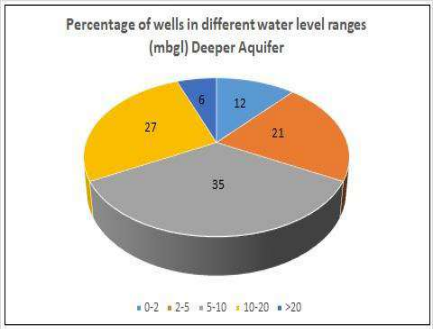
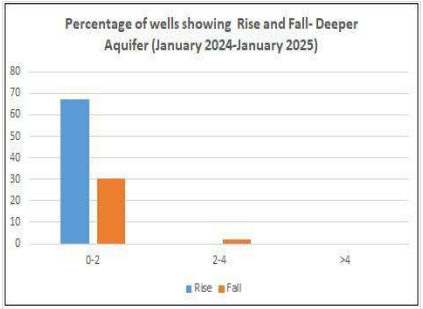
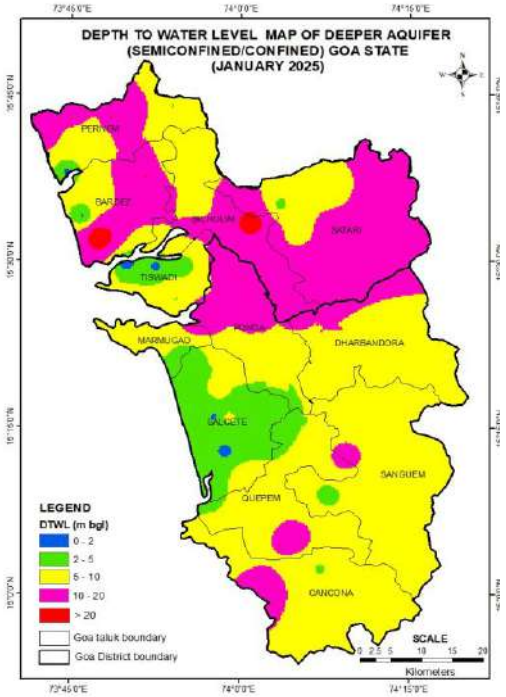






GROUND WATER LEVEL BULLETIN JANUARY 2025 - GOA STATE

Abstract

South Western Region, Bangalore

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. 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.

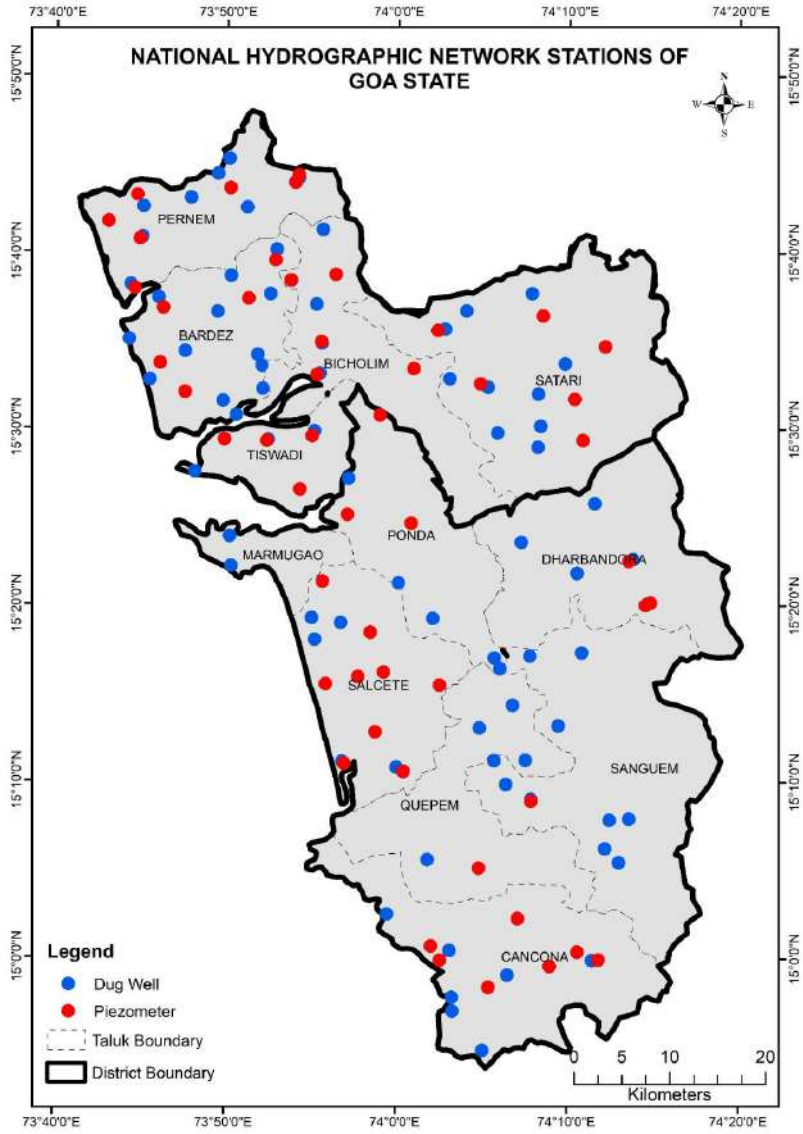


Plate 1: Location of Monitoring stations in Goa State

2. Study Area:

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 of super position. 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.

3. Ground Water level monitoring:

Monitoring of ground water levels was carried out in **135** ground water monitoring wells in the State of Goa during the month of January 2025. Among the wells monitored, **81** are dug wells and **54** are piezometers/tube wells (plate I).

4. Rainfall:

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.

