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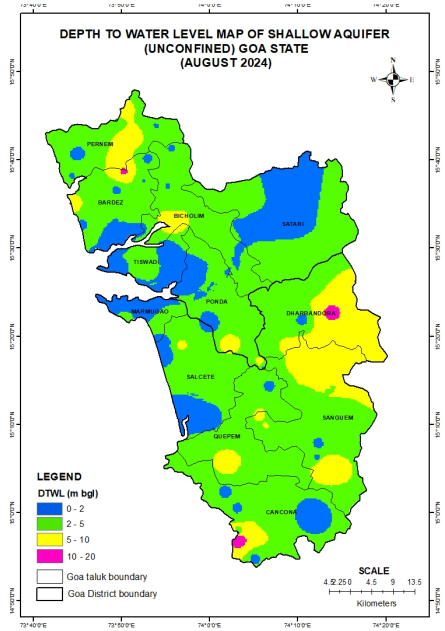
GROUND WATER LEVEL BULLETIN
AUGUST 2024 - GOA STATE



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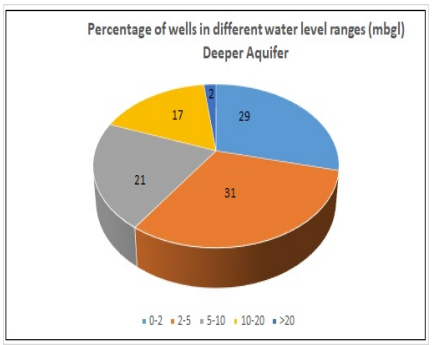
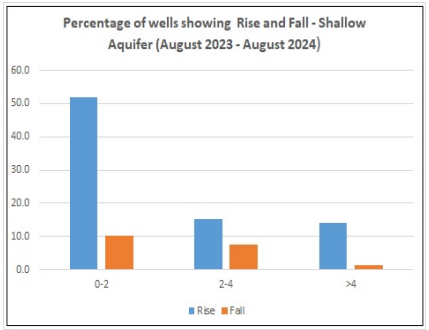
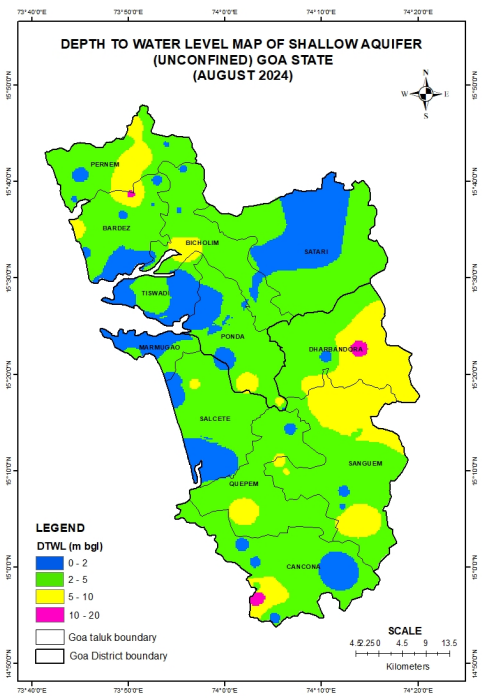






GROUND WATER LEVEL BULLETIN AUGUST 2024 -

GOA STATE

Abstract

The bulletin analyzes the groundwater level scenario in Goa for August 2024, focusing on seasonal, annual, and decadal trends across shallow and deeper aquifers. Groundwater levels were monitored across 135 wells, including dug wells and piezometers, revealing that 94.9% of shallow aquifers and 81% of deeper aquifers have water levels within 10 meters below ground level (bgl). Seasonal rises in water levels were observed in 96% of shallow aquifers and 98% of deeper aquifers from May to August 2024, while annual rises were recorded in 81% and 86% of wells, respectively, compared to August 2023. Decadal trends indicated a rise in shallow aquifers for 61% of wells and a decline in deeper aquifers for 56% of wells, comparing 2024 levels with the decade average for August (2014-2023).

The report underscores the importance of artificial recharge, efficient irrigation, and sustainable water management to maintain and improve groundwater levels. Recommendations include rainwater harvesting, spring-shed development, preventing seawater intrusion, and adopting water-efficient technologies to ensure long-term sustainability.

South Western Region, Bangalore

GROUND WATER LEVEL BULLETIN AUGUST 2024 - GOA STATE

Contents

1. Introduction: 1

2. Depth to water level of Shallow aquifer (unconfined) of August 2024 of Goa State: 2

3. Depth to water level of Deeper aquifer (semi-confined/confined) of August 2024 of Goa State: 3

4. Change in seasonal water level of Shallow aquifer (unconfined) - May 2024 to August 2024 of Goa State: 4

5. Change in seasonal water level of Deeper aquifer 5

6. Change in annual water level of Shallow aquifer (unconfined) - August 2023 to August 2024 of Goa State: 6

7. Change in annual water level of Deeper aquifer (Semi-confined/Confined) - August 2023 to August 2024 of Goa State: 7

8. Mean decadal water levels fluctuation of Shallow aquifer (unconfined) for the period August 2014-2023 & August 2024 of Goa State: 8

9. Mean decadal water levels fluctuation of deeper aquifer (Semi confined/ confined) for the period August 2014-2023 & August 2024 of Goa State: 9

