GROUND WATER YEAR BOOK
(2020-2021)
TELANGANA STATE

1. INTRODUCTION

Central Ground Water Board has taken up the task of ground water development, augmentation, management, 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 National Hydrograph Stations (NHS) on long term basis since 1969 through a network of wells (Dug wells and Piezometers) for studying its long term behaviour 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 ground water regime 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. As on 31-03-2020, there were 748 operational Ground Water Monitoring Wells (GWMS) (306 dug wells and 442 piezometers). During the year (2020-21), 11 (Dug wells) Ground water monitoring wells were abandoned. As on March 2021, the status of monitoring stations is 737 wells, out of which, 295 are Dug wells and 442 Piezometers (***Annexure- I to II***).

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 rest 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

Telangana State is the 29th State (Act, 2014) formed in India covering geographical area of 1,12,077 Km^2 (after transferring 107 villages from Khammam district to residual Andhra Pradesh). It lies between NL 15° 48’ and 19° 54’and EL 77° 12’ and 81° 50’. The state is bordered by the states of Maharashtra, Chattisgarh in the north, Karnataka in the west and Andhra Pradesh in the south, east and north-east.

Administratively, the State comprises 33 districts covering an area of 1,12,077 sq. km (44,273 sq. mi). The largest district is Bhadradri Kothagudem whereas Hyderabad is the smallest

and governed by 585 revenue mandals (blocks/tahsils) with 10,434 revenue villages. Total population of the state is ~3.5 Crores with sex ratio of 988 (2011 census), of which 61 % lives in rural area and 39% in urban area. The density of population is 312 per Sq. Km. The decadal growth in population is ~13.6 % (2001 to 2011 census).

The present ground water year book (2020-2021) depicts the ground water level scenario in the state and describes the behaviour of water levels during the period. Piezometer data of State Ground Water Department is also integrated with CGWB data in order to have holistic Ground water scenario in the state.

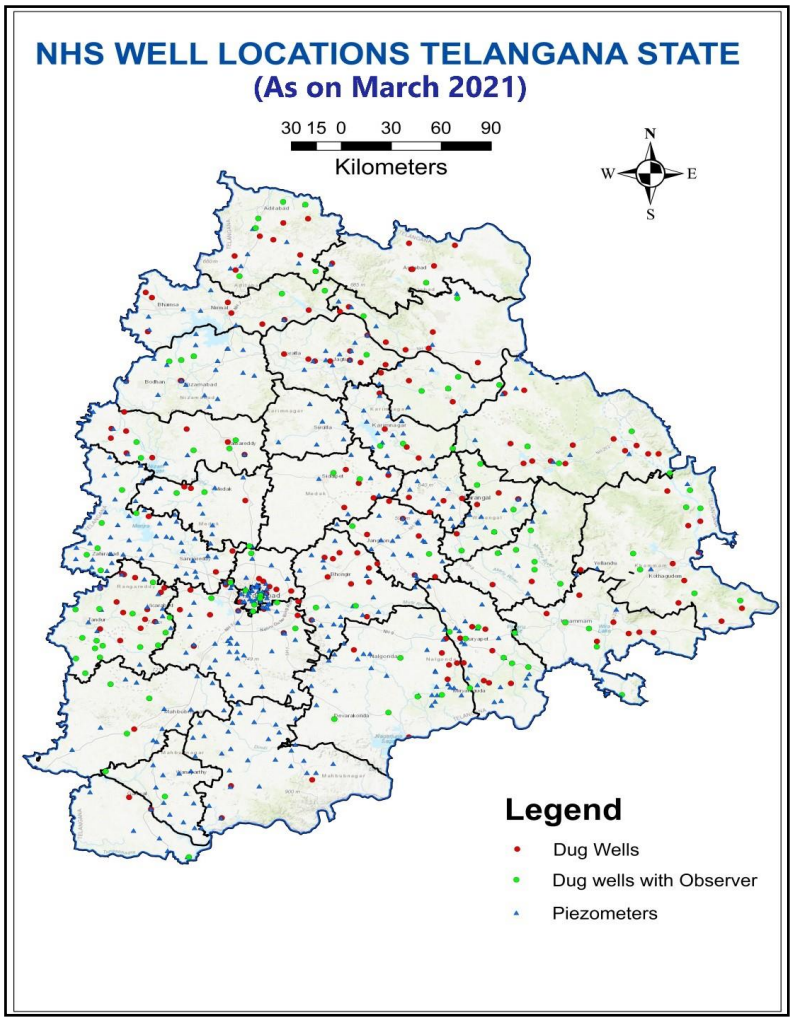


Fig.1.1: Location of GWMS in Telangana State (as on March, 2021).

2. PHYSIOGRAPHY, DRAINAGE AND SOILS

2.1 Physiography

Physiographically, Telangana state is occupied by western pediplains except a fringe of Eastern Ghats in the northeastern part of Khammam district.The pediplains depict rolling topography with flat to undulating tracts. The state extends largely between elevations 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 two major rivers namely, Godavari and Krishna and their tributaries before entering into the state of Andhra Pradesh and finally to Bay of Bengal. There are 2 major basins and 13 sub basins in the state.

The major river basins are Godavari basin with 8 sub-basins namely, lower Godavari, Maneru, Manjira, middle Godavari, Penganga, Pranhita, Sabari and Wardha and Krishna basin with 5 sub basins namely, lower Bhima, lower Krishna, Munneru, Musi and Paleru (**Fig.2.1**). Apart from these, there are 2 other basins namely Tammileru and Yerrakalva lying between Godavari and Krishna covering very small area. The River Godavari with its tributaries viz., Pranahita, Pedda Vagu, Manjira, Maner, Kinnerasani, Sileru and Pamuleru drain whole of northern Telangana. The Tungabhadra, Musi, Paleru and Maneru rivers drain southern part of the state.

The pattern of drainage is generally dendritic with wide valleys in western pediplain. Drainage of the Eastern Ghat is coarse and dendritic with steep and narrow valleys. Most of the smaller streams feed innumerable tanks.

2.3 Soils

The state has a wide variety of soils viz., red soil, lateritic soils and black cotton soils. ~60% of the state is occupied by red soils with loamy sub-soils covering entire Nalgonda district, a major part of Mahabubnagar, Waranagal, Karimnagar and Nizamabad districts. Black cotton soil commonly occurs in Adilabad and Nizamabad districts. Laterite soil occurs in western part of Ranga Reddy and Medak districts.

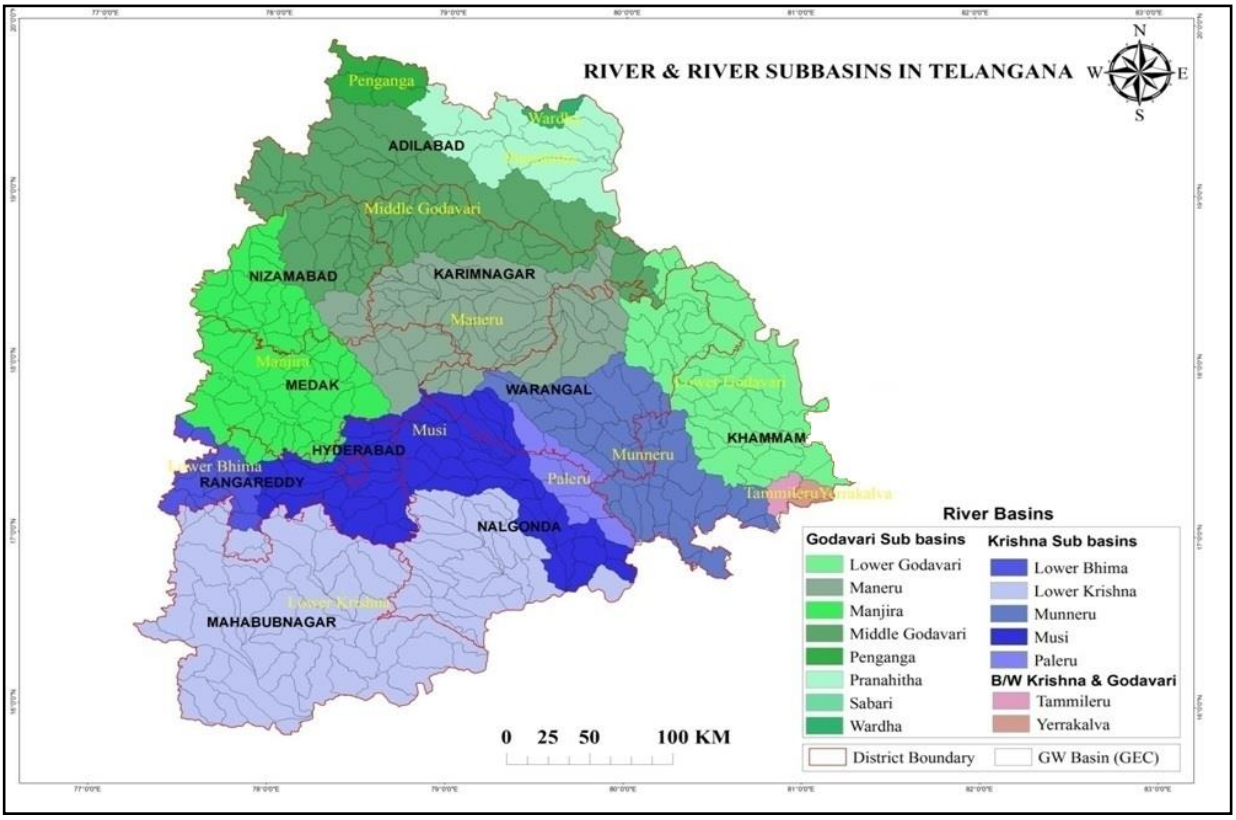


Fig.2.1: Drainage and River sub-basin map of Telangana state.

3. HYDROMETEOROLOGY

3.1 Climate

Telangana state is geographically located in semi-arid region and has predominantly hot and dry climate. Summer starts in March and high temperature is observed in May with average temperature of 42° C. Southwest Monsoon starts in the month of June and lasts until September. As per agricultural department (Govt of Telangna), state can be divided into following 4 sub zones.

- North Telangana Zone
- Southern Telengana Zone
- High Altitude and
- Tribal Zone

3.2 Rainfall Analysis-2020

District-wise monthly, seasonal and annual rainfall of both normal and actual of the year 2020 is compiled from daily and weekly weather reports of India Meteorological Department (IMD) and presented in **Table-3.1.** The normal annual rainfall of the state is 939 mm of which Southwest monsoon (June-September) contributes 80% (749 mm), Northeast monsoon (October-December) contributes 13% (120 mm), winter contributes 1% (12 mm) and summer contributes 6 % (58 mm) of the rainfall. Isohytel map of Telangana state prepared from annual normal rainfall is given in **Fig. 3.1.**

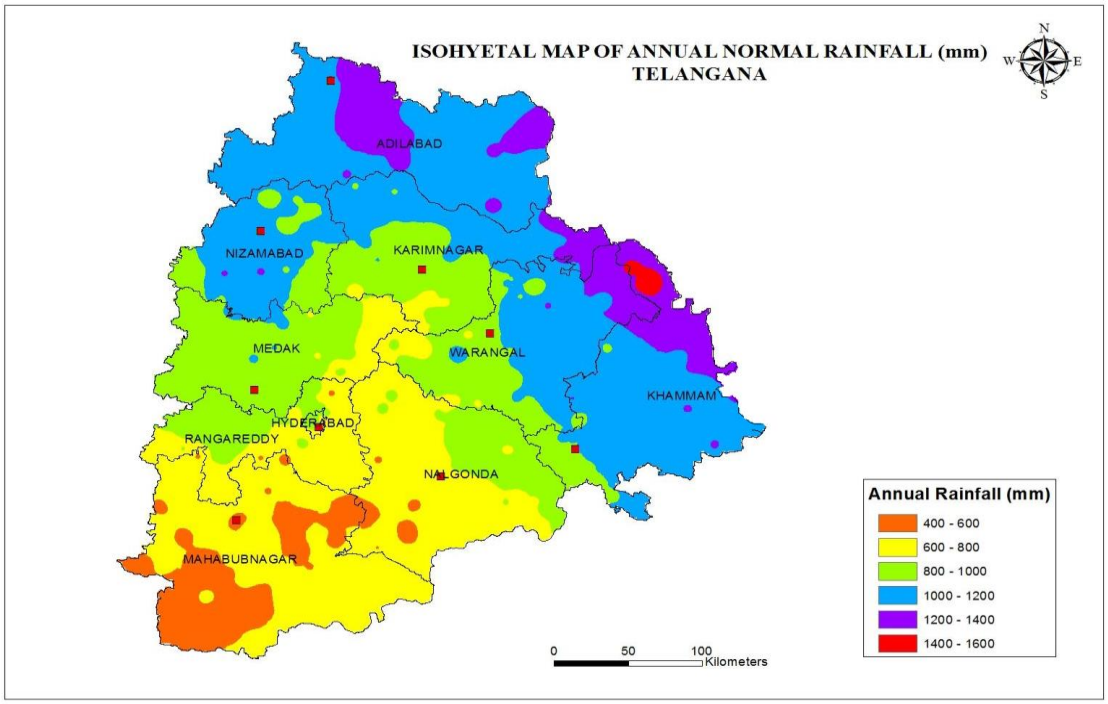


Fig.3.1: Isohytel map of Telangana state (Normal annual rainfall in mm).

During the year 2020, state received 1333 mm rainfall. The seasonal distribution is as follows: Southwest monsoon (June-September) contributed 79% (1055 mm), Northeast monsoon (October-December) contributed 15% (202 mm), winter (January-February) contributed 1% (14 mm) and summer (March-May) contributed 5% (62 mm) of the rainfall. The state received excess rainfall during the year (42% above normal). Adilabad and Warangal districts received large excess (>60% above normal) rainfall during the year. Departure of annual rainfall 2020 from normal is depicted in **Fig 3.2.** Annual rainfall in 2020 ranges from 1046 mm (37% above normal) in Nalgonda district to 1853 mm (88 % above normal) in Warangal district. Monthly mean rainfall ranged from no rain in December to 371 mm in August.

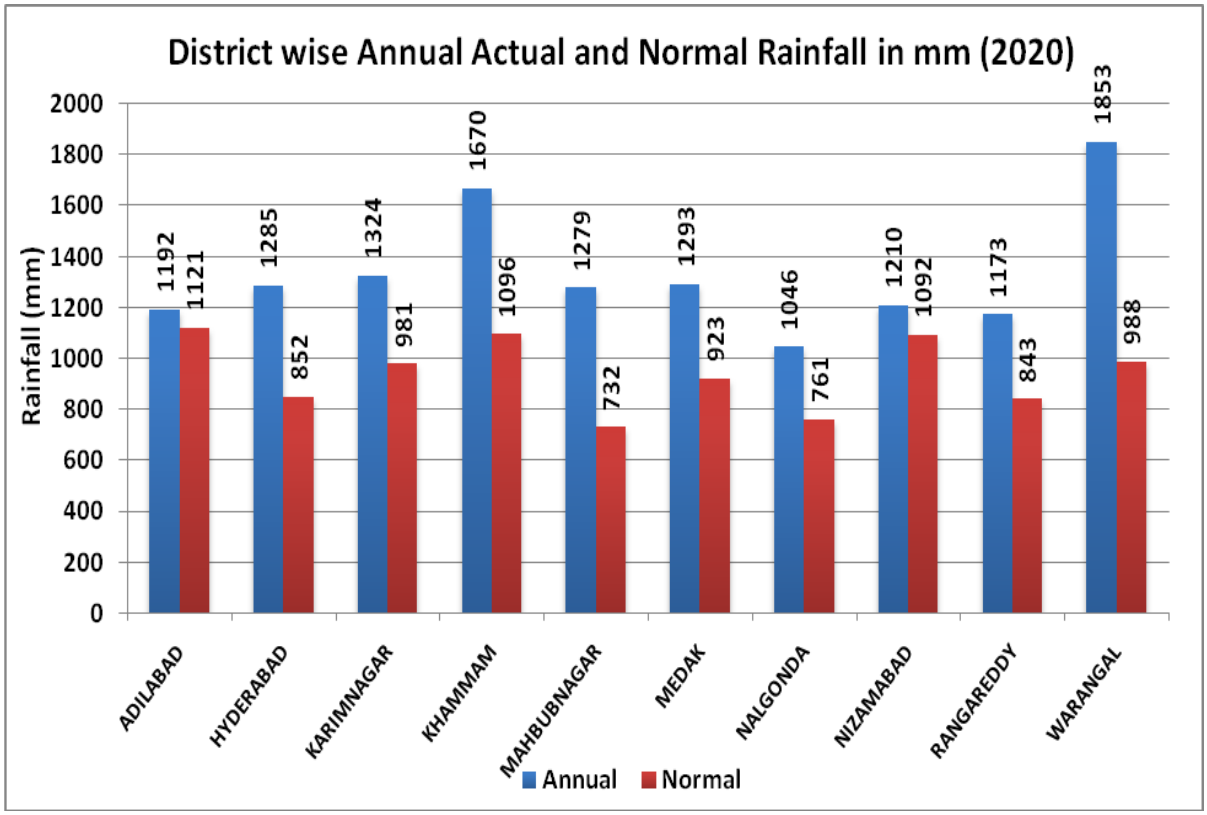


Fig.3.2: District-wise Departure of Annual (2020) rainfall from Normal

Southwest monsoon and Northeast monsoon performance:

Southwest monsoon was excess in Telangana (1055 mm, 40% above normal) due to back to back low pressure systems formed over North Bay of Bengal in August 2020. Warangal, Mahabubnagar & Khammam districts received large excess rainfall (>60% above normal), Adilabad & Nizamabad districts received normal rainfall and remaining districts received excess rainfall (20 to 59% above normal). Warangal district received the highest rainfall during the

season (1579 mm, 98% above normal). During Northeast monsoon (October to December) state received 68% above normal rainfall. Hyderabad, Khammam, Nizamabad districts received large excess rainfall 211%, 114% & 102% above normal, respectively during northeast monsoon.

Significant weather events in 2020:

During October many districts of the state received heavy to very heavy rainfall due to the formation of Deep depression (11- 14 October 2020) in Bay of Bengal and it crossed Telangana as a Depression. Hyderabad, Medak, Rangareddy and Warangal districts received large excess rainfall of 296%, 174%, 160% & 112% above normal, respectively in October 2020. Extremely heavy rainfall of 31.1 cm recorded at Rain gauge in CGWB, SR campus on 14th October 2020.

The rainfall received during the period Jan 2020 to December 2020 is compiled and analysed for correlating with water levels monitored during the period May 2020, August 2020, November 2020 and January 2021. The data is presented in **Table-3.2** to **3.5** and depicted in the **Fig. 3.3** to **3.10.**

Table-3.1: Monthly Actual and Normal rainfall (mm) during 2020.

		JAN		FEB		MAR		APR		MAY		JUNE		JULY	
S No	**DISTRICT**	**ACT**	**NOR**	**ACT**	**NOR**	**ACT**	**NOR**	**ACT**	**NOR**	**ACT**	**NOR**	**ACT**	**NOR**	**ACT**	**NOR**
1	ADILABAD	14.1	7.4	7.7	7.1	29.7	9.7	23.1	14.2	29.1	18.2	161.5	178.4	300.7	317.4
2	HYDERABAD	22.1	5.9	2.1	7.3	15.4	12.6	20.5	22.7	30.8	33.8	203.8	110.7	147.6	176.8
3	KARIMNAGAR	8.5	10.7	11.0	5.5	22.6	10.2	9.1	17.2	23.6	24.0	205.2	153.2	251.8	257.3
4	KHAMMAM	3.2	4.2	3.7	7.4	14.9	8.8	25.6	26.4	18.7	52.6	180.1	150.3	367.9	282.8
5	MAHBUBNAGAR	3.0	1.8	1.2	2.8	3.8	4.9	20.3	17.9	21.2	34.1	169.8	91.1	289.8	161.6
6	MEDAK	0.5	6.5	7.6	4.4	22.9	8.9	29.4	20.1	28.7	28.0	170.2	138.2	257.8	229.4
7	NALGONDA	4.6	3.9	8.9	4.5	17.9	8.4	16.6	16.4	19.3	28.7	135.4	103.2	160.8	154.7
8	NIZAMABAD	19.4	7.9	7.7	4.1	24.1	7.1	17.0	14.4	21.1	24.5	179.3	161.3	236.9	289.4
9	RANGAREDDY	1.8	3.1	2.0	4.0	5.0	6.6	24.6	22.6	29.5	34.6	159.5	109.4	197.6	190.6
10	WARANGAL	0.8	8.3	14.3	7.8	12.1	10.2	16.6	17.3	28.4	28.7	206.4	147.6	321.7	271.2
	STATE MEAN	**7.8**	**6.0**	**6.6**	**5.5**	**16.8**	**8.7**	**20.3**	**18.9**	**25.0**	**30.7**	**177.1**	**134.3**	**253.2**	**233.1**

		AUG		SEP		OCT		NOV		DEC		ANNUAL		
S No	**DISTRICT**	**ACT**	**NOR**	**ACT**	**NOR**	**ACT**	**NOR**	**ACT**	**NOR**	**ACT**	**NOR**	**ACT**	**NOR**	**DEP(%)**
1	ADILABAD	352.7	291.7	191.5	171.4	81.5	83.0	0.7	14.8	0.0	7.3	1192	1121	6%
2	HYDERABAD	244.0	190.5	207.6	165.5	383.0	95.6	7.8	23.7	0.0	6.4	1285	852	51%
3	KARIMNAGAR	406.4	226.7	265.6	163.1	119.7	85.9	0.8	20.8	0.0	5.9	1324	981	35%
4	KHAMMAM	556.1	256.4	269.0	170.9	205.6	106.9	25.2	24.5	0.0	4.5	1670	1096	52%
5	MAHBUBNAGAR	248.8	158.2	334.9	148.8	167.6	85.4	18.4	21.2	0.0	3.8	1279	732	75%
6	MEDAK	269.7	211.1	282.7	165.2	222.4	86.6	1.2	19.3	0.0	4.8	1293	923	40%
7	NALGONDA	231.8	147.2	221.3	149.6	209.4	105.8	20.2	32.0	0.0	6.6	1046	761	37%
8	NIZAMABAD	343.6	296.5	264.0	172.9	96.9	91.3	0.1	17.1	0.0	5.5	1210	1092	11%
9	RANGAREDDY	250.2	176.5	250.7	177.2	243.8	94.5	8.6	19.1	0.0	4.3	1173	843	39%
10	WARANGAL	810.2	222.3	240.4	155.5	191.5	88.9	10.5	22.9	0.0	7.2	1853	988	88%
	STATE MEAN	**371.3**	**217.7**	**252.8**	**164.0**	**192.1**	**92.4**	**9.3**	**21.5**	**0.0**	**5.6**	**1332**	**939**	**42%**

3.2.1 May-2020

The rainfall data collected and compiled from weekly weather reports from India Meteorological Department has been used to analyze the rainfall for the period Jun 2018 to May 2020. **Table 3.2** gives the district-wise rainfall data for the period Jun'18-May'19, Jun'19- May'20 and normal of June – May and the departure of Jun'18- May'20 rainfall with other periods. The data is depicted in **Fig 3.3** and **Fig 3.4.**

Table-3.2: Salient Features of Rainfall and its Variability in Telangana State.

S NO	DISTRICT	Rainfall (mm) (June'19-May'20)	Rainfall (mm) (June'18-May'19)	NORMAL Rainfall (mm) (June-May)	Departure from June' 18-May'19 (%)	Departure from normal (%)	Remarks
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
1	Adilabad	1274	1149	1119	10.8%	13.8%	Normal
2	Hyderabad	929	556	821	67.1%	13.1%	Normal
3	Karimnagar	1286	936	980	37.4%	31.2%	Excess
4	Khammam	1132	1202	1076	-5.8%	5.2%	Normal
5	Mahbubnagar	682	472	721	44.4%	-5.5%	Normal
6	Medak	924	603	925	53.2%	-0.1%	Normal
7	Nalgonda	781	595	768	31.3%	1.7%	Normal
8	Nizamabad	1337	853	1093	56.8%	22.3%	Excess
9	Rangareddy	756	495	839	52.7%	-9.9%	Normal
10	Warangal	1295	1010	988	28.2%	31.1%	Excess
	State Mean	**1040**	**787**	**933**	32.1%	11.4%	**Normal**

Legend: Large Excess (+60% or more), Excess (+20% to +59%), Normal (+19% to -19%), *Source: India Meteorological Department, GOI*

3.2.2.1 Rainfall Departure of June'19- May'20 from Normal Rainfall of Same Period :

Fig 3.3 gives departure of Jun'19- May'20 rainfall from normal of the same period. It is prepared to correlate with depth to water level map of May 2020. During the period Jun'19- May'20, the state has received 11.4 % more rainfall (1040 mm) than normal rainfall (933 mm). It ranges from –9.9% in Rangareddy district to 31.2% in Karimnagar district. The state has received excess rainfall in Karimnagar, Nizamabad & Warangal districts and normal rainfall in the remaining districts.

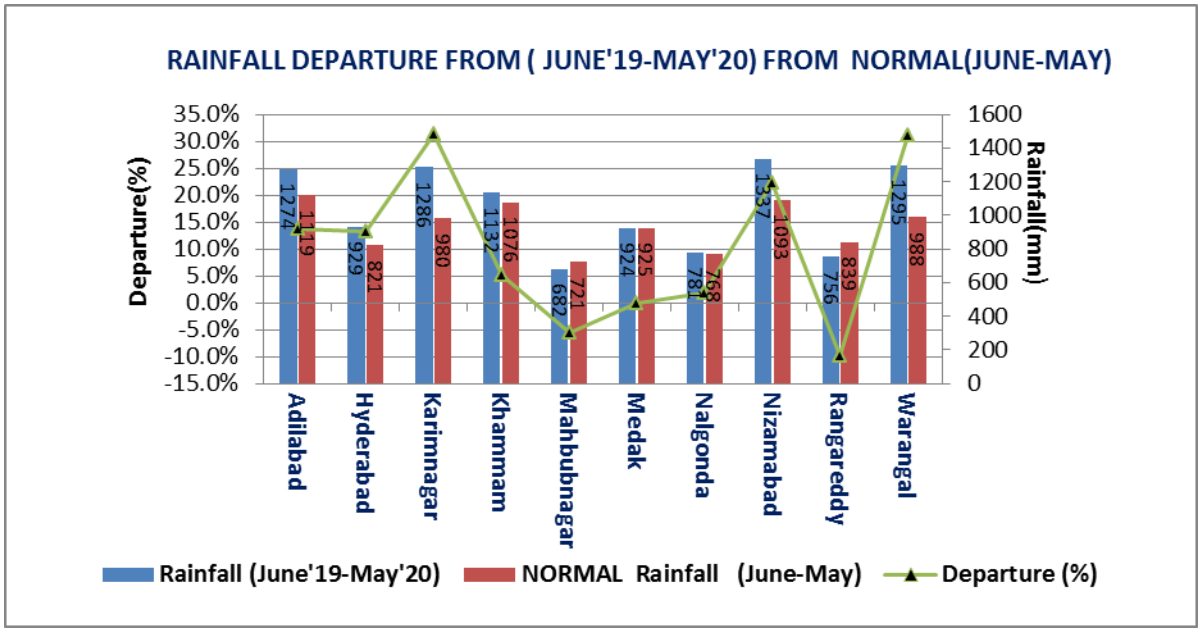


Fig.3.3: Rainfall Departure of June'19- May'20 from Normal of same Period.

3.2.1.2 Rainfall Departure of Jun'19- May'20 from June'18-May'19.

Fig 3.4 gives departure of Jun'19- May'20 rainfall from June'18 to May'19 rainfall. It is prepared to correlate with water level fluctuation map of May 2019 to May 2020. **Table 3.2** indicates that state has received 1040 mm of rainfall during the period June'19- May'20, which is 32.1% more than the rainfall received during June'18 to May'19. The departure in percentage ranges from -5.8% in Khammam district to 67.1% in Hyderabad district.

