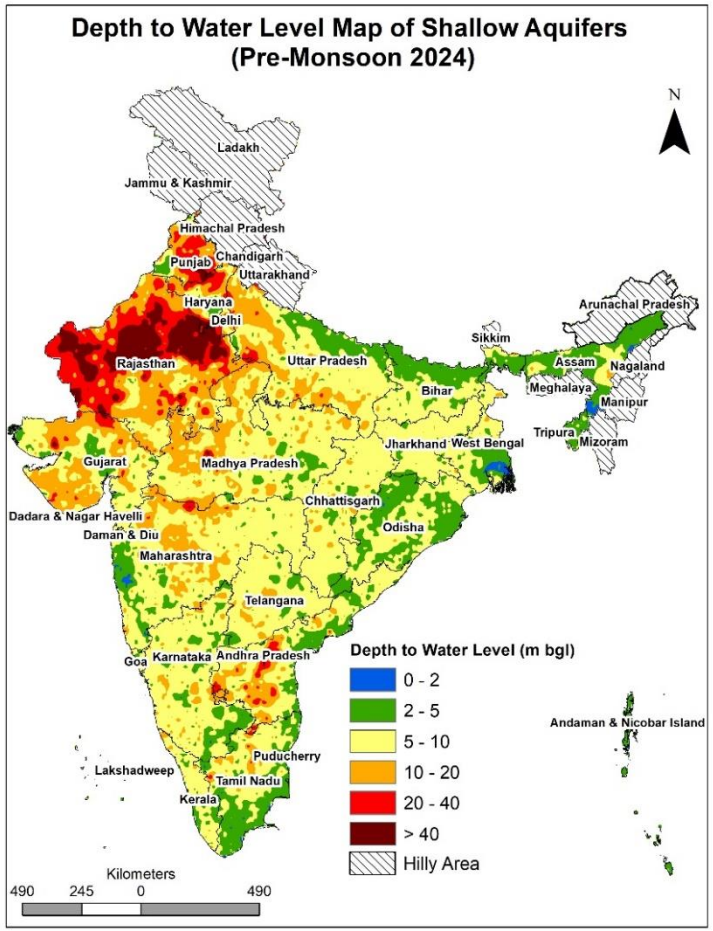

GROUND WATER LEVEL BULLETIN

PRE-MONSOON 2024

ABSTRACT

Groundwater level scenario during Pre-Monsoon 2024 highlighting the findings, status of ground water level in different aquifers and its seasonal, annual and decadal comparison.

National Data Centre
Central Ground Water Board, Faridabad

1.0 INTRODUCTION

Groundwater bulletin is prepared by CGWB depicting changes in groundwater regime of the country through different seasons. It is an effort to obtain information on groundwater levels through representative monitoring wells. The important attributes of groundwater regime monitoring are groundwater level.

The natural conditions affecting the groundwater regime involve climatic parameters like rainfall, evapotranspiration etc., whereas anthropogenic influences include pumpage from the aquifer, recharge due to irrigation systems and other practices like waste disposal etc.

Groundwater levels are being measured by Central Ground Water Board four times a year during January, March/April/May, August and November. The regime monitoring started in the year 1969 by Central Groundwater Board. Currently, a network of 27163 observation wells called National Hydrograph Network Stations (NHNS) located all over the country is being monitored.

2.0 HYDROGEOLOGICAL SETUP OF COUNTRY

India's hydrogeological setup is characterized by diverse aquifer systems across its varied geography. The Indo-Gangetic Plain features extensive, productive alluvial aquifers, while Peninsular India has less permeable hard rock aquifers in the Deccan Plateau and sedimentary basins. Arid regions like Rajasthan and Gujarat experience scanty rainfall and feature less productive, shallow aquifers. The hydrogeological map of India is depicted in Figure -1 and the geographical distribution of hydrogeological units along with their Groundwater potential is given in Table 1.

Table1. Aquifer System in the Country

System	Coverage	Groundwater potential
Unconsolidated formations - alluvial	Indo-Gangetic, Brahmaputra plains	Highly productive system down to 600 m depth.
	Coastal Areas	Reasonably extensive aquifers but risk of saline water intrusion
	Arid areas	Scanty rainfall. Salinity hazards. Groundwater availability at great depths.
Consolidated/semi-consolidated formations - sedimentary, basalts & crystalline rocks	Peninsular Areas	Groundwater available in fractures and in weathered zones with varying yield at shallower depths (20-40 m) in some areas and deeper depths (100-200 m) in other areas.
Hilly	Hilly states	Low storage capacity due to quick runoff

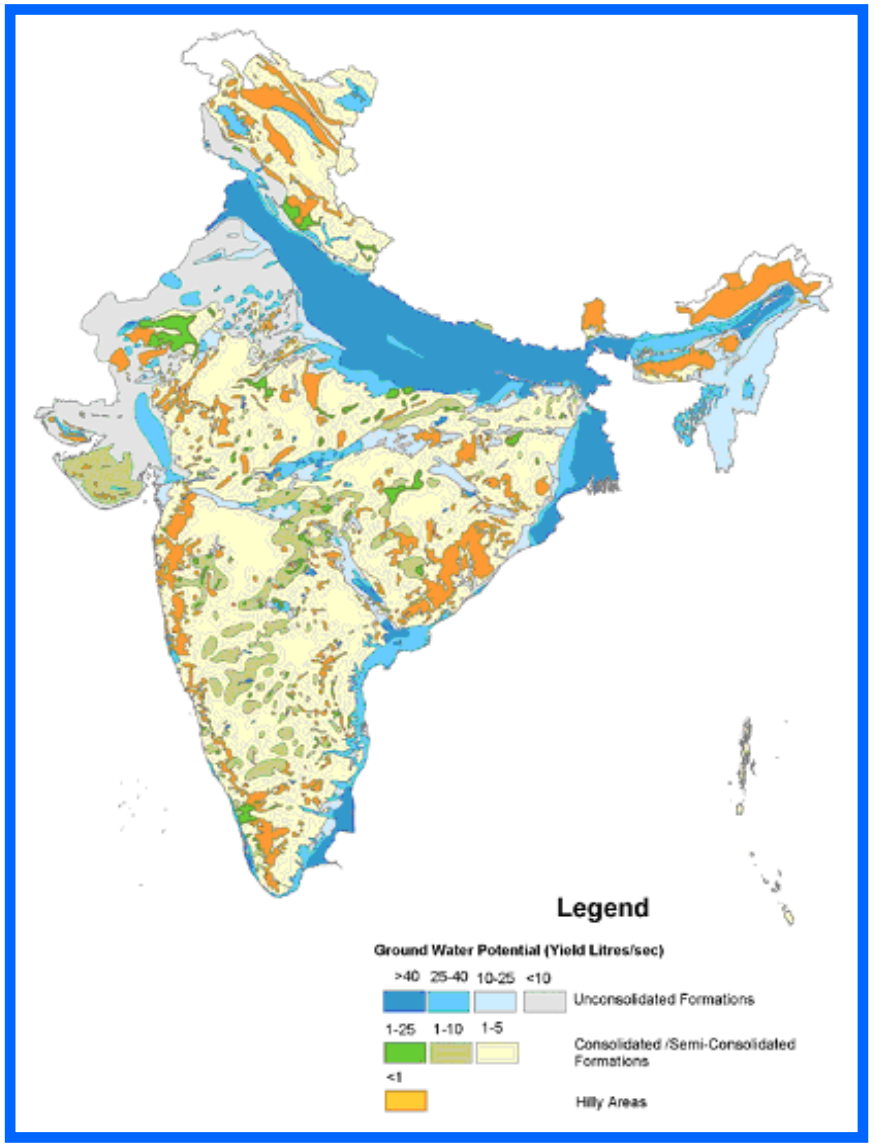

Figure 1: Map showing major aquifers and geomorphic divisions

3.0 GROUND WATER LEVEL MONITORING

Central Ground Water Board is monitoring changes in groundwater regime in the country on quarterly basis continuously. This is facilitated by a network of monitoring stations in the country located in diverse hydrogeological and geomorphic units. The number of operational wells till March 2024 was 27163 which include 16516 dug wells, 9552 piezometers, 913 Handpumps and 182 Springs.