5. Groundwater level scenario:

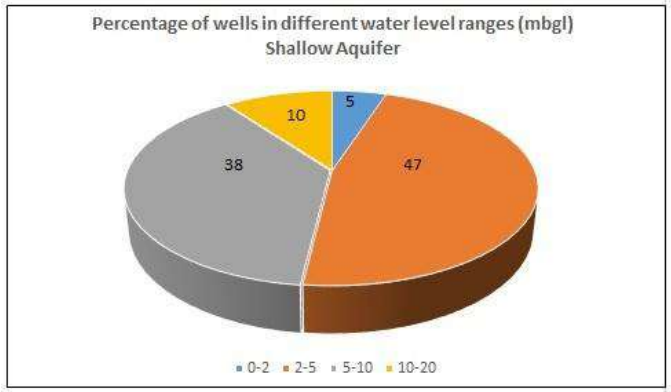
The ground water occurs in the open spaces of weathered fractured gneisses and granites. In these rocks the water bearing and yielding properties are primarily due to weathering and fracturing. In the weathered zone, ground water occurs under water table conditions and in the fractured and jointed formations it occurs under semi-confined conditions. In Laterite ground water occurs under phreatic condition. Alluvium along the river courses, though limited in thickness and aerial extent possess substantial ground water potential.

5.1 Unconfined Aquifer

5.1.1 Depth to water level data:

Salient features of the depth to water level during January 2025 are given below (Plate-II).

- A perusal of the water level data reveals that the depth to water level ranged from **1.1 m bgl (Chikalim)** in Salcete taluk South Goa District to **15.85 m bgl** (Daptomol Lolien) in Canacona taluk South Goa.
- 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. **90%** of wells analysed, while **10%** of wells show depth to water level in the 10-20 m bgl range.
- Depth to water level of less than 2 m bgl has been recorded in **5.1%** of wells analysed and noted in Bardez, Pernem, Salcete and Tiswadi taluks.
- Depth to water level in the range of 2 to 5 m bgl has been recorded in **46.8%** of wells analysed and noted in all the taluks.
- Depth to water level in the range of 5 to 10 m bgl has been recorded in **38%** of wells analysed and noted in Bicholim, Bardez, Canacona, Pernem, Quepem, Salcete, Ponda, Sangeum, Sattari and Tiswadi taluks.
- Depth to water level in the range of 10 to 20 m bgl has been observed in **10%** of wells analysed and noted as pockets in Bicholim, Bardez, Canacona and Sangeum taluks.



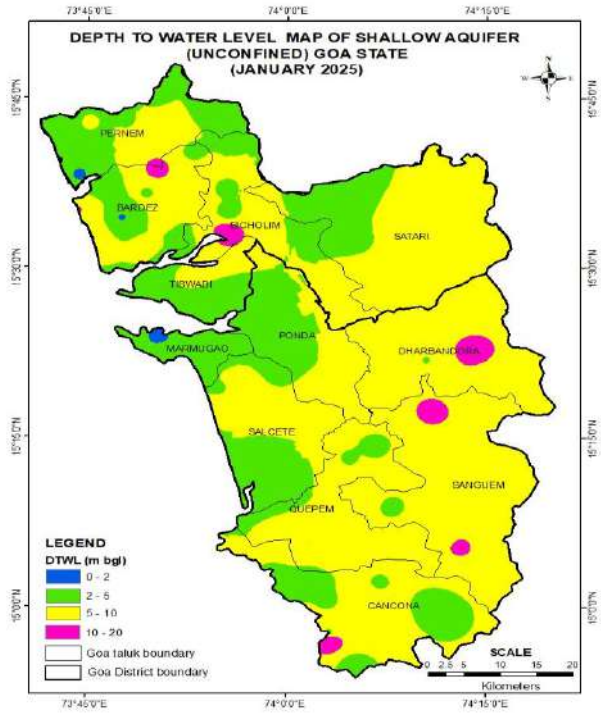


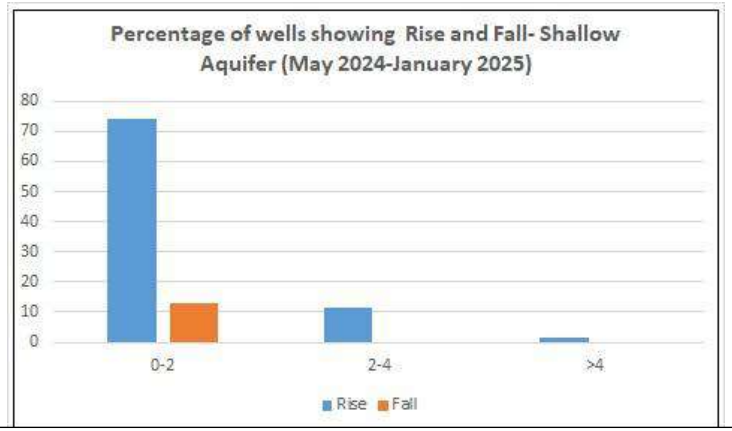
Plate- II: Depth to Water level Map of Shallow Aquifer (Unconfined) of Goa State- January 2025

5.1.2 Seasonal Fluctuation in Water Level

Seasonal Fluctuation of Water Level in Unconfined Aquifer (May/Pre-monsoon 2024 to January 2025)

A comparison of water level of January 2025 with May 2024 shows that a rise in the water level is recorded in **87%** of wells analyzed, while 13**%** 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 is given below.

1. Rise in the water level in the range of 0-2 m has been observed in 74**%** of wells analysed and observed in all the taluks.
2. Rise in the water level in the range of 2-4 m has been observed in 1**2%** of wells analysed in Bardez, Canacona, Salcete, Sangem and Satari taluks.
3. Rise in the water level in the range of >4 m has been observed in **1%** of wells analysed and observed in Bardez taluk.
4. The fall in water level in the range of 0-2 m has been observed in 1**3%** of wells analysed and noted as pockets in Bardez, Bicholim, Canacona, Marmagoa, Pernem, Quepem, Salcete, Sangem and Tiswadi taluks