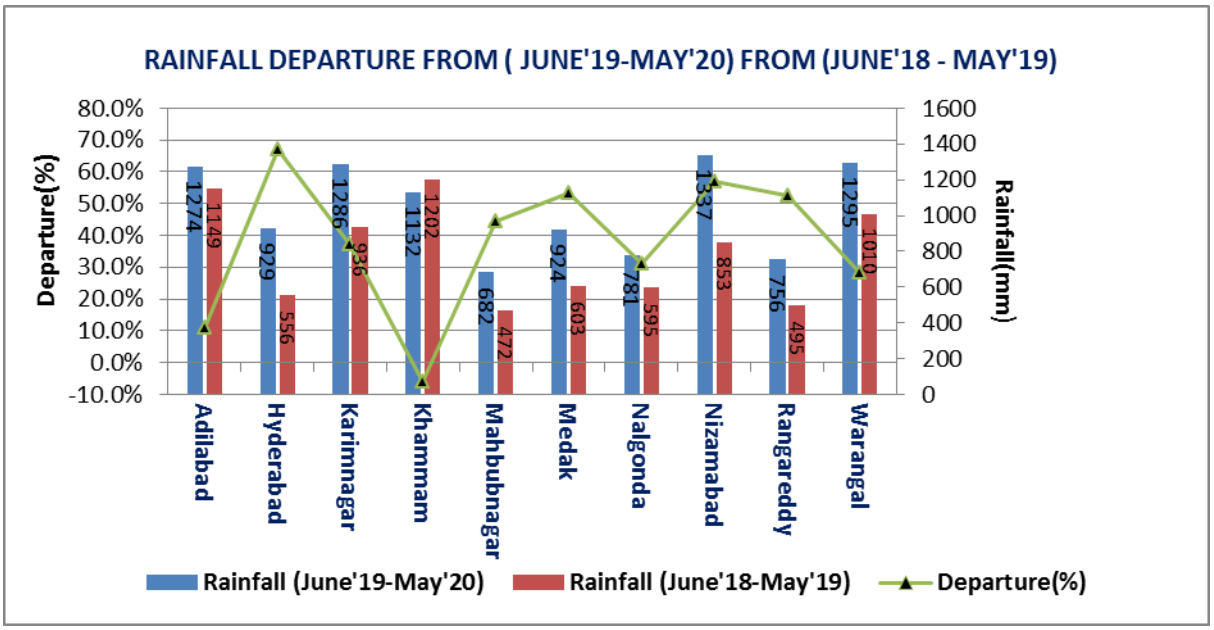


Fig.3.4: Rainfall Departure of Jun'19- May'20 from June '18 to May'19

3.2.2 August, 2020

Table-3.3 gives the district-wise rainfall data for the period June-August 2019, June-August 2020 and normal of June-August and the departure of June- August, 2020 rainfall with other periods. The departure values are used to prepare the graphs and presented in **Fig 3.5** & **Fig 3.6.**

Table-3.3: Salient Features of Rainfall and its Variability in Telangana State.

Sl. No.	DISTRICT	Rainfall (mm) (June'20 -Aug'20)	Rainfall (mm) (June'19 -Aug'19)	Normal Rainfall (mm) (June-Aug)	Departure from 2019 (%)	Departure from Normal (%)	Rainfall Classification
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
1	Adilabad	815	798	788	2.1%	3.4%	Normal
2	Hyderabad	595	360	478	65.3%	24.5%	Excess
3	Karimnagar	862	668	637	29.0%	35.3%	Excess
4	Khammam	1104	631	690	75.0%	60.0%	Large Excess
5	Mahbubnagar	710	315	411	125.5%	72.8%	Large Excess
6	Medak	698	445	579	56.8%	20.5%	Excess
7	Nalgonda	528	315	405	67.6%	30.3%	Excess
8	Nizamabad	760	697	747	9.0%	1.7%	Normal
9	Rangareddy	607	366	477	65.9%	27.3%	Excess
10	Warangal	1327	718	641	84.8%	107%	Large Excess
	State Mean	**801**	**531**	**585**	**50.8%**	**36.9%**	**Excess**

Legend: Large Excess (+60% or more), Excess (+20% to +59%), Normal (+19% to -19%). *Source: India Meteorological Department, GOI*

3.2.2.1 Rainfall Departure of June – August 2020 from Normal Rainfall of Same Period: **Fig 3.5** gives departure of June – August 2020 rainfall from normal of the same period. During the period June – August 2020, the state has received 36.9% more rainfall (801 mm) than normal rainfall (585 mm). It ranges from 1.7% in Nizamabad district to 107% in Warangal. The state has received large excess rainfall in Khammam, Mahabubnagar & Warangal districts, normal in Adilabad & Nizamabad districts and excess rainfall in the remaining districts.

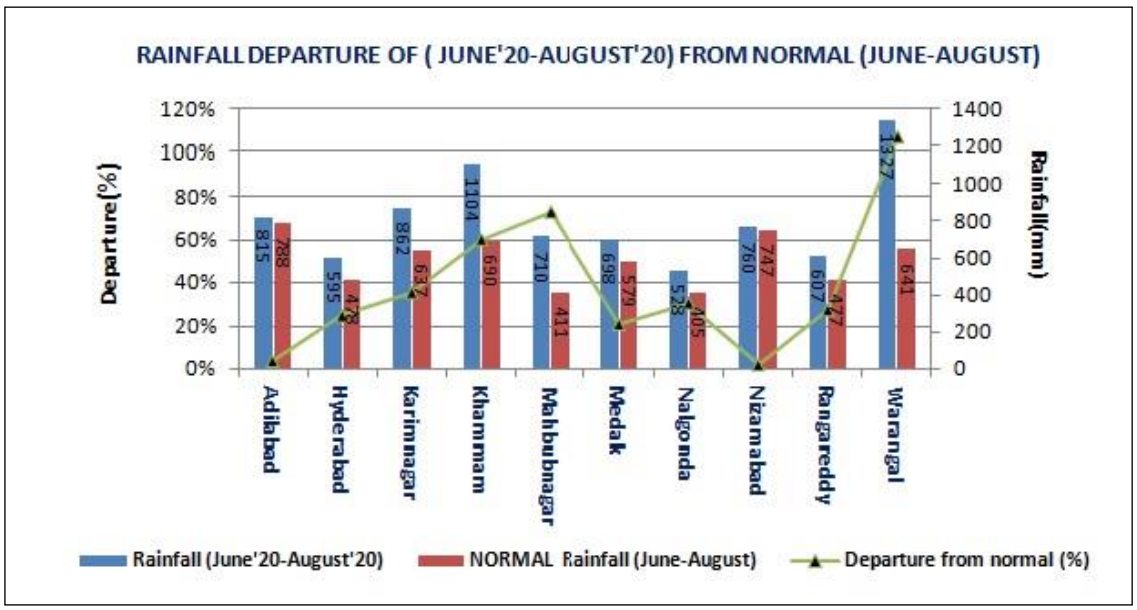


Fig.3.5: Rainfall Departure of June – August 2020 from Normal of same Period.

3.2.2.2 Rainfall Departure of June – August 2020 from June – August 2019.

Fig 3.6 gives departure of June – August 2020 rainfall from June – August 2019 rainfall. **Table 3.3** indicates that state has received 801 mm rainfall during the period June – August 2020, which is 50.8% more than the rainfall received during June – August 2019. The departure in percentage ranges from 2.1% in Adilabad district to 125.5% in Mahbubnagar district.

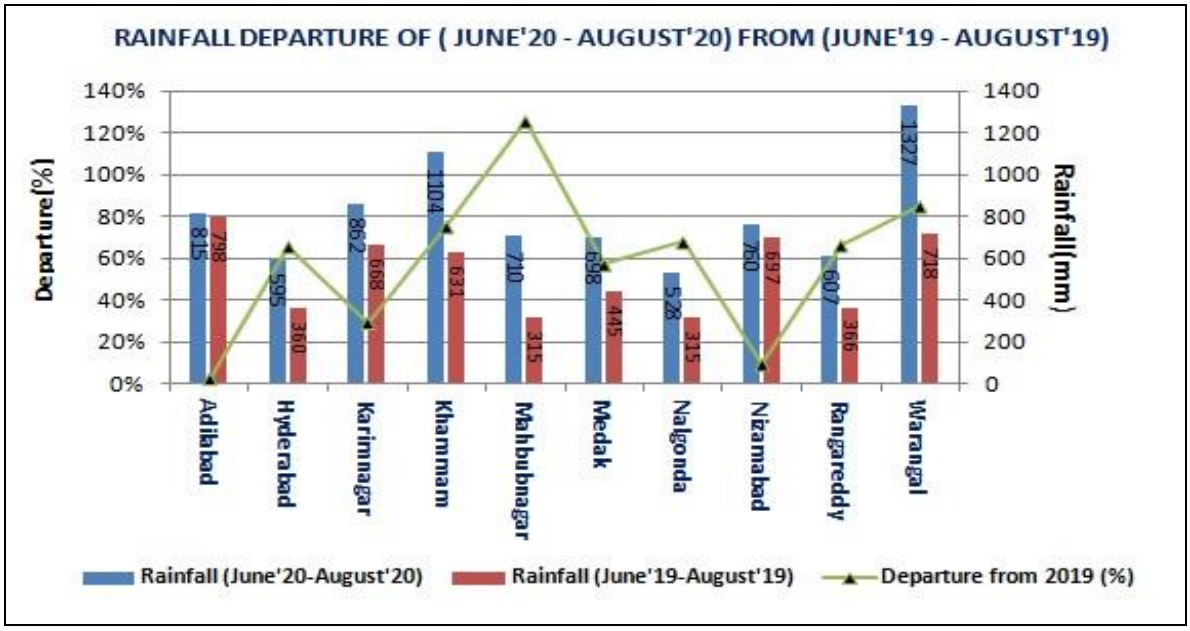


Fig.3.6: Rainfall Departure of Jun'20- Aug'20 rainfall from Jun '19 to Aug'19

3.2.3 November, 2020

Table-3.4 gives the district-wise rainfall data for the period June to October 2020, June to October 2019, normal for June to October and the departure of June to October 2020 rainfall from normal and previous year (2019). The departure values are used to prepare the graphs as shown in **Fig 3.7** and **Fig 3.8.**

Table-3.4: Salient Features of Rainfall and its Variability in Telangana State.

S. No.	District	Rainfall (mm) (June'20-October' 20)	Rainfall (mm) (June'19-October'19)	Normal Rainfall (mm) (June-October)	Departure from 2019 (%)	Departure from Normal (%)	Remarks
1	Adilabad	1088	1158	1042	-6%	4%	Normal
2	Hyderabad	1186	833	739	42%	60%	Large Excess
3	Karimnagar	1249	1202	886	4%	41%	Excess
4	Khammam	1579	1047	967	51%	63%	Large Excess
5	Mahbubnagar	1211	623	645	94%	88%	Large Excess
6	Medak	1203	828	831	45%	45%	Excess
7	Nalgonda	959	707	661	36%	45%	Excess
8	Nizamabad	1121	1230	1011	-9%	11%	Normal
9	Rangareddy	1102	687	748	60%	47%	Excess
10	Warangal	1770	1203	886	47%	100%	Large Excess
	State mean	**1247**	**952**	**842**	**31%**	**48%**	**Excess**

Legend: Large Excess (+60% or more), Excess (+20% to +59%), Normal (+19% to -19%). *Source: India Meteorological Department, GOI*

3.2.3.1 Rainfall Departure (June to October 2020) from Normal Rainfall of Same Period:

During the period June to October 2020, the state has received 48% more rainfall than normal rainfall. **Fig.3.7** gives the departure of June to October 2020 rainfall from normal rainfall of the same period. It ranges from 4% in Adilabad district to 100% in Warangal district. The state has received normal rainfall in Adilabad & Nizamabad districts and excess to large excess rainfall in the remaining districts. During Southwest monsoon period state received excess rainfall (40% above normal) due to back to back low pressure systems formed over North Bay of Bengal in August 2020. During October many districts of the state received heavy to very heavy rainfall due to the formation of Deep depression (11- 14 October 2020) in Bay of Bengal and it

crossed Telangana as a Depression. Extremely heavy rainfall of 31.1 cm recorded at Rain gauge in CGWB, SR campus on 14th October 2020. Hyderabad, Medak, Rangareddy and Warangal districts received large excess rainfall of 296%, 174%, 160% & 112% above normal, respectively in October 2020.

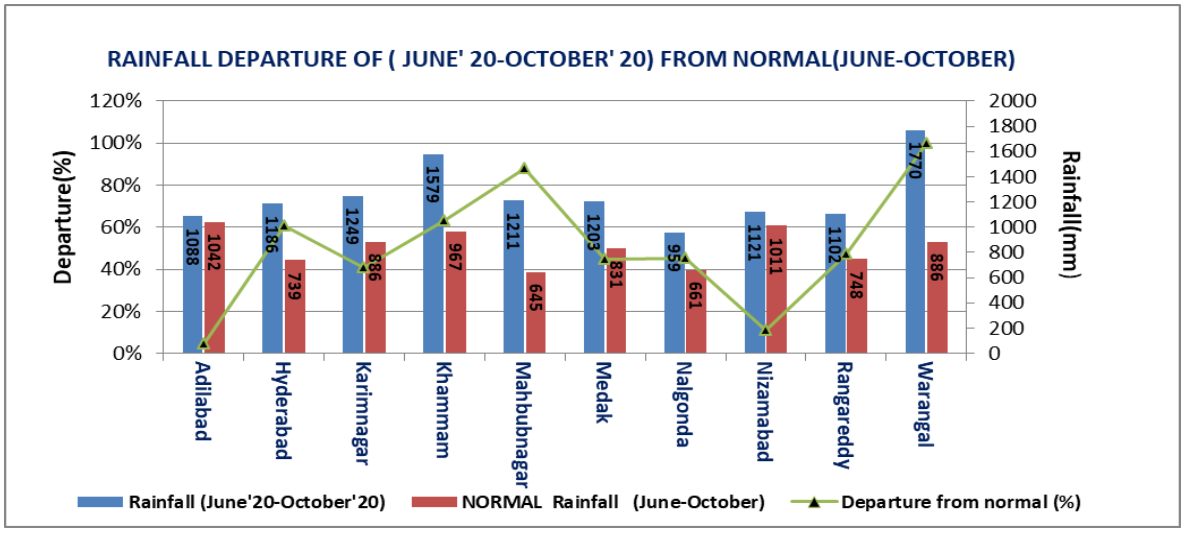


Fig.3.7: Rainfall Departure (June-October'20) from Normal of same Period.

3.2.3.2 Rainfall Departure June to October 2020 from June to October 2019:

State has received 1247 mm of rainfall during the period June to October 2020, which is 31% more than the rainfall (952 mm) received during the same period last year (**Table-3.4**). **Fig.3.8** gives departure of June - October 2020 rainfall from June - October 2019 rainfall. The departure in percentage ranges from -9% in Nizamabad to 94 % in Mahabubnagar district.

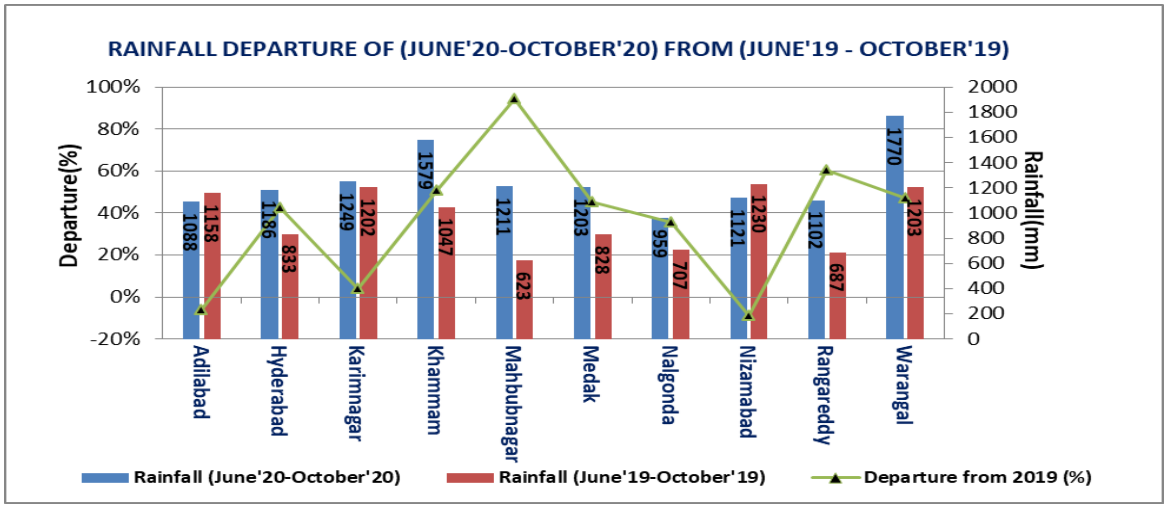


Fig.3.8: Rainfall Departure June-October'20 from June -October'19.

3.2.4 January 2021

The rainfall data collected and compiled from weekly weather reports of India Meteorological Department and used to analyze the rainfall for the period June-December 2020. **Table-3.5** gives the district-wise rainfall data for the period June to December 2020, June to December 2019, normal for June to December and the departure of June to December 2020 rainfall from normal and previous year (2019). The departure values are used to prepare the graphs as shown in **Fig.3.9** and **Fig.3.10.**

Table-3.5: Salient Features of Rainfall and its Variability in Telangana State.

District	Rainfall (mm) (June'20 -Dec' 20)	Rainfall (mm) (June'19-Dec'19)	Normal Rainfall (mm) (June-December)	Departure from 2019 (%)	Departure from Normal (%)	Remarks
Adilabad	1089	1170	1064	-7%	2%	Normal
Hyderabad	1194	838	769	42%	55%	Excess
Karimnagar	1249	1211	913	3%	37%	Excess
Khammam	1604	1066	996	50%	61%	Large Excess
Mahabubnagar	1229	632	670	95%	83%	Large Excess
Medak	1204	835	855	44%	41%	Excess
Nalgonda	979	714	699	37%	40%	Excess
Nizamabad	1121	1248	1034	-10%	8%	Normal
Rangareddy	1110	693	772	60%	44%	Excess
Warangal	1781	1223	916	46%	94%	Large Excess
State Mean	**1256**	**963**	**869**	**30%**	**45%**	**Excess**

Legend: Large Excess (+60% or more), Excess (+20% to +59%), Normal (+19% to -19%). *Source: India Meteorological Department, GOI*

3.2.4.1 Rainfall Departure (June to December 2020) from Normal Rainfall of Same Period:

During the period June to December 2020, the state has received 45% more rainfall (1256 mm) than normal rainfall (869 mm). **Fig.3.9** gives the departure of June to December 2020 rainfall from normal rainfall of the same period. It ranges from 2% in Adilabad district to 94% in Warangal district. The state has received large excess rainfall in Warangal, Mahabubnagar & Khammam districts, excess rainfall in Hyderabad, Karimnagar, Medak, Nalgonda & Rangareddy districts and normal rainfall in Adilabad & Nizamabad districts. During Southwest monsoon

(June to September) period state received excess rainfall (40% above normal) due to back to back low pressure systems formed over North Bay of Bengal in August 2020. During Northeast monsoon (October to December) state received 68% above normal rainfall since many districts of the state received heavy to very heavy rainfall due to the formation of Deep depression (11-14 October 2020) in Bay of Bengal and it crossed Telangana as a Depression. The State has received 57% less rainfall from normal in November and no rainfall reported in IMD rain gauge stations in December.

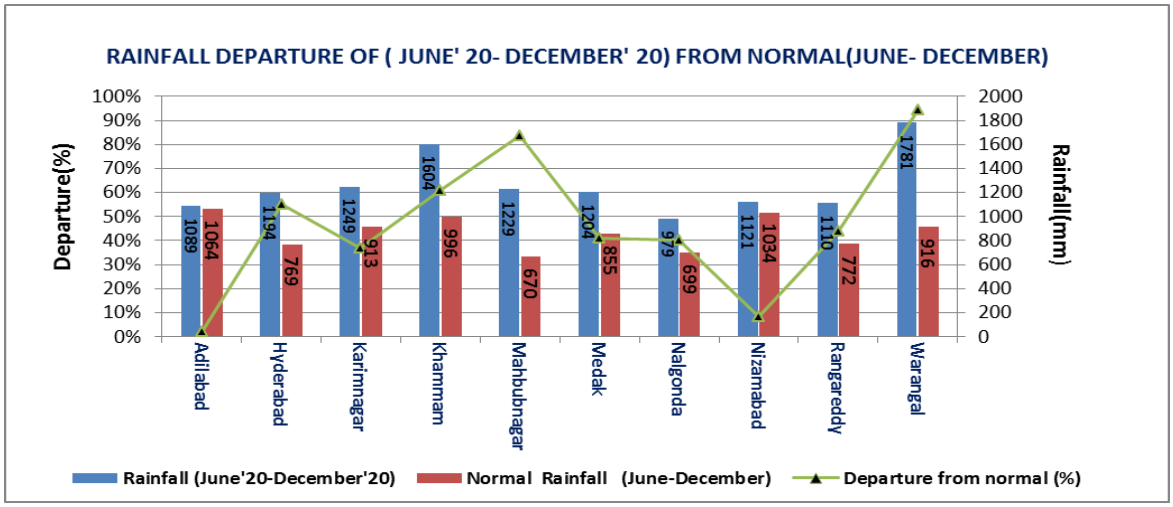


Fig.3.9: Rainfall Departure (June-December'20) from Normal of same Period.

3.2.4.2 Rainfall Departure June to December 2020 from June to December 2019:

State has received 1256 mm of rainfall during the period June to December 2020, which is 30% more than the rainfall (963 mm) received during the same period in 2019 (**Table-3.5**). **Fig.3.10** gives departure of June - December 2020 rainfall from June - December 2019 rainfall. The departure in percentage ranges from -10% in Nizamabad to 95% in Mahabubnagar district.

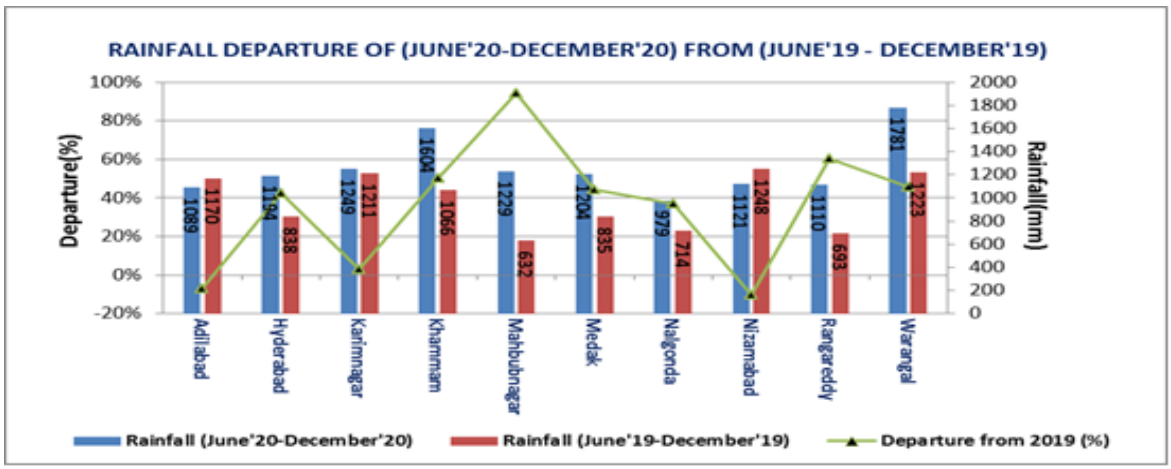


Fig.3.10: Rainfall Departure June-December'20 from June - December'19.

4. GEOLOGY

A wide variety of geological formations occur in Telangana state, ranging from the oldest Archaean crystalline formations to recent alluvium. The geological set up and principal aquifer system are presented in 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 overlain by basaltic lava flows in the northwestern part and is intruded by several younger rocks namely granites, dolerites, pegmatites and quartzites etc.

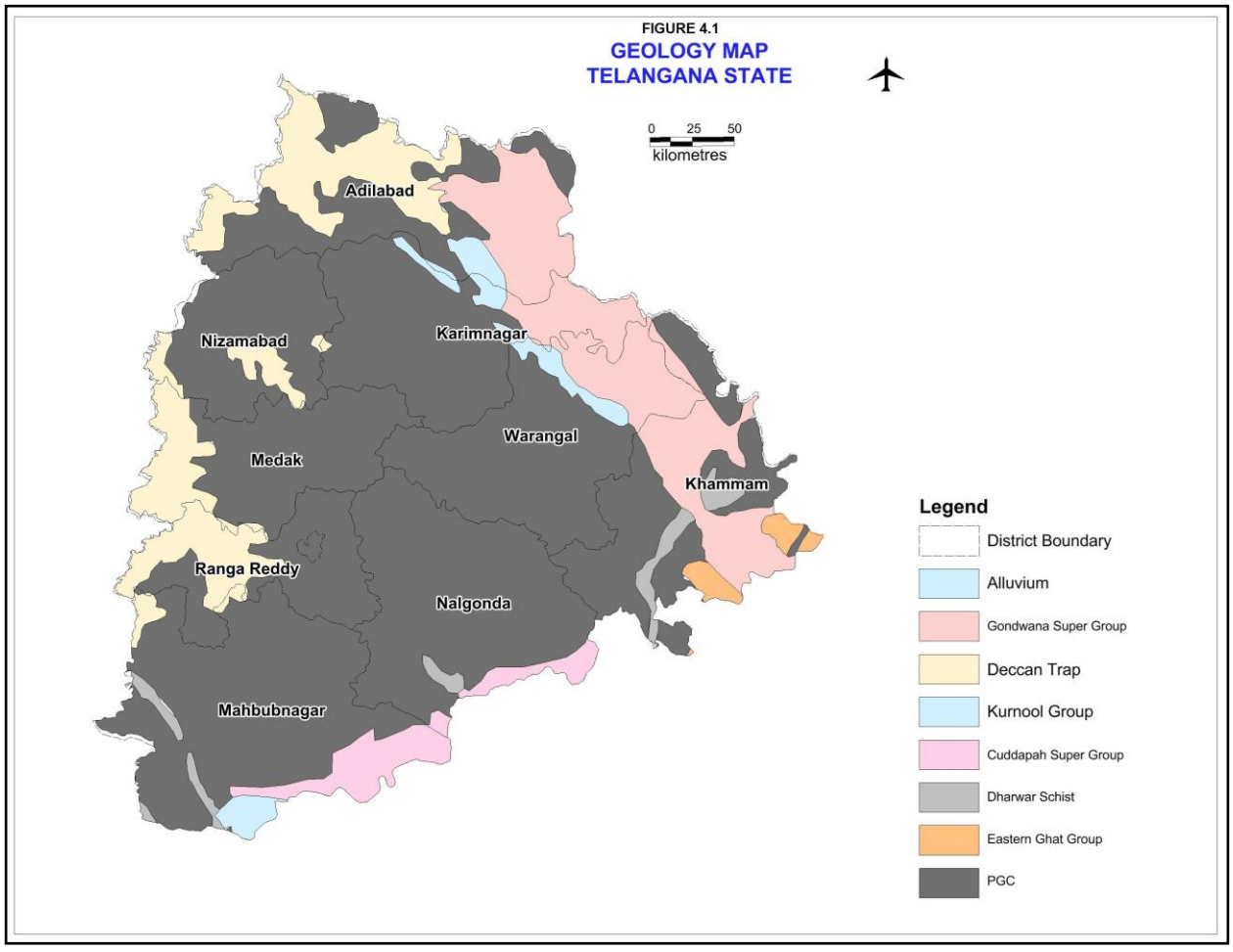


Fig.4.1: Geology of Telangana state.