The state-wise breakup of the water level monitoring stations is given in Table 2.

Table 2. state-wise water level monitoring stations

State/UT	Dug Well	Piezometer	Hand pump	Spring	Total
Andhra Pradesh	676	797	0	0	**1473**
Arunachal Pradesh	26	6	0	0	**32**
Assam	355	80	8	0	**443**
Bihar	796	120	0	0	**916**
Chhattisgarh	1044	269	5	0	**1318**
Goa	83	52	0	0	**135**
Gujarat	789	504	0	0	**1293**
Haryana	478	819	0	0	**1297**
Himachal Pradesh	138	55	0	24	**217**
Jharkhand	460	122	0	0	**582**
Karnataka	1360	931	0	0	**2291**
Kerala	1330	296	0	24	**1650**
Madhya Pradesh	1386	485	0	0	**1871**
Maharashtra	1779	296	0	0	**2075**
Manipur	4	0	0	2	**6**
Meghalaya	67	13	0	19	**99**
Mizoram	3	0	0	0	**3**
Nagaland	99	1	0	28	**128**
Odisha	1507	277	0	0	**1784**
Punjab	175	995	0	0	**1170**
Rajasthan	642	660	0	0	**1302**
Sikkim	0	4	0	0	**4**
Tamil Nadu	743	694	0	0	**1437**
Telangana	273	1008	0	0	**1281**
Tripura	97	18	0	0	**115**
Uttar Pradesh	978	486	0	0	**1464**
Uttarakhand	39	12	149	79	**279**
West Bengal	695	286	751	0	**1732**
Andaman & Nicobar	111	2	0	0	**113**
Chandigarh	1	22	0	0	**23**
DD and DNH	38	5	0	0	**43**
Delhi	22	113	0	0	**135**
Jammu and Kashmir	313	106	0	6	**425**
Puducherry	9	18	0	0	**27**
Total	**16516**	**9552**	**913**	**182**	**27163**

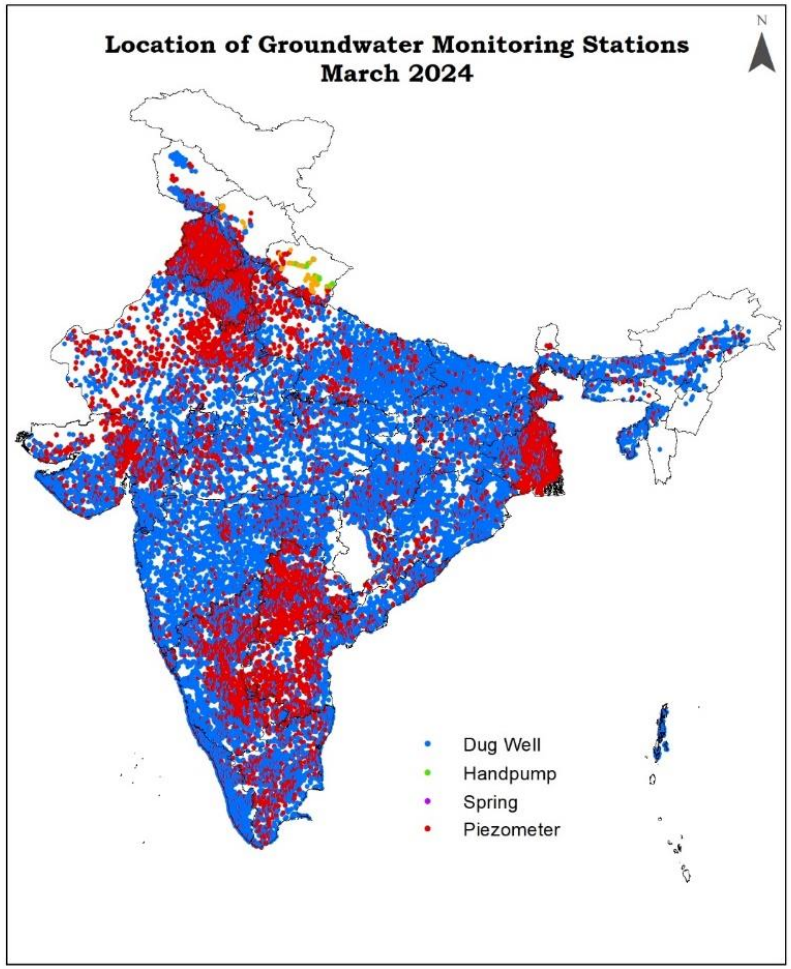

Figure 2: Location of groundwater monitoring stations

4.0 RAINFALL

The state-wise monthly grided rainfall data collected from India Meteorological Department, INDIA WRIS were used to analyze the rainfall pattern. Table 3 gives the state-wise normal rainfall and actual rainfall of Pre-monsoon 2023 and Pre-monsoon 2024 with the departure from normal rainfall.

Table3. State-wise rainfall (mm) during March-May 2023 and March-May 2024.