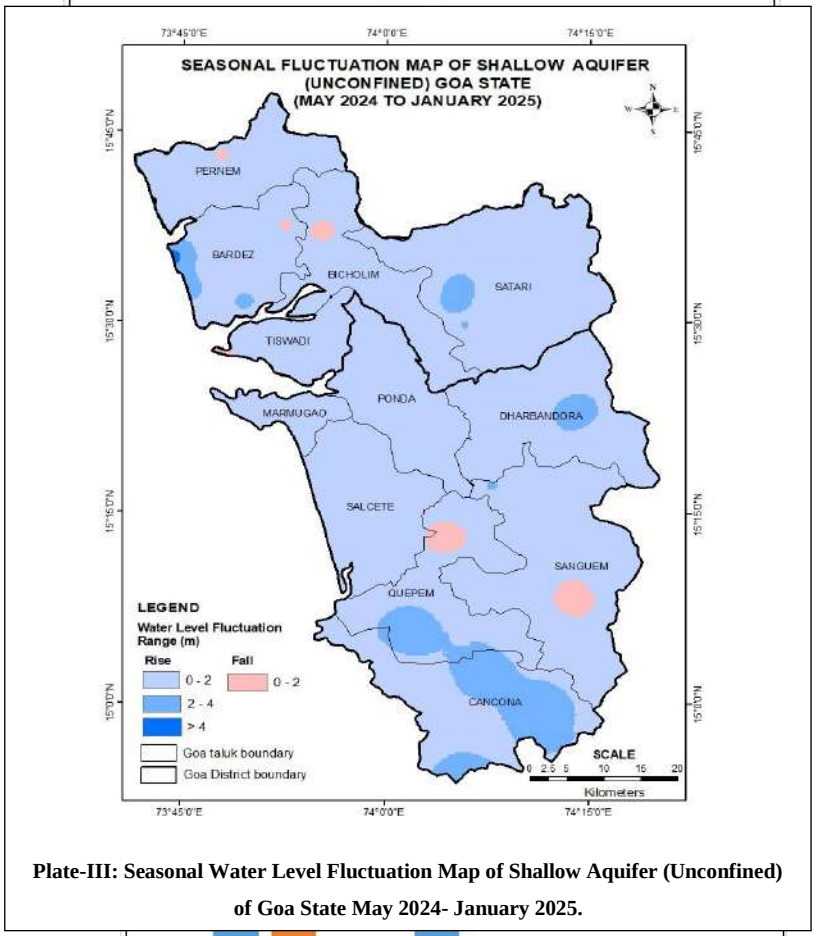
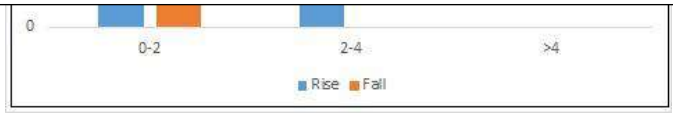


Plate-III: Seasonal Water Level Fluctuation Map of Shallow Aquifer (Unconfined) of Goa State May 2024- January 2025.

Seasonal Fluctuation of Water Level in Unconfined Aquifer (August 2024 to January 2025)

A comparison of water level of August 2024 with January 2025 shows that a rise in the water level is recorded in **44%** of wells analyzed, while 56**%** recorded fall. The Seasonal fluctuation in water level of Shallow aquifer has been plotted in **Plate IV**. A perusal of the plate shows that a general fall and rise in the range of 0 – 2 m is noticed in major part of the area, and further breakup is given below.



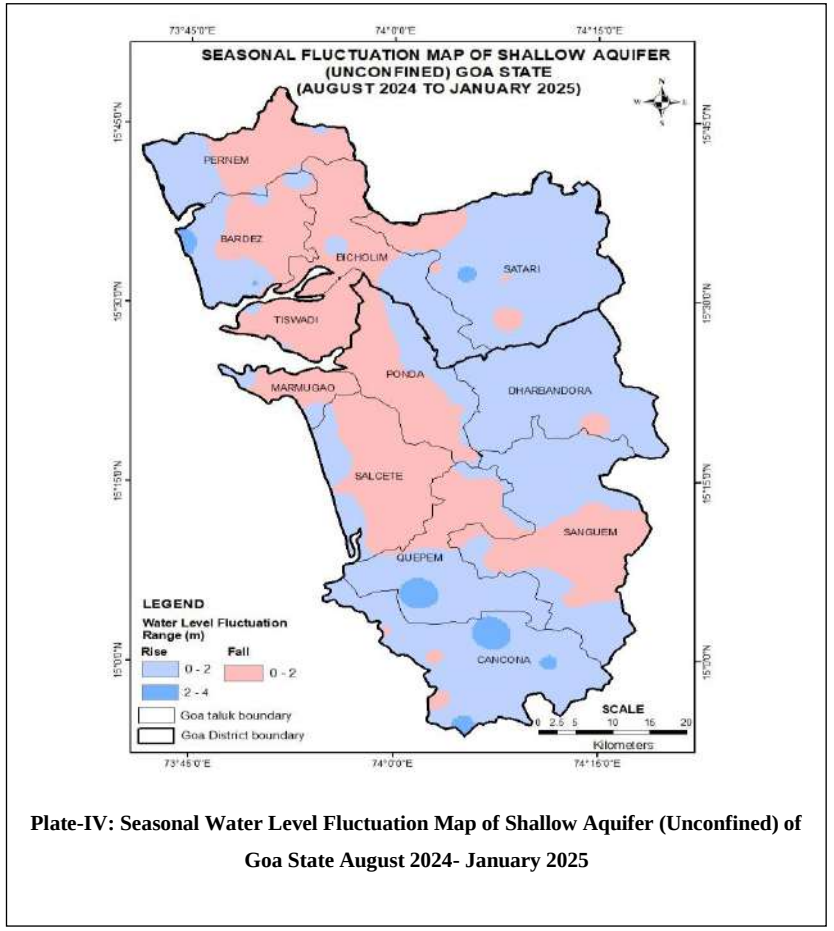
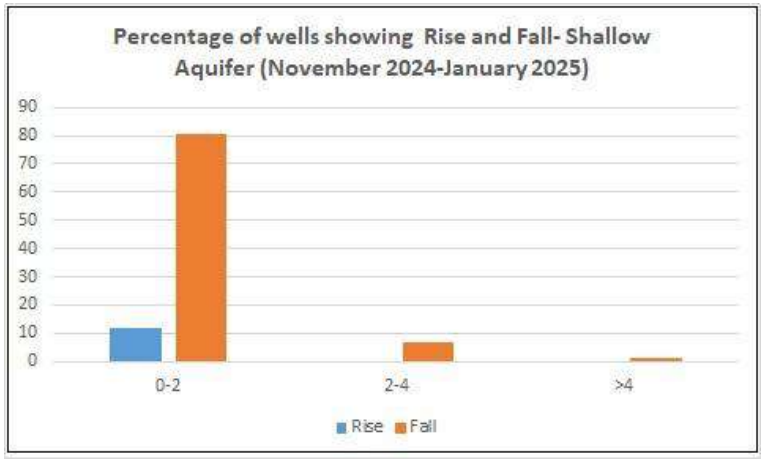