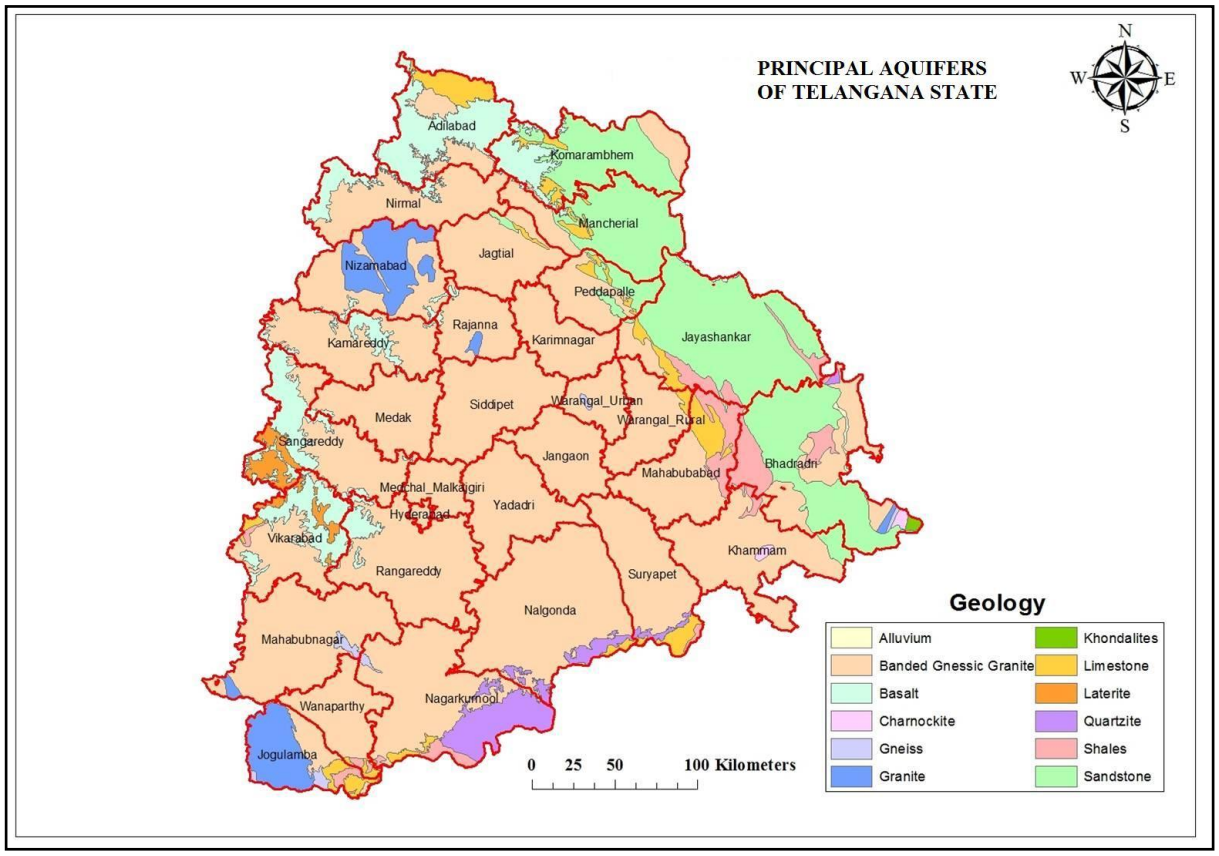


Fig.4.2: Principal Aquifers of Telangana state.

4.1 Archaean and Lower Protorozoic

Peninsular gneisses of Archaean age are dominant rock types in Telangana state. These are intruded by closepet granite and dolerite dykes. Dharwars, comprising amphibolites, gneisses, schists, and quartzites occur as narrow isolated bands within granites in Mahabubnagar, Nalgonda, Khammam, Warangal, Karimnagar and Adilabad districts.

4.2 Middle to Upper protorozoic

The group includes Cuddapahs, Pakhals, Pengangas, Kurnools and Sullavais comprising shales, limestones, dolomites, sandstones and conglomerates. The Cuddapah Super Group of rocks and Kurnool group of rocks occur in parts of Nalgonda and Mahabubnagar districts. The Pengangas, which are considered as equivalent of Pakhals, are exposed in Adilabad district. Bheema group of rocks consisting of flaggy massive and argillaceous limestones occur along western border of Rangareddy district. Sullavais sandstones overlie Pakhals and Penganga rocks consisting shales, limestones, sandstones and conglomerates occur in Adilabad, Karimnagar and Warangal districts.

4.3 Gondwana Super Group

Fresh water fluvial sediments of Gondwana Super group rocks (Upper Carboniferous to Lower Cretaceous), comprising lower group of rocks occur along NW-SE trending Pranhita-Godavari valley extending in Adilabad, Karimnagar and Warnagal districts. Lower Gondwanas are well developed in Godavari valley and sub-divided into Talchirs, Barakars, Barren measures and Kamthis consisting mainly conglomerates, sandstones, shales occassionaly clays in parts of Khammam district. The upper Gondwana is sub-divided into Maleru, Kota, Gangapur and Chikiala formations consisting of sandstones, conglomerates and clays.

4.4 Deccan Traps (Basalt)

Horizontal to sub-horizontal disposed lava flows of the Deccan traps covering ~8210 Km^2 occur in parts of Adilabad (4187 Km^2), Nizamabad(701 Km^2), Medak (1513 Km^2), Ranga Reddy (1680 Km^2)and Mahbubnagar districts (128 Km^2). The thickness of individual flow varies between a few metres to as much as 30 m with total thickness to more than 200 m at places. They overlie Archaean group of rocks except in Ranga reddy district where they overlie Bhima Group of rocks. Inter-trappean beds comprising limestone, chert and sandstone occur between trap flows near Vikarabad and Adilabad.

4.5 Quaternary Depostis

Sub-recent deposits represented by laterite capping occur in Medak and Rangareddy districts at places with thickness up to 30 m. They cover about 916 Km^2 area in the state (Medak: 609 Km^2 and Rangareddy 307 Km^2).

5. GROUND WATER RESOURCES (2017)

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 estimates (March 2017), the net annual ground water availability is about 12361 MCM (436.5 TMC) (Command Area: 3486 MCM (123.1 TMC) and non-command area: 8875 MCM (313.4TMC)). The current annual round water extraction for all uses is 8072 MCM (284.5 TMC) (Domestic and Industrial extraction: 978 MCM (34 TMC) & Irrigation extractions: 7094 MCM (250.5 TMC)). The Annual Extractable Groundwater Resource for future needs is 4317 MCM (152 TMC). The overall Stage of Groundwater Extraction ranges from 23% to 94% (excluding Hyderabad with averages of 65%) (Command-58% & and Non-Command- 68%).

Out of 584 mandals, 70 mandals fall under over exploited, 67 mandals under critical, 169 mandals under semi-critical and 278 mandals under safe category. The categorization of mandals is depicted in **Fig.5.1**.

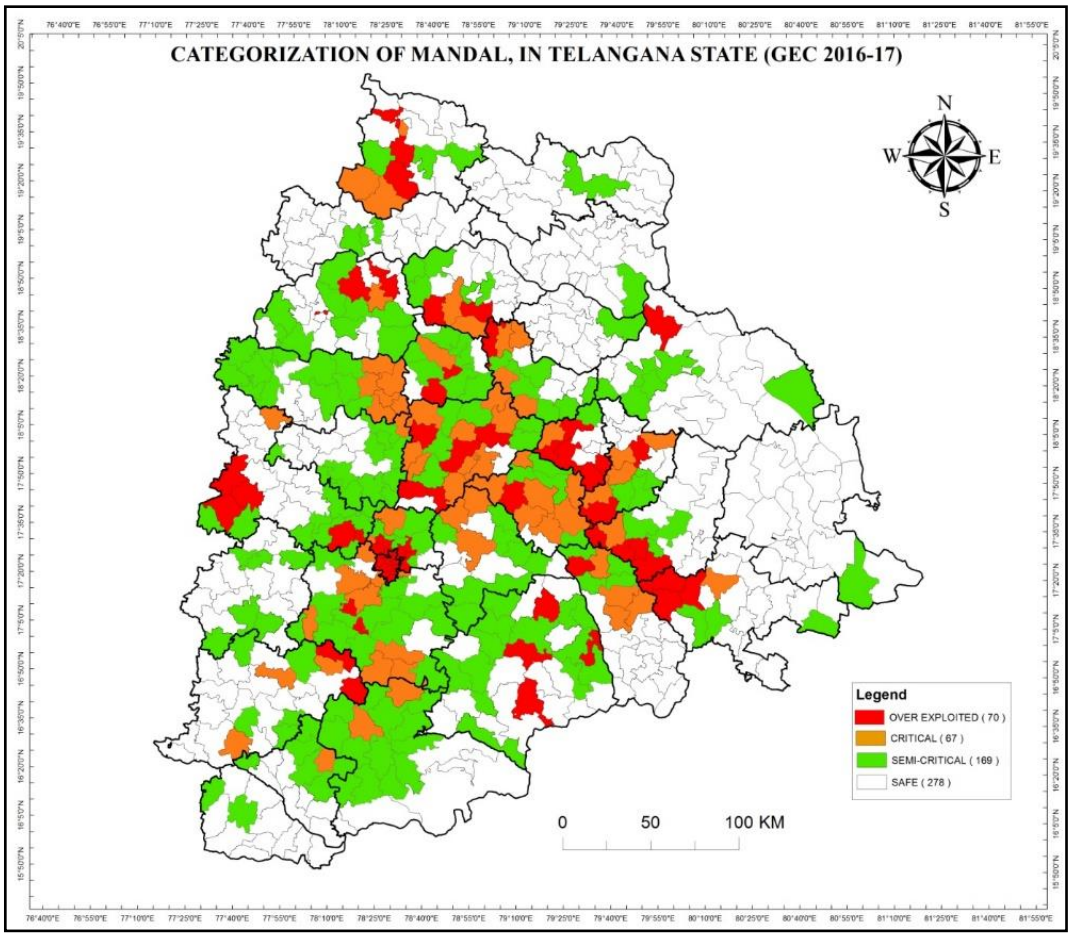


Fig.5.1: Categorization of mandals (as on 2017), Telangana state.

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.

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

Ground water occurrence point of view, litho units of the state are grouped into following 3 groups.

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

6.1 Consolidated formations

Crystalline rocks of Archaean age, metasedimentary rocks of Cuddapahs, Kurnools and basaltic lava flows of Deccan traps are included in these formations. The crystalline rocks which occupy ~83% of area, 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 3 to 20 m bgl and majority of fractures occur within 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 5 lps.

Pakhals, Penganga and Sullavais are relatively poor to moderate potential aquifers and basalts are hard and compact and possess meagre primary porosity (by virtue of interconnected vesicles). Fractures in basalts are developed due to columnar joints and tectonic activities. Yield of ground water in these rocks varies from 0.1 to 3 lps and potential zones exist down to 38-200 m depth.

6.2 Semi-consolidated formations

Semi-consolidated formations are represented by rocks belonging to Gondwana formations. The Talchirs, Barakaras and Kamthi formations yield more ground water (up to 60 lps). At some place auto flows are encountered.

6.3 Unconsolidated formations

Unconsolidated formations represented by river alluvium occur along the major rivers Godavari and Krishna and their tributaries in the state.

6.4 Monitoring Methodology

Ground water regime is monitored through a network of dug wells and piezometers known as Ground Water Monitoring Stations (GWMS). The dug wells, which are owned by government and non-government agencies and individual users, tap shallow aquifers. Piezometers (basically bore wells/tube wells) constructed exclusively for ground water regime monitoring under Hydrology Project tap both shallow and deeper aquifers. Some of the exploratory wells/ observatory wells drilled under exploratory drilling programme of CGWB tapping deeper aquifers 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

To observe micro-level changes in ground water regime, weekly measurements are initiated in phases involving local people as observers under participatory ground water monitoring programme. Participatory observers are engaged since May, 2005, from the local area where GWMS are existing and as on 31st March 2021, 115 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) of every year 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 over a period of time since 1969. The database is maintained in Oracle database 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 district wise, basin wise and aquifer system wise are summarized below.

6.6.1 District-Wise Distribution of Ground Water Monitoring Wells

Total 737 GWMS are monitored in the state (Dug wells: 295 (40%) and Piezometer wells: 442 (60%)) and density varies from 9 Km^2/well (Hyderabad) to 237 Km^2/well in Adilabad district (**Table-6.1** and **Fig.1.1**).

Table-6.1: Distribution of GWMS, Telangana State (As on March, 2021).

S. No.	District	Area (Km2)	No of GWMS			No of Participatory observers	Density of Net work
			DW	Pz	Total	Nos	Km^2/well
1	Adilabad	16105	43	25	68	12	237
2	Hyderabad	217	6	19	25	5	9
3	Karimnagar	11823	26	53	79	8	150
4	Khammam	13266	44	13	57	19	233
5	Mahabubnagar	18432	18	72	90	12	205
6	Medak	9699	17	53	70	9	139
7	Nalgonda	14240	42	75	117	15	122
8	Nizamabad	7956	18	26	44	8	181
9	Ranga reddy	7493	40	54	94	14	80
10	Warangal	12846	41	52	93	13	138
	Total	**112077**	**295**	**442**	**737**	**115**	152

6.6.2 Basin-wise Distribution of Ground Water Monitoring Wells

Out of 737 monitoring wells 329 wells are falling in Godavari basin (45%) and 408 wells are falling in Krishna basin (55%) **(Table-6.2)**.

Table-6.2: Basin-wise Distribution of Ground Water Monitoring Wells

DISTRICT	GODAVARI BASIN	KRISHNA BASIN	TOTAL
Adilabad	68	0	68
Hyderabad	0	25	25
Karimnagar	79	0	79
Khammam	25	32	57
Mahabubnagar	0	90	90
Medak	68	2	70
Nalgonda	0	117	117
Nizamabad	43	1	44
Rangareddy	7	87	94
Warangal	39	54	93
TOTAL	329	408	737

6.6.3 Aquifer-Wise Distribution of Ground Water Monitoring Wells

District-wise and aquifer-wise distribution of Dug wells and Piezometers (GWMS) is given in **Table-6.3.** Majority of GWMS (74% Dugwells and 85% Piezometers) are located in Granitic rocks followed by Sandstone (8%), and basalt rocks (6%).

Table-6.3: District-wise and Principal Aquifer-wise Distribution of monitoring stations, Telangana state (as on March, 2021).

District	Dug wells									DW Total	Piezometers								Pz Total
	AL	BG	BS	GR	LS	LT	QZ	SH	ST		BG	BS	GN	GR	LS	LT	SH	ST	
Adilabad		5	10	15	1			2	10	43	4	5		12			1	3	25
Hyderabad		6								6	19								19
Karimnagar		21							5	26	41							12	53
Khammam	2	28		3				2	9	44	4				2			7	13
Mahabubnagar		15	1		1		1			18	63		3	1	4		1		72
Medak		11	4			2				17	39	10				4			53
Nalgonda		41					1			42	75								75
Nizamabad		15		3						18	15			11					26
Rangareddy		22	12			6				40	43	5				6			54
Warangal		33						2	6	41	47				1			4	52
Grand Total	**2**	**197**	**27**	**21**	**2**	**8**	**2**	**6**	**30**	**295**	**350**	**20**	**3**	**24**	**7**	**10**	**2**	**26**	442

(Note: Al-Alluvium, BGC-Banded Gneissic complex, BS-Basalt, CK-Charnokite, Gn-Gneiss, Gr-Granite, LS-Limestone, Qz-Quartzite, SH-Shale, ST-Sandstone).

7. ANALYSIS OF WATER LEVELS

The ground water levels observed over a period of time provide valuable information on behaviour of the ground water regime, which is constantly subjected to changes due to recharge and discharge phenomena. Balance between recharge and discharge results in 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, 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 shallow aquifers (tapping weathered zone and first fracture zone) are presented in detail. Water levels tapping deeper fractures are discussed separately. The data from GWMS for the year 2019-20 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 in the previous year gives an idea about the change in the ground water level for a particular period with respect to that of the 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 previous year 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.

Note : *Water level monitoring and sampling was not done during May 2020 and August 2020 because of COVID-19 conditions. However NHS observer data and NHS data of Hyderabad and Rangareddy districts along with State monitoring data were utilized for preparing May and August 2020 reports.*

7.1 Depth to Water Levels

7.1.1 Depth to Water Levels (May-2020– Pre-monsoon season)

The depth to water level during May, 2020 based on analysis of water level data of 765 wells is generalized and given below. Depth to water level map is given in **Fig.7.1**.

Analysis of depth to water level data of 765 wells **(Annexure - III)** shows water levels vary between 0.38 m.bgl (Nalgonda district) and 49.11 m.bgl (Medak). The average water level of the state is 11.14 m bgl ranging from 8.37 m bgl in Khammam to 22.00 m bgl Medak district. Water level of less than 2 m bgl is recorded in 2% of wells, between 2-5 m bgl in 19% of wells, between 5-10 m bgl in 33% of wells, between 10-20 m bgl in 33% of wells, between 20-40 m bgl in 12% of wells and the remaining 0.3% of wells with depth to water level more than 40 m bgl. Depth to water level map of May, 2020 **(Fig.7.1)** shows that shallow water levels of less than 2 m bgl are noticed as small isolated scattered patches covering an area of 0.34 % (16 wells) in Adilabad, Mahbubnagar, Nalgonda Khammam, Karimnagar and Ranga Reddy districts of the state. Water level between 2 to 5 m bgl is covered in 13.38% of area (145 wells) and 39.04 % of the area covered by depth to water level of 5 to 10 m bgl (255 wells). Water level 10 to 20 m bgl covered in 37.96 % of the area (253 wells). Deeper water levels of more than 20 m to 40 m covers an area of about 9.24% (94 wells) of the state and more than 40m covers 0.04% (2 wells) of the area, noticed only in Medak.

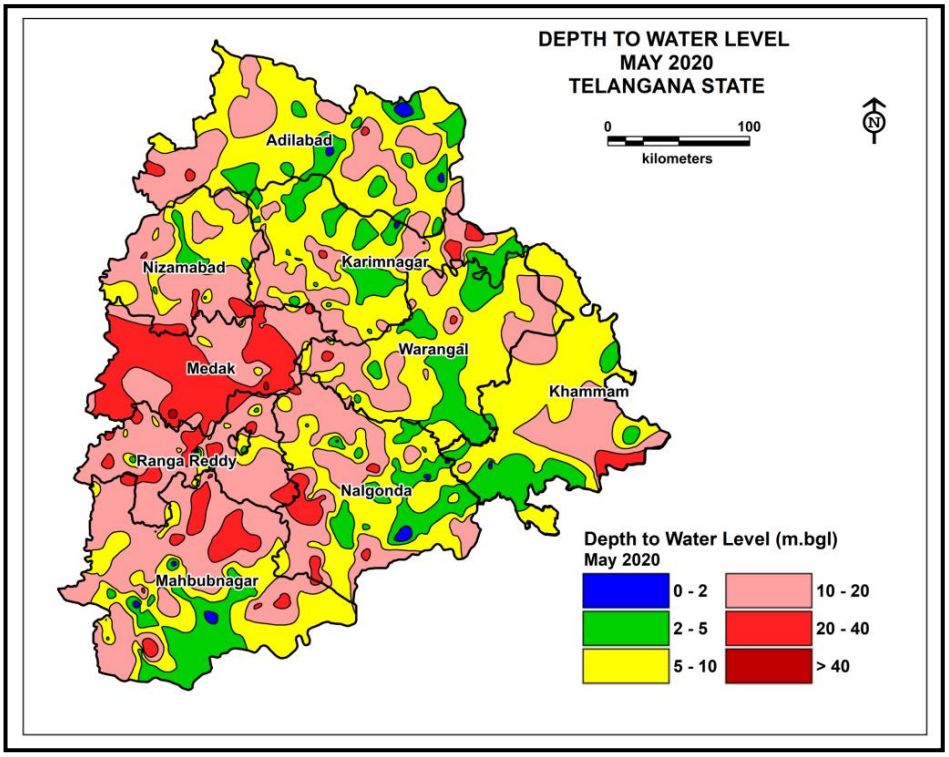


Fig.7.1: Depth to water levels, Premonsoon – May 2020

7.1.2 Depth to Water Levels (August-2020-Mid-monsoon Season)

The depth to water level data of 1136 wells is used for the analysis. Depth to water level map is given in **Fig.7.2**.

Analysis of depth to water level data **(Annexure - IV**) shows that water levels range between 0.1 m bgl (Adilabad, Warangal and Mahabubnagar districts) and 48.3m bgl (Nalgonda district).

Water level of less than 2 m bgl is recorded in 29 % of wells, between 2-5 m bgl in 27% of wells, between 5-10 m bgl in 18% of wells, between 10-20 m bgl in 19% of wells, between 20-40 m bgl in 6% of wells and >40 m bgl in 1% of wells. Depth to water level map of August-2020 **(Fig.7.2)** shows that, shallow water level of less than 2 m bgl are noticed in 21% (331wells) area, small parts in all the districts of the state. Water level between 2 to 5 m bgl is covered in 33% of area (309 wells) and 24% of the area covered by depth to water level of 5 to 10 m bgl. (209 wells). Water level of 10 to 20 m bgl covered in 18% of the area (220 wells). Deeper water level between 20 m to 40 m covers area of about 3% (65 wells) of the state and greater than 40m covers 1% (2 wells) of the area, noticed in Medak, Mahbubnagar, and Nalgonda districts.

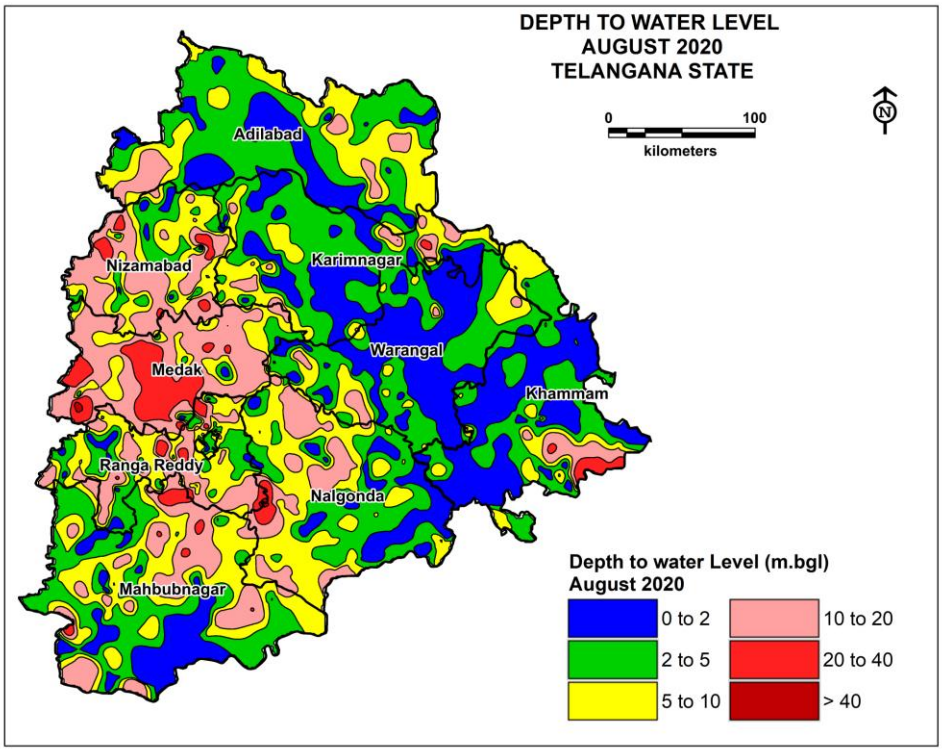


Fig.7.2: Depth to Water Levels-August 2020.

7.1.3 Depth to Water Levels (November-2020-Post-Monsoon)

The depth to water level during November-2020 based on water level data of 552 monitoring wells is generalized. Depth to water level map is given in **Fig.7.3**.

Analysis of depth to water level data of 552 wells **(Annexure - V**) show water level range between ground level and 26.3 m.bgl in Medak district. The average water level of the state is 3.78 m bgl. Water level of less than 2 m bgl is recorded in 38% of wells, between 2-5 m bgl in 40% of wells, between 5-10 m bgl in 17% of wells, between 10-20 m bgl in 4% of wells, between 20-40 m bgl in 1% of wells and in the rest 0.2% of wells with depth to water level more than 40 m bgl. Depth to water level map of November-2020 **(Fig.7.3)** shows that shallow water levels of less than 2 m.bgl, covering an area of 29% are noticed mainly in Warangal, Khammam, Hyderabad, Rangareddy, Karimnagar, Nalgonda, Mahabubnagar and Adilabad districts. Water level between 2 to 5 m.bgl is recorded predominantly in all districts covering an area of 51 % and 16 % of the area covered by depth to water level of 5 to 10 m bgl. Water level 10 to 20 m bgl covered in 3% of the area. Deeper water level of > 20 m are only observed in small parts of Medak, Mahabubnagar and Rangareddy districts, representing about 1% area of the state.

The rainfall received during June 2020 to October 2020 is large excess (>60% of the normal rainfall) in Warangal, Mahbubnagar, Khammam and Hyderabad where the depth to water levels recorded are mostly <5 m.bgl. The shallow water levels in the state can be attributed to excess rainfall received during the period.

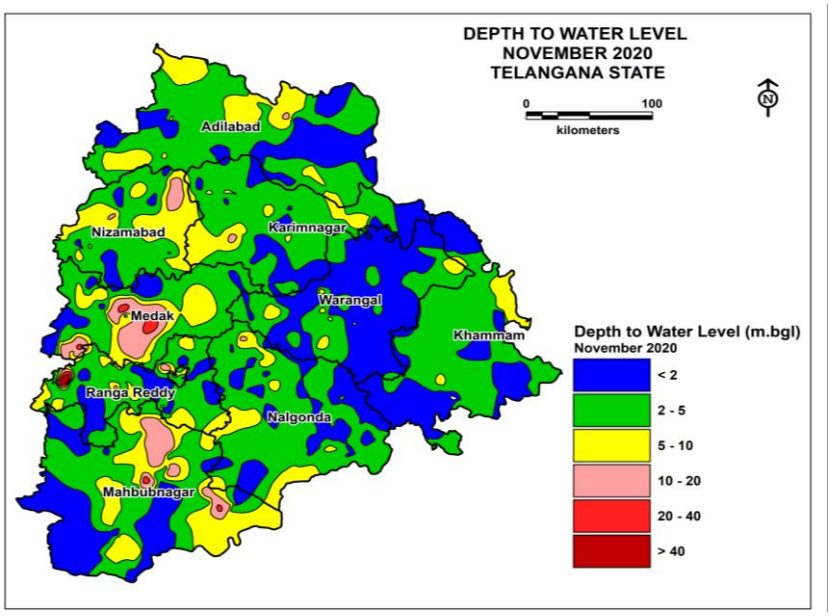


Fig.7.3: Depth to Water Levels-November 2020

7.1.4 Depth to Water Levels (January-2021)

The depth to water level data of 558 wells is used for the analysis. Depth to water level map is given in **Fig.7.4**.

Analysis of depth to water level data of 558 wells **(Annexure - VI**) shows that water level ranges between ground level to 50 m bgl (Medak district). Water level of less than 2 m bgl is recorded in 6% of wells, between 2-5 m bgl in 27% of wells, 5-10 m bgl in 32% of wells, 10-20 m bgl in 26% of wells, 20-40 m bgl in 8% of wells and >40 m bgl in 1% of wells. Depth to water level map of January 2021 **(Fig.7.4)** shows that shallow water level less than 2 m bgl, covering an area of 11% are noticed mainly in parts of Warangal, Khammam, Nalgonda, Mahabubnagar and Adilabad districts. Water level between 2 to 5 m bgl is recorded in parts of all the districts in Telangana state covering 50 % area. Water level between 5 to 10 m bgl covering an area of 31% are noticed mainly in parts of Rangareddy, Mahabubnagar , Hyderabad, Nizamabad, Adilabad and Karimnagar districts. Water level between 10 to 20 m bgl covers 7% area of Mahabubnagar, Nizamabad, Adilabad and Medak districts. Deeper water level (> 20 m) is observed in 1% area of Nizamabad, Adilabad and Medak districts.

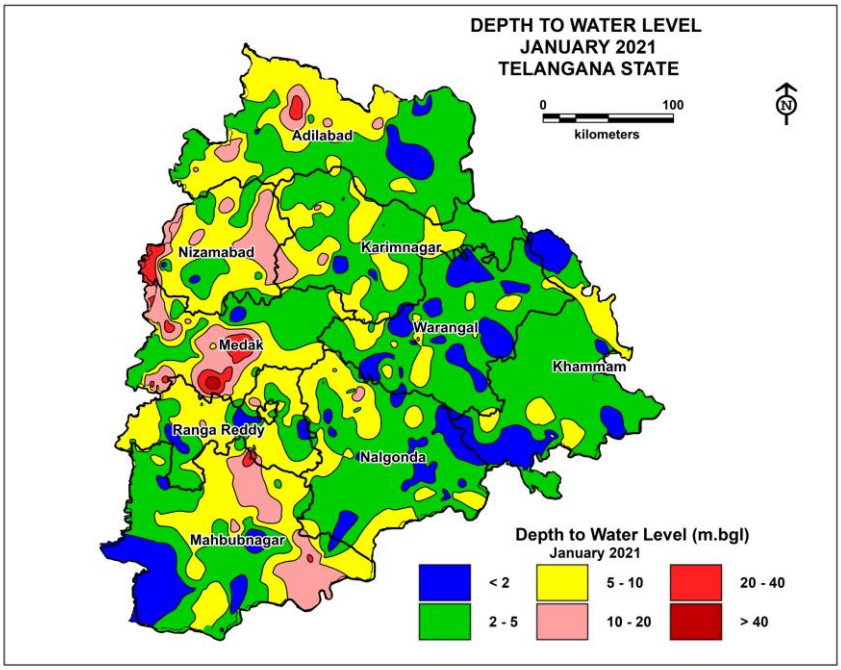


Fig.7.4: Depth to Water Levels-January 2021.