State/UTs	Normal Rainfall	Actual Rainfall 2023	% Deviation	Actual Rainfall 2024	% Deviation	% Deviation 2024 to 2023
Andhra Pradesh	87.3	169.4	94	82.7	-5.29	-104.84
Arunachal Pradesh	693.4	466.9	-32.67	589	-15.05	20.73
Assam	600.6	379.8	-36.77	476.5	-20.66	20.29
Bihar	81.4	77.6	-4.57	94.3	15.88	17.71
Chandigarh	80.1	212.6	165.42	57.3	-28.46	-271.03
Chhattisgarh	50.7	124.4	145.22	78.7	55.1	-58.07
Dadra And NH	-	19	-	4.4	-	-331.82
Daman & Diu	2.7	25.5	844.44	0.2	-94.07	-12650.00
Delhi	49	142.2	190.1	19.3	-60.55	-636.79
Goa	96.1	31	-67.71	76.2	-20.71	59.32
Gujarat	6.5	35	437.94	10.7	64.06	-227.10
Haryana	34.6	122.1	252.77	28.9	-16.46	-322.49
Himachal Pradesh	246.8	269.7	9.3	243.6	-1.29	-10.71
Jammu & Kashmir	314.1	308.1	-1.91	326.6	3.98	5.66
Jharkhand	90.7	113.4	25.04	110.8	22.13	-2.35
Karnataka	132.7	133.2	0.35	141	6.22	5.53
Kerala	428.5	299.8	-30.05	445.5	3.96	32.70
Ladakh	-	100	-	130.9	-	23.61
Madhya Pradesh	20.4	78	283.1	41	101.62	-90.24
Maharashtra	35.6	69	93.99	48.8	37.17	-41.39
Manipur	312.5	169.1	-45.9	391.4	25.27	56.80
Meghalaya	1477.1	468.8	-68.27	881.7	-40.31	46.83
Mizoram	537.3	279.6	-47.95	456.4	-15.05	38.74
Nagaland	350.6	295.1	-15.83	491.5	40.18	39.96
Odisha	120.5	182.7	51.64	141	16.98	-29.57
Puducherry	66.4	114	71.7	66.3	-0.17	-71.95
Punjab	53.7	149	177.6	39	-27.26	-282.05
Rajasthan	17.3	93.6	441.18	10.6	-38.64	-783.02
Sikkim	679.4	797.9	17.44	527.4	-22.37	-51.29
Tamil Nadu	127.5	189	48.27	128.9	1.07	-46.63
Telangana	55.7	168.4	202.33	84	50.86	-100.48
Tripura	625.8	276.8	-55.77	522	-16.59	46.97
Uttar Pradesh	31.8	74.8	135.46	21.6	-32.13	-246.30
Uttarakhand	155.7	225.6	44.93	144.5	-7.16	-56.12
West Bengal	213.9	225.6	5.46	256.2	19.77	11.94
Total	**136**	**152.9**	**12.47**	**133.3**	**-1.95**	**-14.70**

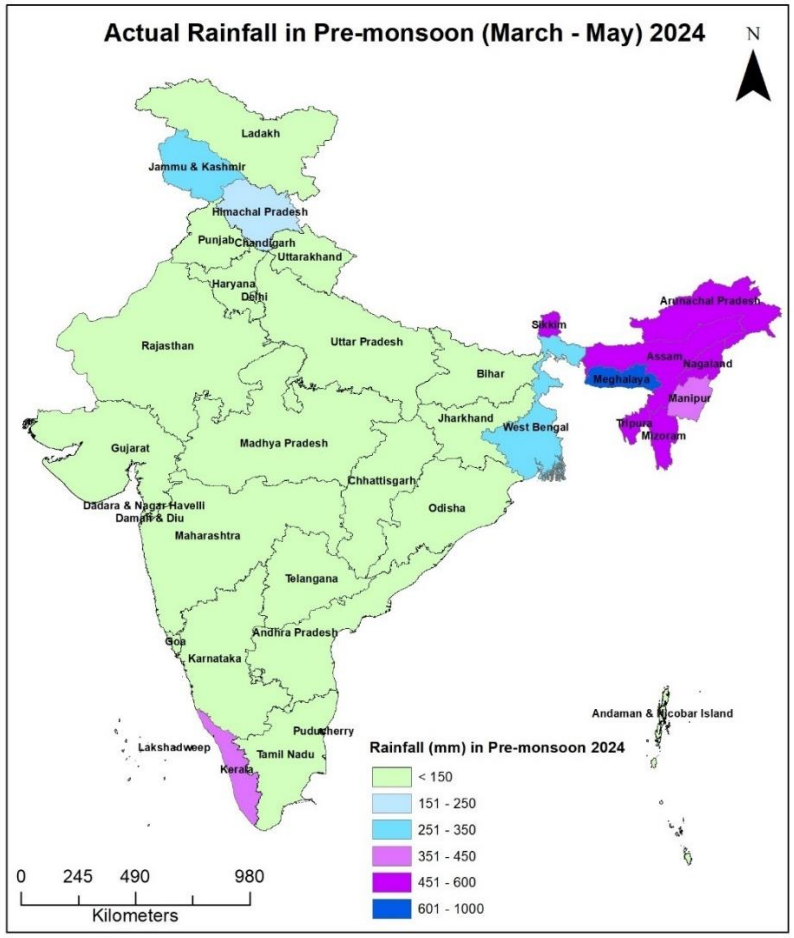

Figure 3: Actual Rainfall of states during the period of March-May 2024

5.0 GROUND WATER LEVEL SCENARIO (PRE-MONSOON 2024)

5.1 SHALLOW AQUIFER (UNCONFINED)

5.1.1 DEPTH TO WATER LEVEL

Depth To Water Level in Unconfined Aquifer (Pre-Monsoon 2024)

The groundwater level data for pre-monsoon 2024 indicates that out of the total 17251 wells analysed, 1027 (6.0%) wells are showing water level less than 2 m bgl (metre below ground level), 5223 (30.3%) wells are showing water level in the depth range of 2 to 5 m bgl, 6882 (39.9%) wells are showing water level in the depth range of 5 to10 m bgl, 2854 (16.5%) wells are showing water level in the depth range of 10 to 20 m bgl, 852 (4.9%) wells are showing water level in the depth range of 20 to 40 m bgl and the remaining 413 (2.4%) wells are showing water level more than 40 m bgl. (Fig. 4).

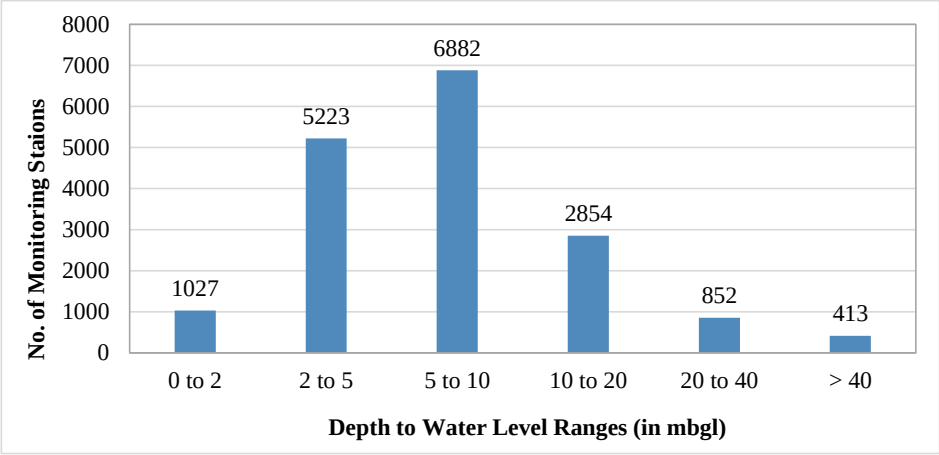

Figure 4: Number of wells showing depth to water level (mbgl) in different ranges, pre-monsoon 2024 in unconfined aquifers, India

Groundwater level data of pre-monsoon 2024 for the country reveals that the general depth to water level of the country ranges from 5 to 10 m bgl. Very shallow water level of less than 2 m bgl is observed in few states, such as Assam, Maharashtra and West Bengal in small patches. Groundwater level in the range of 2 to 5 m bgl is seen in all most all states except Rajasthan. Major part of the country shows water level in the range 5 to 10 m bgl, and small patches in Chandigarh, Punjab and Rajasthan. In major parts of north-western and western states, especially in the states of Delhi, Haryana, Punjab and Rajasthan, depth to water level is generally deeper and ranges from about 20 to more than 40 m bgl. (Fig. 5).