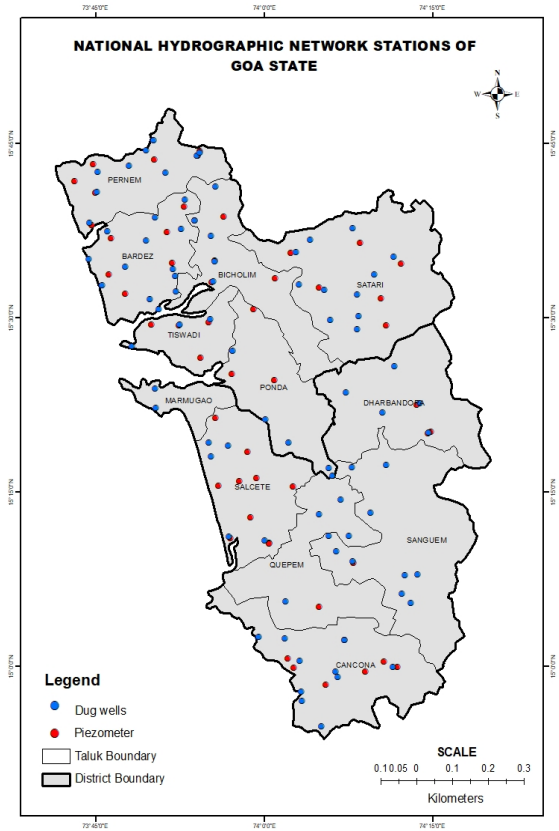
10. Conclusions: 10

11. Summary 11

12. Recommendations 11

1. Introduction:

Goa state having a total geographical area of 3702 sq.km is administratively divided into 2 districts and 12 taluks. In the State of Goa, groundwater has emerged as an important source to meet the water requirements of various sectors especially tourism, domestic and industrial sectors. The state has a tropical-maritime monsoonal type climate with distinct aerographic influence. Due to proximity to the Arabian Sea humidity throughout the year is more than 60% and it ranges from 80 to 90% during monsoon period. Rain occurs during the South West monsoon period from June to September (almost 90% of annual rainfall). As a result of orographic influence rainfall increases towards the Western Ghats from the coast. The normal annual rainfall for entire Goa State is 3367.86 mm. Geomorphologically, Goa state is divided into four morphological units namely, the 1. Coastal plains with dominant marine land forms on the west, followed successively towards the east by the 2. Vast etch plain, 3. Low dissected denudational hills and table land and 4. Deeply dissected high Western Ghats with denudational hills occurring all along the eastern part of Goa rising to a maximum of 832 meters above mean sea level (m amsl). The principal perennial rivers are Terekhol, Chapora, Mandovi, Zuavari and Galjibagh. Kumbharaja canal is an important feature of natural drainage of Goa and it links Mandovi River with Zuavari River about 20 km east of the coast and it provides natural link connecting two major rivers of Goa. Soils of the state can be grouped into 5 classes: Lateritic soil. Alluvial, hilly area soil, saline soil and Marshy soil. Goa state is dominantly covered by the formations of the Goa group belonging to Dharwad Super Group of Archaean to Proterozoic age, except for a narrow strip along the north eastern corner occupied by Deccan Trap of Upper Cretaceous to Lower Eocene age. The Goa group is consisting of green schist facies of the metamorphic rocks and is divided in to Barcem, Sanvordem, Bicholim and Vageri formations in the ascending order



The Goa groups of rocks have been intruded by granite gneiss, feldspathic gneiss, hornblende gneiss and porphyritic granite, followed by basic intrusive. During The Sub-Recent and Recent times the rocks have been subjected to lateritisation of varying thickness. Coastal alluvium occurring along the coastal planes consists of fine to coarse sands with intercalations of sandy loam, silt and clay.Ground water bearing formations in Goa state are alluvium, laterite, granite and granite gneiss, meta-volcanics and sedimentaries. Monitoring of ground water levels was carried out in **135** ground water monitoring wells in the State of Goa during the month of May 2024. Among the wells monitored, **87** are dug wells and **48** are piezometers/tube wells.

2. Depth to water level of Shallow aquifer (unconfined) of August 2024 of Goa State:

Salient features of the depth to water level scenario during August 2024 are given below.

1. A perusal of the water level data reveals that the depth to water level ranged from **0 m bgl** (Ground Level) in Canacona taluk to **15.8 m bgl** (Canacona taluk).

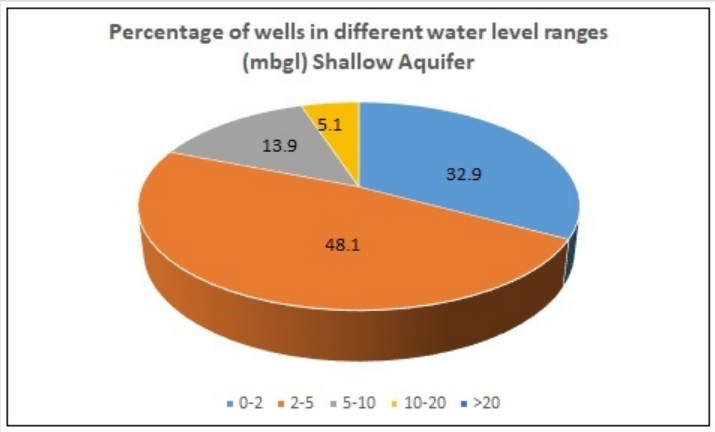
2. The salient feature of the analysis is that the depth to water level over major part of the State lies within 10 m bgl i.e. **94.9%** of wells analysed, while **5.1%** of wells show depth to water level in the 10-20 m bgl range.

3. Depth to water level of less than 2 m bgl has been recorded in **32.9%** of wells analysed and noted in Bardez, Canacona, Dharbandara, Mormugoa, Pernem, Ponda, Quepem, Salcete, Satari,Tiswadi taluks.

4. Depth to water level in the range of 2 to 5 m bgl has been recorded in **48.1%** of wells analysed and noted in all the taluks.

5. Depth to water level in the range of 5 to 10 m bgl has been recorded in **13.9%** of wells analysed noted in Bardez, Salcete, Dharbondra, Bicholim, Sangem, Pernem, Quepem taluks .