7.2 Integrated Depth to Water Level Maps (GWD and CGWB)

7.2.1 May 2020

The water level data of monitoring stations (Piezometers only) of Central Ground Water Board and State Ground Water Board are considered together to analyze the water level data of the monitoring stations in the state. A total of 765 station were considered for the analysis, out of which 690 stations of State GWD and 75 of CGWB are utilized for preparing the depth to water level map **(Fig-7.5.)** and the depth to water levels and percentage of wells in different depth ranges in May 2020. Water level between 2 to 5 m bgl is covered in 13.38% of area (145 wells) and 39.04 % of the area covered by depth to water level of 5 to 10 m bgl (255 wells). Water level 10 to 20 m bgl covered in 37.96 % of the area (253 wells). Deeper water levels of more than 20 m to 40 m covers an area of about 9.24% (94 wells) of the state and more than 40 m covers 0.04% (2 wells) of the area, noticed only in Medak.

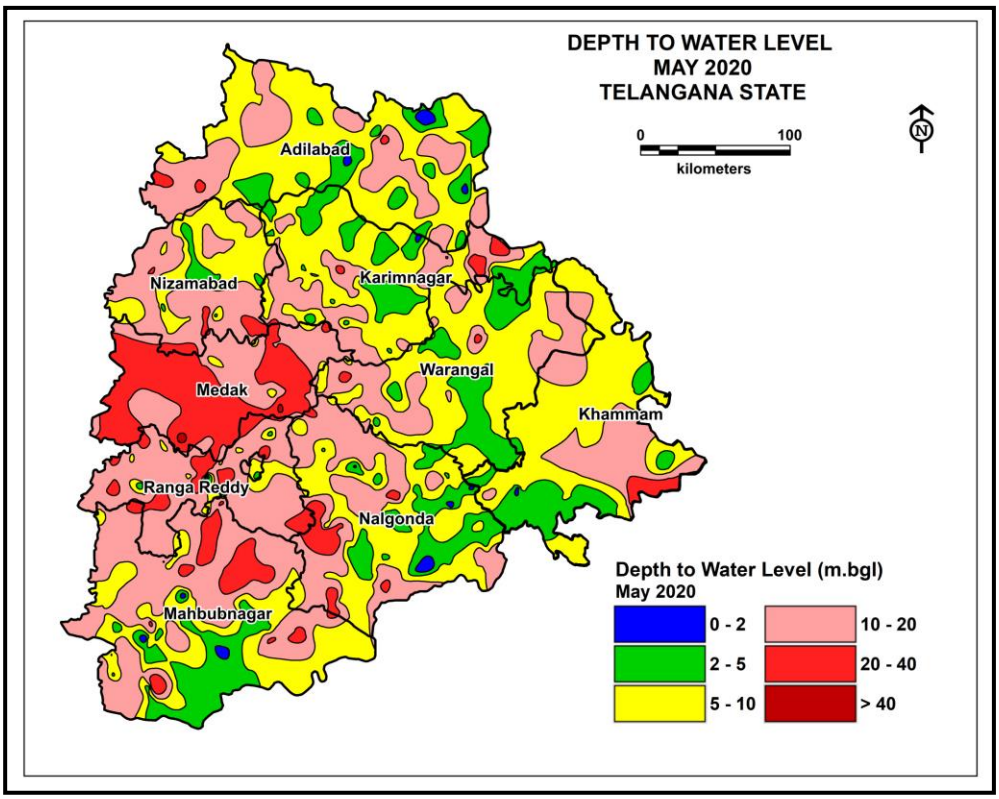


Fig 7.5. : Depth To Water Level Map of May 2020 (Integrated data)

7.2.2 November 2020

The water level data of monitoring stations (Piezometers only) of Central Ground Water Board and State Ground Water Board are considered together to analyze the water level data of the monitoring stations in the state. Water level data of 974 stations of State GWD and 410 of CGWB are utilized for preparing the depth to water level map **(Fig-7.6)** and the depth to water levels and percentage of wells in different depth ranges in Nov 2020. Based on the **(Fig 7.6)** results, it is inferred that, depth to water level of 12% area is in the 0 to 2 m bgl, 53 % of the area is in the range of 2 to 5 m bgl, 27 % of the area is in the range of 5 to 10 m bgl, 7 % area is in the range of 10 to 20 m bgl1 % area is in the of 20 to 40 m bgl.

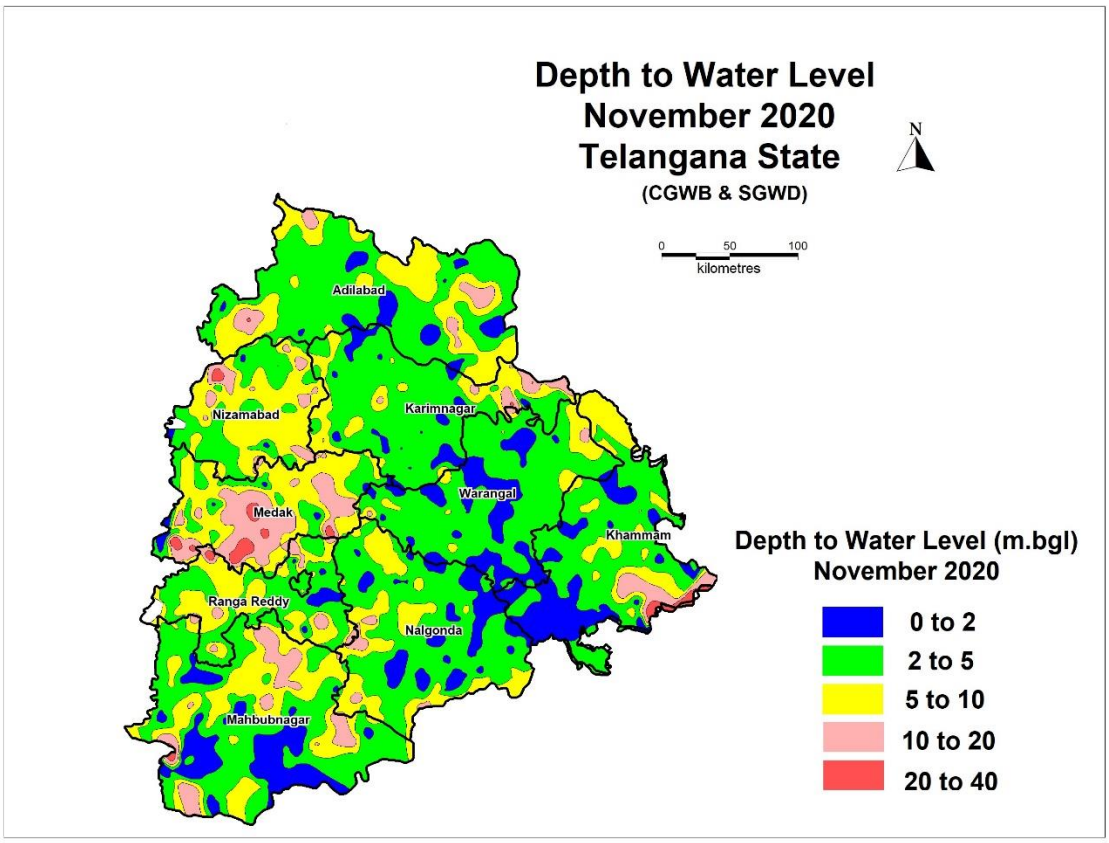


Fig 7.6 : Depth To Water Level Map of November 2020 (Integrated data)

7.3 Water Level Fluctuations with pre-monsoon water levels

7.3.1 Water Level Fluctuation from May, 2020 to August, 2020

Water level fluctuation of May 2020 with August 2020 is presented in **Annexure - VII.** Analysis of data of 1028 wells shows that water level rise is recorded in 95% of wells (980), water level fall is recorded in 5% of wells (48).Map representing water level fluctuations from May 2020 to August 2020 is given in **Fig.7.7**.

Rise in water level:

In the state about 99% of the area (980 wells) experienced rise in water levels compared with pre-monsoon period (May 2020). Out of the 980 wells that have registered rise in water level, 18% of wells have recorded less than 2m rise. 30% of wells in the range of 2 to 4 m while the rest 52% of wells recorded water level rise of more than 4 m. Rise in water level of less than 2 m is noticeable in Nalgonda, Nizamabad and Mahbubnagar districts. Water level rise of 2-4 m is observed in all the districts of the state. Rise in Water level of more than 4 m is observed in all the districts and most predominant in Khammam, Rangareddy, Medak, Karimnagar, Hyderabad, Adilabad and Warangal districts.

Fall in water level:

In the state, 1% of the area (48 wells) experienced fall in water levels compared to the pre-monsoon period (May2020). Out of the 48 wells, 73% of wells have recorded less than 2 m fall, 26% of wells in the range of 2-4 m and the rest 1% wells recorded water level fall more than 4 m. Fall in water level of less than 2 m is observed in parts of Nizamabad Nalgonda and Adilabad districts.

The rainfall received during June 2020 to August 2020 is 37% more than the normal rainfall for the same period. The significant water level rise in Khammam, Rangareddy, Medak, Karimnagar, Hyderabad, Adilabad and Warangal districts can be attributed to excess rainfall received during the period.

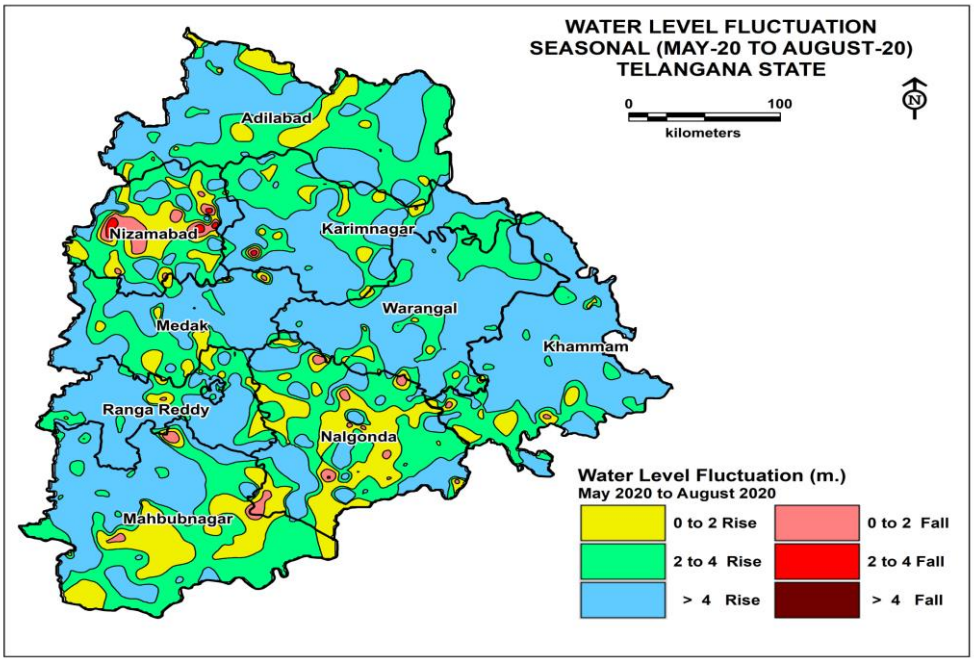


Fig. 7.7: Water Level Fluctuation from May 2020 to Aug 2020

7.3.2 Water Level Fluctuation from May 2020 to November 2020

For seasonal water level fluctuations, 10 years (2010-2019) average of May Water level has been considered. Fluctuations during November 2020 from May 2020 (10 Years Average) are presented in **Annexure-VIII.** An analysis of 537 wells shows that water level rise is recorded in 99% wells (529 Wells) and fall is recorded in 1% wells (8 wells). P p representing water level fluctuations from May 2020 to November 2020 is given in **Fig.7.8**.

Rise in water levels:

In the state about 99% of the area (529 wells) experienced rise in water levels compared to the pre-monsoon period, May-2020 (10 years Average). Out of the 529 wells that have registered rise in water level, 8% of wells have recorded less than 2 m rise. 19% of the wells are in the range of 2 to 4 m while 73 % of the wells recorded water level rise of more than 4 m. Rise in water level of less than 2 m is observed predominantly in Adilabad, Khammam, Nalgonda, Mahbubnagar and Medak districts. Water level rise of 2-4 m is recorded in Adilabad, Nalgonda, Khammam, Mahbubnagar and Karimnagar districts. Rise of water level of more than 4 m is observed in major parts of all the districts.

Fall in water levels:

As the state received 48% excess rainfall, fall in water levels observed only at 8 locations, represented by small isolated parts in the state. In the state about 1% of the area (8

wells) experienced fall in water levels compared to the pre-monsoon period May-2020 (10 years Average).

The rainfall received during June 2020 to October 2020 is 48% more than the normal rainfall for the same period. The significant water level rise in the state can be attributed to excess rainfall received during the period.

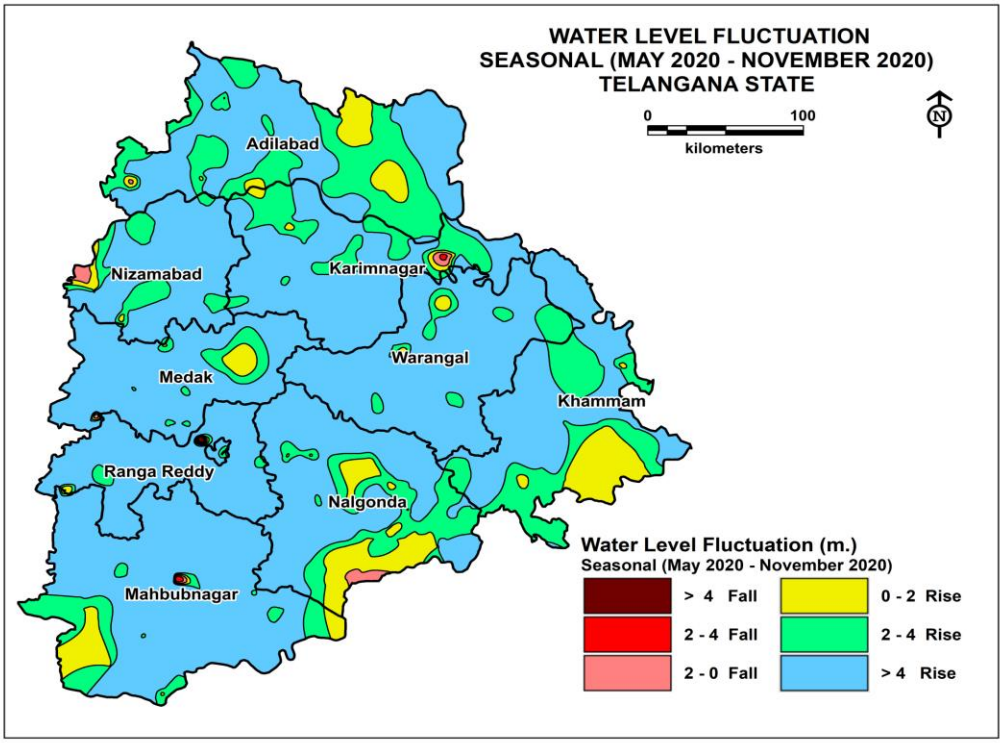


Fig 7.8: Water Level Fluctuation from May, 2020 to Nov 2020

7.3.3 Water Level Fluctuation: May 2020(10 years average) to January 2021

For seasonal water level fluctuations, 10 years (2010-2019) average of May water level has been considered. Water level fluctuation of May 2020 (10 Years Average) with January 2021 is presented in **Annexure - IX.** Analysis of 522 wells shows that water level rise is recorded in 96% of wells (500Nos.), water level fall is recorded in 4% of wells (22Nos). Map representing water level fluctuations from May 2020 (10 Years Average) to January 2021 is given in **Fig.7.9.**

Rise in water levels:

In the state about 96% of the area (500 wells) experienced rise in water levels compared to the pre-monsoon period, May 2020 (10 years Average). Out of the 500 wells that have recorded rise

in water level, 15% of wells have recorded less than 2 m rise. 26% of wells recorded water level in the range of 2 to 4 m whereas 58% of wells recorded water level rise of more than 4 m. Rise in water level of less than 2 m is noticed mainly in Adilabad, Khammam, Nalgonda, Mahbubnagar, Karimnagar and Hyderabad districts. Water level rise of 2-4 m is observed in parts of all the districts. Rise of Water level of more than 4 m is observed in major parts of Mahbubnagar, Rangareddy, Medak, Hyderabad, Nalgonda, Nizamabad and Warangal.

Fall in water levels:

In the state about 4% of the area (22 wells) experienced fall in water levels compared to the pre-monsoon period, May 2020 (10 years Average). Out of the 22 wells that have registered fall in water levels, 64 %wells have recorded less than 2 m fall, 18 % wells in the range of 2-4 m fall and the remaining 18% registered water level fall more than 4 m. Fall of <2 m is observed in small parts of Adilabad, Nalgonda, Nizamabad, Medak and Mahbubnagar districts. Fall in water level range of 2 to 4 m and >4 m recorded in parts of Nizamabad and Adilabad districts.

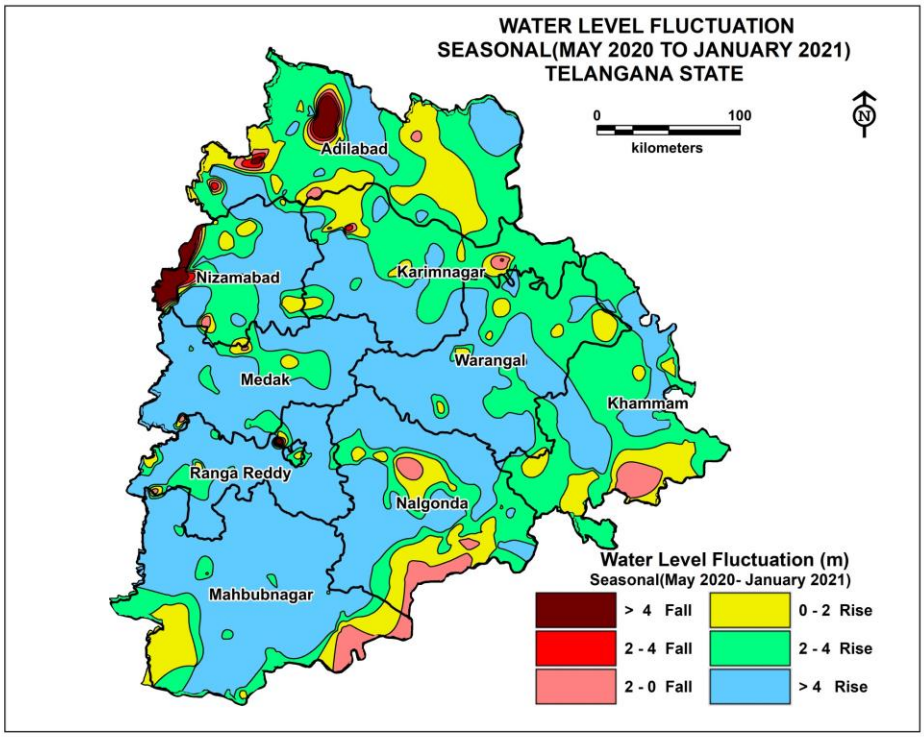


Fig 7.9: Water Level Fluctuation from May, 2020 to Jan 2021

7.4 Annual Water Level Fluctuation

7.4.1 Water Level Fluctuation from May 2019 to May 2020

Water level fluctuation of May 2019 with May 2020 is presented in **Annexure - X.** An analysis of data of 719 wells shows that water level rise is recorded in 84% of wells (601), water level fall is recorded in 16% of wells (118). The average rise in water levels is 4.2 m and the average fall in water levels is 1.4 m. Map representing water level fluctuations from May 2019 to May 2020 is given in **Fig.7.10**

Rise in water level:

In the state about 86% of the area (601 wells) experienced rise in water levels compared with last year same period. Out of the 601wells that have registered rise in water level, 39% of wells have recorded less than 2m rise. 22 % of wells in the range of 2 to 4 m while the rest 39% of wells recorded water level rise of more than 4 m. Rise in water level of less than 2 m is observed mainly in in Khammam, Nalgonda, Mahbubnagar, Karimnagar, Adilabad and RangaReddy districts. Water level rise of 2-4 m is observed in all the districts of the state and significantly in Karimnagar, Mahbubnagar, Nalgonda and Warangal. Rise of Water level more than 4 m is predominant in Nalgonda, Karimnagar, Nizamabad Mahbubnagar, and Warangal districts.

Fall in water level:

In the state about 14 % of the area (118 wells) experienced fall in water levels compared with last year same period (May-2019). Out of the 118 wells that have registered fall in water levels, 81% of wells have recorded less than 2 m fall, 12% of wells in the range of 2-4 m and the rest 7% wells registered water level fall more than 4 m. During May 2020, the fall in water level compared with last year same period is low. Fall in water level range of 0 to 2 m observed in small areas in all the districts of Telangana state. Fall in water level range of 2 to 4m is mainly observed in Medak, Warangal, and Khammam districts. Fall of more than 4 m is observed in small as patches in parts of Medak, Mahbubnagar, Nalgonda, and Khammam districts.

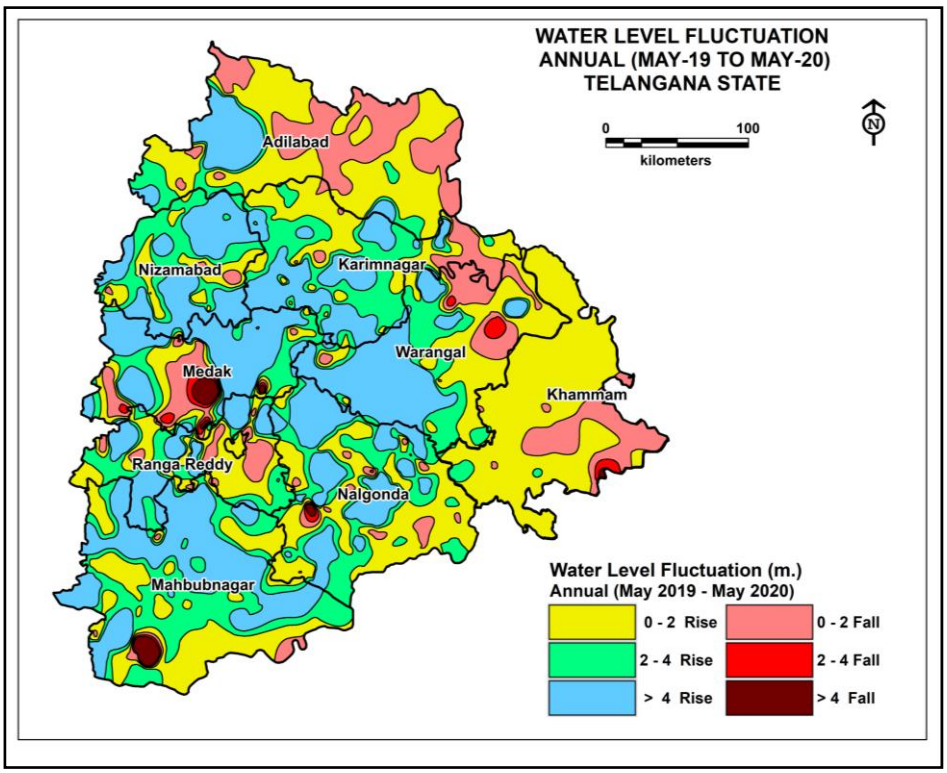


Fig.7.10: Water level Fluctuation from May 2019 to May 2020.

7.4.2 Water Level Fluctuation from August 2019 to August 2020

Water level fluctuation of August 2019 with August 2020 is presented in **Annexure - XI.** Analysis of 1090 wells shows that water level rise is recorded in 91% of wells (997), water level fall is recorded in 9% of wells (93).Map representing water level fluctuations from August 2019 to August2020 is given in **Fig.7.11**

Rise in water level:

In the state, about 91% of the area (997 wells) experienced rise in water level compared to last year same period (August 2019). Out of 997 wells that have registered rise in water level, 28% of wells have recorded less than 2m rise, 22% of wells in the range of 2 to 4 m while 50% of wells recorded water level rise of more than 4 m. Rise in water level is observed in all the districts. Rise in water level more than 4 m is observed mostly in parts of Nalgonda, Mahbubnagar, Rangareddy, Warangal, Hyderabad, Karimnagar and Medak districts.

Fall in water level:

In the state about 8% of the area (93 wells) experienced fall in water levels compared to last year same period (August 2019). Out of 93 wells that have registered fall in water levels, 77% of

wells have recorded less than 2 m fall, 9% of wells in the range of 2-4 m and the rest 13% wells registered water level fall more than 4 m. Fall in water level, less than 2 m is observed mostly in parts of Adilabad, Khammam and Nizamabad districts. Greater than 4m fall is recorded in isolated parts of Medak district.

Annual rainfall of 2019-20 is ~50.8% more than the preceding year annual rainfall (2018-19), thus 91 % area of the state recorded a rise in water level.

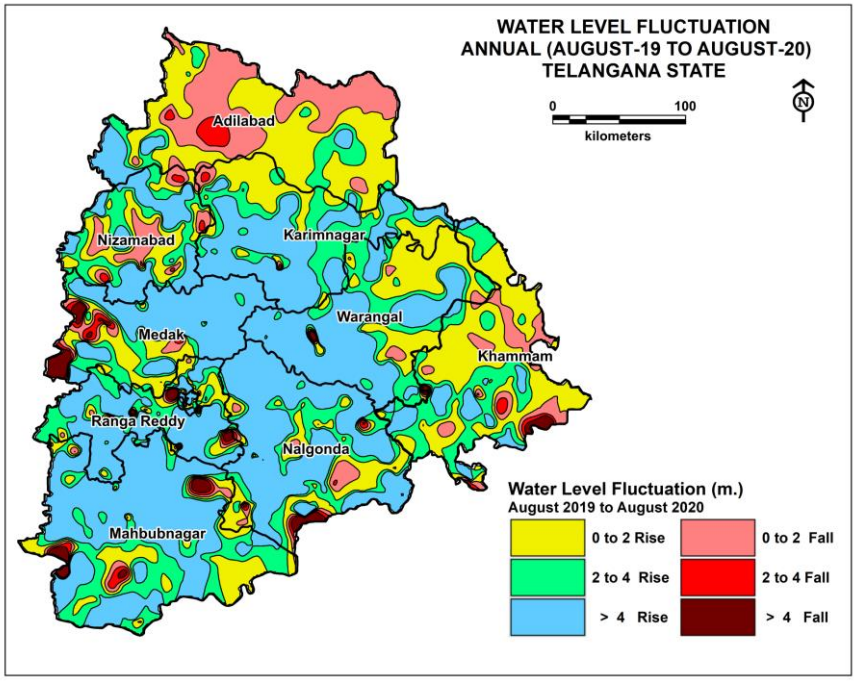


Fig. 7.11: Water Level Fluctuation- August 2019 to August 2020

7.4.3 Water Level Fluctuations from November-2019 to November-2020

Water level fluctuation of November-2019 with November-2020 is presented in **Annexure - XII.** An analysis of data of 524 wells shows that water level rise is recorded in 70% of wells (367), water level fall is recorded in 30% of wells (157).

Map representing water level fluctuations from November-2019 to November-2020 is given in **Fig.7.12**

Rise in water levels:

In the state about 73% of the area (367wells), experienced rise in water levels compared with the last year same period (November-2019). Out of the 367 wells that have registered rise in water level, 50% of wells have recorded less than 2 m rise, 15% of wells in the range of 2 to 4 m while 35% of wells recorded water level rise of more than 4 m. Rise in water level of less than 2 m is observed in all districts. Water level rise of 2-4 m is observed predominantly in

Mahbubnagar, Rangareddy, Nalgonda, Khammam and Warangal districts. Rise of Water level more than 4 m occur mainly in Hyderabad, Rangareddy, Mahbubnagar, Medak, Nalgonda, Warangal and Karimnagar districts.

Fall in water levels:

In the state about 27% of the area (157 wells) experienced fall in water levels level compared with the last year same period (November-2019). Out of the 157 wells that have registered fall in water levels, 90% of wells have recorded less than 2 m. fall, 7 % of wells in the range of 2-4 m. and the rest 3% wells registered water level fall more than 4 m. Fall of <2 m is observed significantly in northern part of the state in Nizamabad, Karimnagar, Adilabad and Warangal districts. Fall in water level range of 2 to 4 m recorded in small parts of Nizamabad, Mahbubnagar, Adilabad and Karimnagar districts. Fall of > 4 m is observed in small parts of Nizamabad, Karimnagar and Adilabad districts.