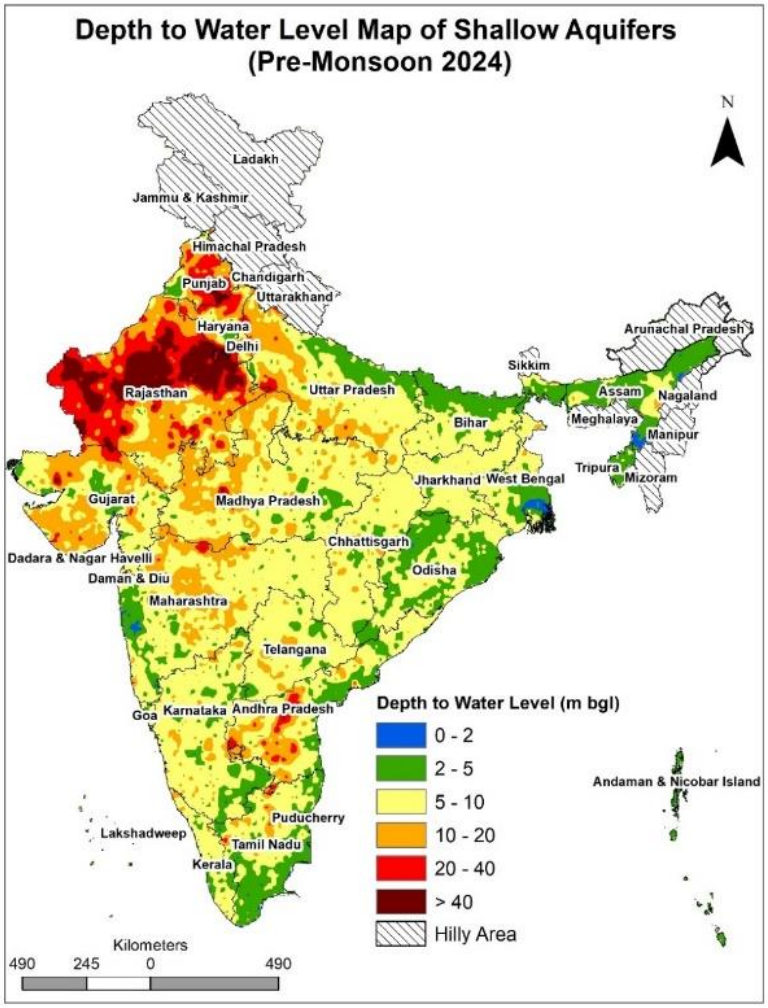

Figure 5: Depth to water level of unconfined aquifer during Pre-Monsoon 2024

5.1.2 ANNUAL FLUCTUATION IN WATER LEVEL

Annual Fluctuation of Water Level in Unconfined Aquifer (Pre-Monsoon 2023 to Pre-Monsoon 2024)

The groundwater level fluctuation analysis done in 14457 wells. The water level fluctuation of pre-monsoon 2023 compared to pre-monsoon 2024 shows that, 6086 (42.1%) are showing rise and 8241 (57.0%) are showing fall in water level. Remaining 130 (0.9%) stations analysed do not show any change in water level. (Fig. 6).

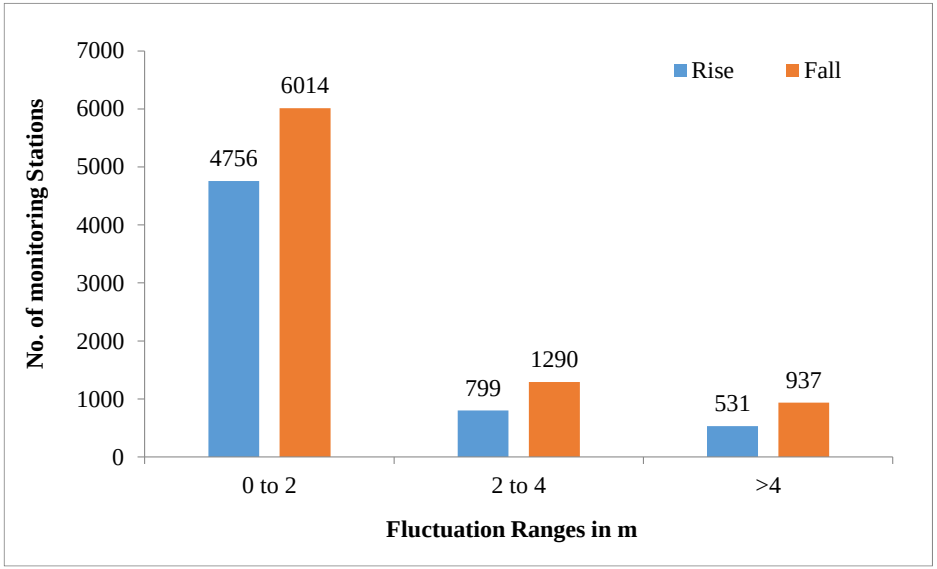

Figure 6: Annual Water Level Fluctuation & Frequency Distribution of Different Ranges from Pre-Monsoon 2023 to Pre-Monsoon 2024 in unconfined aquifer, India

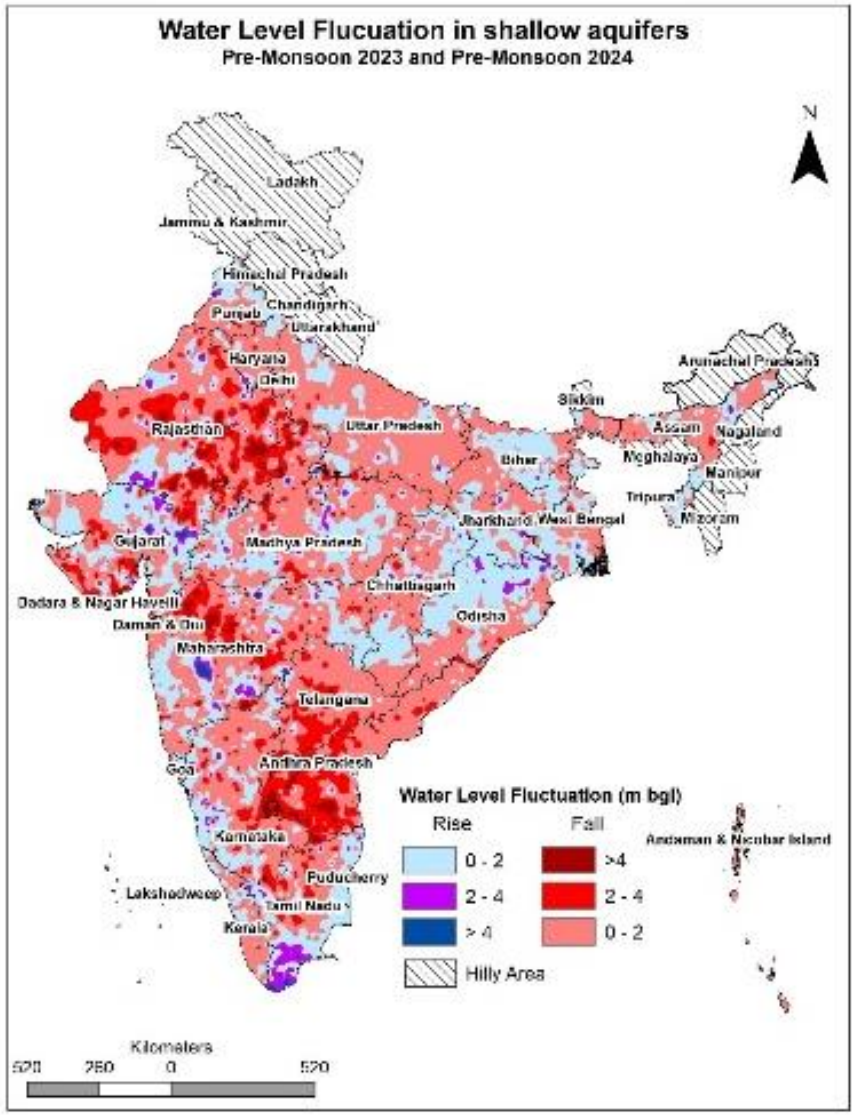

Figure 7: Annual water level fluctuation in unconfined aquifer (Pre-Monsoon 2023 to Pre-Monsoon 2024)