Plate-IV: Seasonal Water Level Fluctuation Map of Shallow Aquifer (Unconfined) of Goa State August 2024- January 2025

Seasonal Fluctuation of Water Level in Unconfined Aquifer (November 2024 to January 2025):

A comparison of water level shows that a rise in the water level is recorded in **12%** of wells analyzed, while **88%** recorded fall. The seasonal fluctuation in water level of Shallow aquifer has been plotted in **Plate V**. A perusal of the plate shows that a



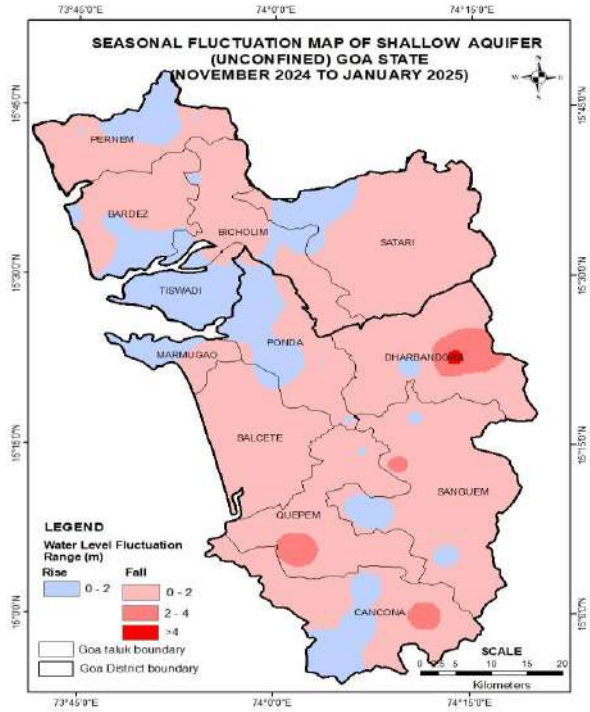


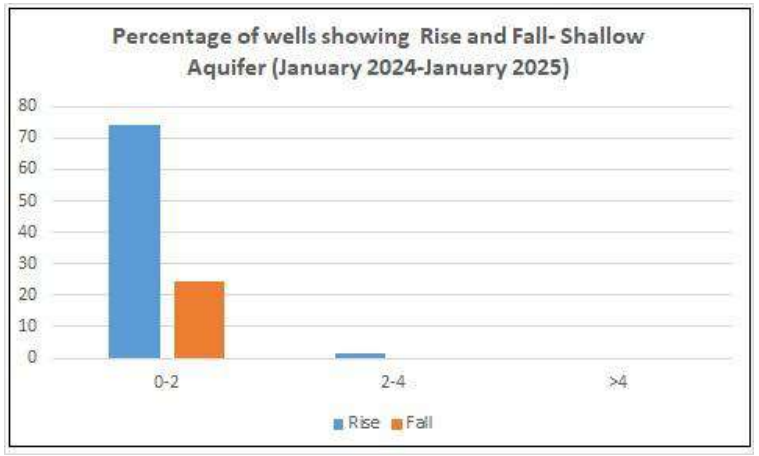
Plate-V: Annual Water Level Fluctuation Map of Shallow Aquifer (Unconfined) of Goa State- November 2024 to January 2025

5.1.3 Annual Fluctuation in Water Level

Annual Fluctuation of Water Level in Unconfined Aquifer (January 2024 To January 2025)

A comparison of water level shows that a rise in the water level is recorded in **76%** of wells analyzed, while **24%** recorded fall. The Annual fluctuation in water level of Shallow 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 is given below.

1. Rise in the water level in the range of 0-2 m has been observed in **74%** of wells
   analysed and observed in all taluks.
2. Rise in water level more than 4 m has been observed in **1%** of wells analysed and noted in Pernem, taluk.
3. Fall in water level in the range of 0-2 m has been observed in **24%** of wells analysed and noted in all the taluks. Major part of Bardez, Bicholim, Tiswadi, Quepem, Murmugoa and Ponda taluks.