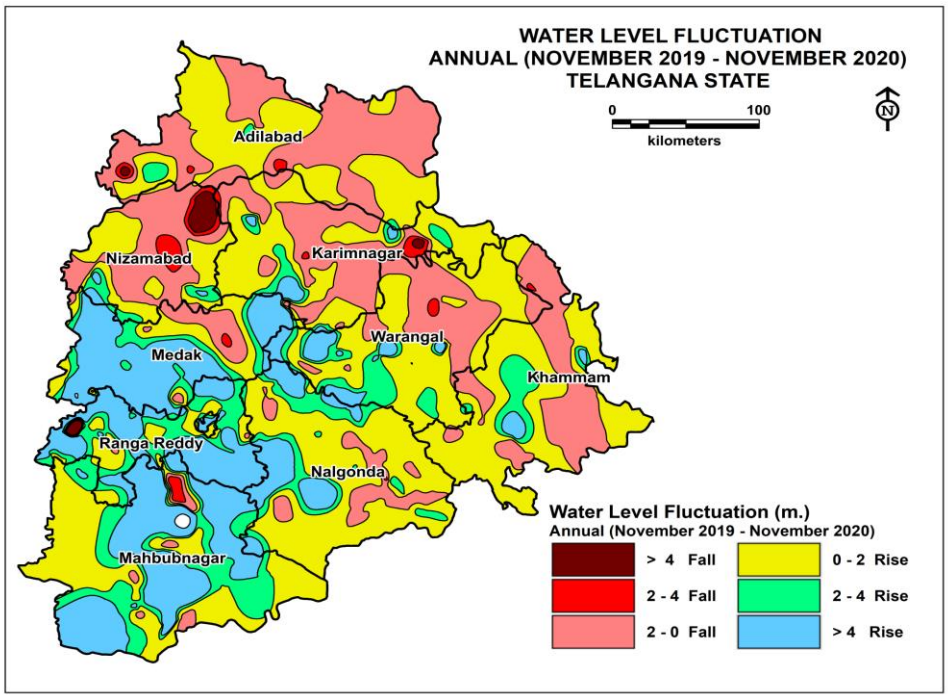


Fig. 7.12: Water Level Fluctuation from November-2019 to November-2020

7.4.4 Water Level Fluctuation from January-2020 to January-2021

Water level fluctuation of January 2020 with January 2021 is presented in **Annexure - XIII.** Analysis of 531 wells shows that water level rise is recorded in 68% of wells (361) and water level fall is recorded in 32% of wells (167). Map representing water level fluctuations from January 2020 to January 2021 is given in **Fig.7.13.**

Rise in water levels:

In the state about 68% of the area (361wells) experienced rise in water levels compared with the last year same period (January 2020). Out of the 361 wells that have registered rise in water level, 51% of wells have recorded less than 2 m rise, 17% of wells in the range of 2 to 4 m while 32% of wells recorded water level rise of more than 4 m. Rise in water level of less than 2 m in parts of all the districts and mainly in Mahabubnagar, Rangareddy Warangal, Khammam and Nalgonda districts. Water level rise of 2-4 m is observed as scattered in parts of all the districts. Rise of water level more than 4 m is observed in major parts of Mahabubnagar, Rangareddy and Medak , as these districts received excess rainfall than June 19- December 19 .

Fall in water levels:

In the state about 32% of the area (167 wells) experienced fall in water levels compared with the last year same period (January 2020). Out of the 167 wells, 86% of wells have recorded less than 2 m fall, 10% of well shows fall of 2-4 m and the remaining 4% wells registered water level fall more than 4 m. Fall of <2 m is observed in major parts of Adilabad, Karimnagar, Medak, Nizamabad and Khammam districts. Fall in water level between 2 to 4 m and > 4 m is observed mainly in parts of Nizamabad and Adilabad districts.

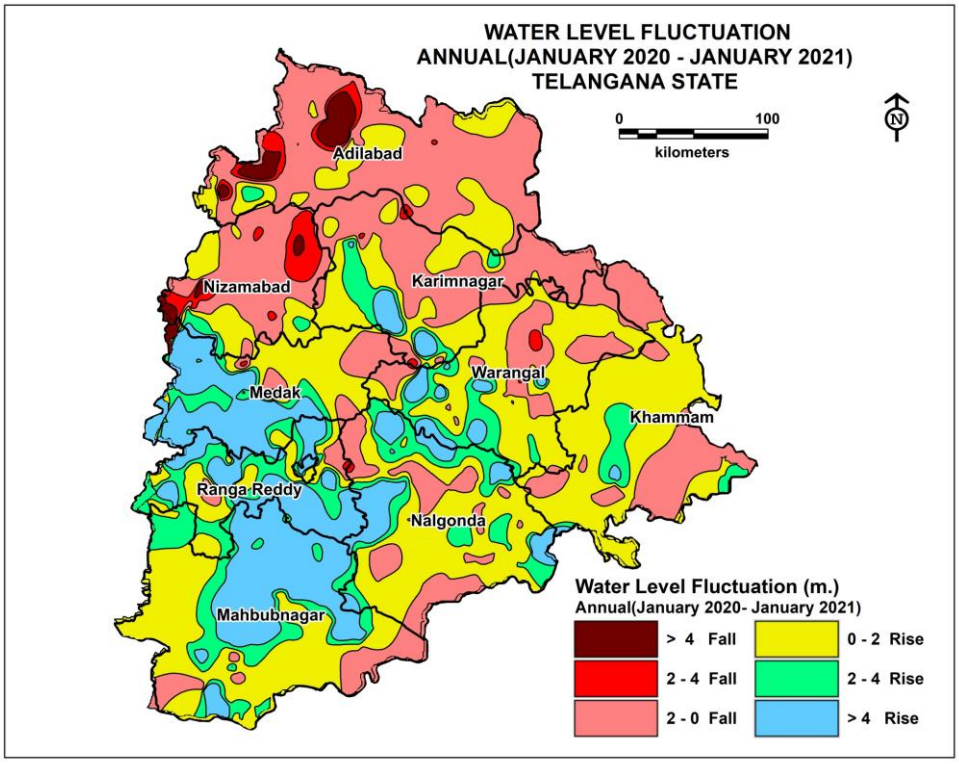


Fig. 7.13: Water Level Fluctuation from January-2020 to January-2021

7.5 Decadal Water Level Fluctuation

7.5.1 Water Level Fluctuation – Decadal Mean (2010-2019) to May 2020

Water level fluctuation of May 2020 from Decadal Mean of May (2010-2019) is presented in **Annexure – XIV**. Water level fluctuation, of May-2020 from Decadal Mean of May (2010-2019) is depicted as map in **Fig. 7.14**. The average rise in water levels is 3.5 m and the average fall in water levels 3.18 m.

An analysis of data of 732 wells shows that water level rise is recorded in 74% wells (543 no of wells), water level fall is recorded in 26% wells (189 no of wells).

Rise in water level:

In the state about 74% of the area experienced rise in water levels compared with decadal mean. Out of 543 wells, water level rise of less than 2 m is recorded in 41 % wells, in the range of 2-4 m in 28 % wells and rise of more than 4 m is recorded in 31% wells. Rise in water level of less than 2 m is observed in all the districts of the state. Water level rise of 2-4 m is also observed in all the districts and most prominent in Karimnagar, Nalgonda, Mahbubnagar, Warangal districts. 31% of the wells covering 17 % of the area show more than 4 m rise in water level.

Fall in water levels:

In the state about 26% of the area experienced fall in water levels compared with decadal mean (2010-2019). Out of the 189 wells that have registered fall in water levels, 56 % have recorded less than 2 m fall, 20 % in the range of 2-4 m and 24 % wells registered water level fall of more than 4 m. Fall of water level less than 2 m is observed in all districts. Water level fall of 2- 4 m is also observed in all districts except in Karimnagar. Fall of water level more than 4m is observed significantly in Medak district.

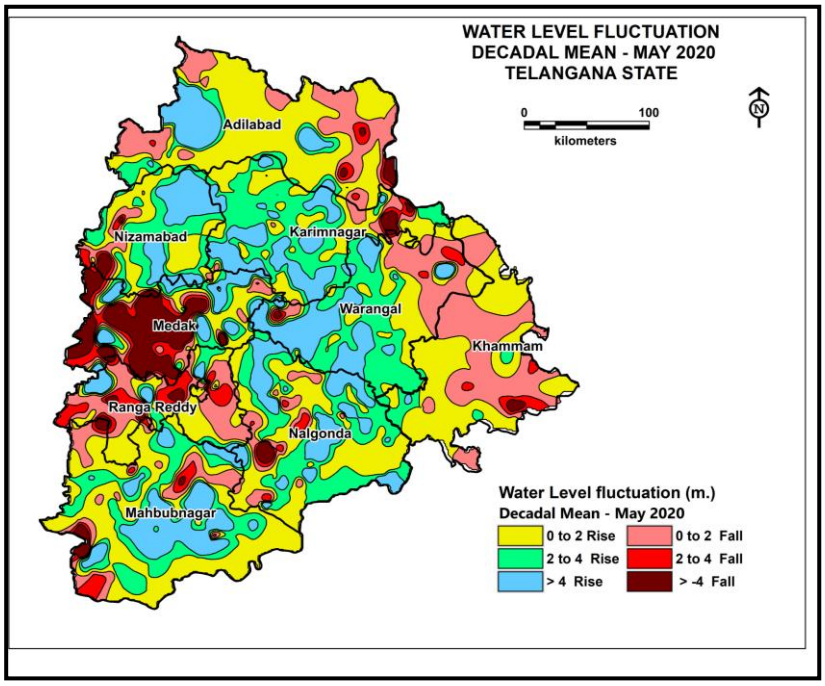


Fig.7.14: Water level Fluctuation from decadal mean of May (2010-19) to May-20**.**

7.5.2 Water Level Fluctuation from Decadal Mean of August (2010-19) to August, 2020

Water level fluctuation of August 2020 from Decadal Mean of August (2010-2019) is presented in **Annexure – XV**. Map representing water level fluctuation from Mean of August (2010-2019) is given in **Fig. 7.15**. The average rise in water levels is 5.3m and the average fall in water levels is 1.31 m. Analysis of data of 775 wells shows that water level rise is recorded in 88 % wells (679 wells), water level fall is recorded in 12% wells (96 wells).

Rise in water level

In the state about 90 % of the area experienced rise in water levels compared with decadal mean. Out of 679 wells, water level rise of less than 2 m is recorded in 24 % wells, in the range of 2-4 m in 23 % wells and rise of more than 4 m is recorded in 53% wells. Rise in water level of less than 2 m is observed in all the districts of the state and most prominent in Adilabad, Khammam, and Nizamabad districts. Water level rise of 2-4 m is observed mainly in Khammam, Warangal, and Mahbubnagar and Karimnagar districts. Rise of water level more than 4 m is observed in all districts and predominantly Medak, Mahbubnagar, Warangal, and Karimnagar districts.

Fall in water level

In the state about 10 % of the area experienced fall in water levels compared with decadal mean (2010-2019). Out of the 96 wells that have registered fall in water levels, 50% have recorded less than 2 m fall, 23% in the range of 2-4 m and 27% wells registered water level fall of more than 4 m. Fall in water level, less than 2 m is observed mainly in parts of Adilabad, Rangareddy and Nizamabad district. Greater than 4m fall is recorded significantly in isolated parts of Medak district.

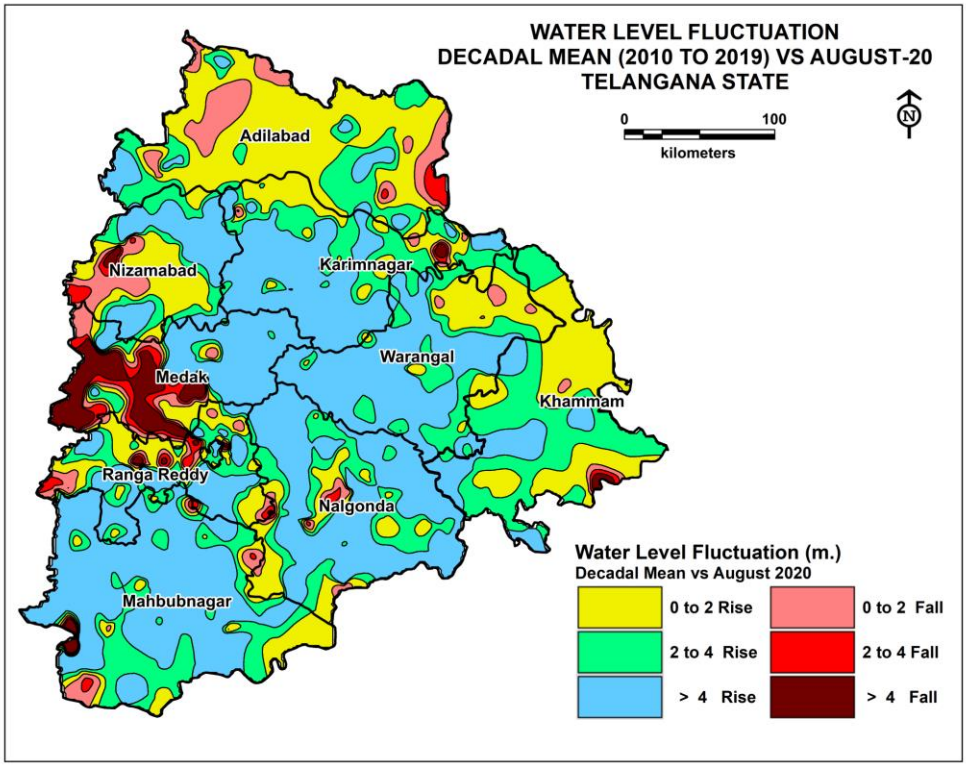


Fig. 7.15: Water Level Fluctuation from Decadal Mean of August (2010-19) to August-20

7.5.3 Water Level Fluctuation from Decadal Mean of November (2010-2019) to November, 2020

Water level fluctuation of November 2020 from Decadal Mean of November (2010-2019) is presented in **Annexure –XVI**. Water level fluctuation of November-20 from Decadal Mean of November (2010-2019) is depicted as map in **Fig. 7.16**.

An analysis of data of 552 wells shows that water level rise is recorded in 91% wells (502 wells), water level fall is recorded in 9% wells (50 wells).

Rise in water levels:

In the state about 94% of the area experienced rise in water levels compared with decadal mean. Out of 502 wells, water level rise of less than 2 m is recorded in 40% wells, in the range of 2-4 m in 24% wells and rise of more than 4 m is recorded in 36% wells. Rise in water level of less than 2 m is observed in Adilabad, Khammam, Karimnagar, Nalgonda, Warangal, Nizamabad and Mahbubnagar districts. Water level rise of 2-4 m is observed in all the districts but mainly in Hyderabad, Rangareddy and Medak. Rise of water level of more than 4 m is recorded significantly in parts of Mahbubnagar, Medak, Hyderabad, Rangareddy, Nizamabad, Karimnagar, Warangal and Nalgonda districts.

Fall in water levels:

In the state about 6% of the area experienced fall in water levels compared with decadal mean (2010-2019). Out of the 50 wells that have registered fall in water levels, 88% have recorded less than 2 m fall, 6% in the range of 2-4 m and 6% wells registered water level fall of more than 4 m. Fall of more than 4 m is observed only in a small isolated parts of Rangareddy and Karimnagar district. Fall in water level range of 0 to 2 m observed in small parts of Adilabad, Khammam, Medak, Nalgonda, Karimnagar and Warangal districts. Fall in water level range of 2 to 4 m is also observed only in small isolated parts of Medak, Mahbubnagar and Karimnagar districts.

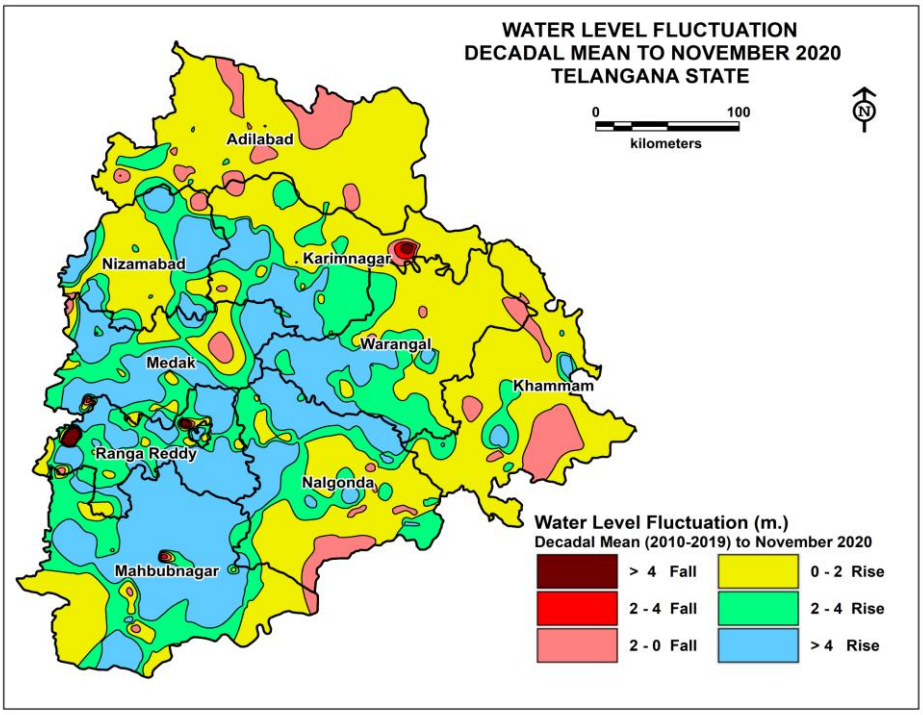


Fig. 7.16: Water Level Fluctuation from Decadal Mean of November (2010-2019) to November- 2020

7.5.4 Water Level Fluctuation from Decadal Mean of January (2011-20) to January 2021

Water level fluctuation of January 2021 from Decadal Mean of January (2011-2020) is presented in **Annexure – XVII**. Water level fluctuation of January -2021 from Decadal Mean of January (2011-2020) is depicted as map in **Fig. 7.17**. Analysis of 558 wells shows that water level rise in 89% of wells (495 nos) and water level fall in 11% of wells (63 nos).

Rise in water levels:

In the state about 88 % of the area experienced rise in water levels compared with decadal mean. Out of 495 wells, water level rise of less than 2 m is recorded in 42% wells, 2-4 m in 26% wells and rise of more than 4 m is recorded in 32% wells. Rise in water level less than 2 m is observed mainly in northern and eastern parts of the state and most prominently in Adilabad, Warangal, Khammam, Karimnagar, Hyderabad and Nalgonda districts. Water level rise of 2-4 m is observed significantly in central and southern parts of the state in Mahbubnagar, Rangareddy, Nalgonda, Karimnagar, Warangal, Nizamabad, Medak and Warangal districts. Rise of water level more than 4 m is observed in parts of Mahbubnagar, Warangal, Medak, Rangareddy, Nalgonda, Nizamabad, Karimnagar and Khammam districts.

Fall in water levels:

In the state about 11% of the area experienced fall in water levels compared with decadal mean (2011-2020). Out of the 63 wells that have registered fall in water level, 79% have recorded less than 2 m fall, 5% recorded 2-4 m fall and 16% wells registered water level fall of more than 4 m. Northern districts prominently recorded fall in water levels .Fall of more than 4 m is significantly observed in Adilabad, Medak, Nizamabad and Rangareddy districts. Fall in water level range of 2 to 4 m is only recorded in Karimnagar and Medak districts. Fall in water level range of 0 to 2 m is observed mainly in Adilabad, Nizamabad, Khammam, Karimnagar, Warangal and Nalgonda districts.

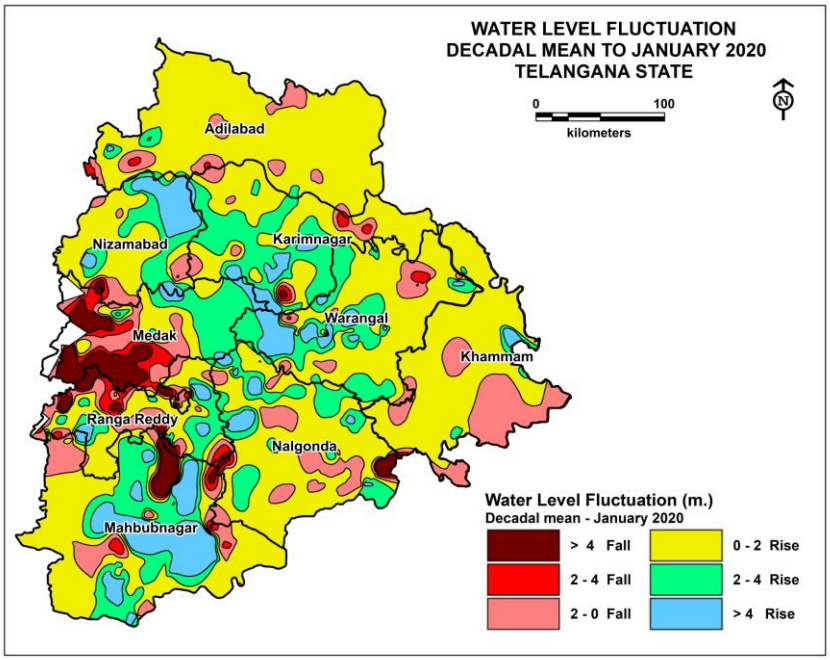


Fig. 7.17: Water Level Fluctuation from Decadal Mean of January (2011-20) to January 2021

7.6 Aquifer wise water levels

Gneissic Complex, which has the largest number of monitoring wells, the pre-monsoon minimum, maximum and average are 0.38 m, 49.1 m and 10.9 m respectively. During the post-monsoon season, minimum, maximum and average are 0.10 m, 26.67 m and 3.62 m respectively. During pre-monsoon season, deepest water level (49.1mbgl) is noticed in Banded Gneissic Complex formation. During post-monsoon season also, the deepest water level is in Basalt (67.5 mbgl). Aquifer wise water level scenario is presented in **Table-7.3.**

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

Principal Aquifer	May 2020 DTWL			Nov 2020 DTWL		
	Min	Max	Average	Min	Max	Average
Banded Gneiss	0.38	49.1	10.9	0.1	26.67	3.62
Basalt	1.46	36.08	12.16	0.1	67.5	5.3
Granite	3.04	19.91	10.32	1.23	12.9	3.6
Limestone	1.5	22.34	8.65	0.41	8.05	3.64
Laterite	10.4	30.8	22.4	2.24	13.3	6.2
Quartzite	6.2	24.66	12.04	6.67	8.3	7.4
Shale	5.2	8.8	7.39	0.65	2.95	2.2
Sandstone	1.09	38.95	11.1	0.01	10.8	3.02

7.7 Long –term Water Level Trends

7.7.1 Long term water level trends

Long term water level trend map has been prepared based on level data from 2011-2020 for, pre-monsoon **(Fig 7.18)** and post-monsoon **(Fig 7.19)** periods. During the pre-monsoon period, about 81% of the area recorded falling trend in the range of 0-2.0 m/yr, high magnitude of fall is seen (1-2m) is seen in parts of Medak and Mahbubnagar districts. 19% of the area recorded rising trend in the range of 0-2.0 m/yr. During the post-monsoon period, about 35% of the area recorded falling trend in the range of 0-2.0 m/yr and 65% of the area rising trend in the range of 0-2.0 m/yr. Rise is more predominant in parts of Warangal, Adilabad, Mahabubnagar, Nalgonda, Karimnagar and Medak districts.

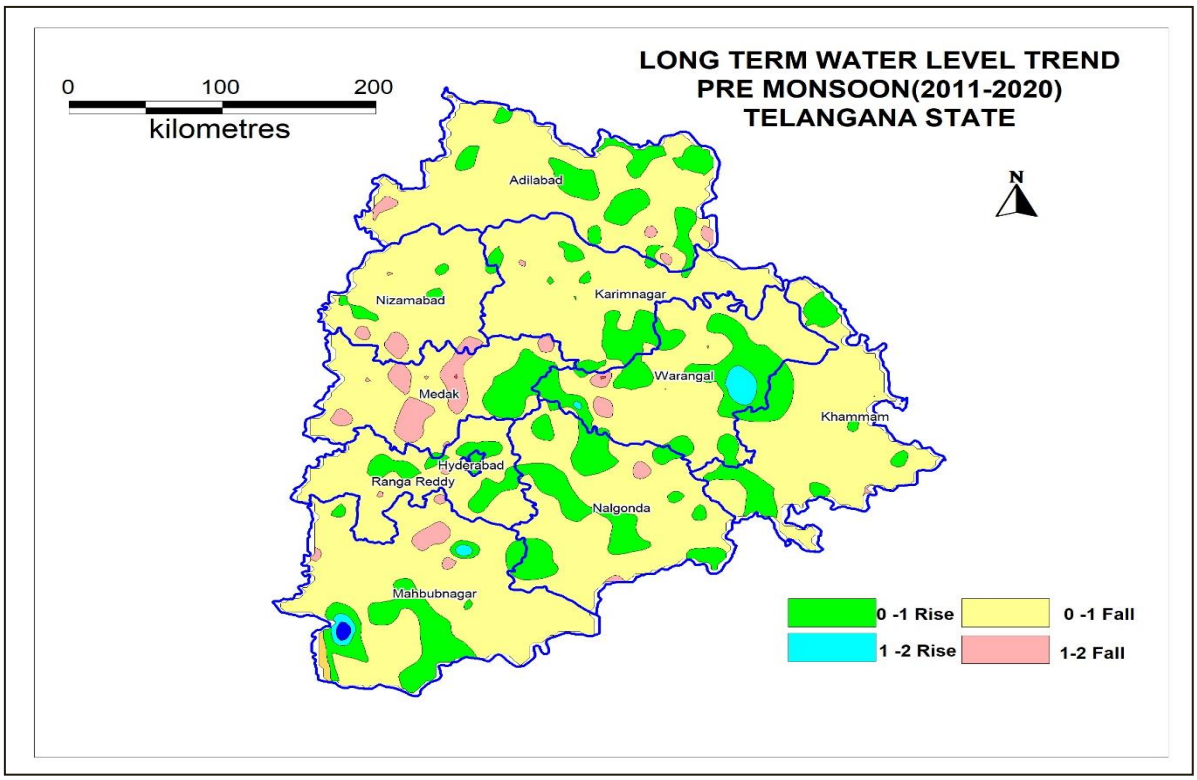


Fig 7.18 Long term water level trend - Pre-monsoon (10 years)

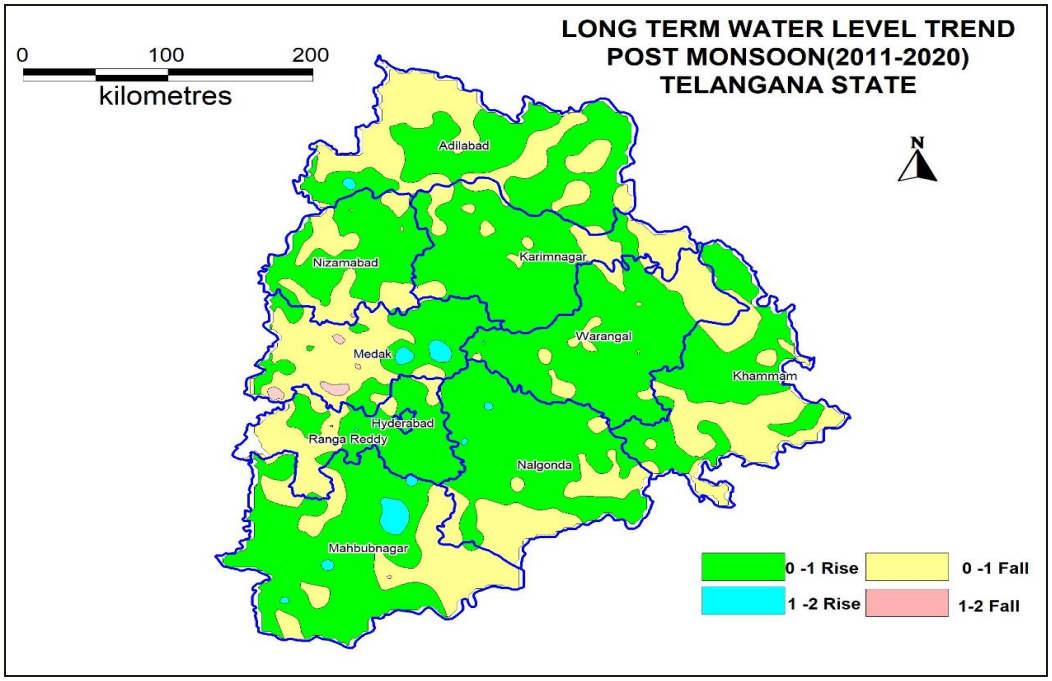


Fig 7.19: Long term water level trend – Post-monsoon (10 years)