Rise in Water Levels:
About 32.9% wells are showing rise in the water level in the range of less than 2 m. About 5.5% wells are showing rise in water level in 2 to 4 m range and 3.7% wells showing rise in water level more than 4 m range. Rise in water level is prominently observed in the states of Assam, Bihar, Chhattisgarh, Karnataka, Kerala, Madhya Pradesh, Gujarat, Maharashtra, Goa, Odisha, Tamil Nadu, Tripura, West Bengal, Northern part of Punjab and south western part of Rajasthan.

Fall in Water Levels:
About, 41.6% wells are showing decline in water level in less than 2 m range. About 8.9% wells are showing decline in water level in 2 to 4 m range and 6.5% wells are showing decline in water level more than 4 m range. Fluctuation is mainly in the range of 0 to 2 m. A comparison of depth to water level of pre-monsoon 2023 to pre-monsoon 2024 also reveals that in general there is fall in water level in most part of the country. Fall is mostly in the range of 0 to 2 m observed in all states of the country. Fall of more than 4 m is observed in isolated pockets, in the states of Andhra Pradesh, Maharashtra, Rajasthan. (Fig. 7).

Annual Fluctuation of Water Level in Unconfined Aquifer (Pre-Monsoon 2022 to Pre-Monsoon 2024)

The groundwater level fluctuation analysis done in 13614 wells. The water level fluctuation of pre-monsoon 2022 compared to pre-monsoon 2024 shows that, 8634 (63.4%) are showing rise and 4895 (36.0%) are showing fall in water level. The remaining 85 (0.6%) stations analysed do not show any change in water level. (Fig. 8).

Rise in Water Levels:
About 43.9% wells are showing rise in the water level in the range of less than 2 m. About 11.8% wells are showing rise in water level in 2 to 4 m range and 7.7% wells showing rise in water level more than 4 m range. Rise in water level is prominently observed in the parts of states of Andaman And Nicobar Islands, Andhra Pradesh, Assam, Bihar, Chhattisgarh, Delhi, Karnataka, Kerala, Gujarat, Jharkhand, Odisha, Punjab, Puducherry, Rajasthan, Telangana, The Dadra And Nagar Haveli And Daman And Diu, Tamil Nadu, Uttarakhand, Uttar Pradesh and West Bengal.

Fall in Water Levels:
About, 36.0% of total analysed wells are showing declining water level, out of which, 27.0% wells are showing decline in water level in less than 2 m range. About 5.3% wells are showing decline in water level in 2 to 4 m range and 3.7% wells are showing decline in water level more than 4 m range. Fluctuation is mainly in the range of 0 to 2 m. A comparison of depth to water level of pre-monsoon 2022 to pre-monsoon 2024 also reveals that in general there is fall in water level in the central part of the country. (Fig. 9).

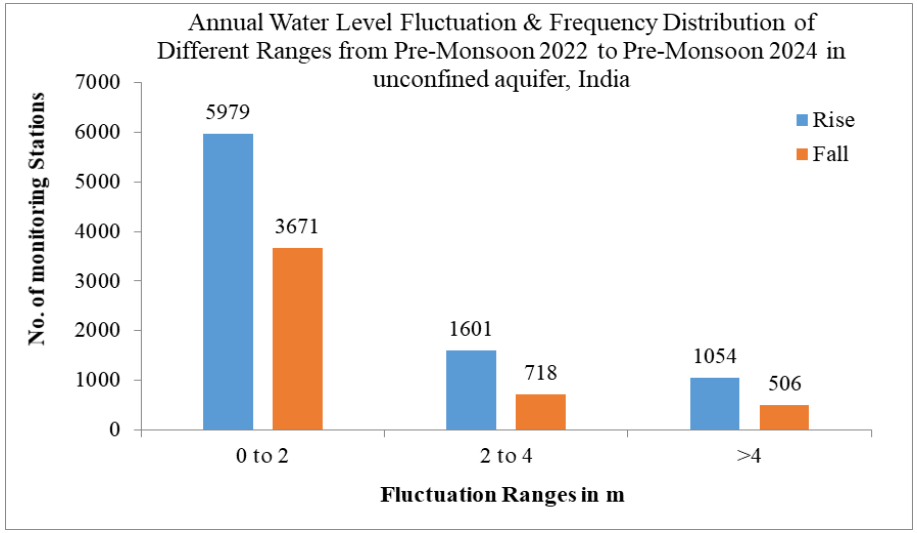

Figure 8: Annual Water Level Fluctuation & Frequency Distribution of Different Ranges from Pre-Monsoon 2022 to Pre-Monsoon 2024 in unconfined aquifer, India

