure-9

Summarized Results of water level fluctuation in A.P.-May-2015 Vs Decadal Mean of May

District	No of Wells analyzed	Range of Fluctuation (m)				No. of wells/Percentage Showing Fluctuation												Total No. of Wells	
		Rise		Fall		Rise						Fall						Rise	Fall
		Min	Max	Min	Max	0 to 2	%	2 to 4	%	> 4	%	0 to 2	%	2 to 4	%	> 4	%		
Anantapur	35	0.12	3.87	0.15	6	11	31.43	3	8.57	0	0	10	28.57	8	22.9	3	8.57	14	21
Chittoor	48	0.05	3.61	0.01	6.55	7	14.58	2	4.17	0	0	20	41.67	9	18.8	6	12.5	9	35
Cuddapah	34	0.12	3.76	0.35	29.55	3	8.82	1	2.94	0	0	13	38.24	7	20.6	6	17.65	4	26
East Godavari	84	0.01	4.14	0.02	4.57	32	38.1	5	5.95	1	1.19	40	47.62	3	3.57	1	1.19	38	44
Guntur	94	0.02	2.71	0.02	18.38	34	36.17	4	4.26	0	0	44	46.81	9	9.57	3	3.19	38	56
Krishna	64	0.03	4.92	0.08	6.92	13	20.31	0	0	1	1.56	43	67.19	4	6.25	3	4.69	14	50
Kurnool	39	0.1	2.67	0.01	6.57	15	38.46	4	10.3	0	0	14	37.9	4	10.3	2	5.13	19	20
Nellore	59	0.03	1.97	0.08	6.17	18	30.51	0	0	0	0	28	47.46	7	11.9	6	10.17	18	41
Prakasam	64	0.02	4.29	0.06	20.55	10	15.63	0	1.56	1	1.56	37	57.81	12	18.8	3	4.69	11	52
Srikakulam	41	0.03	1.78	0.04	8.16	11	26.83	0	0	0	0	25	60.98	3	7.32	2	4.88	11	30
Visakhapatnam	73	0.02	3.86	0.05	4.52	39	53.42	6	8.2	0	0	21	28.77	6	8.22	1	1.37	45	28
Vizianagaram	44	0.04	4.45	0.02	2.78	24	54.55	0	0	1	2.27	17	38.64	2	4.55	0	0	25	19
West Godavari	55	0.04	1.75	0.01	6.88	19	34.55	0	0	0	0	31	56.36	3	5.45	2	3.64	19	36
Total	**734**	**0.01**	**4.92**	**0.01**	**29.55**	**236**	**32.15**	**25**	**3.4**	**4**	**0.5**	**343**	**46.73**	**77**	**10.49**	**38**	**5.17**	**265**	**458**

Annexure-10

Summarized Results of water level fluctuation in A.P.-August 2015 Vs Decadal mean of August

District	No of Wells analyzed	Range of Fluctuation (m)				No. of wells/Percentage Showing Fluctuation												Total No. of Wells	
		Rise		Fall		Rise						Fall						Rise	Fall
		Min	Max	Min	Max	0 to 2	%	2 to 4	%	> 4	%	0 to 2	%	2 to 4	%	> 4	%		
Anantapur	39	0.1	5.66	0.08	5.13	5	12.8	3	7.5	2	5.1	12	30.8	12	30.8	3	7.7	10	27
Chittoor	48	0.2	3.9	0.06	7.9	6	12.5	2	4.2	0	0	19	39.6	11	22.9	4	8.3	8	34
Cuddapah	34	0.11	3.3	0.6	31.28	1	2.9	2	5.88	0	0	6	17.6	12	35.3	8	23.5	3	26
East Godavari	90	0.03	3.05	0.01	3.36	45	50	6	6.7	0	0	36	40	3	3.33	0	0	51	39
Guntur	89	0.04	3.3	0.01	7.76	34	38.2	4	4.5	0	0	37	41.6	9	10.1	4	4.5	38	50
Krishna	64	0.02	3.47	0.02	6.7	24	37.5	1	1.5	0	0	31	48.4	5	7.8	2	3.1	25	38
Kurnool	41	0.44	1.8	0.03	10.11	7	17.1	0	0	0	0	16	29	6	14.6	11	26.8	7	33
Nellore	53	0.05	2.37	0.02	5.4	19	35.8	1	1.9	0	0	17	32.1	8	18.1	4	7.55	20	29
Prakasam	60	0.15	4.3	0.04	4.9	13	21.7	0	0	1	1.7	31	51.7	8	13.3	4	6.7	14	43
Srikakulam	41	0.03	1.96	0.04	5.8	15	36.6	0	0	0	0	21	51.2	4	9.7	1	2.4	15	26
Visakhapatnam	70	0.02	5.68	0.01	3.72	43	61.4	4	5.7	2	2.8	19	27.1	2	2.86	0	0	49	21
Vizianagaram	44	0.03	3.31	0.02	3.14	19	43.2	3	6.8	0	0	18	40.1	4	9.1	0	0	22	22
West Godavari	52	0.05	2.2	0.03	9.7	25	48.1	1	1.9	0	0	19	36.5	3	5.7	2	3.8	26	24
Total	**725**	**0.02**	**5.68**	**0.01**	**31.28**	**256**	**35.3**	**27**	**3.7**	**5**	**0.68**	**282**	**38.9**	**87**	**12**	**43**	**6**	**288**	**412**

Annexure-11

Summarized Results of water level fluctuation in A.P.-November 2015 Vs Decadal mean of November

District Name	No of Wells analyzed	Range of Fluctuation (m)				No. of wells/Percentage Showing Fluctuation												Total No. of Wells	
		Rise		Fall		Rise						Fall						Rise	Fall
		Min	Max	Min	Max	0 to 2	%	2 to 4	%	> 4	%	0 to 2	%	2 to 4	%	> 4	%		
Anantapur	40	0.05	4.43	0.05	4.93	14	35	7	17.5	1	2.5	7	17.5	7	17.5	4	10	22	18
Chittoor	46	0.25	3.51	0.20	7.78	12	26.09	5	10.97	0	0	11	23.91	8	17.39	9	19.57	17	28
Cuddapah	26	0.60	7.90	0.53	5.84	2	7.69	6	23.1	3	11.5	4	15.38	6	23.08	4	15.38	11	14
East Godavari	93	0.01	2.82	0.03	5.47	40	43.01	2	2.15	0	0	44	47.31	4	4.30	3	3.23	42	51
Guntur	103	0.04	3.11	0.03	35.83	11	10.68	1	0.97	0	0	56	54.37	20	19.42	15	14.56	12	91
Krishna	71	0.01	1.65	0.02	10.17	8	11.27	0	0	0	0	47	66.20	12	16.90	4	5.63	8	63
Kurnool	43	0.03	2.82	0.07	8.41	9	20.93	2	4.65	0	0	21	48.84	6	13.95	5	11.63	11	32
Nellore	48	0.06	13.91	0.24	2.20	14	29.17	17	35.4	11	22.9	4	8.33	2	4.17	0	0	42	6
Prakasam	64	0.04	2.83	0.01	27	4	6.25	2	3.13	0	0	28	43.75	19	29.69	10	15.63	6	57
Srikakulam	40	0.03	0.54	0.13	5.93	9	22.50	0	0	0	0	24	60.00	6	15	1	2.5	9	31
Visakhapatnam	72	0.01	2.58	0.03	2.83	34	47.22	2	2.78	0	0	31	43.06	5	6.94	0	0	36	36
Vizianagaram	43	0.01	0.79	0.04	5.73	12	27.91	0	0	0	0	28	65.12	2	4.65	1	2.33	12	31
West Godavari	60	0.01	6.60	0.03	7.92	22	36.67	0	0	1	1.6	29	48.33	5	8.33	3	5	23	37
Total	**749**	**0.01**	**13.91**	**0.01**	**35.83**	**191**	**25.5**	**44**	**5.87**	**16**	**2.13**	**334**	**44.59**	**102**	**22.71**	**59**	**7.8**	**251**	**495**

Annexure-12

Summarized Results of water level fluctuation in A.P. -January 2016 Vs Decadal Mean of January

District Name	No of Wells analyzed	Range of Fluctuation (m)				No. of wells/Percentage Showing Fluctuation												Total No. of Wells	
		Rise		Fall		Rise						Fall						Rise	Fall
		Min	Max	Min	Max	0 to 2	%	2 to 4	%	> 4	%	0 to 2	%	2 to 4	%	> 4	%		
Anantapur	40	0.13	8.00	0.70	4.78	19	47.50	4	10.00	4	10.00	6	15.00	5	12.50	2	5.00	27	13
Chittoor	45	0.08	11.11	0.01	1.91	15	33.33	12	26.67	14	31.11	4	8.89	0	0	0	0	41	4
Cuddapah	33	0.08	6.59	0.01	5.14	8	24.24	7	21.21	3	9.09	8	24.24	2	6.06	4	12.12	18	14
East Godavari	95	0.04	3.95	0.03	5.00	32	33.68	4	4.21	0	0	52	54.74	4	4.21	2	2.11	36	58
Guntur	99	0.01	1.14	0.12	27.23	7	7.07	0	0	0	0	53	53.54	21	21.21	16	16.16	7	90
Krishna	70	0.02	0.56	0.01	13.31	12	17.14	0	0	0	0	37	52.86	15	21.43	6	8.57	12	58
Kurnool	44	0.04	4.55	0.07	8.41	8	18.18	0	0	1	2.27	20	45.45	7	15.91	8	18.18	9	35
Nellore	61	0.04	9.39	0.19	3.25	35	57.38	14	22.95	3	4.92	7	11.48	2	3.28	0	0	52	9
Prakasam	61	0.12	5.98	0.03	24.98	13	21.31	3	4.92	1	1.64	23	37.70	11	18.03	10	16.39	17	44
Srikakulam	40	0.02	0.83	0.05	4.86	6	15.00	0	0	0	0	25	62.50	7	17.50	2	5.00	6	34
Visakhapatnam	73	0.01	4.52	0.01	7.65	40	54.79	2	2.74	1	1.37	25	34.25	3	4.11	2	2.74	43	30
Vizianagaram	42	0.04	2.14	0.15	4.90	7	16.67	1	2.38	0		31	73.81	2	4.76	1	2.38	8	34
West Godavari	61	0.03	4.93	0.08	12.71	23	37.70	0	0	1	1.64	29	47.54	3	4.92	5	8.20	24	37
Total	**764**	**0.01**	**11.11**	**0.01**	**27.23**	**225**	**29.45**	**47**	**6.15**	**28**	**3.6**	**320**	**41.9**	**82**	**10.7**	**58**	**7.5**	**300**	**460**

Annexure-13

District -wise summarized chemical composition of ground water from GWMS during Pre-monsoon season-2015 (May)-A.P.