6. Depth to water level in the range of 10 to 20 m bgl has been observed in **5.1%** of wells analysed and noted in Bardez, Canacona, Dharbandara, and Sangeum



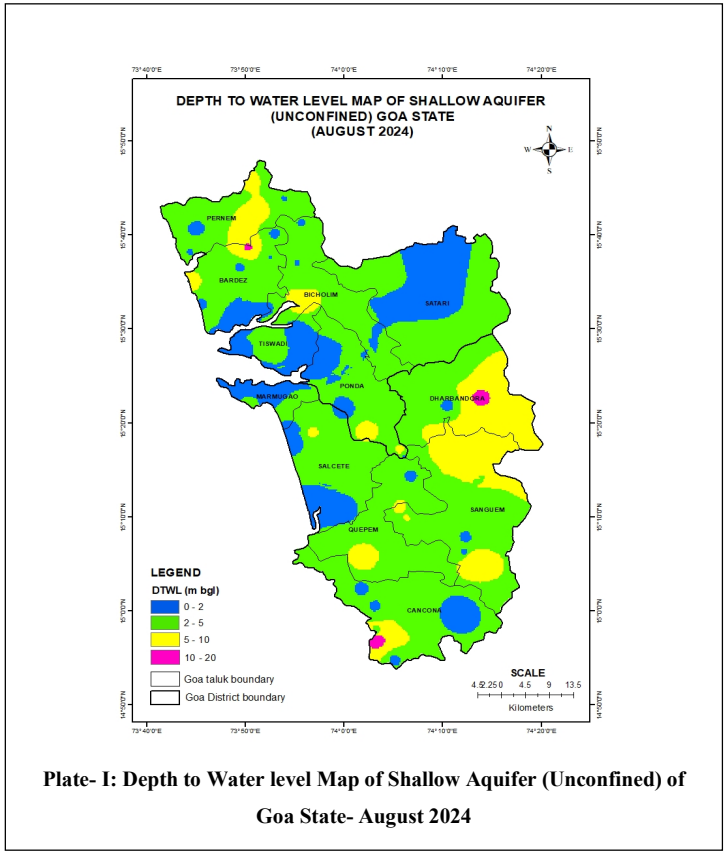
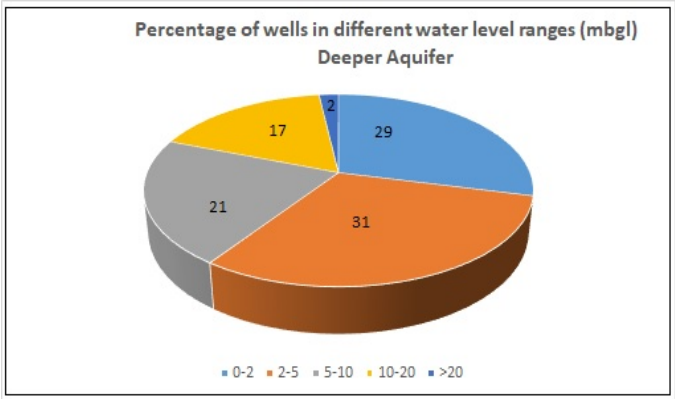


Plate- I: Depth to Water level Map of Shallow Aquifer (Unconfined) of Goa State- August 2024

3. Depth to water level of Deeper aquifer (semi-confined/confined) of August 2024 of Goa State:

Depth to water level of deeper aquifer has been recorded from piezometers spread in hard rock areas all over the State. The statement showing depth to water level of Deeper aquifer is given in **Plate-II** depicts the Piezometric ground water scenario in August 2024. Salient features of the depth to water level of deeper aquifer during August 2024 are given below;

1. The depth to water level of deeper aquifer ranges from **0 m bgl (Ground Level)** in Bardez and Satari taluks to **24.84 m bgl** (Bardez taluk) in Goa State.
2. **81%** of wells have recorded depth to water level of deeper aquifer within 10 m bgl and **19%** of wells show depth to water level of deeper aquifer more than 10 m bgl.
3. Depth to water level of deeper aquifer of less than 2 m bgl has been recorded in **29%** of wells analysed and this has been noted in Bardez, Canacona,, Dharbondara, Pernem, Salcete, Satari & Tiswadi Taluk.
4. Depth to water level of deeper aquifer in the range of 2 to 5 m bgl has been recorded in **31%** of wells analysed and noted in Bardez, Bicholim, Dharbondara, Pernem, Ponda, Salcete and Sanguem, taluks.
5. Depth to water level of deeper aquifer in the range of 5 to 10 m bgl has been recorded in **21 %** of wells analysed and noted in Bicholim, Canacona, Pernem, Ponda, Quepem and Satari taluks.
6. Depth to water level of deeper aquifer in the range of 10 to 20 m bgl has been observed in **17%** of wells analysed and noticed in all taluks except Bardez, Bicholim, Canacona, Pernem, Ponda, Salcete, Satari Taluks.
7. Depth to water level of deeper aquifer in the range more than 20 m bgl has been observed in **2%** of wells analysed and noticed in Bardez taluk.



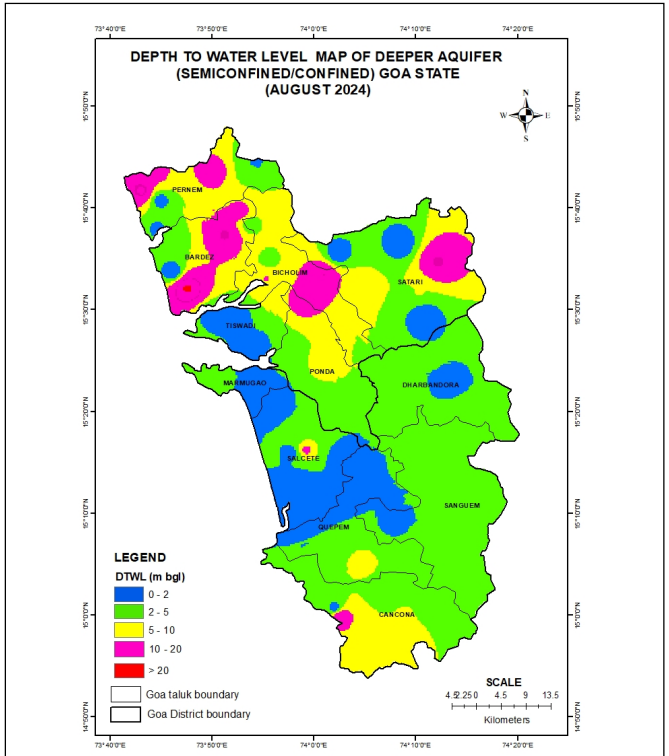
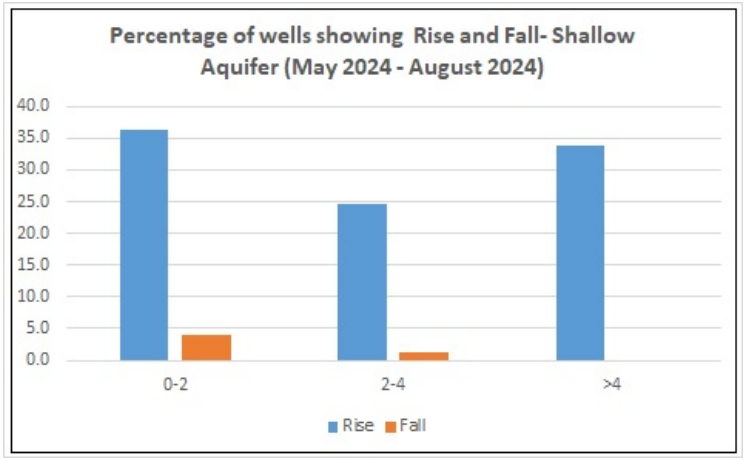