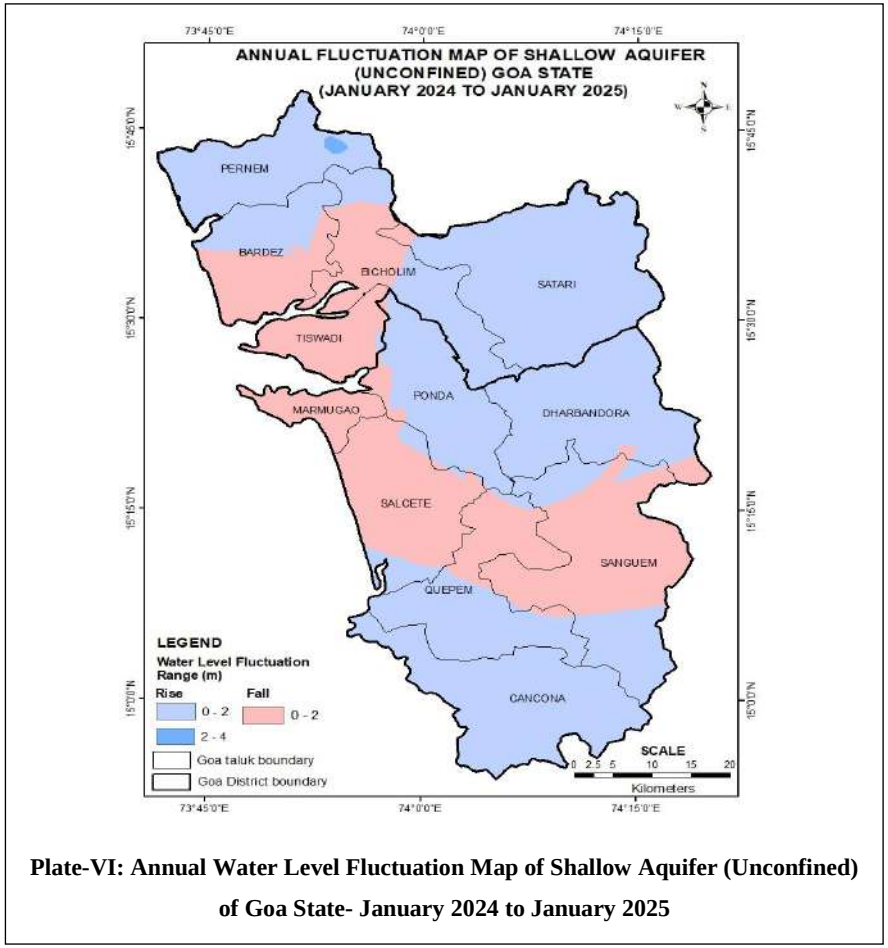
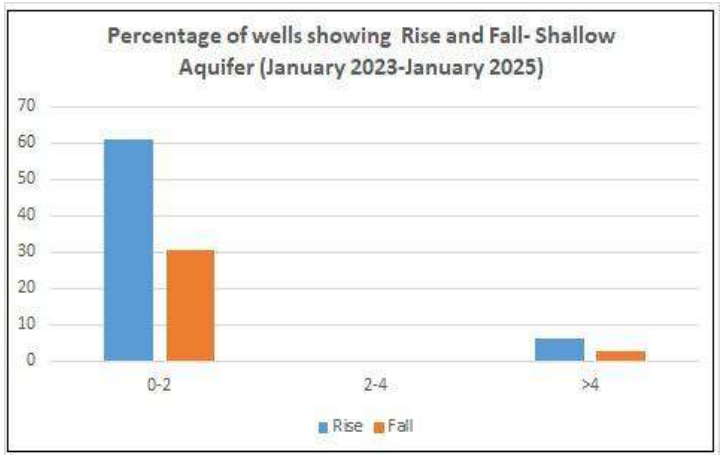


Plate-VI: Annual Water Level Fluctuation Map of Shallow Aquifer (Unconfined) of Goa State- January 2024 to January 2025

Annual Fluctuation of Water Level in Unconfined Aquifer (January 2023 To January 2025)

A comparison of water level shows that a rise in the water level is recorded in **67%** of wells analyzed, while **33%** recorded fall. The Annual fluctuation in water level of Shallow aquifer has been plotted in **Plate VII**. 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 **61%** of wells
   analysed and observed in all taluks.
2. Rise in water level more than 4 m has been observed in **6%** of wells analysed and noted in Canacona and Sattari taluks.
3. Fall in water level in the range of 0-2 m has been observed in **30%** of wells analysed and noted in all the taluks. Major part of Bardez, Bicholim, Canacona, Pernem, Quepem, Murmugoa, Salcete, Sanguem and Sattari taluks.
4. Fall in water level more than 4 m has been observed in **3%** of wells analysed and noted in Darbondara and Sanguem taluks



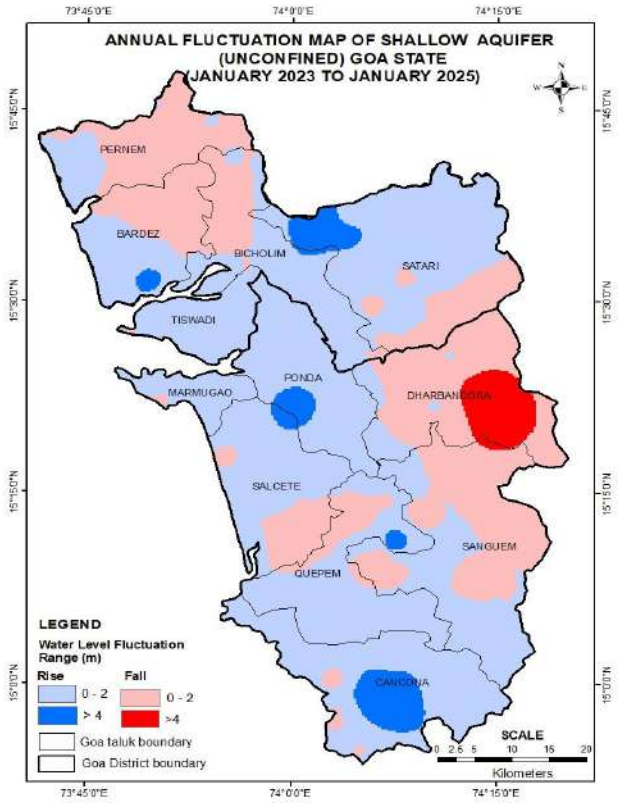


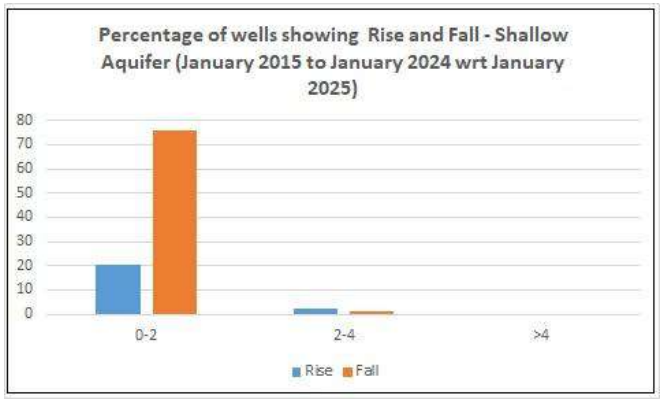
Plate-VII: Annual Water Level Fluctuation Map of Shallow Aquifer (Unconfined) of Goa State- January 2023 to January 2025