Parameters	Average/ Max/ Min	pH	EC	TH	Ca2+	Mg2+	Na+	K+	CO3	HCO3	Cl−	SO4	NO3	F−	TDS
Permissible limit		**6.5-8.85**		**600**	**200**	**100**				**600**	**1000**	**400**	**45**	**1.5**	**2000**
Anantapur	Average	7.4	2148	505	122	49	196	110	0	579	272	108	128	1.1	1339
	Max	7.8	4160	820	268	119	497	600	0	854	659	511	449	5.1	2784
	Min	6.9	180	63	16	5	10	1	0	79	14	0	2	0.1	115
Chittoor	Average	7.2	1369	387	97	35	125	19	0	403	199	50	27	0.6	798
	Max	7.5	2210	580	138	63	234	140	0	817	358	196	79	1.0	1257
	Min	6.8	530	130	29	12	44	2	0	116	64	1	3	0.2	316
YSR Cuddapah	Average	7.5	2219	430	89	51	301	18	0	557	349	125	36	0.9	1310
	Max	7.9	5740	780	204	107	1132	105	0	1281	1120	566	246	3.0	3572
	Min	7.1	740	220	28	26	11	1	0	311	34	2	3	0.4	406
East Godavari	Average	7.9	1477	363	77	42	156	27	4	421	200	68	42	0.2	872
	Max	8.3	4640	680	144	126	755	150	120	1074	936	341	171	1.0	2700
	Min	7.5	310	105	14	2	8	1	0	110	18	2	0	0.10	190
Guntur	Average	8.0	2251	493	96	61	249	85	3	479	289	225	111	0.7	1412
	Max	8.9	7431	1940	240	336	920	500	36	1080	1631	810	1105	3.1	4640
	Min	7.1	589	180	28	4	0	2	0	31	43	8	1	0.0	339

Krishna	Average	8.0	2738	486	101	58	375	72	3	565	454	230	40	0.5	1676
	Max	8.4	10039	1180	432	269	2047	460	84	1488	2304	1415	175	2.4	6859
	Min	7.4	617	125	28	6	15	2	0	85	46	11	1	0.0	362
Kurnool	Average	7.3	2474	692	182	58	233	29	0	450	400	152	180	0.8	1502
	Max	8.2	8535	1920	520	243	1300	200	0	1086	1177	874	1331	2.7	5620
	Min	6.4	277	100	18	0	10	0	0	49	25	4	1	0.1	167
Nellore	Average	7.7	2406	694	117	98	216	31	1	447	497	98	37	0.7	1367
	Max	8.3	15570	6800	1020	1034	640	200	30	878	5211	302	282	4.5	8103
	Min	6.9	416	105	16	10	16	1	0	43	43	1	1	0.0	235
Prakasam	Average	7.3	2604	610	102	87	294	41	0	493	491	126	89	1.1	1531
	Max	8.2	9177	2460	280	477	1300	280	0	1202	3205	600	552	4.8	5045
	Min	5.1	641	120	12	15	30	1	0	24	50	5	1	0.1	368
Srikakulam	Average	7.7	1319	336	74	37	144	18	0	284	240	58	46	0.4	789
	Max	8.2	4152	1000	272	178	500	120	0	561	1064	300	340	1.3	2515
	Min	6.8	220	70	16	7	10	1	0	31	39	2	1	0.1	130
Visakhapatnam	Average	7.9	1267	336	70	39	129	15	5	308	178	66	52	0.4	740
	Max	8.5	7111	1680	488	163	840	180	48	708	2014	323	344	3.4	4057
	Min	6.5	62	25	6	1	5	0	0	12	7	0	0	0.0	65

Vizianagaram	Average	7.9	1228	360	81	39	101	26	0	311	175	56	51	0.5	718
	Max	8.3	5340	950	264	100	1070	200	6	1037	1290	245	255	1.5	3174
	Min	7.4	411	130	34	6	15	0	0	128	11	1	0	0.2	246
West Godavari	Average	8.1	1923	379	91	37	232	60	9	412	323	123	29	0.4	1154
	Max	9.3	5950	900	264	109	995	700	120	659	1595	676	115	3.6	3444
	Min	7.5	410	145	24	5	19	1	0	171	18	1	1	0.1	234
State	**Average**	**7.8**	**1952**	**466**	**97**	**54**	**211**	**44**	**2**	**428**	**310**	**122**	**70**	**0.6**	**1171**
	Max	**9.3**	**15570**	**6800**	**1020**	**1034**	**2047**	**700**	**120**	**1488**	**5211**	**1415**	**1331**	**5.1**	**8103**
	Min	**5.1**	**62**	**25**	**6**	**0**	**0**	**0**	**0**	**12**	**7**	**0**	**0**	**0.0**	**65**

Annexure-14

District wise & Station wise Ground water quality in A.P. (May-2015)

Sl. No.	Well Code	Dist	Location	pH (6.5-8.5)	E C in m S/cm	TH (600)	Ca (200)	Mg (100)	Na	K	CO3 (600)	HCO3 (600)	Cl (1000)	SO4 (400)	NO3 (45)	F (1.5)	TDS
1	R/AT/001B	Anantapur	Guntakal2	7.55	2730	640	120	83	180	260	0	610	319	222	226	0.4	1783
2	R/AT/002A	Anantapur	Gooty-alt	7.41	1850	470	104	51	132	130	0	708	234	1	17	0.1	1101
3	R/AT/007B	Anantapur	Rayadurg-new	7.1	1300	320	88	24	145	10	0	262	174	52	169	0.3	822
4	R/AT/010B	Anantapur	Kalyandurg-alt	7.68	1610	200	32	29	272	8	0	720	131	23	7	4.5	947
5	R/AT/012	Anantapur	Dharmavaram	7.27	2320	660	192	44	225	6	0	525	333	99	194	0.9	1414
6	R/AT/018	Anantapur	Alampur	7.68	1470	310	72	32	193	3	0	628	145	13	2	5.1	848
7	R/AT/020	Anantapur	Penukonda	7.3	2930	610	136	66	386	9	0	854	411	69	140	1.2	1740
8	R/AT/022A	Anantapur	Madakasira1	7.25	1820	370	100	29	222	44	0	500	259	51	101	0.6	1112
9	R/AT/023	Anantapur	Palasamudram	7.53	1320	230	56	22	139	100	0	476	156	31	22	0.4	816
10	R/AT/041	Anantapur	Vajrakarur	7.44	2130	820	200	78	111	2	0	342	135	511	75	0.9	1321
11	R/AT/043	Anantapur	Budipalli	7.18	1510	365	82	39	109	120	0	586	181	5	19	1.9	912
12	R/AT/046A	Anantapur	Narpala (sultanpet).1	7.55	1540	525	98	68	101	20	0	610	188	0	6	2.2	855
13	R/AT/052	Anantapur	Malakavemula-rs	7.53	2080	760	108	119	128	1	0	439	269	94	251	1.7	1239
14	R/AT/055	Anantapur	Korrapadu	7.63	1560	390	86	43	122	97	0	702	128	5	25	0.9	933
15	R/AT/061	Anantapur	Adivi Brahmanapalli	7.46	2620	800	132	114	231	4	0	683	312	68	296	2.0	1577
16	R/AT/064	Anantapur	Kothapalem	7.33	1140	340	88	29	71	59	0	336	124	37	101	0.8	714
17	R/AT/065A	Anantapur	Nilakanthapuram	7.3	2920	590	200	22	393	10	0	622	503	155	98	0.6	1760

18	R/AT/066	Anantapur	Waddipalli	7.67	2820	730	132	97	292	34	0	683	390	111	228	1.3	1702
19	R/AT/071	Anantapur	Ingaluru	7.49	2470	460	92	56	191	280	0	805	291	123	46	0.4	1570
20	R/AT/074	Anantapur	Amidala	7.31	3060	740	268	17	233	220	0	634	369	197	353	0.2	2044
21	R/AT/142	Anantapur	Peddapalli	7.03	1830	625	160	55	127	10	0	329	365	118	9	0.9	1045
22	R/AT/143	Anantapur	Palaram	7.33	1080	255	64	23	128	5	0	488	82	3	27	1.6	631
23	R/AT/144	Anantapur	Kanchisamudrqam	7.49	3780	550	112	66	263	600	0	830	411	256	449	0.1	2663
24	R/AT/145	Anantapur	Tangdikunta	7.73	2580	820	252	46	165	86	0	561	383	167	142	0.4	1584
25	R/AT/147	Anantapur	Uravakonda	7.65	4160	420	160	5	497	450	0	756	659	351	200	0.3	2784
26	R/AT/149	Anantapur	Kundurpi	7.83	3180	560	132	56	238	400	0	854	390	143	236	1.1	2116
27	R/AT/150	Anantapur	Muthyalacherevu/ Poolabhavi	6.87	180	63	16	6	10	5	0	79	14	9	7	0.2	115
		Anantapur Average		7.43	2148	505	122	49		110	0	579	272	108	128	1.1	1339
		Anantapur Max		7.83	4160	820	268	119		600	0	854	659	511	449	5.1	2784
		Anantapur Min		6.87	180	63	16	5		1	0	79	14	0	2	0.1	115
28	R/CT/005B	Chittoor	Tirumala1	7.15	1110	320	108	12	94	24	0	451	121	3	16	0.3	652
29	R/CT/022	Chittoor	Satyavedu	7.2	790	245	74	15	66	4	0	217	113	52	3	0.3	460
30	R/CT/023A	Chittoor	Palamaneru-1	7.39	2070	540	112	63	223	7	0	415	326	180	56	0.8	1221
31	R/CT/030	Chittoor	Venkatagirikota	7.37	1530	460	106	47	137	5	0	116	284	196	79	0.7	925
32	R/CT/039	Chittoor	Suritipalli	7.32	1170	390	122	21	88	2	0	378	181	12	10	0.7	667
33	R/CT/050A	Chittoor	Erpedu1	7.47	760	260	58	28	44	18	0	275	94	12	12	0.2	434
34	R/CT/051	Chittoor	Chinna panduru	7.05	1370	385	114	24	124	23	0	177	280	92	59	0.7	826
35	R/CT/053	Chittoor	Battuvaripalli	7.2	1530	460	138	28	129	17	0	580	188	1	29	0.6	884
36	R/CT/059	Chittoor	Shankrantipalli	7.32	1130	445	98	49	49	9	0	482	103	9	20	0.8	631
37	R/CT/069	Chittoor	Chittoor	7.3	1800	405	120	26	223	5	0	470	358	7	3	0.7	1029