Plate II: Depth to water level Map of Deeper Aquifer (Semi-confined/Confined) of Goa State- August 2024

4. Change in seasonal water level of Shallow aquifer (unconfined) - May 2024 to August 2024 of Goa State:

A comparison of water level shows that a rise in the water level is recorded in **96%** of wells analyzed, while 4**%** recorded fall. The Seasonal fluctuation in water level of Shallow aquifer has been plotted in **Plate III**. A perusal of the plate shows that a general rise in the range of 0 – 2 m is noticed in major part of the area, and further breakup given below.

1. Rise in the water level in the range of 0-2 m has been observed in **36%** of wells analysed and observed in Bardez, Bicholim, Dharbondara, Marmagoa, Pernem, Ponda, Quepem, Sangem, Salcete, Satari, Tiswadi taluks.
2. Rise in the water level in the range of 2-4 m has been observed in **26%** of wells analysed in Bardez, Bicholim, Canacona, Dharbondara, Pernem, Ponda, Quepem, Sangem, Salcete taluks.
3. Rise in the water level in the range of >4 m has been observed in **34%** of wells analysed and observed in Bardez, Bicholim, Canacona, Dharbondara, Ponda, Quepem, Sangem, Salcete, Satari taluks.
4. The fall in water level in the range of 0-2 m has been observed in **3%** of wells analysed and noted in Satari, Bardez taluks.
5. The fall in the water level in the range of 2-4 m has been observed in **1%** of wells analysed in Pernem taluk.



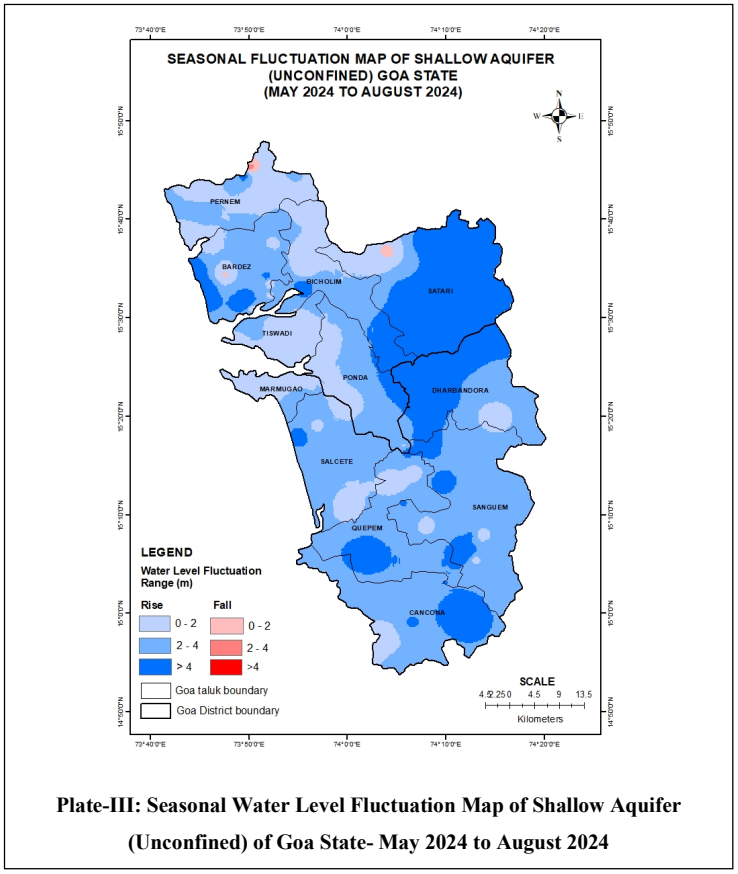
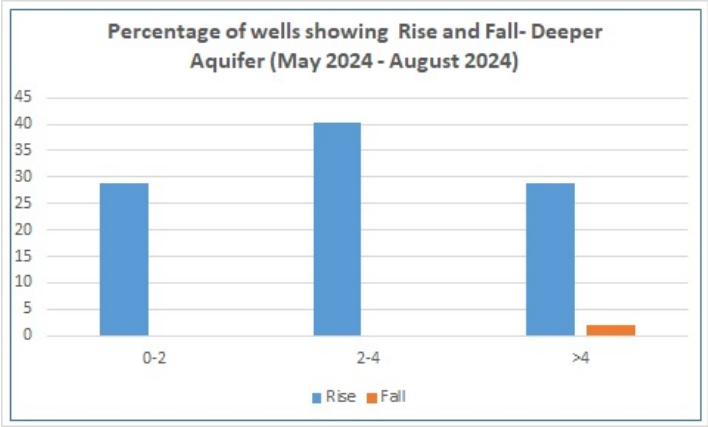


Plate-III: Seasonal Water Level Fluctuation Map of Shallow Aquifer (Unconfined) of Goa State- May 2024 to August 2024

5. Change in seasonal water level of Deeper aquifer (Semi-confined/Confined)- May 2024 to August 2024 of Goa State:

A comparison of water level shows that a rise in the water level is recorded in **98%** of wells analyzed & fall of water level recorded in 2 % of wells analysed. The Seasonal fluctuation in water level of Deeper aquifer has been plotted in **Plate IV**. A perusal of the plate shows that a general rise in the range of 0 – 2 m is noticed in major part of the area, and further breakup given below.