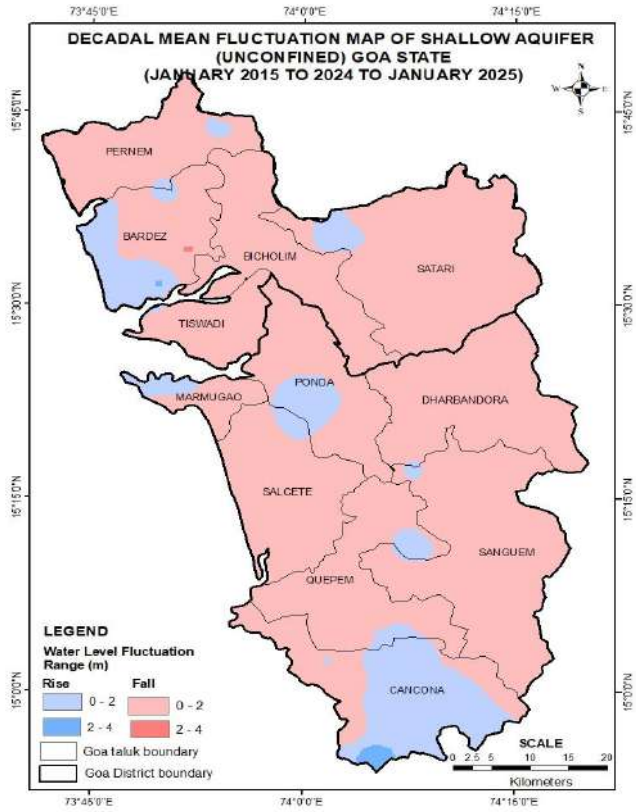
5.1.4 Decadal Fluctuation in Water Level

Decadal Fluctuation of Water Level in Unconfined Aquifer (Decadal Mean January (2015-2024) to January 2025)

A comparison of water level shows that a rise in the water level is recorded in **23%** of wells analysed, while **77%** recorded fall. The Decadal fluctuation of water level of Shallow aquifer has been plotted in **Plate VIII**. Major part of the state shows fall of water level with in 2 m. 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 **20%** of wells analysed and noted in Bardez, Canacona, Pernem, Ponda, Salcete, Sangeum, Sattari and Tiswadi taluks.
2. Rise in the water level in the range of 2-4 m has been observed in **3** % of wells analysed and noted in Bardez and Canacona taluk.
3. Fall in water level in the range of 0-2 m has been observed in **76%** of wells analysed and noted in all the taluks.
4. Fall in water level in the range of 0-2 m has been observed in **1%** of wells analysed and noted in Bardez taluk.





PlateVIII: Decadal Mean Water Level Fluctuation Map of Shallow Aquifer (Unconfined) of Goa State- January 2015-2024 to January 2025

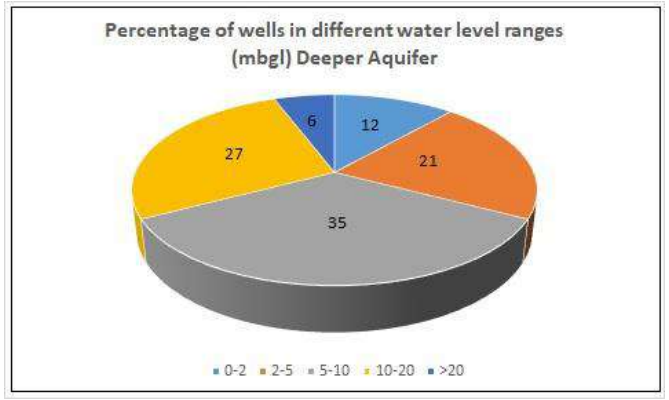
5.2 Confined/Semiconfined Aquifer

5.2.1 Depth to Piezometric Level

Salient features of the depth to piezometric level during January 2025 are given below (Plate IX).

Depth to piezometric 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 VIII** depicts the Piezometric ground water scenario in January 2025. Salient features of the depth to water level of deeper aquifer during January 2025 are given below;

1. The depth to water level of deeper aquifer ranges from from **0.84 m bgl (Mola)** in Tiswadi taluk, North Goa District to **27.97 m bgl** (Saligao) in Bardez taluk, North Goa.
2. **67%** of wells have recorded depth to water level of deeper aquifer within 10 m bgl and **33%** 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 **12%** of wells analysed and this has been noted in Bardez, Pernem, Salcete & Tiswadi Taluks.
4. Depth to water level of deeper aquifer in the range of 2 to 5 m bgl has been recorded in **21%** of wells analysed and noted in Canacona, Pernem, Salcete, Sanguem, Satari and Tiswadi taluks.
5. Depth to water level of deeper aquifer in the range of 5 to 10 m bgl has been recorded in **35%** of wells analysed and noted in all the taluks.
6. Depth to water level of deeper aquifer in the range of 10 to 20 m bgl has been observed in **27%** of wells analysed and noticed in all taluks except Bardez, Bicholim, Canacona, Pernem, Ponda, Quepem, Sanguem and Satari Taluks.
7. Depth to water level of deeper aquifer in the range more than 20 m bgl has been observed in **6%** of wells analysed and noticed in Bardez and Bicholim taluks.