38	R/CT/070	Chittoor	Puttur	7.34	2210	580	128	63	234	10	0	817	277	33	13	0.8	1257
39	R/CT/073	Chittoor	Guthuvaripalli(R.P .Agraharam)	7.14	1200	335	96	23	118	5	0	470	149	1	4	0.2	683
40	R/CT/074	Chittoor	Nilavaai	7.23	1800	350	86	33	169	140	0	342	312	126	58	0.6	1134
41	R/CT/075	Chittoor	Ammasi Reddy Kandriga	6.8	530	130	29	14	59	5	0	134	64	59	4	0.4	316
42	R/CT/079	Chittoor	Yadamari	7.36	1710	460	88	58	178	5	0	537	230	33	68	1.0	990
43	R/CT/080	Chittoor	Naagalapuram (Krishnapuram)	7.15	1280	440	78	60	77	25	0	512	145	2	16	0.4	716
44	R/CT/082	Chittoor	Siddi Raju Kandriga	7.29	1290	370	90	35	117	14	0	482	152	27	8	0.4	738
		Chittoor Average		7.24	1369	387	97	35		19	0	403	199	50	27	0.6	798
		Chittoor Max		7.47	2210	580	138	63		140	0	817	358	196	79	1.0	1257
		Chittoor Min		6.80	530	130	29	12		2	0	116	64	1	3	0.2	316
45	C/EG/001	East Godavari	Addateegala	7.66	450	195	48	18	8	10	0	232	18	6	5	0.2	254
46	C/EG/003	East Godavari	Gokavaram	7.87	910	300	52	41	71	1	0	421	74	3	2	0.6	502
47	C/EG/010A	East Godavari	Kattipudi	8.05	1730	410	74	55	172	63	0	329	284	79	139	0.4	1067
48	C/EG/014	East Godavari	Gollaprolu	7.97	1480	355	120	13	129	81	0	390	191	101	55	0.1	930
49	C/EG/019	East Godavari	Uppada	8.07	1680	495	110	54	128	51	0	561	184	49	86	0.1	1004
50	C/EG/031	East Godavari	Delta gannavarm	8.3	580	210	32	32	35	3	12	256	32	14	1	0.1	312
51	C/EG/033	East Godavari	Yanam	8.09	1100	430	136	22	43	20	0	494	85	9	20	0.0	636
52	C/EG/043B	East Godavari	Rampachodavaram	7.8	810	305	60	38	45	1	0	232	82	37	76	0.1	480
53	C/EG/048	East Godavari	Anaparthy	7.82	800	230	68	15	60	30	0	214	92	55	46	0.1	497
54	C/EG/059	East Godavari	Mummidivarampa d	7.54	3570	640	128	78	522	6	0	634	723	234	2	0.1	2079
55	C/EG/063	East Godavari	Maredumilli	7.69	480	160	36	17	31	9	0	110	60	28	44	0.1	293

56	C/EG/081	East Godavari	Anjaneyanagar	SNC	1620	270	100	5	224	40	0	561	220	20	24	0.1	976
57	C/EG/083	East Godavari	Fishing Horbour	SNC	3770	680	88	112	465	150	0	683	652	341	61	0.3	2286
58	C/EG/088	East Godavari	Korangi	7.54	860	320	46	50	45	10	0	427	50	9	1	0.3	471
59	C/EG/091	East Godavari	Gontuvanipalem	7.99	2340	460	104	49	317	15	0	488	312	184	171	0.8	1450
60	C/EG/093	East Godavari	Tallarevu	8.15	2540	590	144	56	242	120	0	732	326	149	67	0.1	1551
61	C/EG/096	East Godavari	Malikipuram	7.66	830	253	68	20	71	6	0	323	85	27	2	0.2	477
62	C/EG/102	East Godavari	Chinalanka	7.78	650	250	58	26	34	1	0	317	39	10	0	0.2	361
63	C/EG/103	East Godavari	Kesavaram	7.91	890	345	82	34	45	1	0	378	89	8	3	0.4	492
64	C/EG/105	East Godavari	Tallapolom	7.45	1560	290	64	32	222	5	0	659	156	16	4	0.2	901
65	C/EG/106	East Godavari	Annaipeta	7.5	3690	530	88	75	545	100	0	1074	532	203	4	0.1	2201
66	C/EG/107	East Godavari	Sunkarapalem	7.73	1400	445	88	55	115	4	0	342	259	51	2	0.2	782
67	C/EG/112	East Godavari	Samalkot	8.2	1050	380	100	32	61	9	0	207	135	70	114	0.2	647
68	C/EG/114	East Godavari	Pattipuram	7.68	1580	410	120	27	122	90	0	439	184	74	116	0.1	1000
69	C/EG/117	East Godavari	Bhavujipet	7.66	1490	440	76	61	138	3	0	500	234	4	2	0.8	823
70	C/EG/118	East Godavari	Folkspeta	8	2380	660	56	126	242	2	120	512	255	121	104	1.0	1292
71	C/EG/126	East Godavari	Mukteshwaram	7.69	1480	490	76	73	112	4	0	342	220	80	82	0.1	856
72	C/EG/130	East Godavari	Thurpet	8.3	870	260	82	13	76	8	0	458	39	2	3	0.1	502
73	C/EG/131	East Godavari	Komaragiri	8.1	900	200	76	2	106	15	0	390	89	4	2	0.2	532
74	C/EG/133	East Godavari	Mobalacherevu	8.01	4640	640	72	112	755	28	0	927	936	223	9	0.3	2700
75	C/EG/134	East Godavari	Vilasa	8.1	580	205	70	7	38	1	0	299	28	4	1	0.2	333

76	C/EG/139	East Godavari	Lagarai	8.21	740	220	40	29	55	23	0	140	71	65	108	0.1	477
77	C/EG/140	East Godavari	Mallavaram - Mammilla	8.03	310	105	14	17	17	11	0	110	18	10	37	0.1	190
78	C/EG/143	East Godavari	P.Yera Gonda	7.9	470	185	42	19	20	5	0	122	53	31	34	0.1	279
		East Godavari Average		7.89	1477	363	77	42		27	4	421	200	68	42	0.2	872
		East Godavari Max		8.30	4640	680	144	126		150	120	1074	936	341	171	1.0	2700
		East Godavari Min		7.45	310	105	14	2		1	0	110	18	2	0	0.0	190
79	C/GU/001	Guntur	Dachepalle (Alt)	7.1	1418	295	112	4	190	10	0	305	188	188	6	0.3	883
80	C/GU/003	Guntur	Rentachintala	8.1	1447	225	54	22	170	130	0	659	121	17	27	0.5	943
81	C/GU/010	Guntur	Zupudi	7.62	1514	450	138	26	130	8	0	403	170	13	188	0.3	918
82	C/GU/012	Guntur	Krosur	7.68	3135	520	100	66	492	36	0	573	518	267	189	0.8	2018
83	C/GU/013	Guntur	Pisapadu	8.05	4291	490	80	71	720	120	0	964	574	389	227	2.3	2770
84	C/GU/014	Guntur	Rentapalle	7.75	1555	370	104	27	170	5	0	287	152	130	195	1.0	959
85	C/GU/015A	Guntur	Sirigiripadu- alt	7.53	3784	680	236	22	340	300	0	317	610	424	292	0.2	2417
86	C/GU/016B	Guntur	Nekarikallu2	7.87	1823	490	156	24	210	2	0	555	199	146	61	1.6	1138
87	C/GU/020	Guntur	Ipur	8.07	1123	350	82	35	110	4	0	397	89	121	9	0.8	693
88	C/GU/022	Guntur	Pirangipuram	7.75	2485	750	140	97	160	130	0	458	461	134	94	1.2	1496
89	C/GU/023	Guntur	Guntur	7.59	3204	880	144	126	360	10	0	470	674	262	33	0.9	1896
90	C/GU/024	Guntur	Vadlamudi	7.91	985	330	86	28	80	5	0	342	124	8	7	0.6	547
91	C/GU/029	Guntur	Repalle	7.84	1896	415	104	38	170	110	0	488	266	136	9	0.4	1130
92	C/GU/033	Guntur	Nijampatnam	8.3	2806	430	88	51	343	180	0	732	376	164	103	0.1	1751
93	C/GU/035	Guntur	Medikondur	7.93	3777	1150	216	148	360	59	0	378	702	480	254	0.2	2451

94	C/GU/038	Guntur	Chebrolu	8.28	1246	230	56	22	130	90	0	366	135	105	25	0.4	786
95	C/GU/039A	Guntur	Velpur (g.palem)	8.18	718	185	62	7	55	40	0	244	74	43	2	0.8	433
96	C/GU/041	Guntur	Sekuru	8.27	2363	420	54	69	200	280	0	451	248	393	94	0.2	1614
97	C/GU/042	Guntur	Prattipadu	7.62	7431	1940	224	336	900	47	0	817	1631	581	423	0.4	4640
98	C/GU/045	Guntur	Murjampadu	7.85	2141	530	124	54	235	40	0	458	277	204	118	1.6	1332
99	C/GU/049	Guntur	Varagami	8.49	2052	275	56	33	248	219	30	634	206	177	12	0.2	1356
100	C/GU/051	Guntur	Mandadi	8.23	3345	510	140	39	350	350	0	732	532	225	143	0.2	2224
101	C/GU/059	Guntur	Rompicherla	7.82	3156	480	100	56	490	80	0	702	489	277	86	2.3	2008
102	C/GU/060	Guntur	Ungutur	8.31	1500	265	64	26	175	100	0	561	131	108	18	0.2	964
103	C/GU/071	Guntur	Bhattiprolu	7.8	1804	450	148	19	200	12	0	384	255	206	7	0.3	1082
104	C/GU/072	Guntur	Amaravathi	8.34	3573	350	72	41	560	260	21	836	447	309	272	1.9	2485
105	C/GU/081	Guntur	Timmapuram	8.1	1844	225	46	27	320	10	0	634	149	154	33	3.0	1129
106	C/GU/082	Guntur	Chavali	8.12	1320	360	84	36	155	7	0	384	138	170	4	0.4	829
107	C/GU/083	Guntur	Pallapatla	8.11	866	240	62	21	80	15	0	189	110	107	3	0.5	513
108	C/GU/084	Guntur	Mannevaripalem	7.84	1148	315	58	41	125	14	0	476	124	31	6	0.4	689
109	C/GU/086	Guntur	Brahmanpalli	8.16	1475	425	110	36	90	96	0	403	131	121	116	0.3	947
110	C/GU/087	Guntur	Ponnekallu	8.38	2801	330	60	44	200	500	36	671	277	224	193	0.4	1928
111	C/GU/088	Guntur	Ravela	8.13	589	180	52	12	50	7	0	262	43	14	1	0.5	339
112	C/GU/089	Guntur	Tadikonda	8.08	1052	275	78	19	102	18	0	342	142	30	3	0.3	601
113	C/GU/090	Guntur	Inovolu	8.41	2800	300	48	44	442	141	24	793	223	269	167	2.1	1834

114	C/GU/091	Guntur	Vykuntapuram	7.81	3145	635	108	89	220	360	0	860	191	356	234	0.2	2082
115	C/GU/093	Guntur	Thullur	8.05	2526	370	64	51	270	260	0	988	131	235	49	0.0	1663
116	C/GU/094	Guntur	Vellatur	7.61	1815	485	114	49	190	19	0	336	234	193	138	0.8	1143
117	C/GU/096	Guntur	Pillutla	8.07	1194	295	78	24	105	53	0	305	106	160	25	0.8	739
118	C/GU/097	Guntur	Cheruvu Jammulapalem	7.91	5865	840	120	131	828	20	0	476	1078	715	5	0.5	3187
119	C/GU/098	Guntur	Bapatla	8.14	928	200	58	13	70	77	0	275	85	72	31	0.1	574
120	C/GU/100	Guntur	Nallapadu	8.23	1085	360	52	56	100	21	0	464	82	86	11	1.1	691
121	C/GU/101	Guntur	Phanidharam	7.42	5213	1680	240	263	469	7	0	305	1035	810	185	0.3	3195
122	C/GU/104	Guntur	Kollipara	8.3	2410	500	28	105	150	300	0	525	255	350	56	0.1	1563
123	C/GU/105	Guntur	Inturu	8.2	1610	375	78	44	170	49	0	415	202	156	12	0.2	964
124	C/GU/106	Guntur	Govada	8.07	1042	335	70	39	75	2	0	238	117	127	3	0.4	578
125	C/GU/109	Guntur	Pedda Kakani	7.74	2119	790	92	136	134	68	0	610	312	187	38	0.2	1340
126	C/GU/110	Guntur	Penumaka	7.74	1899	445	84	57	135	51	0	238	234	150	148	0.5	1004
127	C/GU/111	Guntur	Kocherla	8.44	1015	515	66	85	0	22	18	427	82	20	29	1.2	576
128	C/GU/112	Guntur	Bellamkonda	7.77	2817	1040	152	161	156	19	0	1080	220	107	109	0.7	1582
129	C/GU/113	Guntur	Mangalgiri	8.17	1191	380	56	58	100	2	0	311	117	87	78	0.9	689
130	C/GU/116	Guntur	Gonuguntla Varipalem	7.76	4955	475	136	33	920	2	0	592	202	776	1105	2.5	3537
131	C/GU/117	Guntur	Santagudipadu	8.26	2658	545	76	86	320	67	0	31	362	677	89	3.1	1698
132	C/GU/118	Guntur	Golapadu	7.77	865	275	70	24	70	8	0	262	67	74	44	1.1	518
133	C/GU/119	Guntur	Mukkamala	8.92	1761	280	28	51	280	5	15	299	234	235	56	0.7	1081