1. Rise in the water level in the range of 0-2 m has been observed in **29%** of wells analysed and observed in Bardez, Bicholim, Canacona, Pernem, Salcete, Tiswadi taluks.
2. Rise in the water level in the range of 2-4 m has been observed in **40%** of wells analysed in Bardez, Bicholim, Canacona, Dharbondara, Pernem, Ponda, Sangem, Salcete, Satari, Tiswadi taluks.
3. Rise in the water level in the range of >4 m has been observed in **29%** of wells analysed and observed in Bardez, Bicholim, Canacona, Dharbondara, Pernem, Ponda, Quepem, Satari taluks.
4. Fall in the water level in the range of 2-4 m has been observed in **2%** of wells analysed and observed in Salcete taluk.



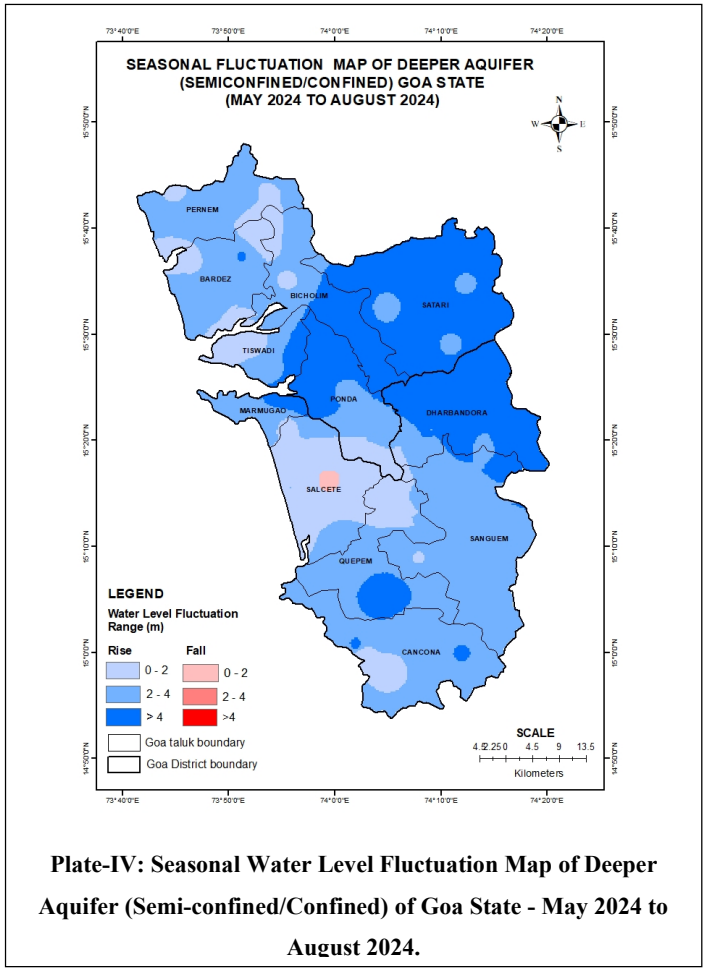
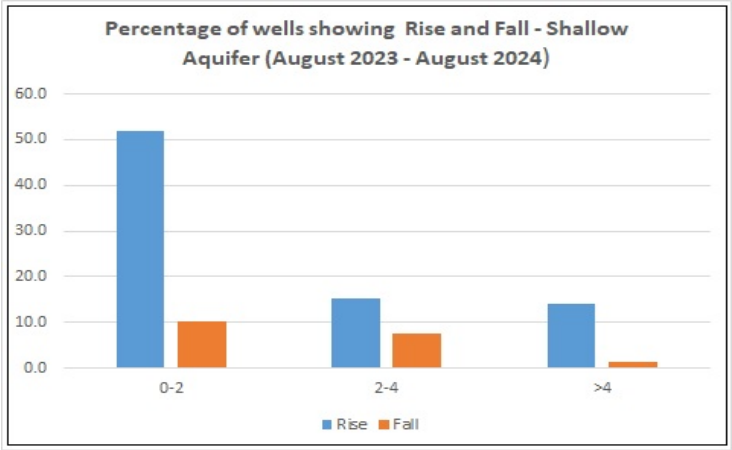


Plate-IV: Seasonal Water Level Fluctuation Map of Deeper Aquifer (Semi-confined/Confined) of Goa State - May 2024 to August 2024.

6. Change in annual water level of Shallow aquifer (unconfined) - August 2023 to August 2024 of Goa State:

A comparison of water level shows that a rise in the water level is recorded in **81%** of wells analyzed, while **19%** recorded fall. The Annual fluctuation in water level of Shallow aquifer has been plotted in **Plate V**. A perusal of the plate shows that a general rise in the range of 0 – 2 m is noticed in major part of the area, and further breakup is given below.

1. Rise in the water level in the range of 0-2 m has been observed in **52%** of wells analysed and observed in all taluks.
2. Rise in the water level in the range of 2-4 m has been observed in **15%** of wells analysed Bardez, Bicholim, Dharbondara, Ponda, Quepem, Sanguem, Satari taluks.
3. Rise in water level more than 4 m has been observed in **14%** of wells analysed and noted in Bardez, Bicholim, Canacona, Pernem, Quepem, Salcete, Sanguem, Satari taluks.
4. Fall in water level in the range of 0-2 m has been observed in **10%** of wells analysed and noted in Bardez, Bicholim, Pernem, Sanguem, Satari taluks.
5. The Fall in the water level in the range of 2-4 m has been observed in **8%** of wells analysed and noted in Canacona, Dharbondara, Pernem, Quepem taluks.
6. The fall in water level more than 4 m has been observed in **1%** of wells analysed and noted in Tiswadi taluk.