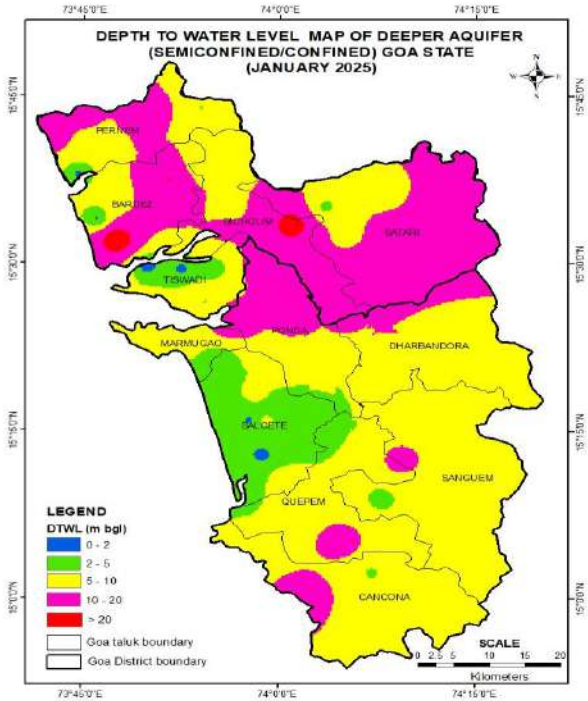


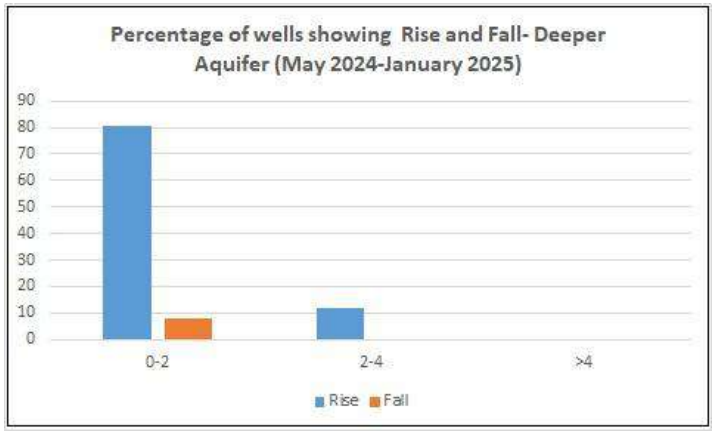
Plate-IX: Depth to Water level Map of Deeper Aquifer (Unconfined) of Goa State- January 2025

5.2.2 Seasonal Fluctuation in Piezometric level

Seasonal Fluctuation of Piezometric Level in Unconfined Aquifer (May/Pre-monsoon 2024 to January 2025)

A comparison of water level shows that a rise in the water level is recorded in **92%** of wells analyzed & fall of water level recorded in **8%** of wells analysed. The Seasonal fluctuation in piezometric level of Deeper aquifer has been plotted in **Plate X**. 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 **81%** of wells analysed and observed in all the taluks.
2. Rise in the water level in the range of 2-4 m has been observed in **12%** of wells analysed in Canacona, Ponda, Sanguem and Satari taluks.
3. Fall in the water level in the range of 0-2 m has been observed in **8%** of wells analysed and observed in Bardez, Bicholim, Canacona, and



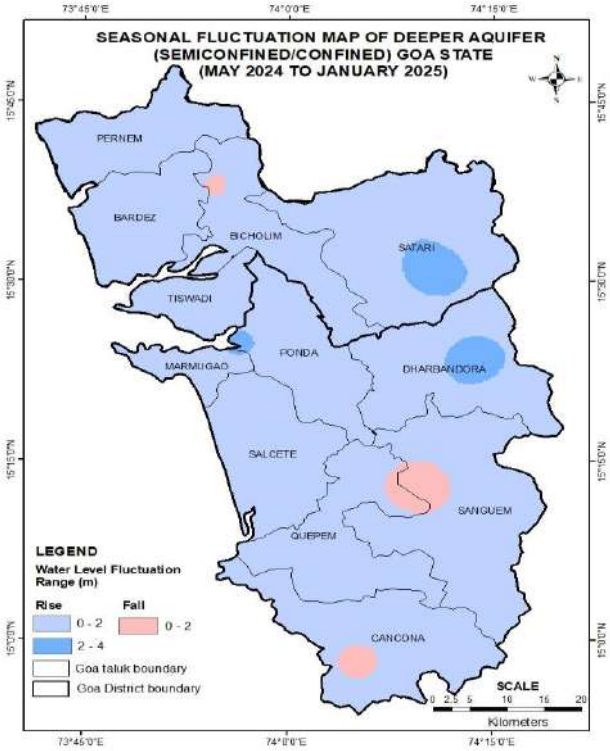


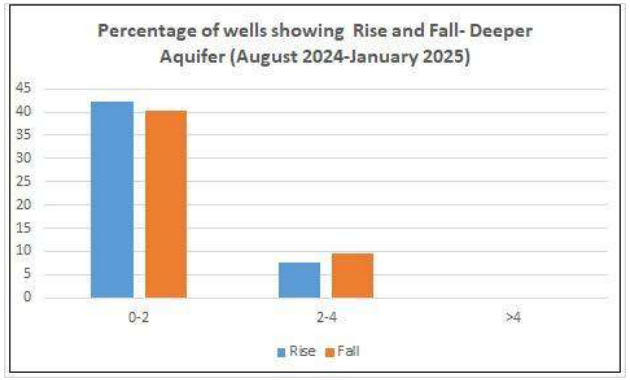
Plate-X: Seasonal Water Level Fluctuation Map of Deeper Aquifer (Semi-confined/Confined) of Goa State - May 2024- January 2025.

Seasonal Fluctuation of Piezometric Level in Semi-confined Aquifer (August 2024 to January 2025)

A comparison of water level shows that a rise in the water level is recorded in **50%** of wells analysed & fall of water level recorded in **50%** of wells analysed. The Seasonal fluctuation in piezometric level of Deeper aquifer has been plotted in **Plate XI**. A perusal of the plate shows that a general rise and fall 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

   42% of wells analysed and observed in all the taluks.
2. Rise in the water level in the range of 2-4 m has been observed in **8%** of wells analysed in Canacona, Ponda, Satari and Sanguem taluks.
3. Fall in the water level in the range of 0-2 m has been observed in **40%** of wells analysed and observed in all the taluks
4. Fall in the water level in the range of 2-4 m has been observed in **10%** of wells analysed and observed in Bardez, and Salcete