134	C/GU/120	Guntur	Narakullapadu	8.6	3605	700	188	56	515	15	0	543	432	586	191	0.8	2315
135	C/GU/121	Guntur	Sattenapalli	7.76	2699	605	88	94	340	3	0	421	440	302	74	0.8	1598
136	C/GU/122	Guntur	Vijayapuri South, N. Sagar	8.06	983	280	78	21	84	25	0	305	106	80	6	0.3	585
137	C/GU/123	Guntur	Jonnalagadda	8.8	1214	205	36	28	134	134	27	506	82	72	1	1.1	812
138	C/GU/124	Guntur	Etukuru	8.58	1264	195	38	24	110	150	12	354	121	111	20	0.1	797
139	C/GU/125	Guntur	Pamidimarru	7.89	1431	270	56	32	205	3	0	397	142	161	17	1.0	858
140	C/GU/126	Guntur	A. Muppalla	8.45	2586	540	60	95	276	130	30	946	206	144	19	1.2	1525
141	C/GU/128	Guntur	Punnapalle	8.04	1606	540	146	43	110	18	0	195	248	192	110	0.0	985
142	C/GU/132	Guntur	Maddirala	8.17	3840	1050	84	204	400	3	0	403	333	562	663	0.9	2496
143	C/GU/135	Guntur	Nadendla	8.13	2526	720	168	73	140	180	0	390	333	236	265	0.2	1633
		Guntur Average		8.04	2251	493	96	61		85	3	479	289	225	111	0.7	1412
		Guntur Max		8.92	7431	1940	240	336		500	36	1080	1631	810	1105	3.1	4640
		Guntur Min		7.10	589	180	28	4		2	0	31	43	8	1	0.0	339
144	R/CD/004B	Cuddapah	Vbmatham	7.51	1210	370	54	57	98	17	0	494	124	20	5	1.4	678
145	R/CD/018	Cuddapah	Guvvalacheruvu	7.52	740	295	54	39	34	1	0	336	57	7	9	1.0	406
146	R/CD/026	Cuddapah	Sanipai	7.43	1840	370	92	34	249	5	0	647	273	3	3	0.6	1053
147	R/CD/032a	Cuddapah	Anjaneyapuram	7.46	2650	740	120	107	262	11	0	817	454	2	17	1.0	1472
148	R/CD/037	Cuddapah	Pincha	7.73	830	290	52	39	51	10	0	311	85	14	31	0.5	473
149	R/CD/053	Cuddapah	Alludupally (Devalalu)	7.47	1420	300	78	26	126	105	0	409	174	120	4	0.4	883
150	R/CD/056	Cuddapah	Pullareddy pet	7.07	3470	780	204	66	433	7	0	573	723	224	12	0.5	2020
151	R/CD/057	Cuddapah	Chinnamandyam	7.25	1470	530	140	44	93	2	0	323	266	47	57	1.0	847

152	R/CD/061	Cuddapah	Chowdariwaripalli	7.7	3320	220	28	36	640	34	0	1281	425	7	3	3.0	1959
153	R/CD/063	Cuddapah	pathur	7.47	2510	480	108	51	341	24	0	549	340	287	29	0.5	1515
154	R/CD/069	Cuddapah	Jammalamadugu	7.88	5740	400	80	49	1132	6	0	610	1120	566	246	1.1	3572
155	R/CD/070	Cuddapah	Chadipiralla. T	7.69	2860	440	96	49	448	9	0	500	461	319	43	0.6	1730
156	R/CD/073	Cuddapah	Idupulapaya	7.41	790	370	50	60	11	1	0	397	34	12	12	0.5	421
		Cuddapah Average		7.51	2219	430	89	51		18	0	557	349	125	36	0.9	1310
		Cuddapah Max		7.88	5740	780	204	107		105	0	1281	1120	566	246	3.0	3572
		Cuddapah Min		7.07	740	220	28	26		1	0	311	34	2	3	0.4	406
157	C/KR/004	Krishna	Nuzivedu	7.36	1768	375	66	51	210	38	0	543	291	11	5	0.6	1003
158	C/KR/008A	Krishna	Kaikaluru1	7.6	6570	1180	432	24	915	100	0	634	1290	827	68	0.1	4044
159	C/KR/011	Krishna	Sultan nagar	7.89	2736	640	116	85	300	58	0	543	418	292	33	0.2	1633
160	C/KR/016	Krishna	Garikapadu	8.13	1686	560	40	112	120	19	0	512	145	137	91	0.7	976
161	C/KR/019A	Krishna	Bantumilli1	8.15	2740	545	124	57	340	71	0	512	482	216	56	0.1	1659
162	C/KR/020	Krishna	Mudinepalli	8	1372	360	80	39	150	3	0	360	170	143	3	0.3	807
163	C/KR/021	Krishna	Balliparru	7.85	5412	935	128	208	800	21	0	390	780	1175	11	0.4	3360
164	C/KR/022	Krishna	uopparagudem	8.08	2060	510	124	49	220	13	0	342	319	249	17	0.3	1200
165	C/KR/023	Krishna	Munjuluru	8.06	1524	365	90	34	150	39	0	293	191	167	59	0.3	908
166	C/KR/025	Krishna	Vissannapet	7.93	1743	480	90	62	160	38	0	677	160	74	21	0.6	1018
167	C/KR/027	Krishna	Tiruvur	7.75	2008	695	92	113	140	4	0	470	333	118	30	0.7	1117
168	C/KR/030	Krishna	Kakarla	8.33	2317	220	44	27	425	6	30	695	291	99	10	2.4	1346
169	C/KR/033	Krishna	Pedda Autapalli	7.95	4518	1040	224	117	570	5	0	714	1021	217	9	0.4	2598

170	C/KR/035	Krishna	Mailavaram	8.08	1726	410	96	41	195	8	0	336	262	177	4	0.2	989
171	C/KR/036	Krishna	Gampala gudem	8.09	2870	590	100	83	280	180	0	537	440	209	175	0.6	1794
172	C/KR/039	Krishna	Muktyala- PZ 2	7.52	617	255	92	6	15	2	0	85	46	136	12	0.2	362
173	C/KR/047	Krishna	Tiruvuru-PZ	8.38	1403	125	28	13	290	2	18	512	145	78	11	1.6	893
174	C/KR/050	Krishna	Lankapalli	7.69	3446	935	208	101	350	22	0	268	723	432	14	0.9	2015
175	C/KR/051	Krishna	Mandavalli	7.6	3835	695	96	111	550	9	0	885	709	115	64	0.3	2193
176	C/KR/052	Krishna	Konakallu	7.96	9436	500	80	73	2047	6	0	1488	2162	515	125	0.5	5916
177	C/KR/054	Krishna	Itavaram	8.27	1857	580	66	101	135	41	0	573	195	99	72	1.2	1059
178	C/KR/056	Krishna	Venkatapragada	8.15	2913	570	108	73	300	180	0	622	369	266	170	0.1	1845
179	C/KR/057	Krishna	Angaluru	7.88	1343	345	84	33	145	4	0	488	82	102	1	0.2	748
180	C/KR/059	Krishna	B B Gudem	7.86	1227	315	52	45	145	6	0	342	213	20	4	0.5	693
181	C/KR/061	Krishna	Vadlamanu	7.42	831	355	78	39	30	10	0	317	78	45	BDL	1.0	474
182	C/KR/063	Krishna	Nidumolu	7.82	3508	670	72	119	432	156	0	775	610	279	17	0.2	2159
183	C/KR/064	Krishna	Gudlavalleru-New	7.82	947	275	62	29	108	4	0	360	99	72	3	0.0	597
184	C/KR/066	Krishna	Polukonda	8.2	2733	330	92	24	360	200	0	769	425	126	4	0.0	1701
185	C/KR/068	Krishna	Gopalpuram-New	7.76	1010	415	92	45	55	7	0	366	92	86	9	0.7	610
186	C/KR/069	Krishna	Ayyanki	8.29	1539	250	78	13	160	145	0	537	145	114	3	0.1	986
187	C/KR/070	Krishna	Annasagaram	8.24	1439	285	102	7	130	130	0	506	128	111	5	0.5	922
188	C/KR/071	Krishna	Nimmakuru(NTR village)	8.21	798	210	38	28	100	16	0	311	82	70	1	0.4	524
189	C/KR/072	Krishna	Repudi Tanda	8.27	2332	340	64	44	390	4	0	677	347	119	4	2.2	1387

190	C/KR/075	Krishna	Tadanki	8.28	2310	350	116	15	240	240	0	726	291	143	1	0.0	1488
191	C/KR/076	Krishna	Palevada	7.9	5897	800	120	122	960	30	0	1025	1305	220	7	0.4	3388
192	C/KR/079	Krishna	Kottareddigudem	7.88	2836	310	60	39	490	36	0	573	468	218	71	0.8	1733
193	C/KR/080	Krishna	Hemalatanda	7.53	1580	355	102	24	195	10	0	342	280	62	12	0.5	895
194	C/KR/081	Krishna	Kalidindi	8.21	2324	450	76	63	330	22	0	763	262	172	25	0.3	1415
195	C/KR/082	Krishna	Bomminampadu	7.75	4722	940	252	75	380	460	0	842	773	469	97	0.1	3019
196	C/KR/083	Krishna	Mallapparajgudem	7.73	2973	450	116	39	450	18	0	439	560	276	5	0.4	1732
197	C/KR/084	Krishna	Singarayapalem	7.69	3402	390	88	41	550	120	0	744	567	262	45	0.1	2127
198	C/KR/085	Krishna	Gudur	8.32	5976	390	144	7	1060	297	84	1110	1035	462	94	0.3	3827
199	C/KR/086	Krishna	Nadupur	7.61	10039	1180	30	269	1800	400	0	1037	2304	1415	9	0.1	6859
200	C/KR/088	Krishna	Koduru	8.21	909	215	48	23	115	8	0	342	74	65	2	0.2	544
201	C/KR/089	Krishna	Mandapakala	7.92	2325	420	72	58	330	23	0	537	369	169	30	0.3	1379
202	C/KR/092	Krishna	Kautaram	8.15	1438	365	110	22	165	19	0	506	177	60	4	0.2	866
203	C/KR/093	Krishna	Penuganchiprolu	8.19	1131	245	70	17	140	3	0	153	117	116	157	0.6	714
204	C/KR/094	Krishna	Ramchandrapuram	8.29	2361	310	92	19	250	250	0	683	248	145	132	0.6	1553
205	C/KR/096	Krishna	Makkpeta	8.26	1674	305	98	15	195	70	0	445	167	99	130	1.4	1045
		Krishna Average		7.97	2738	486	101	58		72	3	565	454	230	40	0.5	1676
		Krishna Max		8.38	10039	1180	432	269		460	84	1488	2304	1415	175	2.4	6859
		Krishna Min		7.36	617	125	28	6		2	0	85	46	11	1	0.0	362
206	R/KU/007A	Kurnool	Venkatapuram2	7.74	3433	520	80	78	550	1	0	799	652	69	87	1.2	2006
207	R/KU/011	Kurnool	Veldurthy	7.44	2788	600	104	83	350	26	0	1086	326	32	6	1.8	1591