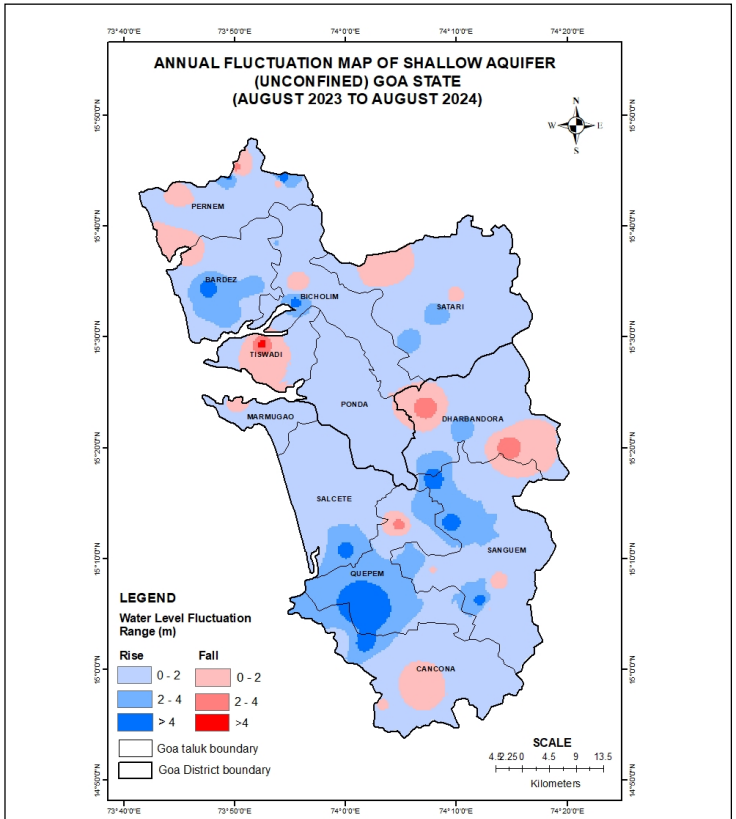
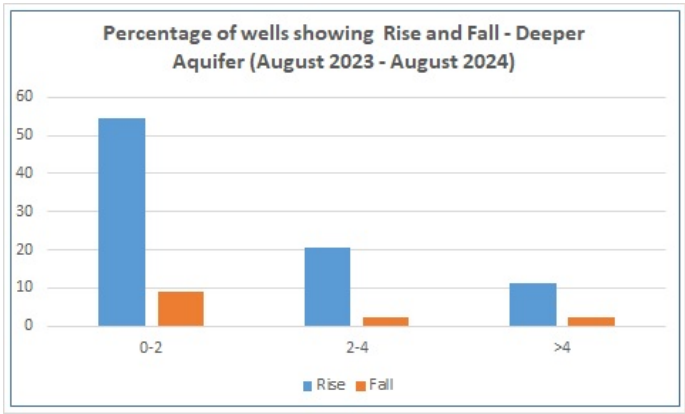


Plate-V: Annual Water Level Fluctuation Map of Shallow Aquifer (Unconfined) of Goa State- August 2023 to August 2024

7. Change in annual water level of Deeper aquifer (Semi-confined/Confined) - August 2023 to August 2024 of Goa State:

The statement showing the distribution of ground water monitoring wells annual fluctuation in different ranges in comparison with August 2023 of Deeper aquifer is presented in **Annexure-VI**. A comparison of water level shows that a rise in the water level is recorded in **86%** of wells analyzed, while **14%** recorded fall. The Annual fluctuation in water level of Deeper aquifer has been plotted in **Plate VI**. A perusal of the plate shows that a general rise in the range of 0 – 2 m is noticed in major part of the area, and further breakup given below.

1. Rise in the water level in the range of 0-2 m has been observed in **55%** of wells analysed and observed in all taluks.
2. Rise in the water level in the range of 2-4 m has been observed in **20**% of wells analysed and noted in Bardez, Bicholim, Canacona, Dharbondara, Pernem, Ponda, Satari, Tiswadi taluks
3. Rise in water level more than 4 m has been observed in **11%** of wells analysed and noted in Bicholim, Ponda, Quepem, Satari taluk.
4. The Fall in water level in the range of 0-2 m has been observed in 9**%** of wells analysed and noted in Canacona, Dharbondara and Salcete taluks.
5. The Fall in the water level in the range of 2-4 m has been observed in **2%** of wells analysed and noted in Pernem taluk.
6. The Fall in the water level in the range >4 m has been observed in **2%** of wells analysed and noted in Salcete taluk.