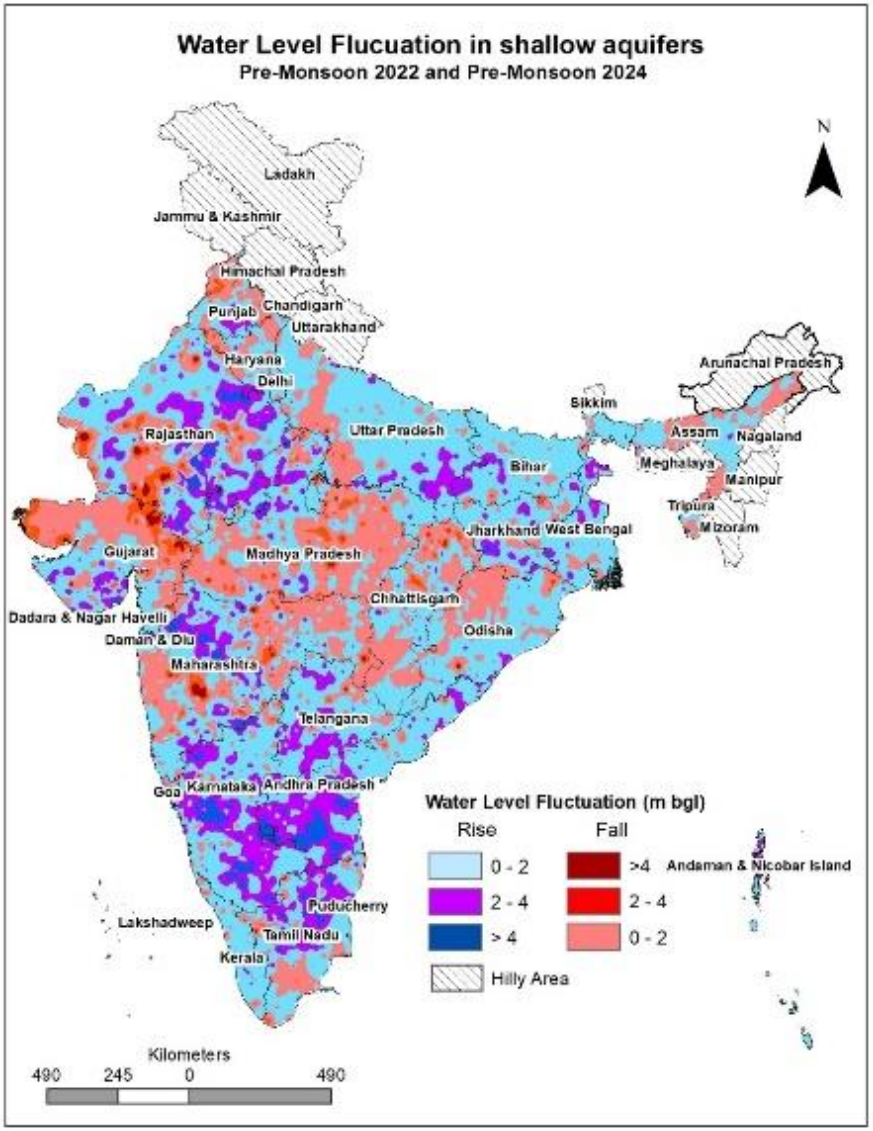

Figure 9: Annual water level fluctuation in unconfined aquifer (Pre-Monsoon 2022 to Pre-Monsoon 2024)

5.1.3 DECADAL FLUCTUATION IN WATER LEVEL

Decadal Fluctuation of Water Level in Unconfined Aquifer (Decadal Mean Pre-Monsoon (2014-2023) to Pre-Monsoon 2024)

The groundwater level fluctuation analysis done in 13135 wells. A comparison of depth to water level of pre-monsoon 2024 with decadal mean of pre-monsoon (2014-2023) indicate that, 6600 (50.2%) are showing rise and 6527 (49.7%) are showing fall in water level. Remaining 08 stations analysed do not show any change in water level. (Fig. 10).

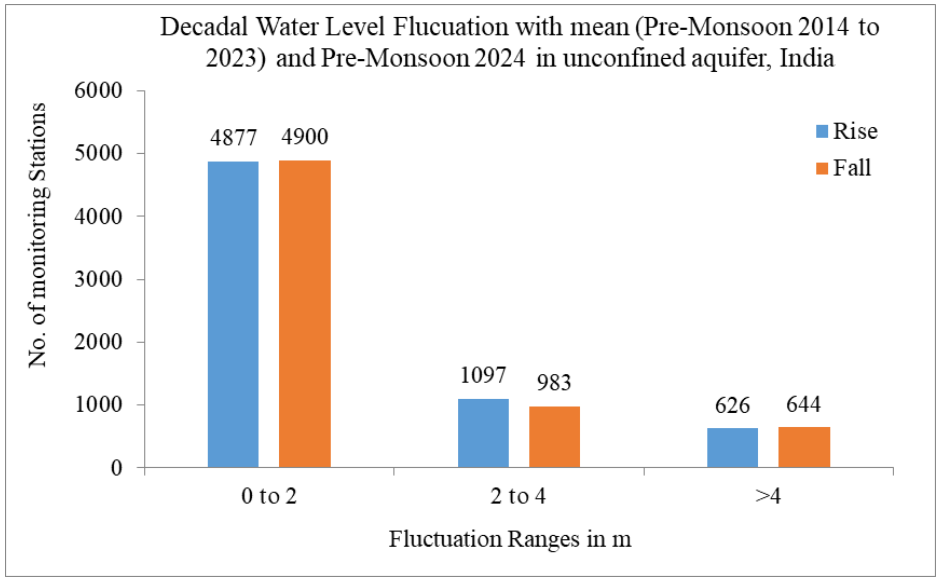

Figure 10: Decadal Water Level Fluctuation with mean (Pre-Monsoon 2014 to 2023) and Pre-Monsoon 2024 in unconfined aquifer, India

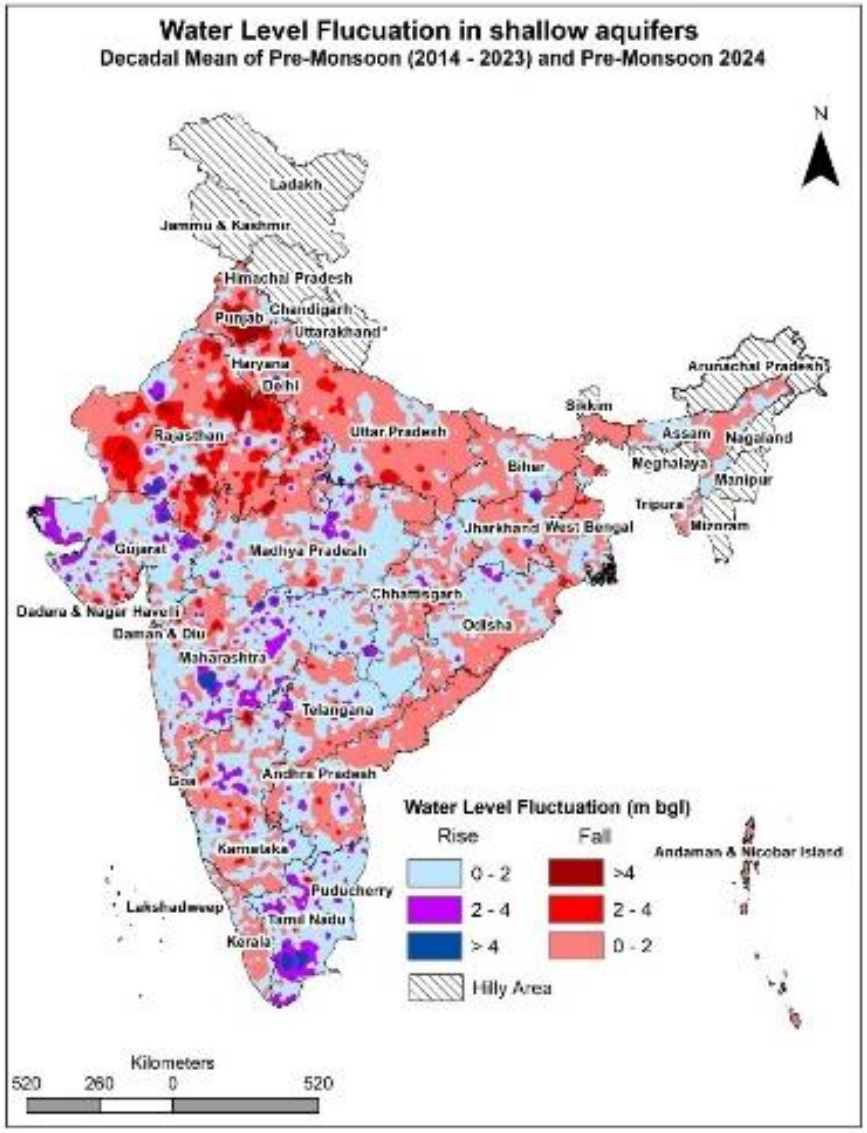

Figure 11: Decadal Water Level Fluctuation with mean (Pre-Monsoon 2014 to 2023) and Pre-Monsoon 2024 in unconfined aquifer, India

Rise in Water Levels:
About 37.1% wells are showing rise of water level less than 2 m. About 8.4% wells are showing rise in water level in the range of 2 to 4 m and about 4.8% wells are showing rise in water level in the range of more than 4 m. Rise in water level is prominently observed in the states of Assam, Bihar, Chhattisgarh, Karnataka, Kerala, Madhya Pradesh, Gujarat, Maharashtra, Odisha, Tamil Nadu, Tripura, West Bengal, Northern part of Punjab and south western part of Rajasthan.