208	R/KU/015	Kurnool	Holagondi	7.18	2808	900	272	54	220	18	0	342	666	8	214	0.3	1661
209	R/KU/027	Kurnool	Gonegondla	7.37	2822	780	248	39	260	45	0	421	567	84	216	0.3	1716
210	R/KU/028	Kurnool	Karivemula	7.73	1335	270	84	15	166	29	0	567	106	4	58	0.8	809
211	R/KU/030	Kurnool	Naganathanahalli	7.77	5015	740	128	102	800	13	0	665	553	128	1283	2.7	3416
212	R/KU/031	Kurnool	Moravakonda	7.52	2015	700	224	34	140	0	0	189	312	226	211	0.7	1263
213	R/KU/041	Kurnool	Yenugumarri	6.63	1952	410	88	46	250	12	0	927	128	12	15	2.6	1119
214	R/KU/046	Kurnool	Santajutur	7.05	2879	620	136	68	310	110	0	769	468	119	11	0.8	1691
215	R/KU/047	Kurnool	Battulur	7.15	2492	500	200	0	260	140	0	476	369	240	100	1.1	1600
216	R/KU/055	Kurnool	Nossam	6.79	1798	480	144	29	140	83	0	311	291	59	193	0.3	1129
217	R/KU/086	Kurnool	Madhavaram	6.4	4928	1860	512	141	250	48	0	506	993	413	265	0.1	2930
218	R/KU/087	Kurnool	Ahobilam	7.34	637	280	72	24	10	14	0	256	57	15	12	1.0	361
219	R/KU/088	Kurnool	Aspari1	7.04	1216	510	172	19	45	5	0	360	142	46	78	0.7	727
220	R/KU/090	Kurnool	Aluru1	6.6	3778	1320	344	112	260	3	0	409	794	133	361	0.4	2257
221	R/KU/093	Kurnool	Tungabhadra	6.55	4767	1500	480	73	400	10	0	336	993	420	329	0.1	2909
222	R/KU/094	Kurnool	Kodumuru	7.19	3556	1400	160	243	150	41	0	549	567	197	397	0.7	2090
223	R/KU/095	Kurnool	Alamuru	6.93	4945	1920	488	170	250	3	0	287	1007	766	15	0.5	2873
224	R/KU/096	Kurnool	Nandyal	7.42	1057	350	80	36	80	4	0	317	121	85	3	0.6	603
225	R/KU/097	Kurnool	Mahanandi	7.57	770	320	46	50	24	9	0	378	46	6	BDL	0.9	412
226	R/KU/098	Kurnool	Rudravaram	7.5	1333	350	56	51	140	5	0	317	170	154	2	0.3	771
227	R/KU/099	Kurnool	Gudivemula	7.38	1022	290	80	22	100	1	0	220	149	110	3	0.5	598

228	R/KU/106	Kurnool	Ratan	7.64	637	145	30	17	79	1	0	323	25	12	4	2.0	367
229	R/KU/107	Kurnool	Gulyan	7.49	8535	1440	320	156	1300	1	0	756	1177	874	1331	1.6	5620
230	R/KU/108	Kurnool	Sullavai	7.57	1130	330	100	19	102	10	0	366	177	11	4	2.3	648
231	R/KU/109	Kurnool	Srisailam	6.71	277	100	18	13	15	4	0	49	39	7	40	0.1	167
232	R/KU/112	Kurnool	Podalakunta	7.09	4745	1460	520	39	400	37	0	482	950	230	488	0.8	2959
233	R/KU/113	Kurnool	Yemmiganur	7.45	519	190	50	16	30	2	0	207	43	20	7	0.4	294
234	R/KU/115	Kurnool	Banaganapalli	7.2	1748	480	108	51	180	2	0	311	277	193	30	0.8	1031
235	R/KU/116	Kurnool	Adoni Kota / Veerabhadra swamigudi	7.47	3062	600	176	39	310	200	0	787	553	87	12	0.1	1857
236	R/KU/117	Kurnool	Kurnool	7.34	2371	840	304	19	150	17	0	397	482	162	10	0.3	1387
237	R/KU/118	Kurnool	Rajala Mandagiri	8.21	593	260	68	22	10	11	0	293	25	15	1	0.2	330
238	R/KU/119	Kurnool	Doddanakere	8.04	1515	620	136	68	60	5	0	397	170	64	143	0.9	888
239	R/KU/120	Kurnool	Regadi Gudur	7.93	1651	440	144	20	140	63	0	439	213	150	10	0.5	988
		Kurnool Average		7.31	2474	692	182	58		29	0	450	400	152	180	0.8	1502
		Kurnool Max		8.21	8535	1920	520	243		200	0	1086	1177	874	1331	2.7	5620
		Kurnool Min		6.40	277	100	18	0		0	0	49	25	4	1	0.1	167
240	C/NL/001	Nellore	Kavali	7.3	1045	300	68	32	100	6	0	122	206	47	100	0.1	633
241	C/NL/013	Nellore	Penubarti	8.14	1308	510	68	83	63	4	0	555	113	25	8	0.7	704
242	C/NL/022	Nellore	Ramathirdam	7.66	1915	440	108	41	180	100	0	238	362	100	174	0.0	1210
243	C/NL/023	Nellore	Venkatachalam-r	7.57	416	130	26	16	35	1	0	92	74	22	5	0.1	235
244	C/NL/026	Nellore	Sullurpet	7.61	4201	900	320	24	500	82	0	525	978	256	16	0.1	2497
245	C/NL/028	Nellore	North rajupalem	7.96	1414	340	68	41	140	48	0	390	177	83	59	0.7	855

246	C/NL/031A	Nellore	Vidyanagar-alt	7	539	135	28	16	60	3	0	43	106	2	96	0.0	337
247	C/NL/034	Nellore	Krishnapuram	7.33	15570	6800	1020	1034	450	7	0	244	5211	227	5	0.5	8103
248	C/NL/046A	Nellore	Tadaparthi-alt	7.76	5400	2000	192	370	320	6	0	445	1404	302	48	0.8	2914
249	C/NL/047	Nellore	Durgaraja- patnam	7.86	1241	300	104	10	120	46	0	287	213	61	22	0.1	750
250	C/NL/048	Nellore	Aravapalem	7.92	3183	1040	112	185	250	10	0	708	638	91	20	1.1	1738
251	C/NL/050	Nellore	Tikkavaram	7.75	2986	840	280	34	300	5	0	323	652	277	20	0.5	1766
252	C/NL/052	Nellore	Bata	8.1	981	325	40	55	61	26	0	427	60	18	45	0.7	566
253	C/NL/054A	Nellore	Budamam-1	8.19	1093	260	56	29	132	3	0	519	64	19	13	1.5	633
254	C/NL/059	Nellore	Podalakur1	7.88	2390	660	104	97	240	10	0	720	369	49	38	1.4	1347
255	C/NL/071	Nellore	Nagulavellaturu	8.06	2247	620	80	102	220	21	0	720	241	133	66	1.2	1303
256	C/NL/072	Nellore	Bodipadu	8.01	1138	240	60	22	150	3	0	451	121	25	3	0.5	659
257	C/NL/073	Nellore	Gopalpuram	8.01	2118	740	88	126	146	2	0	610	355	50	4	1.1	1144
258	C/NL/074	Nellore	Ademasatram(Jaga devipeta)	7.99	1298	250	80	12	180	6	0	445	163	49	2	0.7	764
259	C/NL/075	Nellore	Alluru	7.6	5108	1520	168	268	460	24	0	580	1276	254	16	0.4	2820
260	C/NL/076	Nellore	Brahmadevam	8.2	1760	390	108	29	220	8	0	439	305	77	6	0.3	1020
261	C/NL/079	Nellore	Kesavaram	7.4	444	155	30	19	16	28	0	159	43	8	29	0.4	269
262	C/NL/080	Nellore	Brahmana Puduru Agraharam	7.45	2430	460	104	49	240	180	0	476	454	102	91	0.3	1510
263	C/NL/081	Nellore	Kastam Pahad	7.97	2591	240	16	49	440	75	0	878	213	241	20	4.5	1593
264	C/NL/082	Nellore	Wasite	7.55	2682	680	56	131	300	5	0	610	482	130	24	1.1	1501
265	C/NL/083	Nellore	Manubolu	7.78	3067	440	32	88	500	3	0	872	425	204	3	1.2	1787

266	C/NL/085	Nellore	Ramareddypalem	7.1	1152	420	92	46	70	7	0	177	255	54	16	0.3	648
267	C/NL/086	Nellore	Tallampadu	6.89	925	310	56	41	58	20	0	415	71	1	20	0.6	521
268	C/NL/087	Nellore	Atkanitipa	7.09	1825	360	64	49	135	200	0	549	319	2	12	0.3	1116
269	C/NL/089	Nellore	Shanti Nagar	7.53	973	105	22	12	175	2	0	421	78	29	1	1.2	576
270	C/NL/090	Nellore	Sarvepalli	7.3	1246	250	52	29	120	88	0	336	191	69	3	0.5	757
271	C/NL/092	Nellore	S Sakapalli	7.31	1661	410	80	51	185	19	0	573	213	50	7	0.5	955
272	C/NL/094	Nellore	Vadlapudi	7.08	5456	1300	240	170	640	28	0	531	1262	273	282	0.7	3219
273	C/NL/O64	Nellore	Brehmeshpuram	8.33	890	105	16	16	152	9	30	378	46	12	9	1.3	510
274	C/NL/O67	Nellore	Tomedimil	8.07	1512	320	60	41	200	1	0	384	248	86	2	0.8	873
		Nellore Average		7.67	2406	694	117	98		31	1	447	497	98	37	0.7	1367
		Nellore Max		8.33	15570	6800	1020	1034		200	30	878	5211	302	282	4.5	8103
		Nellore Min		6.89	416	105	16	10		1	0	43	43	1	1	0.0	235
275	C/PR/002	Prakasham	Santamaguluru	7.25	3027	240	40	34	580	9	0	817	397	217	66	3.2	1844
276	C/PR/003	Prakasham	Guttala Mumadivarm	7.73	5182	500	48	92	960	3	0	1202	858	245	157	3.5	3100
277	C/PR/008A	Prakasham	Darsi-new	7.81	1668	200	32	29	150	240	0	470	213	69	94	0.9	1114
278	C/PR/010	Prakasham	Muppavaram	7.38	960	325	68	38	70	6	0	372	85	44	11	0.7	549
279	C/PR/011	Prakasham	Chirala	7.15	1246	400	104	34	75	50	0	445	149	40	7	0.1	731
280	C/PR/015	Prakasham	Chimakurti	7.35	893	260	80	15	85	1	0	305	96	54	2	0.4	519
281	C/PR/016	Prakasham	Uppugundur	6.93	2946	940	168	126	220	43	0	390	652	118	131	0.7	1697
282	C/PR/017A	Prakasham	Ongole-new	7.31	1079	340	48	54	65	49	0	342	142	47	10	0.4	623
283	C/PR/019	Prakasham	Kanigiri	6.6	2859	860	168	107	260	7	0	464	681	71	15	4.8	1596