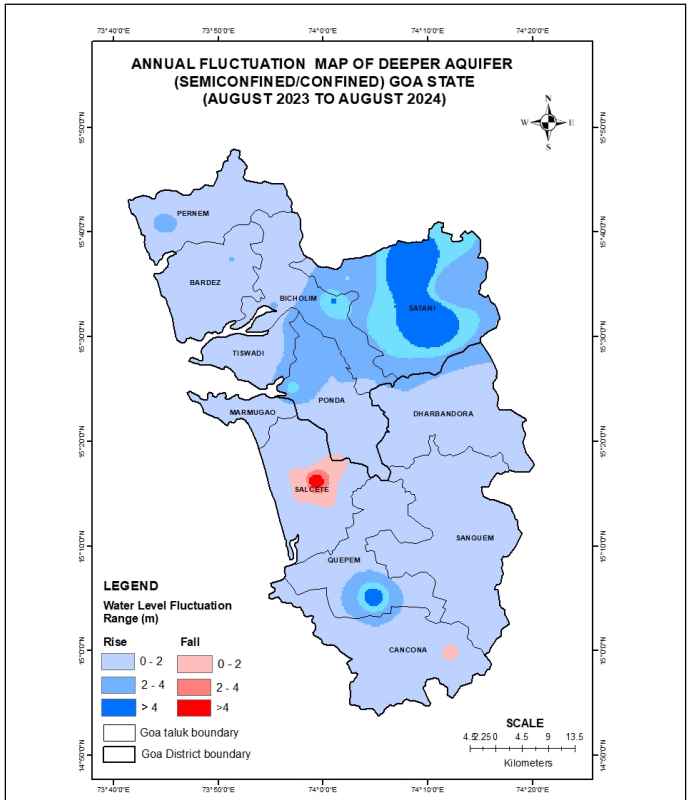
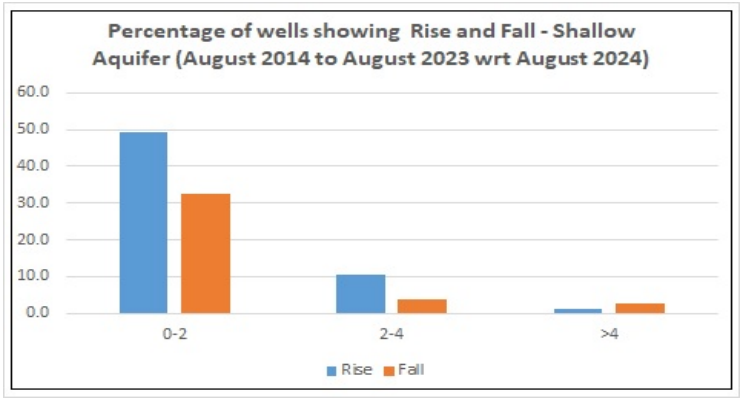


Plate-VI: Annual Water Level Fluctuation Map of Deeper Aquifer (Semi-confined/Confined) of Goa State- August 2023 to August 2024

8. Mean decadal water levels fluctuation of Shallow aquifer (unconfined) for the period August 2014-2023 & August 2024 of Goa State:

The statement showing the distribution of decadal water level fluctuation in Shallow aquifer is presented in **Annexure-VII**. The Decadal fluctuation of water level of Shallow aquifer has been plotted in **Plate VII**. A comparison of water level shows that a rise in the water level is recorded in **61%** of wells analysed, while **39%** recorded fall. Salient features of the comparison of water levels are given below.

1. Rise in the water level in the range of 0-2 m has been observed in **49.4%** of wells analysed and noted in all over the taluks.
2. Rise in the water level in the range of 2-4 m has been observed in **10.4** % of wells analysed and noted in Bardez, Dharbondara, Sanguem and Satari taluks
3. Rise in water level more than 4 m has been observed in **1.3%** of wells analysed and noted in Sanguem taluk.
4. Fall in water level in the range of 0-2 m has been observed in **32.5%** of wells analysed and noted in Bardez, Bicholim, Canacona, Mormugao, Pernem, Quepem, Salcete, Sangeum, Sattari and Tiswadi taluks.
5. Fall in water level in the range of 2-4 m has been observed in **3.9%** of wells analysed and noted in Bardez, Bicholim, Pernem taluks.
6. The Fall in water level of more than 4 m is observed in 2.6% of wells analysed & noted in Dharbondara taluk.



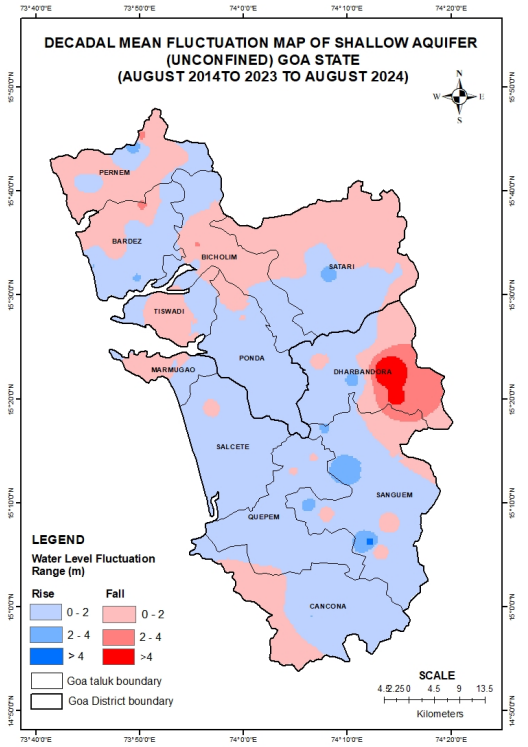
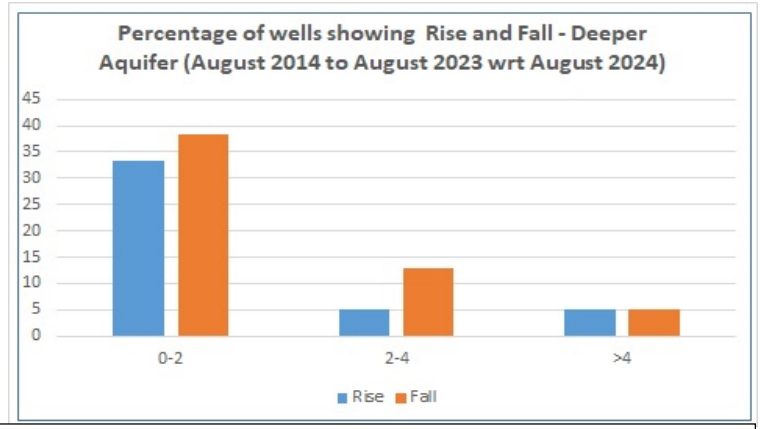


Plate VII: Decadal Mean Water Level Fluctuation Map of Shallow Aquifer (Unconfined) of Goa State- August 2014-2023 to August 2024

9. Mean decadal water levels fluctuation of deeper aquifer (Semi confined/ confined) for the period August 2014-2023 & August 2024 of Goa State:

The statement showing the distribution of ground water monitoring wells decadal fluctuation in deeper aquifer is presented in **Annexure-VIII**. The decadal fluctuation of water level of Shallow aquifer has been plotted in **Plate VIII**. A comparison of water level shows that a fall in the water level is recorded in **56%** of wells analysed, while **44%** recorded rise. Salient features of the comparison of water levels are given below.