Fall in Water Levels:
About 37.3% wells are showing decline in water in the range of 0 to 2 m. 7.5% wells are showing decline in water level in 2 to 4 m range and remaining 4.9% are in the range of more than 4 m. Fall is mostly in the range of 0 to 2 m observed in all states of the country. Fall of more than 4 m is observed prominently in the states of Rajasthan, Punjab and Haryana. (Fig. 11).

5.2 DEEPER AQUIFER (CONFINED/ SEMI-CONFINED)

5.2.1 DEPTH TO PIEZOMETRIC LEVEL/ HEAD

Depth To Piezometric Level in Confined/Semi-Confined Aquifer (Pre-Monsoon 2024)

The piezometric water level of deeper aquifers for pre-monsoon 2024 indicates that out of the total 5392 wells analysed. It is observed from the analysis that the piezometric water level of 84 (1.6%) wells are less than 2 m bgl, 638 (11.8%) wells are in the depth range of 2 to 5 m bgl, 1573 (29.2%) wells are in the depth range of 5 to 10 m bgl, 1661 (30.8%) wells in the depth range of 10 to 20 m bgl, 922 (17.1%) wells are in the depth range of 20 to 40 m bgl and the remaining 514 (9.5%) wells have more than 40 m bgl. (Fig. 12). Thus, the typical range of piezometric water levels in the country is between 5 and 20 meters. From the analysis of the data, it's also revealed that deeper piezometric level of more than 20 m is prominently observed in Chandigarh, Dadra and Nagar Haveli And Daman And Diu, Gujarat, Haryana, Punjab and Puducherry.

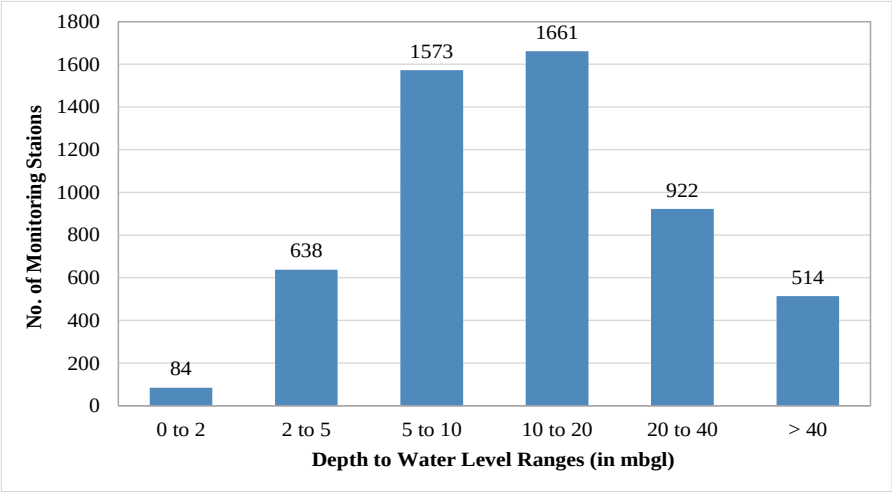

Figure 12: Number of wells showing depth to piezometric water level (mbgl) in different ranges, pre-monsoon 2024 in confined aquifers, India

5.2.2 ANNUAL FLUCTUATION IN PIEZOMETRIC HEAD

Annual Fluctuation of Piezometric Water Level in confined Aquifer (Pre-Monsoon 2023 to Pre-Monsoon 2024)

A comparison of depth to piezometric water level of pre-monsoon 2024 with pre-monsoon 2022 reveals that out of a total of 4315 wells analysed, 1258 (29.2%) of wells are showing rise in piezometric water level, among which 17.6% wells are showing rise of less than 2 m. About 4.8% wells are showing rise in water level in the range of 2 to 4 m and 6.8% wells are showing rise in the range of more than 4 m. Among the 3044 (7.5%) wells showing decline in water level, 32.2% wells are showing decline in piezometric level in the range of 0 to 2 m. 14.2% wells are showing decline in piezometric water level in 2 to 4 m range and remaining 24.1% are in the range of more than 4 m. 13 wells are showing no change in their piezometric head. (Fig. 13).

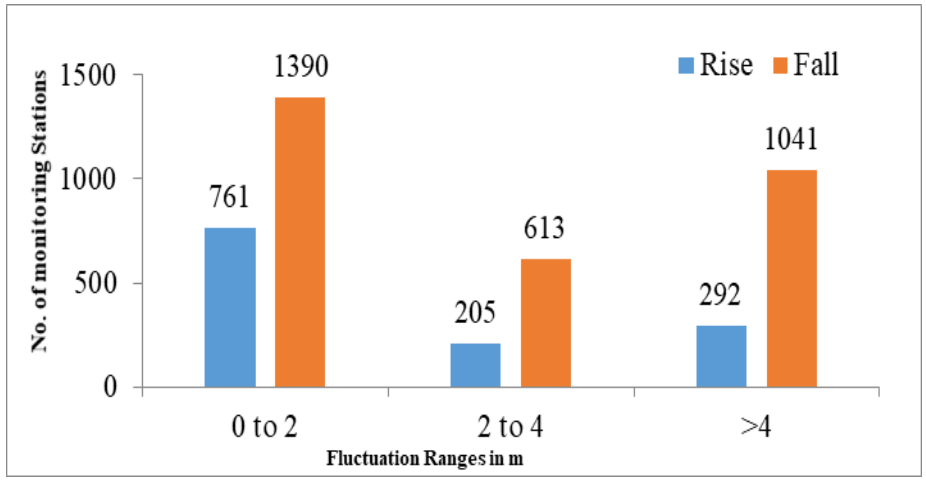

Figure 13: Annual Piezometric Water Level Fluctuation & Frequency Distribution of Different Ranges from Pre-Monsoon 2023 to Pre-Monsoon 2024 in confined aquifer, India

Rise in piezometric water level in the majority of wells observed in Arunachal Pradesh, Assam, Goa, Jharkhand, Sikkim, Tripura, Uttarakhand, and Chandigarh. Similarly fall in significant number of wells is observed in Andhra Pradesh, Bihar, Chhattisgarh, Gujarat, Haryana, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Odisha, Punjab, Tamil Nadu, Telangana, Uttar Pradesh and West Bengal.