284	C/PR/021	Prakasham	Kandukur	7.15	5735	1420	168	243	640	40	0	763	1361	259	63	1.2	3240
285	C/PR/024	Prakasham	Voletivaripalem	7.4	1515	610	104	85	60	13	0	622	57	32	164	1.1	896
286	C/PR/026	Prakasham	Vengaiahpalem	7.65	1967	350	28	68	220	120	0	726	184	96	34	1.6	1194
287	C/PR/028	Prakasham	Tangaturu	7.69	4198	960	144	146	500	38	0	793	780	236	122	0.3	2449
288	C/PR/034	Prakasham	Donakonda	7.4	3158	1020	128	170	250	10	0	671	610	150	10	1.0	1738
289	C/PR/035	Prakasham	Kotta Patnam	7.42	1482	430	80	56	120	38	0	275	220	14	232	0.2	927
290	C/PR/036	Prakasham	Kadavakuduru	7.15	2551	700	160	73	100	280	0	360	411	152	298	0.1	1693
291	C/PR/041	Prakasham	Gollapalli	7.1	2119	660	120	88	180	8	0	445	326	136	109	0.9	1239
292	C/PR/043	Prakasham	Tallamalla	7.34	924	320	72	34	60	7	0	317	124	10	16	1.3	517
293	C/PR/047	Prakasham	Turumella	7.28	2676	760	120	112	180	140	0	756	284	140	209	0.5	1646
294	C/PR/051	Prakasham	Santanutalapadu	7.37	941	260	56	29	95	5	0	360	96	35	5	0.6	541
295	C/PR/052	Prakasham	Rajupalem	7.02	743	215	56	18	60	21	0	256	82	34	10	0.5	437
296	C/PR/058	Prakasham	Parchur	6.97	3984	1060	192	141	420	18	0	744	837	179	14	0.6	2255
297	C/PR/063	Prakasham	Veggampalli	7.15	1078	260	48	34	122	11	0	488	78	12	16	1.4	619
298	C/PR/064	Prakasham	Pedda Kanumalla	5.05	9177	2460	200	477	950	47	0	24	3205	9	48	0.1	4950
299	C/PR/065	Prakasham	Ongole	7.64	1202	120	12	22	220	3	0	342	149	102	1	0.6	717
300	C/PR/066	Prakasham	Venkupalem	7.37	1312	330	48	51	145	9	0	543	78	83	17	1.1	763
301	C/PR/078	Prakasham	Chedalavada	7.48	1911	300	60	36	299	6	0	561	234	133	28	1.1	1140
302	C/PR/080	Prakasham	Duddukuru	7.27	1115	310	68	34	110	3	0	378	149	34	1	0.5	629
303	C/PR/081	Prakasham	Inkolu	7.5	1361	130	20	19	130	210	0	464	149	61	28	0.6	901

304	C/PR/082	Prakasham	Somavaripeta	7.35	960	260	56	29	98	4	0	409	74	25	14	0.8	551
305	C/PR/084	Prakasham	Muttarasupalem	6.66	3176	920	112	156	300	13	0	781	553	120	50	1.6	1782
306	C/PR/088	Prakasham	Voolagallu	7.32	1201	180	36	22	170	43	0	439	113	62	19	2.8	736
307	C/PR/090	Prakasham	Neethalapdu	6.99	5432	1200	280	122	700	4	0	488	978	470	552	0.8	3405
308	C/PR/091	Prakasham	Duddapadu	8.23	5337	820	120	126	850	1	0	476	1219	482	64	1.8	3155
309	C/PR/092	Prakasham	Vetapalem	7.91	2991	880	184	102	200	140	0	366	510	177	360	0.1	1897
310	C/PR/093	Prakasham	Vadarevu	7.61	4109	980	224	102	450	69	0	348	978	170	259	0.1	2464
311	C/PR/094	Prakasham	Karamchedu	7.21	1814	590	132	63	140	12	0	378	340	105	9	0.7	1032
312	C/PR/097	Prakasham	Chagallu	7.3	7675	1420	176	238	1100	19	0	567	2155	307	15	1.3	4358
313	C/PR/099	Prakasham	Ramannapeta	7.28	641	200	52	17	45	18	0	189	106	5	9	0.1	368
314	C/PR/100	Prakasham	Agraharam	7.8	1060	460	96	54	30	8	0	354	50	18	190	1.3	661
315	C/PR/101	Prakasham	Dubagunte	7.83	1167	380	60	56	80	24	0	336	206	13	3	0.7	647
316	C/PR/102	Prakasham	Pedde Alavalepady	7.76	8350	1320	200	199	1300	22	0	1061	1659	600	416	1.2	5045
317	C/PR/70	Prakasham	Vaidana Kopperapadu	7.21	2192	660	112	92	200	6	0	512	312	164	78	0.9	1277
318	C/PR/71	Prakasham	C.S. Puram	6.84	1469	390	88	41	140	33	0	329	262	65	29	0.8	860
319	C/PR/74	Prakasham	Venkupalem	7.41	1787	380	60	56	230	10	0	567	177	152	22	1.1	1054
320	C/PR/77	Prakasham	Oneguruvaipalem	7.37	1434	280	48	39	180	40	0	397	184	72	68	2.9	875
		Prakasham Average		7.30	2604	610	102	87		41	0	493	491	126	89	1.1	1531
		Prakasham Max		8.23	9177	2460	280	477		280	0	1202	3205	600	552	4.8	5045
		Prakasham Min		5.05	641	120	12	15		1	0	24	50	5	1	0.1	368
321	C/SR/001	Srikakulam	Ichapuram	7.76	1990	500	74	77	210	15	0	488	294	52	131	0.5	1151

322	C/SR/003	Srikakulam	Kotturu	7.83	365	140	40	10	12	12	0	110	46	21	3	0.2	210
323	C/SR/004	Srikakulam	Patapatnam	7.72	620	225	46	27	40	10	0	262	74	2	2	0.3	361
324	C/SR/005	Srikakulam	Baruva	8.23	2387	320	64	39	421	12	0	451	496	173	2	0.5	1483
325	C/SR/007	Srikakulam	Veeraghattam	7.78	1350	325	58	44	150	13	0	342	238	50	1	0.2	761
326	C/SR/008	Srikakulam	Heeramandalam	7.6	3066	800	28	178	340	15	0	329	638	300	87	0.6	1787
327	C/SR/009	Srikakulam	Palakonda	7.96	986	415	40	77	50	1	0	354	124	21	43	0.2	572
328	C/SR/011	Srikakulam	Tekkali	7.44	1430	500	120	49	90	6	0	195	333	20	64	0.4	801
329	C/SR/012A	Srikakulam	Rajam	7.73	1026	340	58	47	81	1	0	287	128	50	55	0.6	594
330	C/SR/013	Srikakulam	Narasannapeta	7.45	2419	780	184	78	221	1	0	201	659	100	74	0.3	1440
331	C/SR/015	Srikakulam	Patasrikakulam	7.68	947	290	66	30	58	40	0	305	131	25	5	0.5	542
332	C/SR/016	Srikakulam	Kalingapatnam	7.75	2477	440	80	58	324	120	0	439	532	164	19	0.2	1565
333	C/SR/020	Srikakulam	Meliaputti	8.02	596	170	42	16	45	17	0	128	92	17	40	0.1	347
334	C/SR/021A	Srikakulam	Chilakalapalem (new)	8.06	1830	210	30	33	320	2	0	561	248	40	69	0.8	1085
335	C/SR/023	Srikakulam	Pata tekkali	7.67	1546	345	98	24	181	30	0	323	213	130	94	0.3	966
336	C/SR/024	Srikakulam	Kanchili	8	220	70	16	7	10	12	0	31	39	10	18	0.1	130
337	C/SR/025	Srikakulam	Tekkalipatnam	7.65	1176	255	52	30	150	10	0	336	177	30	46	0.6	700
338	C/SR/026A	Srikakulam	Sitampeta1	7.47	1940	410	78	52	200	60	0	348	401	40	36	0.1	1079
339	C/SR/027	Srikakulam	Haripuram	7.63	2131	410	88	46	260	60	0	281	503	46	78	0.3	1253
340	C/SR/028	Srikakulam	Ponduru	7.74	1206	240	52	27	157	3	0	342	160	30	55	0.7	692
341	C/SR/029	Srikakulam	Aldu	6.81	3018	740	160	83	320	18	0	293	752	100	51	0.5	1663

342	C/SR/030	Srikakulam	Gara	7.56	1414	240	50	28	210	15	0	317	241	75	46	0.2	858
343	C/SR/031	Srikakulam	Ramchandrapuam	7.62	636	240	76	12	45	1	0	232	67	33	24	0.6	400
344	C/SR/032	Srikakulam	Kalata	7.68	717	240	82	9	60	20	0	305	71	30	14	0.2	471
345	C/SR/034	Srikakulam	Srikurmam	8.04	1276	300	106	9	139	50	0	421	160	80	14	0.5	814
346	C/SR/035	Srikakulam	Sallapeta	8.00	770	260	38	40	85	1	0	403	53	30	10	0.9	503
347	C/SR/036	Srikakulam	Arasavalli (Srikakkulam)	7.74	1020	280	62	30	130	1	0	342	128	90	14	0.3	663
348	C/SR/037	Srikakulam	Bendigetu	7.75	545	175	52	11	60	8	0	244	53	30	6	0.4	369
349	C/SR/038	Srikakulam	Korlam	7.85	892	255	52	30	102	1	0	287	131	50	7	1.3	550
350	C/SR/039	Srikakulam	Veerabhadrapuram	7.77	524	175	52	11	50	2	0	220	57	20	6	0.6	331
351	C/SR/040	Srikakulam	Nandigam	7.73	1085	305	88	21	120	11	0	336	174	50	8	0.5	676
352	C/SR/041	Srikakulam	Gotta	7.6	1106	320	100	17	90	51	0	268	149	65	94	0.2	730
353	C/SR/042	Srikakulam	Kadakella	7.79	628	260	56	29	40	1	0	275	64	20	14	0.2	391
354	C/SR/043	Srikakulam	Pydi Bhimavaram	7.72	726	225	68	13	60	7	0	140	124	37	40	0.5	435
355	C/SR/045	Srikakulam	Chalavaripeta	7.65	500	170	52	10	30	7	0	85	78	20	49	0.2	298
356	C/SR/046	Srikakulam	Tharli Bodapadu	7.61	900	270	72	22	85	6	0	244	131	35	48	0.6	549
357	C/SR/047	Srikakulam	Sompet	7.38	4152	1000	272	78	500	3	0	220	1064	125	340	0.3	2515
358	C/SR/048	Srikakulam	Palasa	7.65	995	205	68	9	120	1	0	214	174	35	15	0.5	552
359	C/SR/049	Srikakulam	Pedda Padmapuram	7.78	820	270	68	24	35	45	0	134	149	17	73	0.3	493
		Srikakulam Average		7.71	1291	336	74	37		18	0	284	240	58	46	0.4	789
		Srikakulam Max		8.23	4152	1000	272	178		120	0	561	1064	300	340	1.3	2515
		Srikakulam Min		6.81	0	70	16	7		1	0	31	39	2	1	0.1	130