1. Rise in the water level in the range of 0-2 m has been observed in **33%** of wells analysed, noted in Bardez, Bicholim, Canacona, Darbondara, Pernem, Salcete, Sattari and Tiswadi taluks.
2. Rise in the water level in the range of 2-4 m has been observed in **5%** of wells analysed and noted in Bicholim and Satari taluks
3. Rise in the water level in the range of >4 m has been observed in **5%** of wells analysed, noted in Pernem & Salcete taluks.
4. The Fall in water level in the range of 0-2 m has been observed in **38%** of wells analysed and noted in all taluks except Marmugoa taluk.
5. The Fall in water level in the range of 2-4 m has been observed in **13%** of wells analysed and noted in Bardez, Canacona, Dharbondara, Pernem taluk.
6. The Fall in water level in the range of >4 m has been observed in **5%** of wells analysed and noted in Bardez, Salcete taluk.



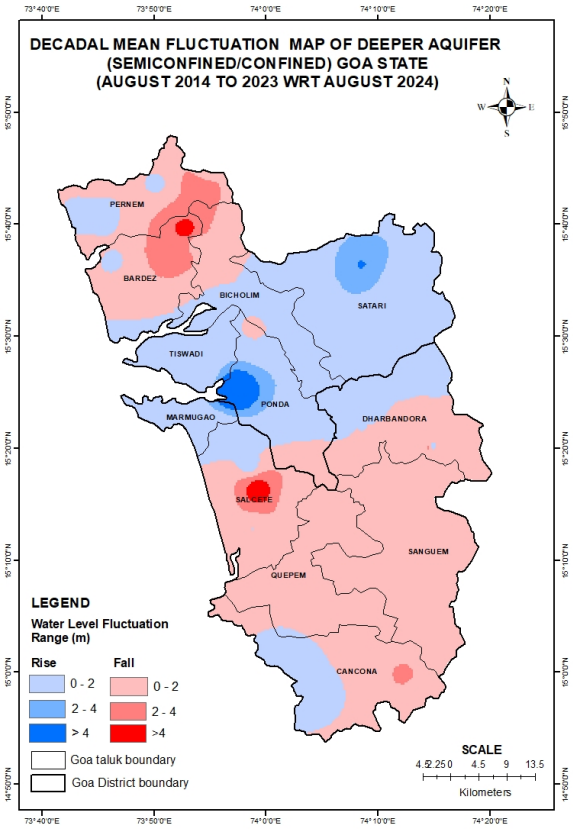


Plate VIII: Decadal Mean Water Level Fluctuation Map of Deeper Aquifer (Semi-confined/ Confined) of Goa State- August 2014-2023 to August 2024

10. Conclusions:

The behaviour of ground water table during **August 2024** in Goa State has been studied by monitoring the dug wells and bore wells. The data on water levels was analyzed in detail and salient features are as under.

1. Depth to water level of Shallow aquifer (Unconfined) over major part of the State covering the is within 10 m bgl in about **94.9%** of wells analysed, while **5.1%** of wells show depth to water level between 10 to 20 m bgl.
2. **81%** of wells have recorded depth to water level of Deeper aquifer (Semi-confined/Confined) within 10 m bgl, while **19%** of wells show depth to water level of Deeper aquifer (Semi-confined/Confined) in more than 10 m bgl.
3. **96%** of wells have recorded seasonal rise in water levels of Shallow aquifer (Unconfined) and **4%** of wells have recorded fall in Seasonal water levels fluctuation during August 2024 in comparison to May 2024.
4. **98%** of wells have recorded seasonal rise in water levels of Deeper aquifer (Semi-confined/Confined) and **2%** of wells have recorded fall in Seasonal water levels fluctuation during during August 2024 in comparison to May 2024.
5. **81%** of wells have recorded annual rise in water levels of Shallow aquifer (Unconfined) and **19%** of wells have recorded fall in Annual water levels fluctuation during August 2024 in comparison to August 2023.
6. **86%** of wells have recorded annual rise in water levels of Deeper aquifer (Semi-confined/Confined) and **14%** of wells have recorded fall in Annual water levels fluctuation during August 2024 in comparison to August 2023.
7. **61%** of wells have recorded decadal rise in water levels of Shallow aquifer (Unconfined) and **39%** of wells recorded fall in water levels during August 2024 in comparison to decadal mean for the month of August (2014-23).
8. **56%** of wells have recorded decadal fall in water levels of Deeper aquifer (Confined) and **44%** of wells recorded rise in water levels during August 2024 in comparison to decadal mean for the month of August (2014-23).

11. Summary

In Goa state, 81% of wells have recorded annual rise in water levels of Shallow aquifer & **86%** of wells have recorded rise in Deeper aquifer during August 2024 in comparison to August 2023. **61%** of wells have recorded decadal rise in water levels of Shallow aquifer (Unconfined) and **44%** of wells have recorded decadal rise in water levels of Deeper aquifer (Confined) during August 2024 in comparison to decadal mean for the month of

12. Recommendations

- In order to enhance the groundwater scenario of Goa state utmost effort should be made to harvest the rainwater received during monsoon days and use it for artificial recharge. Periodic maintenance of the structures is also recommended to maintain the efficiency of the structure. Abandoned bore wells/dug well / Mine pits can be used to recharge the aquifer utilizing the surplus surface runoff available during rainy days. Master plan for artificial recharge of Goa as well as NAQUIM reports of CGWB help in selecting sites for artificial recharge structures.
- Spring-shed development should be taken up for developing the springs.
- Point recharge structures are recommended to recharge deeper aquifers
- Efficient micro irrigation practices can save up-to 40% of water
- Sea water ingression should be arrested.
- Use of Grey water after treatment, opting for water efficient