7.7.2 Long term water level scenario

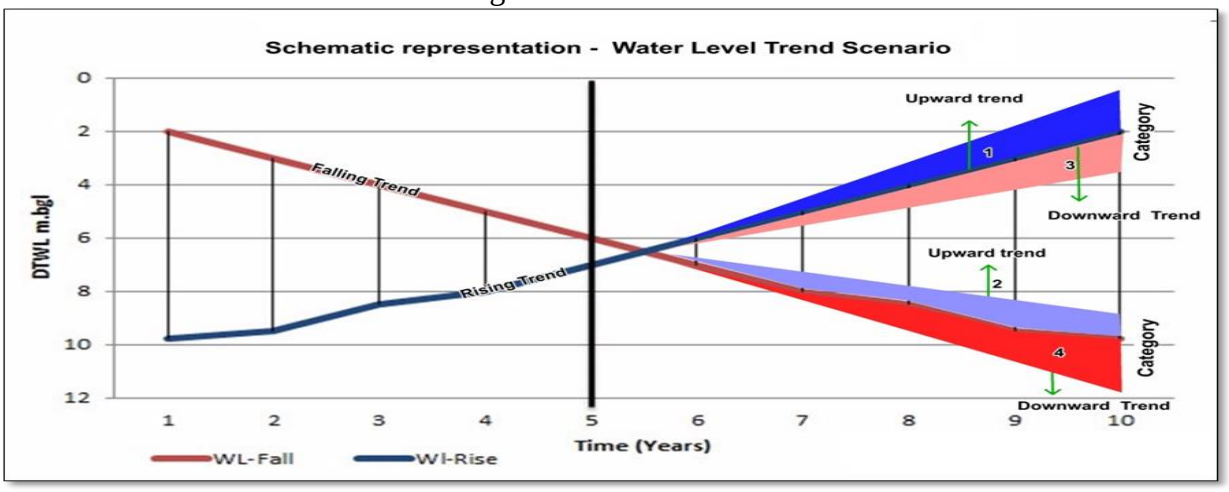
To study the change in Ground water scenario, the pre and post monsoon long term water level trend data of 10 years (2011 – 2020) is compared with pre and post monsoon water level trend data of last five years (2016-2020). The change in water level trends in last five years is categorized into 4 categories, represented in Table-7.5 and Fig-7.20

Water level Trend	Category	Description
Rising (Upward trend)	1	Areas with rising trend showing further improvement (increase in rising rate) in water level trends in last five years
	2	Areas with falling trend, showing improvement (fall in declining rate) in water level trends in last five years
Declining (Downward trend)	3	Areas with rising trends, showing decline (fall in rising rate) in water level trends in last five years.
	4	Areas with falling trend showing further decline (increase in falling rate) in water level trends in last five years

Fig:-7.2 Schematic representation of water level trend scenario

During pre-monsoon 68% area of the state shows rise in water level trends and 32% of the area shows decline in water level trends. Significant Improvement in water level trends in last five years is observed in Mahbubnagar (68%), Nizamabad (82%), Karimnagar (71%), Khammam (60%) whereas Decline in water level trend is observed in parts of Medak (42%) and Warangal (45%)districts. It is further observed that, long term 10 years falling trend further declined in last 5 years in 10% of the area in the State ranging from 1% in Nalgonda to 29% in Medak district (Fig-7:21 & Table-7:6)

Table-7.2: Categorization of Water Level Scenario



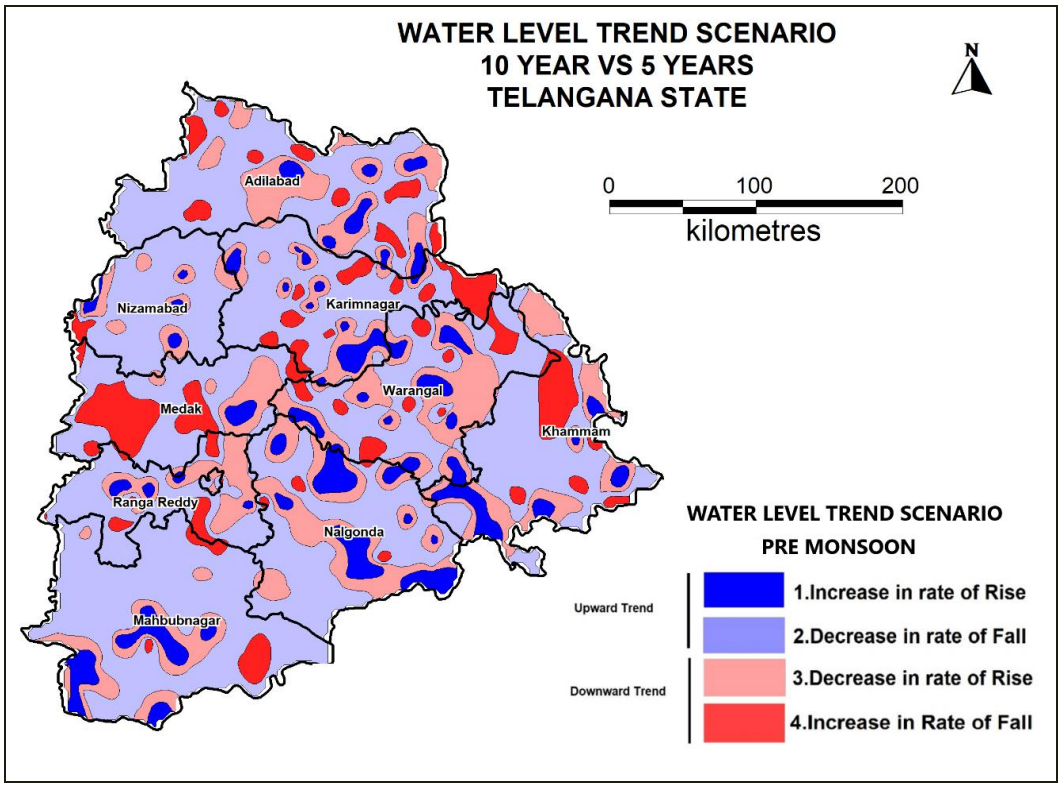


Fig- 7:21: Pre monsoon Water Level Trend Scenario

During post-monsoon, 51% area of the state show rise in water level trends and 49 % of the area shows decline in water level trends. Significant Improvement in last five years is observed in all the districts Mahbubnagar (62%), Rangareddy (56%), Karimnagar (57%), whereas decline in water level trend is observed in major parts of Nizamabad (60%) Adilabad (67%), Warangal (58%) and Nalgonda (56%) districts. It is further observed that long term 10 years falling trend further declined in last 5 years in 9% area of the State ranging from 1% in Karimnagar to 26% in Adilabad district (Fig-7:22 & Table-7:6).

Table7:3: District wise Water Level Trend Scenario

District	Category-1		Category-2		Category-3		Category-4		Rise		Fall	
	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post
Adilabad	4%	5%	60%	29%	25%	41%	10%	26%	65%	33%	35%	67%
Nizamabad	5%	23%	78%	34%	16%	40%	2%	3%	82%	57%	18%	43%
Medak	3%	18%	55%	34%	14%	23%	29%	25%	58%	52%	42%	48%
Mahbubnagar	9%	33%	72%	30%	15%	35%	5%	3%	81%	62%	19%	38%
Khammam	10%	16%	55%	39%	23%	36%	13%	8%	64%	55%	36%	45%
Warangal	6%	23%	49%	19%	35%	53%	10%	5%	55%	42%	45%	58%
Karimnagar	9%	36%	62%	21%	15%	42%	14%	1%	71%	57%	29%	43%
Nalgonda	16%	21%	53%	23%	30%	49%	1%	7%	69%	44%	31%	56%
Ranga Reddy	4%	21%	62%	35%	26%	38%	9%	6%	65%	56%	35%	44%
Total	8%	22%	60%	29%	22%	40%	10%	9%	68%	51%	32%	49%

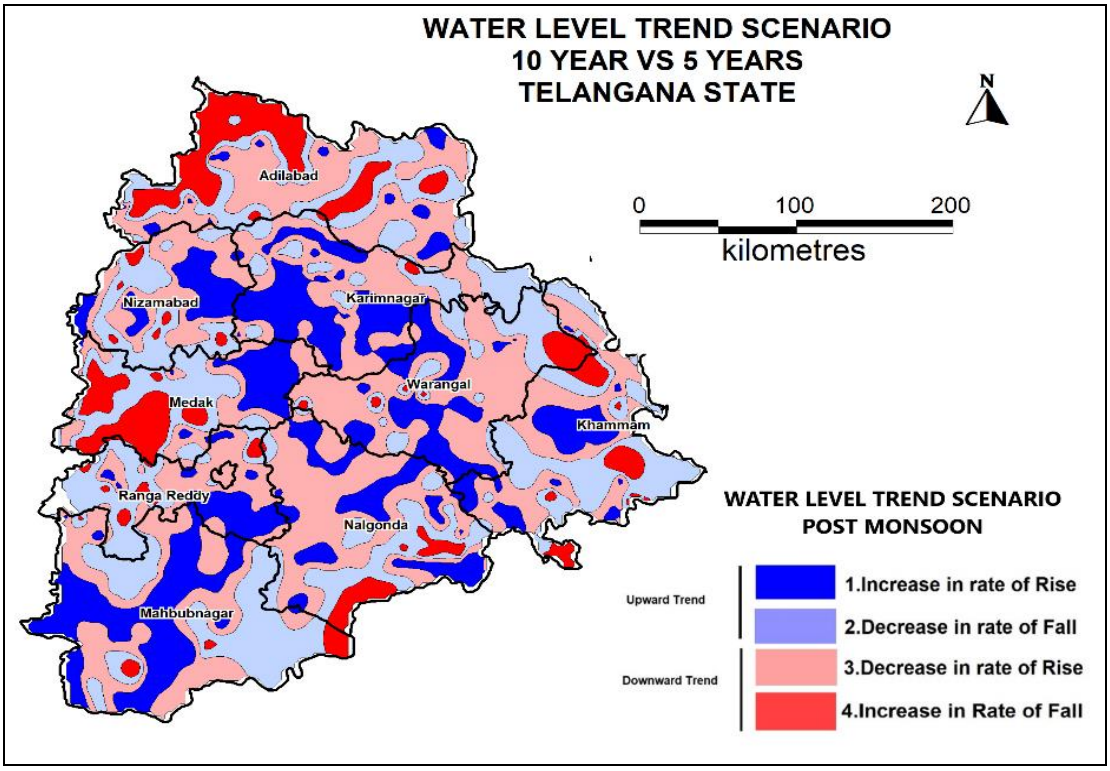


Fig:-7:22 Post monsoon Water Level Trend Scenario

The improvement in water level trends in last five years can be attributed to improvement in minor and major irrigation projects. The rehabilitation of MI tanks under Mission Kakatiya, lift irrigation projects and sustenance of command area under major irrigation projects have increased availability of surface water for irrigation. Major and medium irrigation projects like Priyadarshini Jurala Project, Koilsagar, Kalwakurthi LIS, Rajoli banda diversion schemes improved the availability of surface water in Mahbubnagar district where good improvement in water level trends are observed, Similarly Sriram Sagar Project, Alisagar LIS, Nizam Sagar Project, Arugula Rajaram-Gutpa LIS in Nizamabad district, Upper and Lower Manair, Shanigaram Projects in Karimnagar and Battayram, Wyra, Lankasagar Projects etc. in Khammam district increased the availability of surface water, which in turn reduced the stress on ground water system and resultant rise in ground water levels.

7.7.3 Long-term Water Level trends- Hydrographs: A total 20 hydrographs are generated (2 from each district) by using the existing long term data and the summary is presented in **Table-7.4** and the hydrographs are presented in **Fig.7.23 (a to t)**. Out of 20 hydrograph, 8 hydrographs show rising trend in seasons, 6 wells show falling trend in both seasons and 2 wells show rising

trend during pre-monsoon season and falling trend in post-monsoon season and 4 wells show falling trend during pre-monsoon and rising trend during post-monsoon season.

Table-7.4: Representative Hydrograph Stations showing rising and falling trends

S. No.	Location	District	Pre (m/yr)		Post (m/yr)	
			Rise	Fall	Rise	Fall
1	Bhimavaram	Adilabad	0.024			0.0156
2	Gudihatnur	Adilabad	0.06		0.036	
3	Bahadurpura	Hyderabad	0.084		0.06	
4	Khudubshahi Tombs	Hyderabad		0.072		0.048
5	Chigurumamidi	Karimnagar		0.084	0.192	
6	Dharmapuri	Karimnagar		0.072		0.048
7	Bhadrachalam	Khammam	0.06		0.0936	
8	Kesavapuram	Khammam	0.024		0.06	
9	Alampur	Mahabubnagar	0.048		0.0108	
10	Bandrapal	Mahabubnagar	0.156		0.072	
11	Nacharam	Medak	0.06		0.018	
12	Narayankhed	Medak		0.048		0.108
13	Devarakonda	Nalgonda		0.024	0.132	
14	Miryalaguda	Nalgonda		0.036		0.000024
15	Chinnakodapgol	Nizamabad		0.108		0.132
16	Dudgaon	Nizamabad	0.0216			0.0216
17	Vanasthalipuram	Rangareddy		0.36	0.156	
18	Bandlaguda	Rangareddy	0.6		0.444	
19	Govindaraopet	Warangal		0.024	0.0048	
20	Katapuram	Warangal		0.144		0.012