360	C/VS/001	Vishakhapattanam	Aruku	7.52	486	145	46	7	35	8	0	116	53	2	51	0.1	274
361	C/VS/002	Vishakhapattanam	Dharakonda	7.58	291	125	28	13	10	1	0	79	25	0	48	0.1	174
362	C/VS/003	Vishakhapattanam	Chintapalli	7.56	141	50	12	5	10	2	0	61	7	1	14	0.1	88
363	C/VS/005A	Vishakhapattanam	Koyyuru1	7.59	156	75	26	2	5	0	0	73	7	1	6	0.0	92
364	C/VS/006	Vishakhapattanam	Mallampet	7.8	1414	435	48	77	130	0	0	512	160	48	19	0.9	794
365	C/VS/007A	Vishakhapattanam	Bonkulapalem1	8.05	620	265	86	12	25	0	0	348	21	0	1	0.0	357
366	C/VS/008	Vishakhapattanam	Medivoda	8.07	827	305	88	21	35	30	0	305	60	27	60	0.3	507
367	C/VS/010	Vishakhapattanam	Paderu	7.95	310	105	28	9	19	4	0	61	35	0	33	0.1	165
368	C/VS/011	Vishakhapattanam	Narsipatnam	8.37	968	190	30	28	130	0	36	427	32	1	1	0.1	503
369	C/VS/012	Vishakhapattanam	Anakapalli	8.46	1504	140	30	16	291	1	48	525	92	110	9	2.3	899
370	C/VS/013	Vishakhapattanam	Pendurti	7.77	1104	430	76	58	55	1	0	311	156	60	0	0.4	597
371	C/VS/014	Vishakhapattanam	Bhimunipatnam-1	8.16	1949	490	120	46	180	80	0	543	245	87	123	0.2	1211
372	C/VS/015	Vishakhapattanam	Bhimunipatnam-2	8	437	145	38	12	25	7	0	110	46	10	41	0.4	246
373	C/VS/018A	Vishakhapattanam	Yelamanchili	8.06	1416	455	114	41	70	75	0	372	181	94	54	0.1	856
374	C/VS/019	Vishakhapattanam	Pudimadaka	8.19	1421	180	64	5	200	75	0	421	174	65	64	0.0	903
375	C/VS/020	Vishakhapattanam	Addaroddu	8.31	3382	625	84	101	500	9	42	671	617	211	4	0.7	1961
376	C/VS/021	Vishakhapattanam	Gurrajupeta	7.58	3406	1000	240	97	299	20	0	378	645	231	250	0.2	2014
377	C/VS/022	Vishakhapattanam	Revupolavaram	8.08	3430	840	164	105	340	80	0	415	638	153	344	0.1	2076
378	C/VS/023	Vishakhapattanam	Bangarumitta	7.86	1422	575	72	96	60	1	0	476	167	59	16	0.4	761
379	C/VS/024B	Vishakhapattanam	Rolugunta1	8.35	1149	185	54	12	170	1	30	317	89	63	49	3.4	652

380	C/VS/025B	Vishakhapattanam	Purshotta Puram-alt2	7.73	1178	395	72	52	80	41	0	439	131	37	37	0.5	718
381	C/VS/026A	Vishakhapattanam	Tallapalem	8.32	1756	330	62	43	230	14	30	451	181	108	60	1.3	992
382	C/VS/027	Vishakhapattanam	Kotauratla	8.31	1877	375	58	56	250	2	42	488	156	89	157	1.1	1092
383	C/VS/028	Vishakhapattanam	Pata K.d.peta	7.76	860	395	82	46	5	4	0	305	67	10	30	0.7	431
384	C/VS/030	Vishakhapattanam	Rayavaram	7.77	2938	360	124	12	490	27	0	677	546	115	8	0.0	1735
385	C/VS/031	Vishakhapattanam	Haripalem	7.88	5268	1560	488	83	260	180	0	433	1120	323	103	0.3	2821
386	C/VS/032	Vishakhapattanam	Garikabanda	8.3	199	70	16	7	15	1	6	79	11	10	1	0.2	112
387	C/VS/034	Vishakhapattanam	Dimriguda	7.84	420	140	52	2	43	2	0	134	50	10	41	0.1	281
388	C/VS/035A	Vishakhapattanam	Lambasingi1	7.72	262	110	20	15	10	1	0	67	21	10	42	0.1	159
389	C/VS/036	Vishakhapattanam	Kottur	7.79	247	110	26	11	10	2	0	98	14	25	4	0.1	152
390	C/VS/037	Vishakhapattanam	Lotugadda jn.	7.79	161	65	8	11	10	8	0	18	50	10	0	0.1	108
391	C/VS/039	Vishakhapattanam	Gudem	7.73	105	50	14	4	5	2	0	12	18	15	12	0.0	77
392	C/VS/040	Vishakhapattanam	Gandhigramam	8.41	2083	700	52	139	150	10	12	122	496	107	126	0.9	1162
393	C/VS/042	Vishakhapattanam	Mindivanipalem	8.17	1287	470	76	68	64	4	0	378	121	52	94	0.6	710
394	C/VS/044	Vishakhapattanam	Visalakshinagar	7.74	1116	260	70	21	135	3	0	390	128	43	8	0.7	646
395	C/VS/045	Vishakhapattanam	Rishikonda	7.43	7111	1680	404	163	840	42	0	488	2014	296	2	0.2	4057
396	C/VS/046	Vishakhapattanam	Vadapalem	7.99	1437	445	28	91	120	12	0	287	181	80	166	0.2	852
397	C/VS/047	Vishakhapattanam	Chepalauppada	8.25	1314	290	64	32	165	7	0	372	174	82	16	0.4	765
398	C/VS/048	Vishakhapattanam	Potinamallayapalem	8.25	1145	380	82	43	95	0	0	366	124	53	64	1.0	685
399	C/VS/049	Vishakhapattanam	Peddagadili	7.88	1392	420	120	29	125	4	0	281	170	88	164	0.4	872

400	C/VS/050	Vishakhapattanam	Moolapalem	7.96	1314	305	64	35	154	19	0	439	177	48	4	0.4	769
401	C/VS/051	Vishakhapattanam	Lawson's Bay	8.49	2613	70	12	10	560	16	12	604	383	176	71	0.7	1603
402	C/VS/053	Vishakhapattanam	Kancherapalem (Govt. Polytechnic)	8.42	1042	305	38	51	100	0	18	305	117	58	12	1.5	574
403	C/VS/054	Vishakhapattanam	Marripalem	8.17	1339	390	104	32	120	27	0	433	145	67	56	0.4	815
404	C/VS/055	Vishakhapattanam	Pithapuram Colony	8.07	900	300	94	16	70	4	0	287	82	62	43	0.1	546
405	C/VS/056	Vishakhapattanam	Kotaveedhi	8.21	2016	410	104	36	239	61	0	336	298	113	239	0.1	1295
406	C/VS/057	Vishakhapattanam	SCIndia	8.26	1577	350	76	39	190	10	0	708	67	49	58	0.8	922
407	C/VS/058	Vishakhapattanam	Gnanapuram	8.3	974	320	64	39	74	20	12	403	67	48	BDL	0.7	565
408	C/VS/062	Vishakhapattanam	M.V.P colony sector '9'	7.92	1044	335	78	34	90	5	0	329	103	62	49	0.5	622
409	C/VS/068	Vishakhapattanam	Lalam Kottur	8.3	1580	415	40	77	175	2	30	494	195	60	3	0.5	871
410	C/VS/069	Vishakhapattanam	Kothakota	8.2	2209	540	84	80	280	4	0	592	163	63	6	0.7	1042
411	C/VS/070	Vishakhapattanam	L.Singavaram	7.73	620	280	66	28	30	2	0	317	39	16	2	0.6	377
412	C/VS/071	Vishakhapattanam	Vontlamamidi	7.98	165	60	16	5	10	3	0	67	11	10	1	0.3	95
413	C/VS/072	Vishakhapattanam	Minimuluru	7.68	327	125	28	13	10	10	0	49	39	10	65	0.1	205
414	C/VS/073	Vishakhapattanam	Kontela	7.85	257	100	20	12	10	17	0	122	14	12	8	0.1	168
415	C/VS/074	Vishakhapattanam	Rangasheela	7.71	137	65	14	7	5	6	0	24	18	10	29	0.0	103
416	C/VS/075	Vishakhapattanam	Sunkarametta	7.6	145	40	14	1	23	6	0	49	11	10	35	0.1	130
417	C/VS/076	Vishakhapattanam	Anantagiri (Iktaguda)	7.83	62	25	6	2	13	1	0	37	7	10	4	0.0	65
418	C/VS/077	Vishakhapattanam	Bangarammapeta	7.91	421	190	66	6	20	2	0	214	32	10	0	0.2	266
419	C/VS/078	Vishakhapattanam	Yendapalli	8.14	1057	165	34	19	165	15	0	275	92	110	74	0.9	679

420	C/VS/079	Vishakhapattanam	Bandavaripalem X road	8.15	2030	870	92	156	135	12	0	634	262	136	169	0.6	1350
421	C/VS/080	Vishakhapattanam	Gurrampalem	8.19	1462	390	78	47	140	7	0	427	145	95	54	0.9	827
422	C/VS/081	Vishakhapattanam	Gandigundam check post	8.3	1608	505	44	96	145	1	18	586	145	84	9	1.1	894
423	C/VS/084	Vishakhapattanam	Bhimsingi	6.45	222	75	14	10	15	6	0	55	21	1	29	0.1	130
424	C/VS/085	Vishakhapattanam	Gamparai	7.08	105	55	6	10	5	3	0	55	7	11	2	0.0	76
425	C/VS/086	Vishakhapattanam	Naganna Dorapalem	7.6	769	335	52	50	30	3	0	336	53	40	3	0.4	436
426	C/VS/088	Vishakhapattanam	Vaddadi Madugula	7.58	2143	595	104	81	220	1	0	305	305	146	295	0.2	1338
427	C/VS/089	Vishakhapattanam	Devarapalle	7.92	138	55	14	5	5	1	0	49	7	10	2	0.2	74
428	C/VS/090	Vishakhapattanam	Timmarajupeta	7.59	2458	440	72	63	360	9	0	592	347	199	45	0.3	1457
429	C/VS/092	Vishakhapattanam	Vepagunta	7.57	1177	380	100	32	80	10	0	226	152	133	23	0.3	668
430	C/VS/093	Vishakhapattanam	Tamaram	7.58	931	225	38	32	110	1	0	342	78	68	2	0.4	537
431	C/VS/094	Vishakhapattanam	Santosh Puram	7.98	377	125	38	7	20	13	0	110	28	40	9	0.1	222
		Vishakhapattanam Average		7.93	1267	336	70	39		15	5	308	178	66	52	0.4	740
		Vishakhapattanam Max		8.49	7111	1680	488	163		180	48	708	2014	323	344	3.4	4057
		Vishakhapattanam Min		6.45	62	25	6	1		0	0	12	7	0	0	0.0	65
432	C/VJ/001	Vijayanagaram	Gumma	8.17	693	155	46	10	30	66	0	189	50	33	47	0.3	397
433	C/VJ/002A	Vijayanagaram	Parvatipuram1	8.05	411	140	44	7	35	2	0	171	25	28	15	0.3	260
434	C/VJ/003	Vijayanagaram	Maripivalsa	7.53	801	360	106	23	20	1	0	159	138	27	60	0.2	471
435	C/VJ/004	Vijayanagaram	Bobbili	7.87	986	395	110	29	35	2	0	134	131	101	87	0.3	577
436	C/VJ/005	Vijayanagaram	Saluru	7.82	795	275	58	32	60	0	0	336	71	19	1	0.3	446
437	C/VJ/006	Vijayanagaram	Ramabhadra puram	7.79	1112	380	58	57	80	7	0	372	131	48	19	0.5	627