Annual Fluctuation of Piezometric Water Level in confined Aquifer (Pre-Monsoon 2022 to Pre-Monsoon 2024)

A comparison of depth to piezometric water level of pre-monsoon 2024 with pre-monsoon 2022 reveals that out of a total of 2227 wells analysed, 1599 (71.8%) of wells are showing rise in piezometric water level, among which 33.0% wells are showing rise of less than 2 m. About 15.9% wells are showing rise in water level in the range of 2 to 4 m and 22.9% wells are showing rise in the range of more than 4 m. Among the 623 (27.97%) wells showing decline in water level, 16.4% wells are showing decline in piezometric level in the range of 0 to 2 m. 4.6% wells are showing decline in piezometric water level in 2 to 4 m range and remaining 7.0% are in the range of more than 4 m. 5 wells are showing no change in their piezometric head.

Rise in piezometric water level is observed in almost the entire country except Arunachal Pradesh, Assam, Chandigarh, Delhi and Meghalaya (Fig. 14).

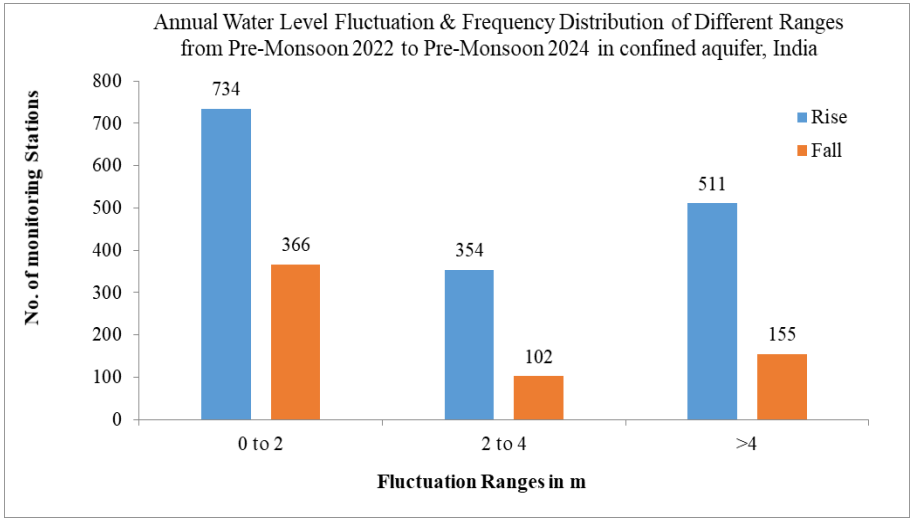

Figure 14: Annual Piezometric Water Level Fluctuation & Frequency Distribution of Different Ranges from Pre-Monsoon 2022 to Pre-Monsoon 2024 in confined aquifer, India

5.2.3 DECADAL FLUCTUATION IN PIEZOMETRIC HEAD

A comparison of depth to piezometric water level of pre-monsoon 2024 with decadal mean of pre-monsoon (2014-2023) indicates that, out of total 1760 wells analysed,45.6 % of wells are showing rise in piezometric head, among which 20.8% wells are showing rise of less than 2 m. About 10.7% wells are showing rise in piezometric head in the range of 2 to 4 m and only 14.1% wells are showing rise in the range of more than 4 m. Among the 54.0% wells showing decline in piezometric head, 26.0% wells are showing decline in piezometric head in the range of 0 to 2 m. 12.4% wells are showing decline in piezometric head in 2 to 4 m range and remaining 16.0% are in the range of more than 4 m. (Fig. 15).

Rise in piezometric head in majority of wells observed in Arunachal Pradesh, Andhra Pradesh, Assam, Gujarat, Karnataka, Madhya Pradesh, Maharashtra, Odisha, Tamil Nadu, Telangana, Andaman and Nicobar, Chandigarh and Delhi.
Similarly fall in significant number of wells is observed in Andhra Pradesh, Bihar, Chhattisgarh, Goa, Haryana, Kerala, Punjab, Tripura, Uttar Pradesh, West Bengal and Puducherry.

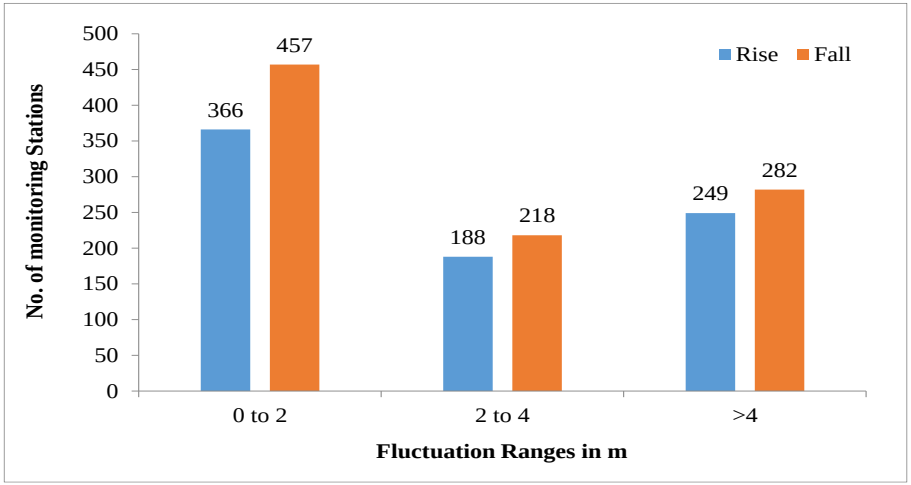

Figure 15: Decadal Piezometric Water Level Fluctuation with mean (Pre-Monsoon 2014 to 2023) and Pre-Monsoon 2024 in confined aquifer, India

6.0 SUMMARY

As a component of the National Ground Water Monitoring Programme, the CGWB conducts monitoring of the groundwater conditions on a quarterly basis: in January, pre-monsoon May, post-monsoon August, and November. As of March 2024, the Central Ground Water Board supervises total 27163 monitoring stations. This comprehensive effort aims to portray the variations in the country's ground water conditions across different aquifers.

In Pre-Monsoon 2024, around 76% of the country's monitoring stations exhibited a depth to water level within 10 meters below ground level. Deeper water levels of more than 20 m are observed in around 7 % of stations of the country covering mainly the western states, especially Rajasthan, Punjab, Haryana and Chandigarh.

The deeper groundwater level in the states like Rajasthan, Punjab, Haryana and Chandigarh during Pre-Monsoon 2024 has been significantly influenced by the deficient rainfall from March 2024 to May 2024.

Annual water level comparison with the previous year Pre-Monsoon 2023 to Pre-Monsoon 2024 has shown that about 57% of total analyzed stations of the country experienced fall in annual water level fluctuation because of the deficient rainfall in 2024 compared to 2023 in Pre-Monsoon period.

About 50% of the shallow aquifer area experienced rise of water level in decadal mean water level fluctuation of 2014-2023 with respect to Pre-Monsoon 2024, whereas about 46% of the area of deeper aquifers experienced rise in the decadal mean piezometric water level of 2014-2023 with respect to Pre-Monsoon 2024.

Rain water is the primary source for recharging the aquifers. The Pre-monsoon 2024 witnessed significant fluctuations in rainfall patterns across the country. The evident decline in annual groundwater level during Pre-monsoon 2024 in the country can be attributed to a substantial -14% deficit rainfall when comparing Pre-monsoon 2024 to Pre-monsoon 2023. This drastic reduction in rainfall has far-reaching implications, leading to a further depletion of groundwater resources.

Central Ground Water Board
Ministry of Jal Shakti
Department of Water Resources,
River Development and Ganga Rejuvenation
Government of India