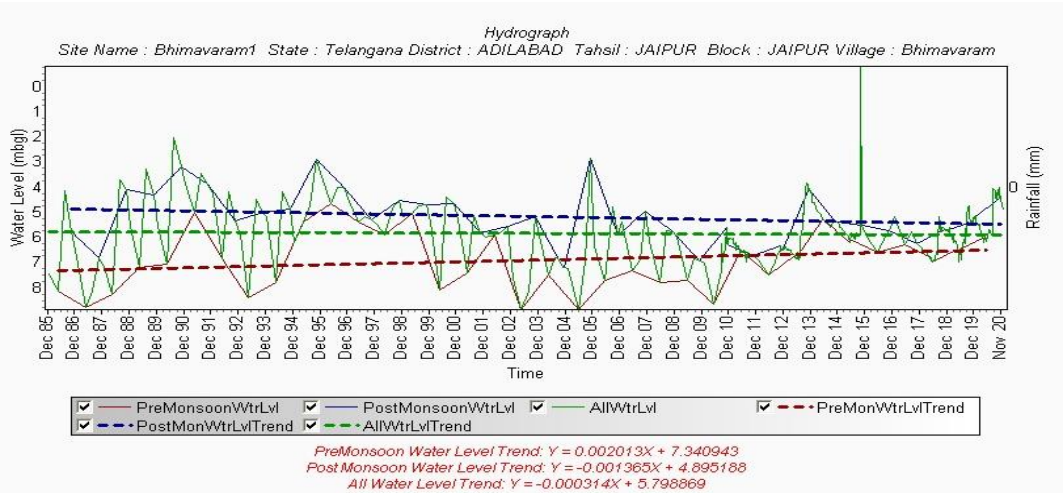


Fig 7.23-a

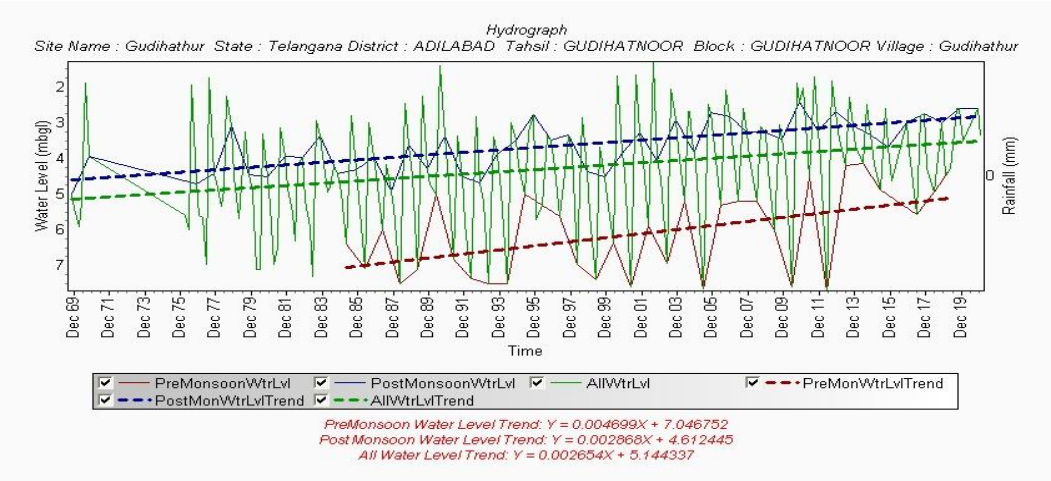


Fig 7.23-b

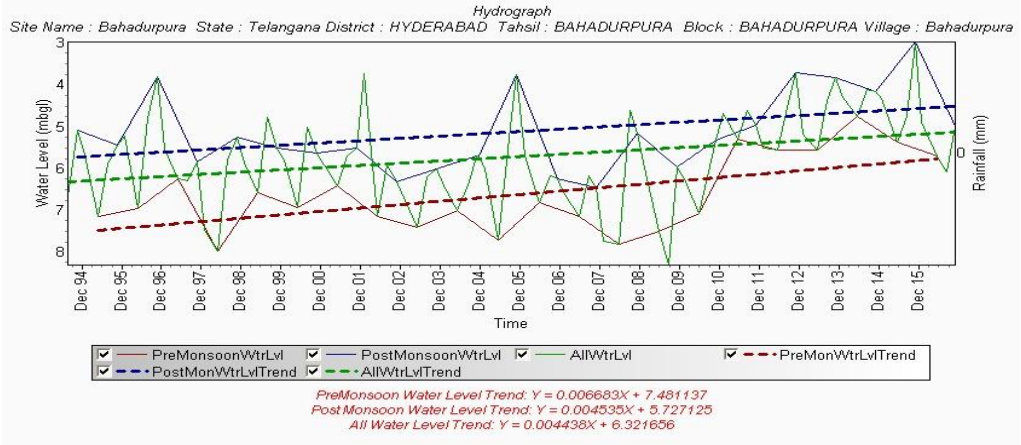


Fig 7.23-c

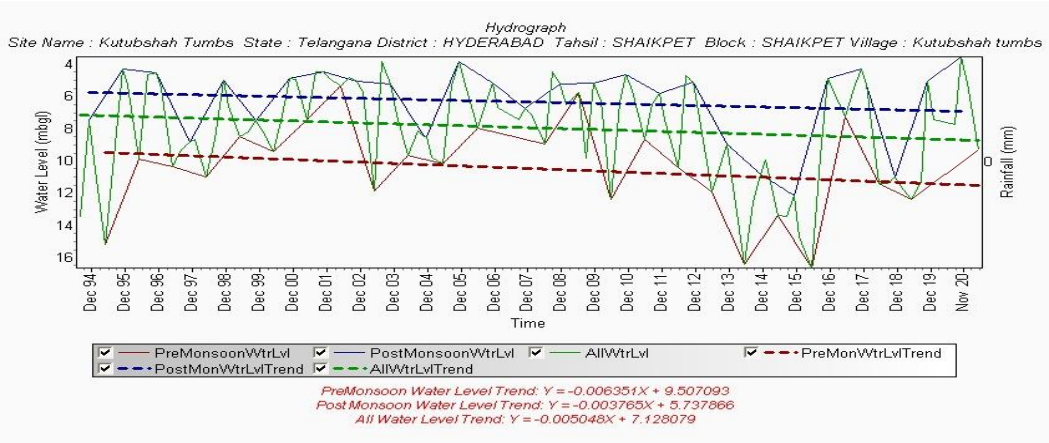


Fig 7.23-d

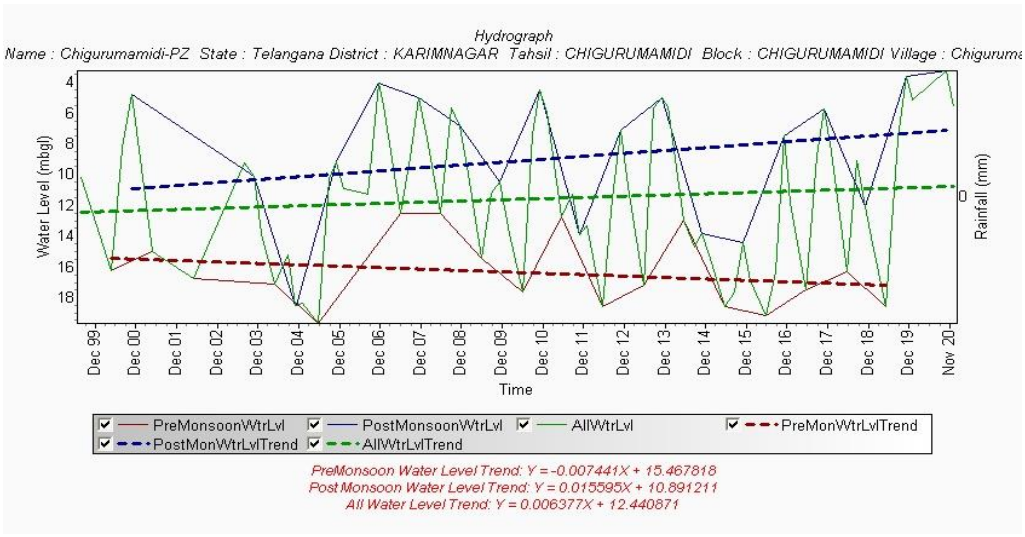


Fig 7.23-e

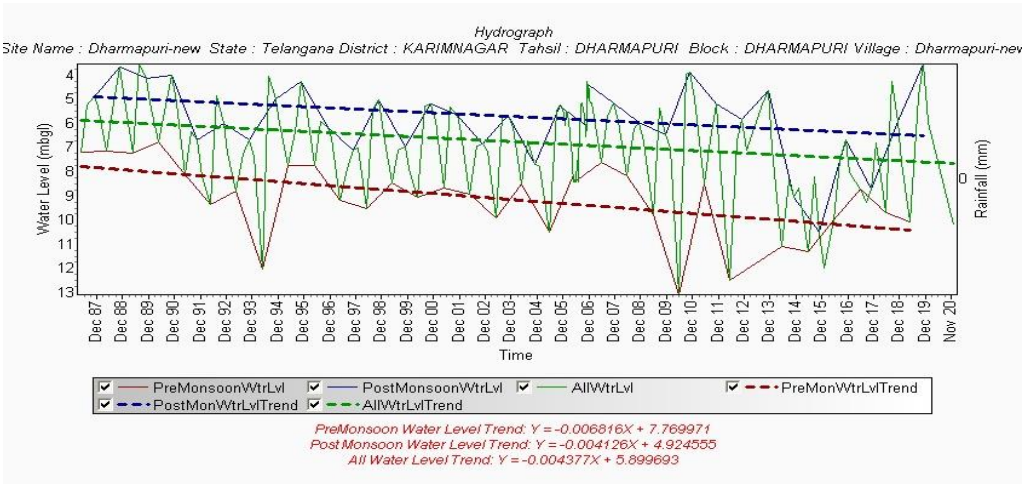


Fig 7.23-f

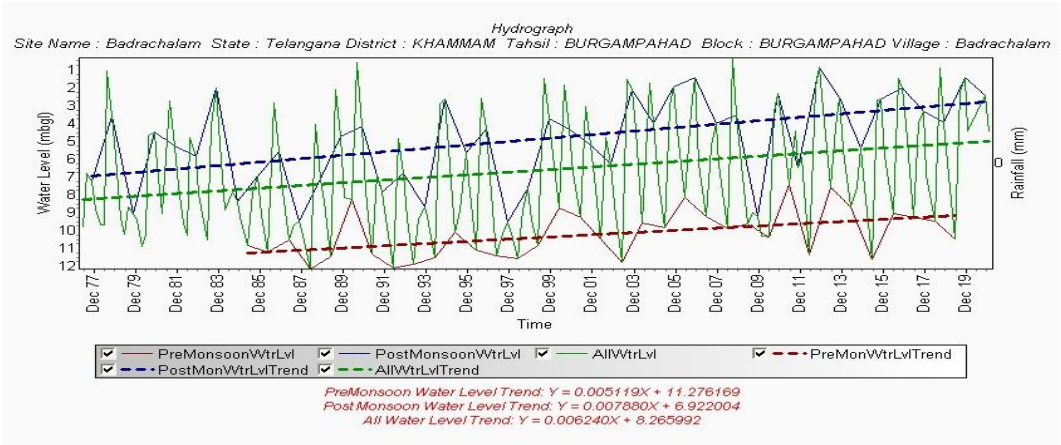


Fig 7.23-g

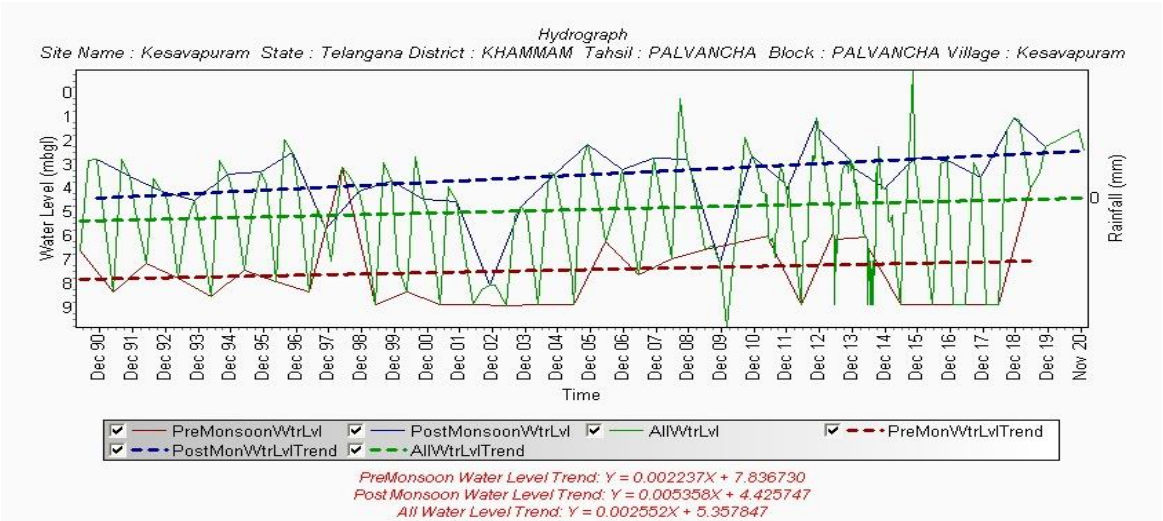


Fig 7.23-h

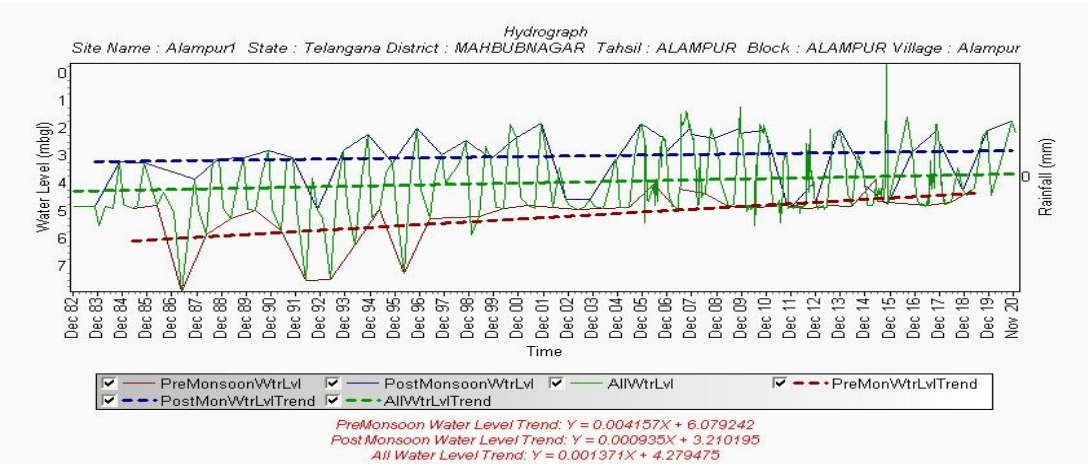


Fig 7.23-i

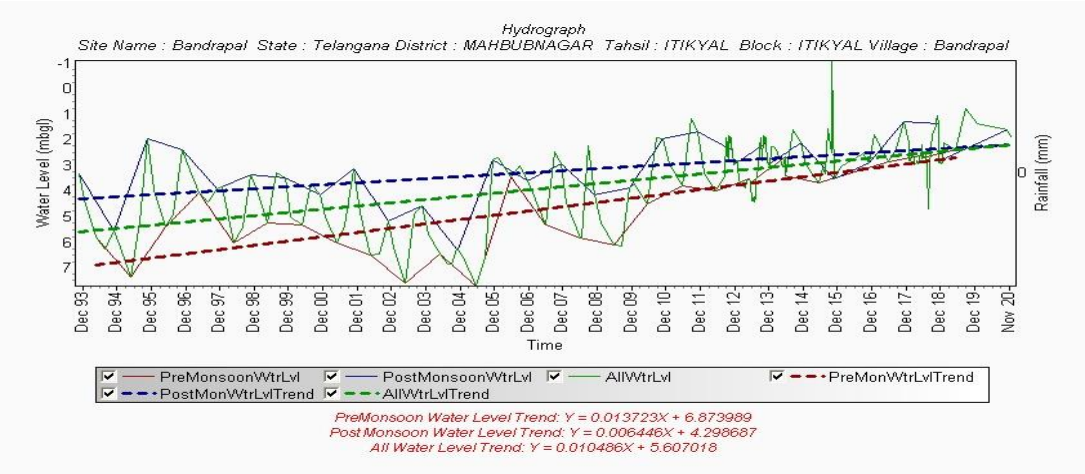


Fig 7.23-j

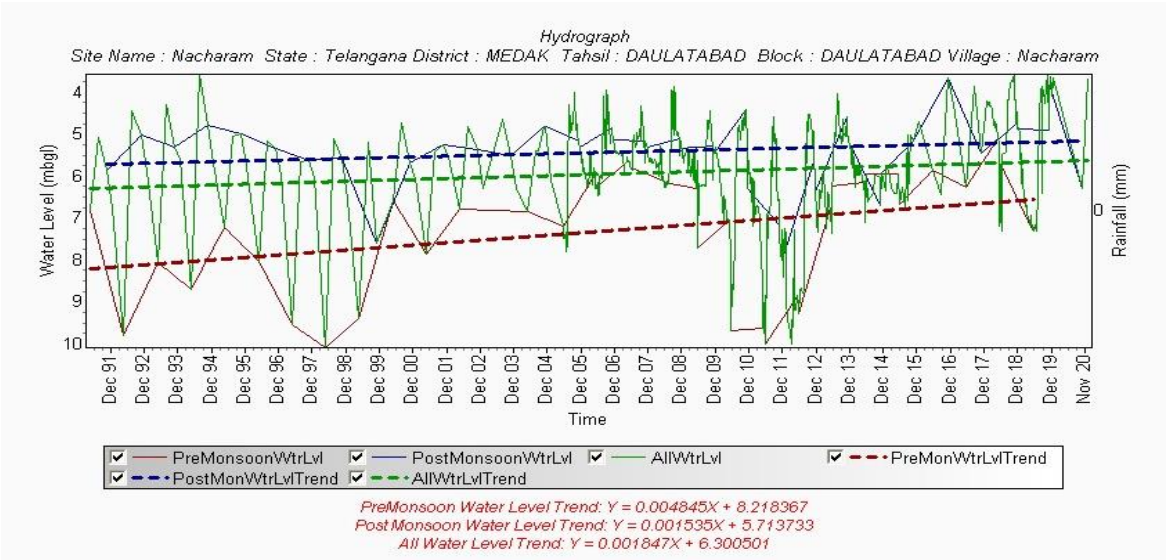


Fig 7.23-k

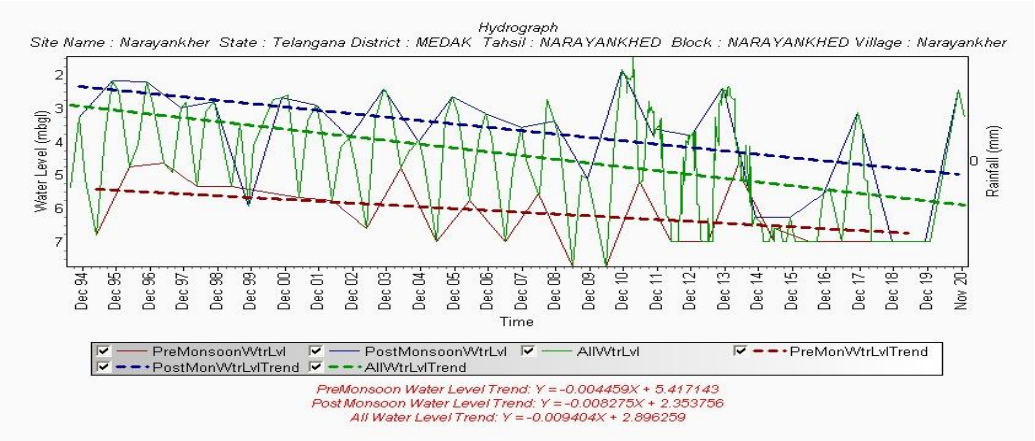


Fig 7.23-l

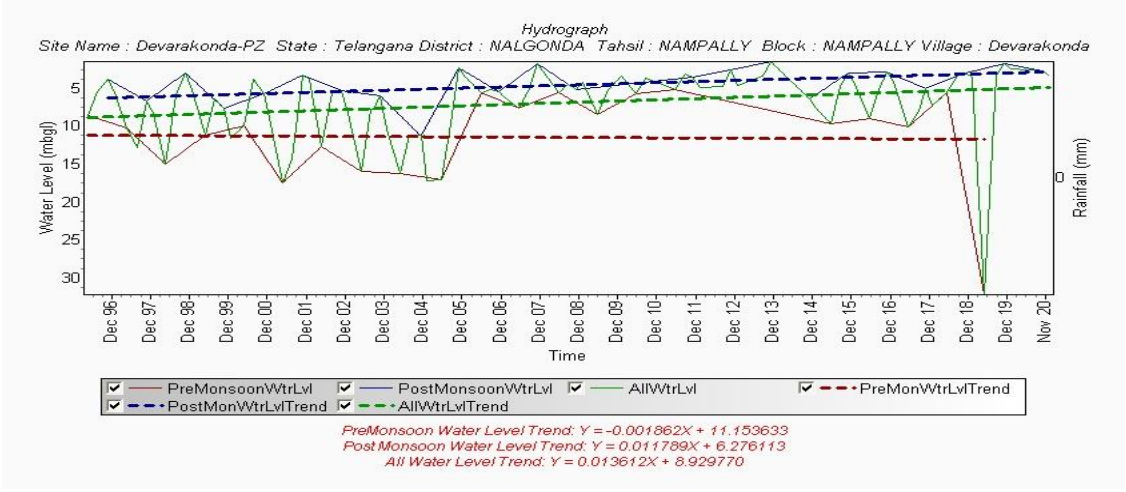


Fig 7.23-m

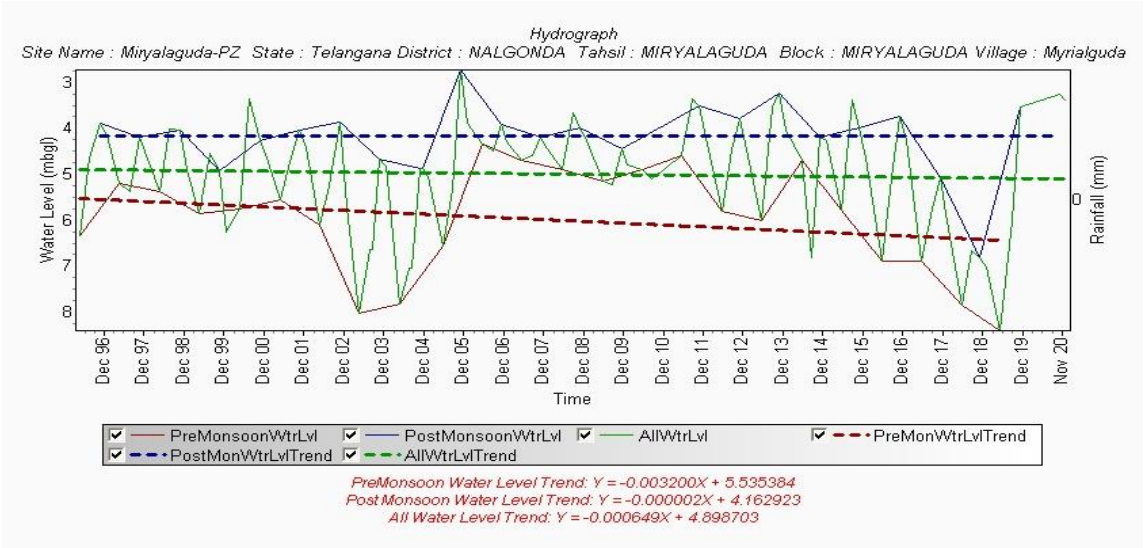


Fig 7.23-n

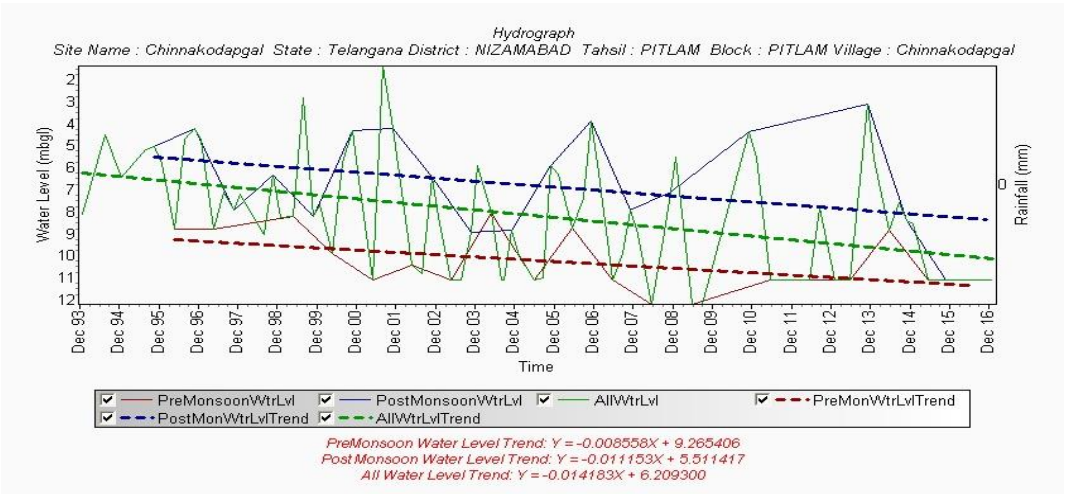


Fig 7.23-o

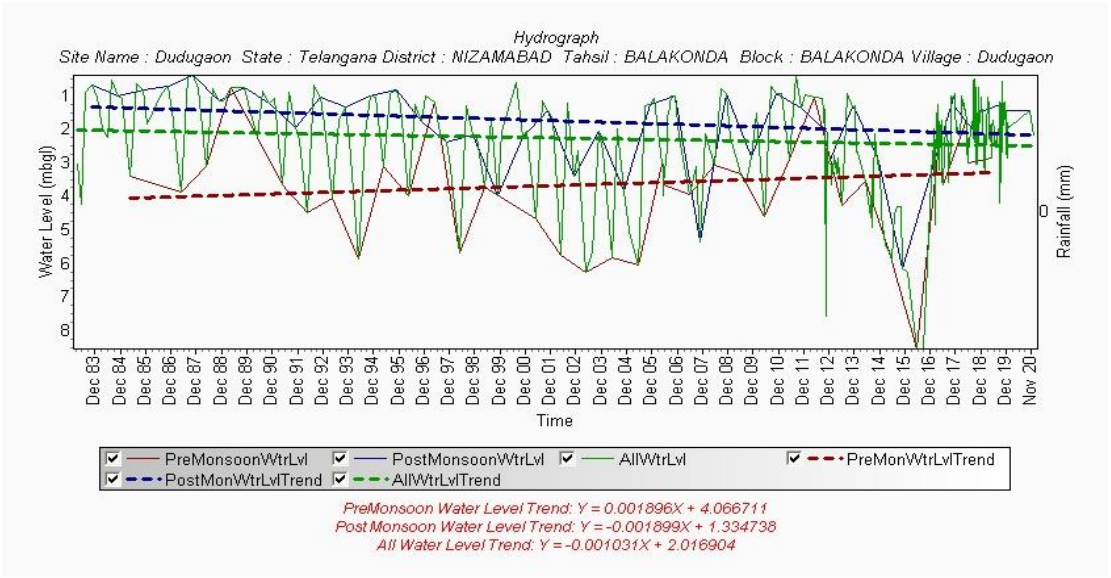


Fig 7.23-p

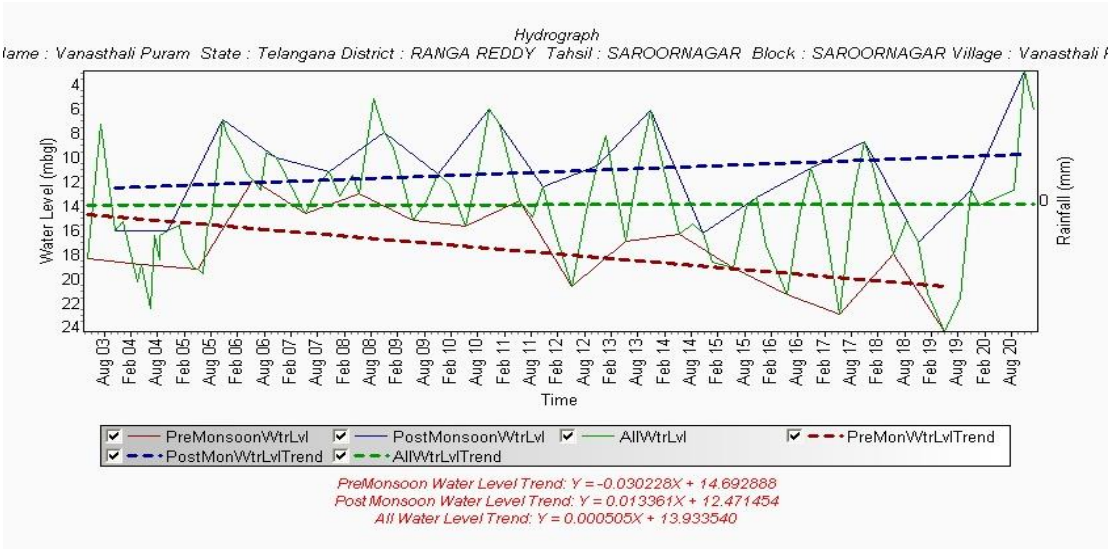


Fig 7.23-q

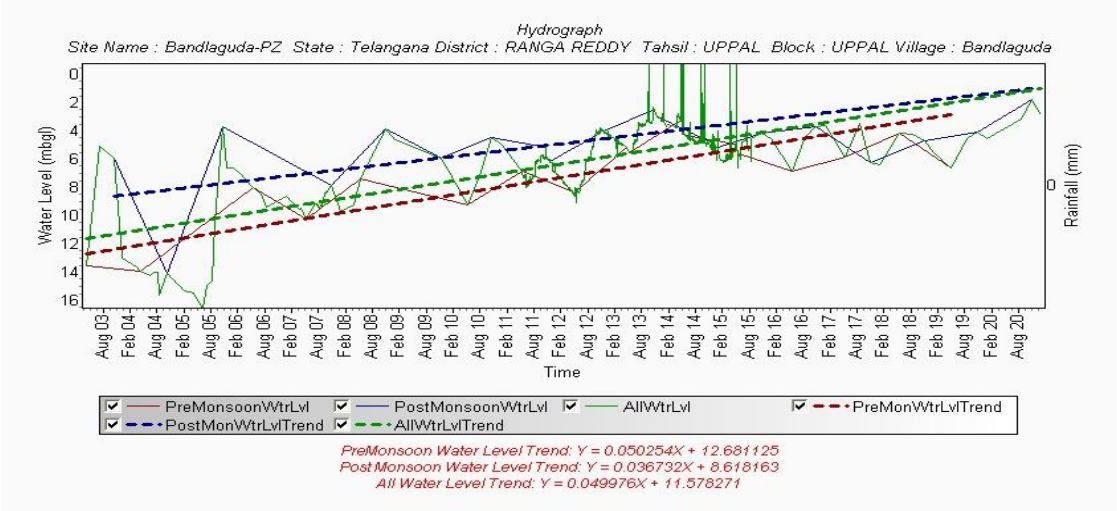


Fig 7.23-r

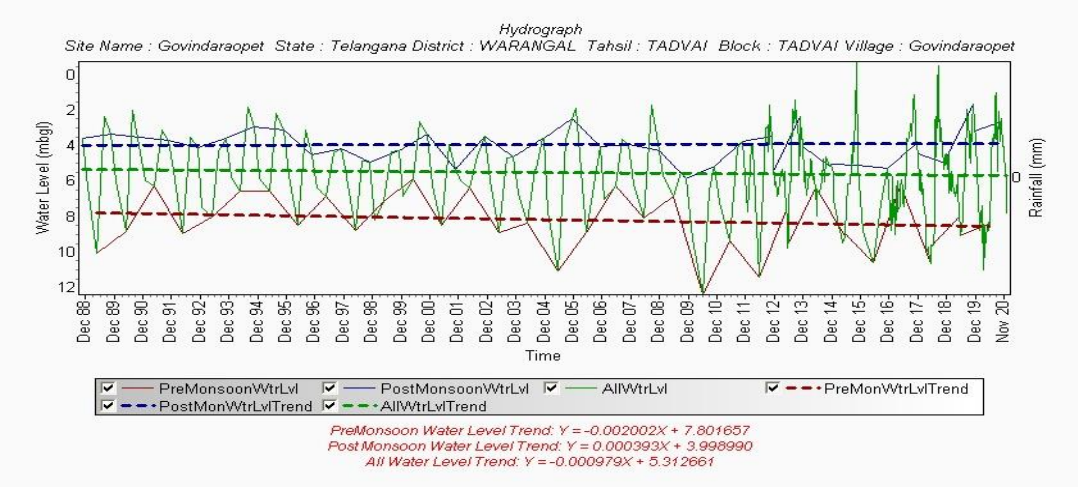


Fig 7.23-s

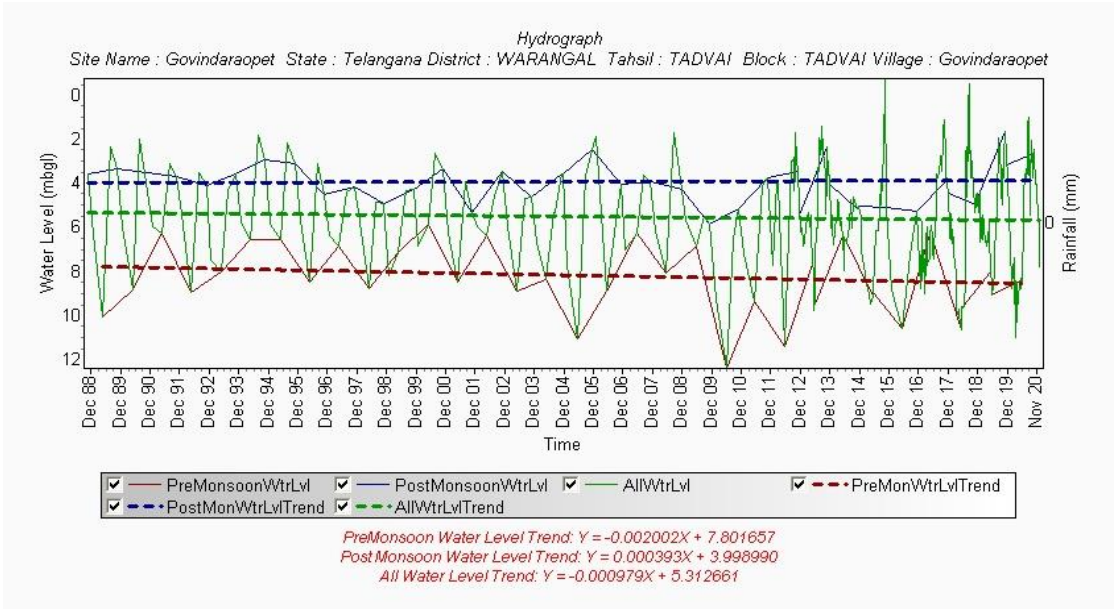


Fig 7.23- t

Fig-7.22 a-t: Representative Hydrographs from Telengana State

Annexure -I

DISTRICT WISE STATUS OF GROUND WATER MONITORING WELLS-NOVEMBER, 2020, TELANGANA STATE

S. No.	District	No of Stations to be monitored			No of Stations where WL data Recorded			No of Stations Monitored as Dry			No of Stations not Monitored due to Various Reasons			No of Stations Abandoned			No of Stations Established			No of Stations as on Nov 2020		
		DW	Pz	Total	DW	Pz	Total	DW	Pz	Total	DW	Pz	Total	DW	Pz	Total	DW	Pz	Total	DW	Pz	Total
1	Adilabad	44	25	69	43	21	64	0	0	0	0	4	4	1	0	1	0	0	0	43	25	68
2	Hyderabad	6	19	25	6	18	24	0	0	0	0	1	1	0	0	0	0	0	0	6	19	25
3	Karimnagar	28	53	81	24	49	73	0	0	0	2	4	6	2	0	2	0	0	0	26	53	79
4	Khammam	45	13	58	42	11	53	0	0	0	2	2	4	1	0	1	0	0	0	44	13	57
5	Mahbubnagar	19	72	91	15	66	81	0	0	0	3	6	9	1	0	1	0	0	0	18	72	90
6	Medak	17	53	70	17	45	62	0	0	0	0	8	8	0	0	0	0	0	0	17	53	70
7	Nalgonda	42	75	117	42	64	106	0	0	0	0	11	11	0	0	0	0	0	0	42	75	117
8	Nizamabad	18	26	44	18	23	41	0	0	0	0	3	3	0	0	0	0	0	0	18	26	44
9	RangaReddy	43	54	97	40	46	86	0	0	0	0	8	8	3	0	3	0	0	0	40	54	94
10	Warangal	44	52	96	39	39	78	0	0	0	2	13	15	3	0	3	0	0	0	41	52	93
	Total	**306**	**442**	**748**	**286**	**382**	**668**	**0**	**0**	**0**	**9**	**60**	**69**	**11**	**0**	**11**	**0**	**0**	**0**	**295**	**442**	**737**

Annexure –II

District Wise Status of Ground Water Monitoring Wells, Telangana State – January 2021

S. No.	District	No of Stations to be monitored			No of Stations where WL data Recorded			No of Stations Monitored as Dry			No of Stations not Monitored due to Various Reasons			No of Stations Abandoned			No of Stations Established			No of Stations as on January 2021		
		DW	Pz	Total	DW	Pz	Total	DW	Pz	Total	DW	Pz	Total	DW	Pz	Total	DW	Pz	Total	DW	Pz	Total
1	Adilabad	43	25	68	42	18	60	0	0	0	0	8	8	0	0	0	0	0	0	43	25	68
2	Hyderabad	6	19	25	6	18	24	0	0	0	0	1	1	0	0	0	0	0	0	6	19	25
3	Karimnagar	26	53	79	24	48	72	0	0	0	2	5	7	0	0	0	0	0	0	26	53	79
4	Khammam	44	13	57	41	10	51	0	0	0	3	3	6	0	0	0	0	0	0	44	13	57
5	Mahabubnagar	18	72	90	17	66	83	0	0	0	1	6	7	0	0	0	0	0	0	18	72	90
6	Medak	17	53	70	17	49	66	0	0	0	0	4	4	0	0	0	0	0	0	17	53	70
7	Nalgonda	42	75	117	42	63	105	0	0	0	0	12	12	0	0	0	0	0	0	42	75	117
8	Nizamabad	18	26	44	17	24	41	1	1	2	0	1	1	0	0	0	0	0	0	18	26	44
9	Rangareddy	40	54	94	37	43	80	0	0	0	3	11	14	0	0	0	0	0	0	40	54	94
10	Warangal	41	52	93	39	43	82	0	0	0	3	8	11	0	0	0	0	0	0	41	52	93
	Total	**295**	**442**	**737**	**282**	**382**	**664**	**1**	**1**	**2**	**12**	**59**	**71**	0	0	0	0	0	0	**295**	**442**	**737**

Annexure –III

DEPTH TO WATER TABLE																
DISTRIBUTION OF PERCENTAGE OF OBSERVATION WELLS (MAY, 2020)																
Sl. No	District	No of Wells Analysed	Depth to Water Table (m bgl)		No and Percentage of Wells Showing Depth to Water Table (m bgl) in Ranga of											
					0.0 - 2.0		2.0 - 5.0		5.0- 10.0		10.0 - 20.0		20.0 - 40.0		> 40.0	
			Min	Max	No	%	No	%	No	%	No	%	No	%	No	%
1	Adilabad	73	1.09	24.1	3	4%	15	21%	30	41%	22	30%	3	4%	0	0%
2	Hyderabad	17	2.93	25.87	0	0%	3	18%	8	47%	3	18%	3	18%	0	0%
3	Karimnagar	119	1.55	32.75	1	1%	31	26%	47	39%	33	28%	7	6%	0	0%
4	Khammam	42	1.4	38.95	2	5%	12	29%	15	36%	11	26%	2	5%	0	0%
5	Mahbubnagar	102	1.2	33.33	4	4%	22	22%	23	23%	39	38%	14	14%	0	0%
6	Medak	68	7.62	49.11	0	0%	0	0%	4	6%	27	40%	35	51%	2	3%
7	Nalgonda	140	0.38	36.75	5	4%	32	23%	52	37%	39	28%	12	9%	0	0%
8	Nizamabad	59	3.21	25.68	0	0%	6	10%	20	34%	27	46%	6	10%	0	0%
9	Ranga Reddy	54	1.46	36.08	1	2%	3	6%	12	22%	28	52%	10	19%	0	0%
10	Warangal	91	2.32	22.34	0	0%	21	23%	44	48%	24	26%	2	2%	0	0.0%
	Total State	**765**	**0.38**	**49.11**	**16**	**2%**	**145**	**19%**	**255**	**33%**	**253**	**33%**	**94**	**12%**	**2**	**0.3%**

Annexure -IV

Depth To Water Level and Percentage of Wells in Different Depth Ranges, Telangana State, August 2020

Sl. No	District	No of Wells Analysed	Depth to Water Table (m bgl)		No and Percentage of Wells Showing Depth to Water Table (m bgl) in Range of											
					0.0 - 2.0		2.0 - 5.0		5.0- 10.0		10.0 - 20.0		20.0 - 40.0		> 40.0	
			Min	Max	No	%	No	%	No	%	No	%	No	%	No	%
1	**Adilabad**	77	0.1	17.5	31	40%	17	22%	17	22%	12	16%	0	0%	0	0%
2	**Hyderabad**	32	0.7	22.0	9	28%	14	44%	5	16%	3	9%	1	3%	0	0%
3	**Karimnagar**	134	0.2	26.2	48	36%	41	31%	23	17%	17	13%	5	4%	0	0%
4	**Khammam**	132	0.2	35.4	67	51%	39	30%	10	8%	11	8%	5	4%	0	0%
5	**Mahbubnagar**	133	0.1	39.5	33	25%	49	37%	20	15%	23	17%	8	6%	0	0%
6	**Medak**	91	0.5	45.9	6	7%	8	9%	17	19%	37	41%	22	24%	1	1%
7	**Nalgonda**	156	0.2	48.3	36	23%	35	22%	45	29%	36	23%	3	2%	1	1%
8	**Nizamabad**	88	0.3	32.5	11	13%	20	23%	19	22%	31	35%	7	8%	0	0%
9	**Ranga Reddy**	158	0.7	37.8	18	11%	45	28%	38	24%	45	28%	12	8%	0	0%
10	**Warangal**	135	0.1	32.3	72	53%	41	30%	15	11%	5	4%	2	1%	0	0%
	Total State	**1136**	**0.1**	**48.3**	**331**	**29%**	**309**	**27%**	**209**	**18%**	**220**	**19%**	**65**	**6%**	**2**	**1%**