438	C/VJ/007	Vijayanagaram	Mallavedu	8.04	865	355	118	15	28	3	0	250	106	42	22	0.3	487
439	C/VJ/008	Vijayanagaram	Gajapatinagaram	7.98	936	260	50	33	100	1	0	244	92	114	23	0.6	563
440	C/VJ/009	Vijayanagaram	S.kota	7.76	1054	280	64	29	115	0	0	421	85	45	7	1.2	603
441	C/VJ/010	Vijayanagaram	Vijayanagaram	8.1	668	200	62	11	55	6	0	232	50	41	25	0.6	391
442	C/VJ/011	Vijayanagaram	Rajapulova	8.1	928	230	50	26	90	29	0	262	117	53	24	0.7	550
443	C/VJ/012	Vijayanagaram	Kurupana	8.06	1450	425	110	36	105	60	0	323	202	70	122	0.2	902
444	C/VJ/013	Vijayanagaram	Chipurupalli	7.57	1542	575	150	49	80	14	0	232	213	61	255	0.3	963
445	C/VJ/014	Vijayanagaram	Natavalasa	8.18	1372	340	82	33	145	18	0	348	163	84	85	0.4	822
446	C/VJ/016	Vijayanagaram	Garbham	8.03	665	240	70	16	25	23	0	134	57	42	100	0.2	414
447	C/VJ/017	Vijayanagaram	Agraharam	7.42	1582	510	88	71	120	8	0	336	255	78	70	0.8	895
448	C/VJ/018	Vijayanagaram	Balajipet	7.45	979	385	100	33	40	5	0	220	142	58	40	0.2	551
449	C/VJ/019	Vijayanagaram	Komarada	7.47	1013	460	86	60	25	1	0	293	106	43	86	0.3	585
450	C/VJ/020	Vijayanagaram	Payakapadu	7.36	1477	605	152	55	35	40	0	256	234	93	112	0.3	877
451	C/VJ/021	Vijayanagaram	Maradam	7.82	1187	445	50	78	45	30	0	415	113	51	30	1.0	651
452	C/VJ/023	Vijayanagaram	Kanimetta	7.77	440	160	40	15	21	8	0	128	43	17	25	0.2	246
453	C/VJ/024	Vijayanagaram	Lakkavarapu kota	7.72	1879	505	68	81	135	100	0	427	319	78	35	0.7	1077
454	C/VJ/025A	Vijayanagaram	Kothavalasa1	8.18	888	275	54	34	75	2	0	299	82	41	37	0.9	508
455	C/VJ/027	Vijayanagaram	Sanyasirajupeta	8.05	1347	540	52	100	55	1	0	482	113	47	59	0.4	721
456	C/VJ/028	Vijayanagaram	Kokadavalasa	8.08	571	225	72	11	25	2	0	220	46	17	1	1.5	309
457	C/VJ/029	Vijayanagaram	Kollivalasa	8.19	758	285	56	35	40	18	0	329	53	26	7	1.0	437

458	C/VJ/030	Vijayanagaram	Vikrampuram	7.55	1089	130	42	6	190	1	0	275	170	13	64	0.5	654
459	C/VJ/033	Vijayanagaram	Dattirajeru	8.18	672	265	64	26	30	2	0	214	25	92	29	0.8	399
460	C/VJ/035	Vijayanagaram	Narava	8	1127	340	102	21	85	20	0	226	213	59	3	0.2	639
461	C/VJ/036	Vijayanagaram	Tatipudi	8.31	606	270	78	18	15	0	6	329	11	1	2	1.0	330
462	C/VJ/037	Vijayanagaram	Seetammapeta	7.9	5340	420	80	54	1070	4	0	1037	1290	25	18	0.9	3174
463	C/VJ/038	Vijayanagaram	Bondapalli	7.75	3435	950	264	71	322	50	0	366	780	245	59	0.6	2014
464	C/VJ/039	Vijayanagaram	Kotha Bheemasinghi	7.76	819	315	62	39	35	8	0	336	64	23	1	0.3	436
465	C/VJ/040	Vijayanagaram	Appayyapet	7.68	1579	525	68	86	40	130	0	415	181	79	113	0.4	950
466	C/VJ/041	Vijayanagaram	Venkatabhairipuram	7.59	1980	475	98	56	120	200	0	378	316	103	151	0.2	1274
467	C/VJ/042	Vijayanagaram	Chilakalapalli	7.66	1717	465	72	69	140	65	0	378	262	77	91	0.6	1007
468	C/VJ/043	Vijayanagaram	Gotlam	7.88	1421	380	94	35	145	13	0	195	287	63	78	0.2	835
469	C/VJ/044	Vijayanagaram	Gajarayanivalasa	7.55	676	285	88	16	20	0	0	220	64	25	30	0.3	377
470	C/VJ/045	Vijayanagaram	Garividi	8.12	541	150	34	16	50	4	0	232	43	9	0	0.5	297
471	C/VJ/046	Vijayanagaram	Gowripuram	8.18	1214	365	60	52	105	12	0	506	103	30	0	1.1	672
472	C/VJ/047	Vijayanagaram	Almanda village	7.75	1736	435	104	43	140	100	0	439	245	93	74	0.4	1065
		Vijayanagaram Average		7.86	1228	360	81	39		26	0	311	175	56	51	0.5	718
		Vijayanagaram Max		8.31	5340	950	264	100		200	6	1037	1290	245	255	1.5	3174
		Vijayanagaram Min		7.36	411	130	34	6		0	0	128	11	1	0	0.2	246
473	C/WG/002A	West Godavari	Polavaram	7.95	2160	520	168	24	187	120	0	610	227	166	107	0.1	1372
474	C/WG/025B	West Godavari	Attili	8.2	1900	420	80	54	138	180	0	610	206	116	48	0.1	1193
475	C/WG/026	West Godavari	Bhimavaram	8.05	780	280	68	27	39	19	0	250	74	69	10	0.3	459

476	C/WG/028A	West Godavari	Tadipudi	8.12	750	165	40	16	87	17	0	366	46	5	6	0.5	440
477	C/WG/033	West Godavari	Undi	8.09	1600	450	92	54	145	27	0	464	199	108	33	0.2	940
478	C/WG/039	West Godavari	Nidadavolu	8.14	640	210	56	17	36	24	0	293	53	2	4	0.2	371
479	C/WG/041A	West Godavari	Kamavarapukota	8	1580	380	64	54	118	120	0	342	238	100	87	0.3	989
480	C/WG/056	West Godavari	Rachuru	9.31	3540	260	24	49	284	700	120	171	447	676	115	0.3	2470
481	C/WG/058	West Godavari	Perupalem	8.02	640	255	72	18	24	10	0	244	46	49	5	0.1	373
482	C/WG/067	West Godavari	Kovvur	8.08	540	190	54	13	36	1	0	275	28	2	3	0.3	306
483	C/WG/069	West Godavari	Munipalli	7.48	4520	900	192	102	614	19	0	403	1134	314	1	0.1	2623
484	C/WG/070	West Godavari	Marteru	8.12	3570	740	136	97	474	10	0	476	723	334	31	0.3	2097
485	C/WG/071	West Godavari	Relangi	8.17	1330	265	88	11	171	22	0	567	128	12	10	0.2	788
486	C/WG/077	West Godavari	Mogalturu	8.1	1360	290	96	12	166	22	0	476	156	50	22	0.2	815
487	C/WG/078	West Godavari	Gowrabalu	8.17	450	175	44	16	19	7	0	232	18	8	2	0.3	255
488	C/WG/079	West Godavari	Eluru	7.77	1660	270	72	22	242	26	0	500	230	69	29	0.2	995
489	C/WG/82	West Godavari	Palakolu	8.07	2520	430	80	56	372	16	0	366	553	141	40	0.3	1482
490	C/WG/83	West Godavari	Narsimhapuram	7.86	5950	790	136	109	995	16	0	610	1595	197	23	0.3	3444
491	C/WG/85	West Godavari	Cherukuwada	8.16	410	145	42	10	25	5	0	195	28	4	2	0.3	234
492	C/WG/87	West Godavari	Sarepalle	8.08	2240	330	72	36	351	20	0	659	355	57	25	0.6	1319
493	C/WG/88	West Godavari	Pentapadu	7.88	3810	730	264	17	525	26	0	390	801	423	16	0.2	2310
494	C/WG/89	West Godavari	Eluru (Postal colony)	8.15	1340	330	84	29	149	13	0	482	181	15	5	0.6	771
495	C/WG/91	West Godavari	Buttayagudem	7.84	1130	270	100	5	124	19	0	458	128	1	10	0.3	667

496	C/WG/96	West Godavari	Dondapudi	8.38	1730	310	48	46	254	2	90	458	167	43	74	3.6	971
		West Godavari Average		8.09	1923	379	91	37	232	60	9	412	323	123	29	0.4	1154
		West Godavari Max		9.31	5950	900	264	109	995	700	120	659	1595	676	115	3.6	3444
		West Godavari Min		7.48	410	145	24	5	19	1	0	171	18	1	1	0.1	234
		State Average		7.75	1950	466	97	54	211	44	2	428	310	122	70	0.6	1171
		State Max		9.31	15570	6800	1020	1034	2047	700	120	1488	5211	1415	1331	5.1	8103
		State Min		5.05	62	25	6	0	0	0	0	12	7	0	0	0.10	65

CONSERVE WATER FOR THE FUTURE

CENTRAL GROUND WATER BOARD

Ministry of Water Resources,
River Development & Ganga Rejuvenation
Govt. of India

Southern Region
GSI Post, Bandlaguda
Hyderabad – 500 068
Tel: 040-24225200
Email: rdsr-cgwb@nic.in

NH – IV, Faridabad
Haryana
Tel: 0129-2477213
Website: www.cgwb.gov.in

GROUND WATER YEAR BOOK
2015-16
ANDHRA PRADESH