Annexure V

DEPTH TO WATER LEVEL- TELANGANA STATE																
DISTRIBUTION OF PERCENTAGE OF OBSERVATION WELLS (NOVEMBER, 2020)																
Sl. No	**District**	**No of Wells Analysed**	**Depth to Water Table (m bgl)**		**No and Percentage of Wells Showing Depth to Water Level (m bgl)**											
					0.0 - 2.0		**2.0 - 5.0**		**5.0- 10.0**		**10.0 - 20.0**		**20.0 -40.0**		**> 40.0**	
			Min	**Max**	**No**	**%**	**No**	**%**	**No**	**%**	**No**	**%**	**No**	**%**	**No**	**%**
1	**Adilabad**	58	0.0	10.8	16	28%	31	53%	10	17%	1	2%	0	0%	0	0%
2	**Hyderabad**	11	0.0	8.6	4	36%	4	36%	3	27%	0	0%	0	0%	0	0%
3	**Karimnagar**	58	0.5	11.3	20	48%	27	47%	10	17%	1	2%	0	0%	0	0%
4	**Khammam**	46	0.0	9.1	19	41%	21	46%	6	13%	0	0%	0	0%	0	0%
5	**Mahbubnagar**	68	0.2	23.6	23	34%	18	26%	18	26%	7	10%	2	3%	0	0%
6	**Medak**	46	0.3	26.3	10	22%	18	39%	5	11%	9	20%	4	9%	0	0%
7	**Nalgonda**	87	0.4	12.0	35	40%	39	46%	12	14%	1	1%	0	0%	0	0%
8	**Nizamabad**	36	1.2	12.9	10	28%	14	39%	9	25%	3	8%	0	0%	0	0%
9	**Ranga Reddy**	71	0.0	17.1	23	32%	31	44%	14	20%	2	3%	0	0%	1	1%
10	**Warangal**	71	0.0	6.9	48	68%	16	23%	7	10%	0	0%	0	0%	0	0%
	Total State	**552**	**0.0**	**26.3**	**208**	**38%**	**219**	**40%**	**94**	**17%**	**24**	**4%**	**6**	**1%**	**1**	**0.2%**

Annexure -VI

Depth to Water Level and percentage of wells in different depth ranges- January 2021																
Sl. No	**District**	**No of Wells Analyzed**	**Depth to Water Level (m bgl)**		**No and Percentage of Wells Showing Depth to Water Table (m bgl) in Range of**											
					0.0 - 2.0		**2.0 - 5.0**		**5.0- 10.0**		**10.0 - 20.0**		**20.0 - 40.0**		**> 40.0**	
			Min	**Max**	**No**	**%**	**No**	**%**	**No**	**%**	**No**	**%**	**No**	**%**	**No**	**%**
1	Adilabad	55	0.00	28.60	5	9	24	44	21	38	4	7	1	2	0	0
2	Hyderabad	11	0.74	11.28	1	9	4	36	5	45	1	9	0	0	0	0
3	Karimnagar	59	0.42	12.12	7	12	31	53	17	29	4	7	0	0	0	0
4	Khammam	45	0.00	9.82	13	29	21	47	11	24	0	0	0	0	0	0
5	Mahabubnagar	70	0.17	22.12	13	19	23	33	23	33	10	14	1	1	0	0
6	Medak	51	1.38	50.00	1	2	17	33	13	25	12	24	7	14	1	2
7	Nalgonda	87	0.49	14.12	23	26	42	48	19	22	3	3	0	0	0	0
8	Nizamabad	38	1.14	32.10	2	5	11	29	16	42	8	21	1	3	0	0
9	Rangareddy	67	0.55	31.73	7	10	17	25	39	58	3	4	1	1	0	0
10	Warangal	75	0.27	10.64	24	32	40	53	10	13	1	1	0	0	0	0
	Total State	**558**	**0.00**	**50.00**	**96**	**6**	**230**	**27**	**174**	**32**	**46**	**26**	**11**	**8**	**1**	1

Annexure -VII

District-wise water level fluctuations and frequency in different fluctuation ranges from May 2020 to August 2020

Sl. No	District	No of Wells Analysed	Range of Fluctuation (m)				No of Wells / Percentage Showing Fluctuation													
			Rise		Fall		Rise						Fall						Total No. of Wells	
							0 to 2		2 to 4		> 4		0 to 2		2 to 4		> 4			
			Min	Max	Min	Max	No	%	No	%	No	%	No	%	No	%	No	%	Rise	Fall
1	**Adilabad**	75	0.1	21.38	2	3.44	15	21%	20	28%	37	51%	0	0%	3	100%	0	0.0%	72	3
2	**Hyderabad**	20	1.25	13.72	0	0	3	15%	6	30%	11	55%	0	0%	0	0%	0	0.0%	20	0
3	**Karimnagar**	128	0.48	14.84	0.1	2.99	17	14%	44	35%	64	51%	2	67%	1	33%	0	0.0%	125	3
4	**Khammam**	131	0.02	19.34	1.12	2.23	16	12%	26	20%	86	67%	1	50%	1	50%	1	50.0%	129	2
5	**Mahbubnagar**	130	0.1	38.91	0.1	1.8	26	20%	40	31%	61	48%	3	100%	0	0%	0	0.0%	127	3
6	**Medak**	86	0.3	15.7	0.3	0.64	9	11%	23	28%	51	61%	3	100%	0	0%	0	0.0%	83	3
7	**Nalgonda**	152	0.05	30.92	0.02	2.14	45	34%	46	34%	43	32%	16	89%	2	11%	0	0.0%	134	18
8	**Nizamabad**	85	0.4	22.18	0.31	3.93	21	30%	27	38%	23	32%	9	64%	5	36%	0	0.0%	71	14
9	**Ranga Reddy**	88	0.49	18.82	0.2	2.43	12	14%	31	36%	43	50%	1	50%	1	50%	0	0.0%	86	2
10	**Warangal**	133	1.1	20.46	0	0	10	8%	35	26%	88	66%	0	0%	0	0%	0	0.0%	133	0
	Total State	**1028**	**0.02**	**38.91**	**0.02**	**3.93**	**174**	**18%**	**298**	**30.4%**	**507**	**51.7%**	**35**	**73%**	**13**	**26.00**	**1**	**0.01**	**980**	**48**

Annexure -VIII

DISTRICT WISE FLUCTUATION AND FREQUENCY DISTRIBUTION FROM DIFFERENT RANGES, TELANGANA STATE																				
May, 2020 to Nov, 2020																				
Sl. No	District	No of Wells Analysed	Range of Fluctuation (m)				No of Wells / Percentage Showing Fluctuation												Total No. of Wells	
			Rise		Fall		Rise						Fall							
							0 to 2		2 to 4		> 4		0 to 2		2 to 4		> 4			
			Min	Max	Min	Max	No	%	No	%	No	%	No	%	No	%	No	%	Rise	Fall
1	**ADILABAD**	58	0.62	11.42	-	0.35	7	12%	20	34%	30	52%	1	2%	0	0%	0	0.0%	57	1
2	**HYDERABAD**	10	0.98	9.73	-	-	2	20%	2	20%	6	60%	0	0%	0	0%	0	0.0%	10	0
3	**KARIMNAGAR**	58	0.68	14.33	-	2.53	1	2%	17	29%	39	67%	0	0%	1	2%	0	0.0%	57	1
4	**KHAMMAM**	38	0.56	10.62	-	-	6	16%	10	26%	22	58%	0	0%	0	0%	0	0.0%	38	0
5	**MAHBUBNAGAR**	68	1.76	32.31	-	3.73	3	4%	8	12%	56	82%	0	0%	1	1%	0	0.0%	67	1
6	**Medak**	43	0.80	35.17	-	1.03	2	5%	5	12%	35	81%	1	2%	0	0%	0	0.0%	42	1
7	**Nalgonda**	87	0.19	28.40	-	0.19	14	16%	22	25%	50	57%	1	1%	0	0%	0	0.0%	86	1
8	**Nizamabad**	36	0.62	16.56	-	1.33	2	6%	9	25%	24	67%	1	3%	0	0%	0	0.0%	35	1
9	**Rangareddy**	68	2.44	30.79	0.02	7.27	0	0%	2	3%	64	94%	1	1%	0	0%	1	1.5%	66	2
10	**Warangal**	71	0.62	22.73	-	-	2	3%	7	10%	62	87%	0	0%	0	0%	0	0.0%	71	0
	Total	**537**	**0.19**	**35.17**	**0.02**	**7.27**	**39**	**7%**	**102**	**19%**	**388**	**73%**	**5**	**63%**	**2**	**25%**	**1**	**13%**	**529**	**8**

Annexure-IX

District-wise water level fluctuation and frequency in different fluctuation ranges (May 2020 to January 2021)

Sl. No	District	No of Wells Analysed	Range of Fluctuation (m)				No of Wells / Percentage Showing Fluctuation													
			Rise		Fall		Rise						Fall						Total No. of Wells	
							0 to 2		2 to 4		> 4		0 to 2		2 to 4		> 4			
			Min	Max	Min	Max	No	%	No	%	No	%	No	%	No	%	No	%	Rise	Fall
1	Adilabad	55	0.7	10.2	0.4	18	17	34%	22	44%	11	22%	2	40%	1	20%	2	40%	50	5
2	Hyderabad	10	1.2	7.2	1.2	1.2	2	22%	3	33%	4	44%	1	100%	0	0%	0	0%	9	1
3	Karimnagar	57	0.91	12.64	0.19	3.34	7	13%	19	36%	27	51%	2	50%	2	50%	0	0%	53	4
4	Khammam	37	0.3	10.3	1.2	1.2	9	25%	16	44%	11	31%	1	100%	0	0%	0	0%	36	1
5	Mahabubnagar	66	1.3	32.4	0.8	0.8	5	8%	8	12%	52	80%	1	100%	0	0%	0	0%	65	1
6	Medak	43	1.0	30.4	0.8	2	5	12%	10	24%	26	63%	2	100%	0	0%	0	0%	41	2
7	Nalgonda	85	0.1	28.2	0.5	1	16	20%	23	28%	43	52%	3	100%	0	0%	0	0%	82	3
8	Nizamabad	36	0.3	11.9	1.9	20	6	18%	7	21%	20	61%	1	33%	1	33%	1	33%	33	3
9	Rangareddy	64	0.6	27.1	0.8	7	3	5%	11	18%	48	77%	1	50%	0	0%	1	50%	62	2
10	Warangal	69	0	18	0	0	7	10%	13	19%	49	71%	0	0%	0	0%	0	0%	69	0
	Total State	**522**	**0.1**	**32.4**	**0.0**	**20**	**77**	**15%**	**132**	**26%**	**291**	**58%**	**14**	**64%**	**4**	**18%**	**4**	**18%**	**500**	**22**

Annexure -X

DISTRICT WISE FLUCTUATION AND FREQUENCY DISTRIBUTION FROM DIFFERENT RANGES FROM ONE PERIOD TO OTHER																				
May - 2019 to May - 2020																				
Sl. No	District	No of Wells Analysed	Range of Fluctuation (m)				No of Wells / Percentage Showing Fluctuation												Total No. of Wells	
			Rise		Fall		Rise						Fall							
							0 to 2		2 to 4		> 4		0 to 2		2 to 4		> 4			
			Min	Max	Min	Max	No	%	No	%	No	%	No	%	No	%	No	%	Rise	Fall
1	Adilabad	68	0.18	9.66	-1.88	-0.01	31	47%	9	14%	4	6%	24	100%	0	0%	0	0%	66	24
2	Hyderabad	14	0.1	18.47	-2.76	-0.08	3	21%	1	7%	1	7%	7	78%	2	22%	0	0%	14	9
3	Karimnagar	115	0.1	21.66	-3.04	-0.25	32	35%	30	33%	42	46%	10	91%	1	9%	0	0%	92	11
4	Khammam	39	0.08	12.13	-4.55	-0.03	25	64%	4	10%	0	0%	9	90%	0	0%	1	10%	39	10
5	Mababubnagar	97	0.02	38.1	-26.55	-0.07	33	40%	24	29%	33	40%	6	86%	0	0%	1	14%	83	7
6	Medak	61	0.02	16.48	-12.62	-0.24	7	15%	10	21%	25	52%	8	42%	6	32%	5	26%	48	19
7	Nalgonda	134	0.04	32.1	-7.47	-0.01	47	42%	24	21%	46	41%	14	82%	2	12%	1	6%	113	17
8	Nizamabad	60	0.1	26.88	-2.95	-0.05	17	40%	8	19%	30	71%	4	80%	1	20%	0	0%	42	5
9	Ranga Reddy	48	0.18	14.95	-1.97	-0.69	19	46%	9	22%	13	32%	7	100%	0	0%	0	0%	41	7
10	Warangal	83	0.1	21.95	-3.5	-0.13	20	32%	15	24%	39	62%	7	78%	2	22%	0	0%	63	9
	Total State	**719**	**0.02**	**38.10**	**-26.55**	**-0.01**	**234**	**39%**	**134**	**22%**	**233**	**39%**	**96**	**81%**	**14**	**12%**	**8**	**7%**	**601**	**118**

Annexure -XI

District-wise water level fluctuations and frequency in different fluctuation ranges from May 2020 to August 2020

Sl. No	District	No of Wells Analysed	Range of Fluctuation (m)				No of Wells / Percentage Showing Fluctuation													
			Rise		Fall		Rise						Fall						Total No. of Wells	
							0 to 2		2 to 4		> 4		0 to 2		2 to 4		> 4			
			Min	Max	Min	Max	No	%	No	%	No	%	No	%	No	%	No	%	Rise	Fall
1	**Adilabad**	75	0.1	21.38	2	3.44	15	21%	20	28%	37	51%	0	0%	3	100%	0	0.0%	72	3
2	**Hyderabad**	20	1.25	13.72	0	0	3	15%	6	30%	11	55%	0	0%	0	0%	0	0.0%	20	0
3	**Karimnagar**	128	0.48	14.84	0.1	2.99	17	14%	44	35%	64	51%	2	67%	1	33%	0	0.0%	125	3
4	**Khammam**	131	0.02	19.34	1.12	2.23	16	12%	26	20%	86	67%	1	50%	1	50%	1	50.0%	129	2
5	**Mahbubnagar**	130	0.1	38.91	0.1	1.8	26	20%	40	31%	61	48%	3	100%	0	0%	0	0.0%	127	3
6	**Medak**	86	0.3	15.7	0.3	0.64	9	11%	23	28%	51	61%	3	100%	0	0%	0	0.0%	83	3
7	**Nalgonda**	152	0.05	30.92	0.02	2.14	45	34%	46	34%	43	32%	16	89%	2	11%	0	0.0%	134	18
8	**Nizamabad**	85	0.4	22.18	0.31	3.93	21	30%	27	38%	23	32%	9	64%	5	36%	0	0.0%	71	14
9	**Ranga Reddy**	88	0.49	18.82	0.2	2.43	12	14%	31	36%	43	50%	1	50%	1	50%	0	0.0%	86	2
10	**Warangal**	133	1.1	20.46	0	0	10	8%	35	26%	88	66%	0	0%	0	0%	0	0.0%	133	0
	Total State	**1028**	**0.02**	**38.91**	**0.02**	**3.93**	**174**	**18%**	**298**	**30.4%**	**507**	**51.7%**	**35**	**73%**	**13**	**26.00**	**1**	**0.01**	**980**	**48**

Annexure -XII

DISTRICT WISE FLUCTUATION AND FREQUENCY DISTRIBUTION FROM DIFFERENT RANGES, TELANGANA STATE																				
NOV 2019 / NOV 2020																				
Sl. No	District	No of Wells Analysed	Range of Fluctuation (m)				No of Wells / Percentage Showing Fluctuation												Total No. of Wells	
			Rise		Fall		Rise						Fall							
							0 to 2		2 to 4		> 4		0 to 2		2 to 4		> 4			
			Min	Max	Min	Max	No	%	No	%	No	%	No	%	No	%	No	%	Rise	Fall
1	**Adilabad**	55	0.02	3.17	0.04	5.29	22	39%	2	4%	0	0%	28	50%	2	4%	1	2%	24	31
2	**Hyderabad**	9	0.04	10.84	-	-	5	56%	1	11%	3	33%	0	0%	0	0%	0	0%	9	0
3	**Karimnagar**	56	0.05	8.25	0.07	4.87	21	37%	3	5%	4	7%	26	46%	1	2%	1	2%	28	28
4	**Khammam**	45	0.06	5.9	0	2.52	17	37%	3	7%	2	4%	22	48%	1	2%	0	0%	22	23
5	**Mahbubnagar**	64	0.09	55.93	0.55	3.84	19	30%	9	14%	29	45%	5	8%	2	3%	0	0%	57	7
6	**Medak**	46	0.17	41.3	0.3	2.18	6	13%	5	11%	29	63%	5	11%	1	2%	0	0%	40	6
7	**Nalgonda**	83	0.01	19.65	0.11	2.64	39	47%	12	14%	13	16%	18	22%	1	1%	0	0%	64	19
8	**Nizamabad**	32	0.14	5.1	0.01	8.87	7	22%	3	9%	2	6%	17	53%	1	3%	2	6%	12	20
9	**RangaReddy**	65	0.01	20.62	0.19	27.33	16	25%	12	18%	33	51%	3	5%	0	0%	1	2%	61	4
10	**Warangal**	69	0.01	11.23	0.01	2.4	30	42%	7	10%	13	18%	18	25%	1	1%	0	0%	50	19
Total State		**524**	**0.01**	**42.8**	**0.01**	**10.59**	**182**	**50%**	**57**	**15%**	**128**	**35%**	**142**	**90%**	**10**	**7%**	**5**	**3%**	**367**	**157**

Annexure –XIII

District-wise water level fluctuation and frequency in different fluctuation ranges, (January 2020 to January 2021)

Sl. No	District	No of Wells Analysed	Range of Fluctuation (m)				No of Wells / Percentage Showing Fluctuation												Total No. of Wells	
			Rise		Fall		Rise						Fall							
							0 to 2		2 to 4		> 4		0 to 2		2 to 4		> 4			
			Min	Max	Min	Max	No	%	No	%	No	%	No	%	No	%	No	%	Rise	Fall
1	Adilabad	55	0.03	3.02	0.05	25.30	14	93%	1	7%	0	0%	33	85%	2	5%	4	10%	15	39
2	Hyderabad	9	0.03	6.42	-	-	5	56%	1	11%	3	33%	0	0%	0	0%	0	0%	9	0
3	Karimnagar	58	0.02	10.79	0.01	4.25	15	65%	4	17%	4	17%	32	91%	2	6%	1	3%	23	35
4	Khammam	42	0.01	4.37	0.01	1.25	23	85%	3	11%	1	4%	14	100%	0	0%	0	0%	27	14
5	Mahabubnagar	66	0.04	32.78	0.17	1.98	19	32%	11	19%	29	49%	7	100%	0	0%	0	0%	59	7
6	Medak	48	0.01	39.13	0.92	5.33	9	21%	8	19%	25	60%	3	50%	2	33%	1	17%	42	6
7	Nalgonda	78	0.01	16.80	0.01	2.32	34	61%	10	18%	12	21%	20	95%	1	5%	0	0%	56	21
8	Nizamabad	35	0.10	3.00	0.06	5.88	11	79%	3	21%	0	0%	13	62%	6	29%	2	10%	14	21
9	Rangareddy	66	0.02	34.73	0.01	1.75	22	36%	9	15%	30	49%	5	100%	0	0%	0	0%	61	5
10	Warangal	74	0.01	10.95	0.01	3.21	33	60%	10	18%	12	22%	16	84%	3	16%	0	0%	55	19
Total State		**531**	**0.01**	**39.13**	**0.01**	**25.30**	**185**	**51%**	**60**	**17%**	**116**	**32%**	**143**	**86%**	**16**	**10%**	**8**	**5%**	**361**	**167**

Annexure –XIV

DISTRICT WISE FLUCTUATION OF WATER LEVEL WITH MEAN AND SELECTED PERIOD																				
Decadal mean (2010 may-2019 may)/may 2020																				
Sl. No	**District**	**No of Wells Analysed**	**Range of Fluctuation (m)**				**No of Wells / Percentage Showing Fluctuation**												**Total No. of Wells**	
			Rise		**Fall**		**Rise**						**Fall**						**Rise**	**Fall**
							0 to 2		**2 to 4**		**> 4**		**0 to 2**		**2 to 4**		**> 4**			
			Min	**Max**	**Min**	**Max**	**No**	**%**	**No**	**%**	**No**	**%**	**No**	**%**	**No**	**%**	**No**	**%**		
1	Adilabad	70	0.317	10.8	5.67	0	35	54%	7	11%	5	8%	18	78%	2	9%	3	13%	65	23
2	Hyderabad	13	0.265	11.69	7.35	1.79	4	31%	3	23%	0	0%	2	33%	2	33%	2	33%	13	6
3	Karimnagar	117	0.044	14.27	12.5	0.04	33	43%	34	44%	37	48%	9	69%	0	0%	4	31%	77	13
4	Khammam	40	0.294	8.298	6.78	0.32	17	44%	7	18%	1	3%	10	67%	4	27%	1	7%	39	15
5	Mahbubnagar	97	0.019	14.82	28.3	0.32	27	42%	21	32%	25	38%	16	67%	5	21%	3	13%	65	24
6	Medak	73	0.023	11.41	20.9	0.18	13	23%	7	13%	16	29%	8	22%	4	11%	25	68%	56	37
7	Nalgonda	133	0.032	31.46	14.4	0.27	47	48%	31	32%	33	34%	14	64%	7	32%	1	5%	97	22
8	Nizamabad	59	0.165	10.73	7.94	0.07	16	43%	13	35%	19	51%	7	64%	2	18%	2	18%	37	11
9	Ranga Reddy	45	0.285	7.188	7.1	0.31	11	27%	3	7%	4	10%	13	48%	10	37%	4	15%	41	27
10	Warangal	85	0.345	21.56	5.39	0.25	17	32%	27	51%	30	57%	8	73%	2	18%	1	9%	53	11
	Total State	**732**	**0.019**	**31.46**	**28.3**	**0**	**220**	**41%**	**153**	**28%**	**170**	**31%**	**105**	**56%**	**38**	**20%**	**46**	**24%**	**543**	**189**

Annexure-XV

District-wise water level fluctuations and frequency in different fluctuation ranges from Decadal Mean August (2010 – 2019) To August 2020

Sl. No	District	No of Wells Analysed	Rise		Fall		No of Wells / Percentage Showing Fluctuation													
							Rise						Fall						Total No. of Wells	
							0 to 2		2 to 4		> 4		0 to 2		2 to 4		> 4		Rise	Fall
			Min	Max	Min	Max	No	%	No	%	No	%	No	%	No	%	No	%		
1	Adilabad	66	0.048	7.794	0.38	3.10	32	58%	14	25%	9	16%	9	82%	2	18%	0	0%	55	11
2	Hyderabad	14	0.165	9.278	0.04	1.80	3	27%	5	45%	3	27%	3	100%	0	0%	0	0%	11	3
3	Karimnagar	111	0.136	15.5	0.06	8.53	25	24%	23	22%	56	54%	3	43%	3	43%	1	14%	104	7
4	Khammam	34	0.2005	5.926	0.12	7.08	10	31%	12	38%	10	31%	1	50%	0	0%	1	50%	32	2
5	Mahbubnagar	97	0.813	31.22	0.01	26.85	7	8%	16	18%	66	74%	4	50%	2	25%	2	25%	89	8
6	Medak	73	0.659	19.64	0.47	14.10	8	17%	4	8%	36	75%	6	24%	5	20%	14	56%	48	25
7	Nalgonda	133	0.04	31.22	0.25	5.02	21	17%	29	23%	75	60%	3	38%	3	38%	2	25%	125	8
8	Nizamabad	48	0.221	9.85	0.12	7.50	15	38%	8	21%	16	41%	4	44%	3	33%	2	22%	39	9
9	Ranga Reddy	99	0.258	22.72	0.04	6.41	27	34%	21	26%	32	40%	11	58%	4	21%	4	21%	80	19
10	Warangal	100	0.103	22.37	0.06	0.66	14	15%	24	25%	58	60%	4	100%	0	0%	0	0%	96	4
Total State		**775**	**0.04**	**31.22**	**0.01**	**26.85**	**162**	**24%**	**156**	**23%**	**361**	**53%**	**48**	**50%**	**22**	**23%**	**26**	**27%**	**679**	**96**

Annexure-XVI

DISTRICT WISE FLUCTUATION OF WATER LEVEL WITH MEAN AND SELECTED PERIOD, TELANAGANA STATE																				
10YEARS Mean(2010 NOV-2019 NOV) -2020/NOV																				
Sl. No	District	No of Wells Analysed	Rise		Fall		No of Wells / Percentage Showing Fluctuation												Total No. of Wells	
							Rise						Fall							
							0 to 2		2 to 4		> 4		0 to 2		2 to 4		> 4		Rise	Fall
			Min	Max	Min	Max	No	%	No	%	No	%	No	%	No	%	No	%		
1	Adilabad	58	0.02	3.23	0.03	2.02	36	62%	7	12%	0	0%	14	24%	1	2%	0	0%	43	15
2	Hyderabad	11	0.86	8.68	0.02	0.02	4	36%	4	36%	2	18%	1	9%	0	0%	0	0%	10	1
3	Karimnagar	58	0.12	10.94	0.01	5.35	26	45%	15	26%	14	24%	2	3%	0	0%	1	2%	55	3
4	Khammam	46	0.05	7.37	0.09	0.87	31	67%	3	7%	3	7%	9	20%	0	0%	0	0%	37	9
5	Mahbubnagar	68	0.35	30.62	0.41	3.01	13	19%	15	22%	37	54%	2	3%	1	1%	0	0%	65	3
6	Medak	46	0.46	24.15	0.50	2.92	10	22%	12	26%	21	46%	2	4%	1	2%	0	0%	43	3
7	Nalgonda	87	0.08	23.85	0.15	1.29	33	38%	15	17%	31	36%	8	9%	0	0%	0	0%	79	8
8	Nizamabad	36	0.19	11.62	0.12	0.86	16	44%	10	28%	8	22%	2	6%	0	0%	0	0%	34	2
9	RangaReddy	71	0.17	23.77	0.19	39.88	10	14%	21	30%	37	52%	1	1%	0	0%	2	3%	68	3
10	Warangal	71	0.23	15.34	0.23	0.90	23	32%	20	28%	25	35%	3	4%	0	0%	0	0%	68	3
	Total State	552	0.02	30.62	0.01	39.88	202	40%	122	24%	178	35%	44	88%	3	6%	3	6%	502	50

Annexure -XVII

District-wise water level fluctuation and frequency in different fluctuation ranges from Decadal Mean (2011– 2020) to January 2021

Sl. No	District	No of Wells Analysed	Range of Fluctuation (m)				No of Wells / Percentage Showing Fluctuation													
			Rise		Fall		Rise						Fall						Total No. of Wells	
							0 to 2		2 to 4		> 4		0 to 2		2 to 4		> 4		Rise	Fall
			Min	Max	Min	Max	No	%	No	%	No	%	No	%	No	%	No	%		
1	Adilabad	55	0	3.03	0.03	24.69	27	87%	4	13%	0	0%	21	88%	0	0%	3	13%	31	24
2	Hyderabad	11	0.45	6.47	-	-	8	73%	2	18%	1	9%	0	0%	0	0%	0	0%	11	0
3	Karimnagar	59	0.24	9.91	0.03	4.43	30	56%	13	24%	11	20%	2	40%	2	40%	1	20%	54	5
4	Khammam	45	0.07	7.1	0.05	1.88	30	77%	7	18%	2	5%	6	100%	0	0%	0	0%	39	6
5	Mahabubnagar	70	0.31	21.67	0.3	0.3	10	14%	20	29%	39	57%	1	100%	0	0%	0	0%	69	1
6	Medak	51	0.15	21.09	0.11	14.95	12	27%	11	25%	21	48%	4	57%	1	14%	2	29%	44	7
7	Nalgonda	87	0.02	10.02	0.03	1.63	34	42%	23	28%	24	30%	6	100%	0	0%	0	0%	81	6
8	Nizamabad	38	0.14	5.53	0.27	5.03	18	60%	9	30%	3	10%	6	75%	0	0%	2	25%	30	8
9	Rangareddy	67	0.35	16.12	0.96	10.31	12	19%	23	36%	29	45%	1	33%	0	0%	2	67%	64	3
10	Warangal	75	0.06	14.2	0.66	1.84	26	36%	17	24%	29	40%	3	100%	0	0%	0	0%	72	3
	Total State	**558**	**0**	**21.67**	**0.03**	**24.69**	**207**	**42%**	**129**	**26%**	**159**	**32%**	**50**	**79%**	**3**	**5%**	**10**	**16%**	**495**	**63**

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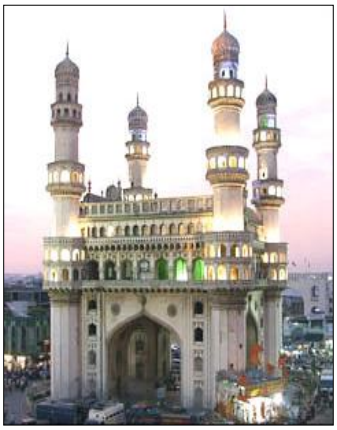

NH – IV, Faridabad
Haryana
Tel: 0129-2419105
Website: www.cgwb.gov.in

Email: rdsr-cgwb@nic.in