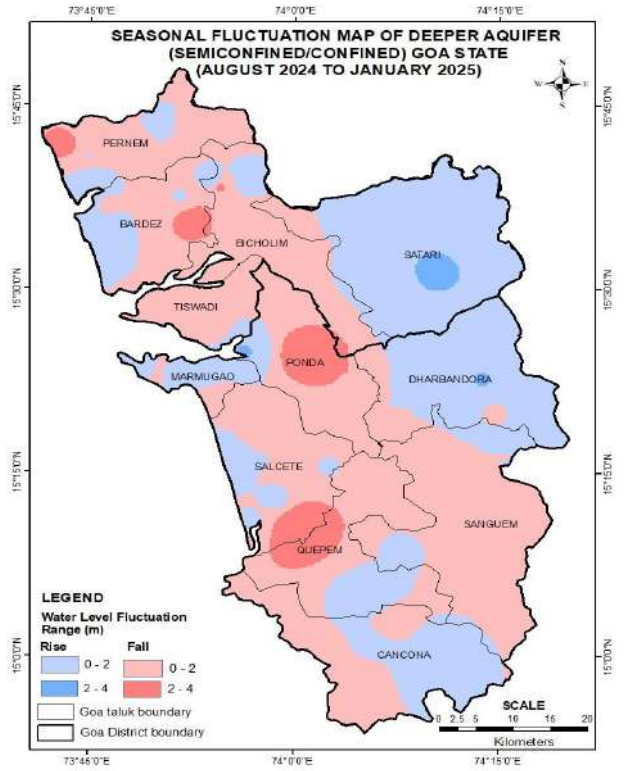
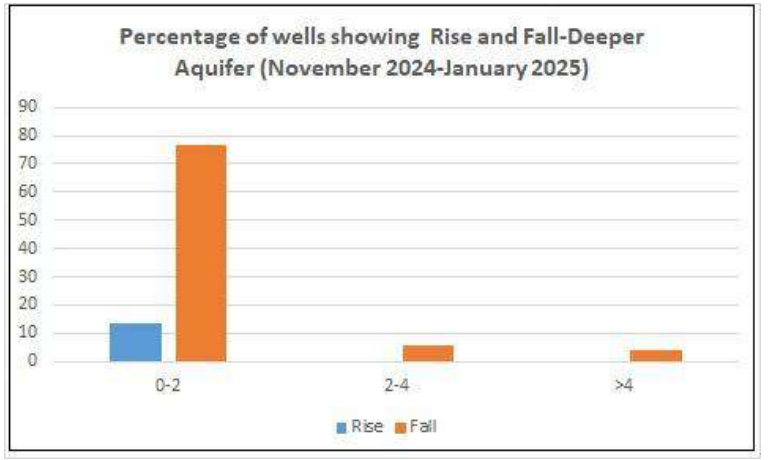


Plate-XI: Seasonal Water Level Fluctuation Map of Deeper Aquifer (Semi-confined/Confined) of Goa State - August 2024- January 2025.

Seasonal Fluctuation of Water Level in Semi-confined Aquifer (November 2024 to January 2025):

A comparison of water level shows that a rise in the water level is recorded in **14%** of wells analyzed, while **86%** recorded fall. The seasonal fluctuation in piezometric level of Deeper aquifer has been plotted in **Plate XII**. A perusal of the plate shows that a general fall 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 **14%** of wells
   analysed and observed in Bicholim, Pernem, Quepem, Salcete, Sattari and Tiswadi taluks.
2. Fall in water level in the range of 0-2 m has been observed in **76%** of wells analysed and noted in all the taluks.
3. Fall in water level in the range of 2-4 m has been observed in **6%** of wells analysed and noted Bardez and Sanguem taluks.
4. The Fall in the water level in the range of >4 m has been observed in **4%** of wells analysed and noted in Bicholim, Sanguem and Ponda taluks.



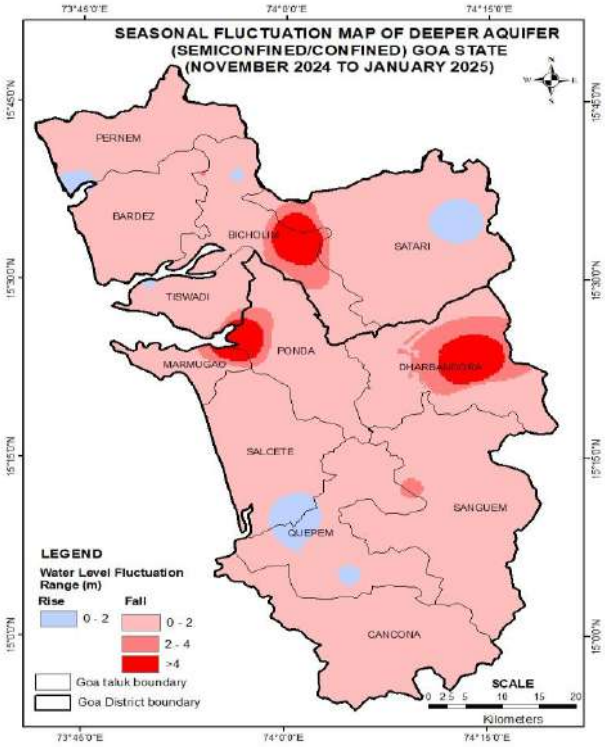


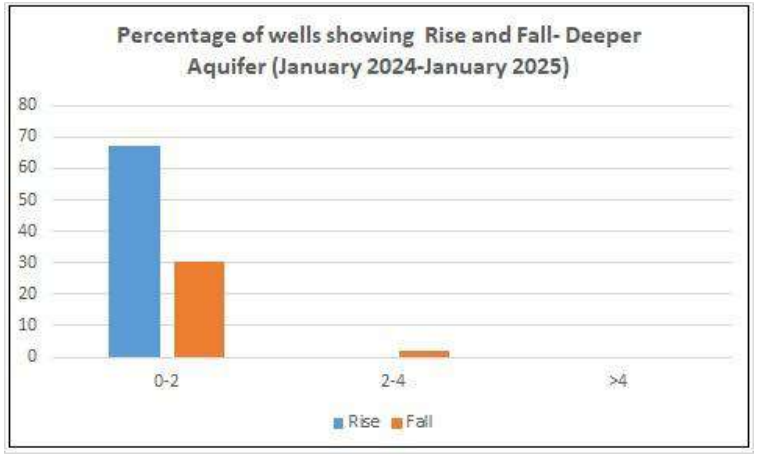
Plate-XII: Annual Water Level Fluctuation Map of Deeper Aquifer (Semi-confined) of Goa State- November 2024 to January 2025

5.2.3 Annual Fluctuation in Water Level

Annual Fluctuation of Piezometric Level in Semi confined Aquifer (January 2024 to January 2025)

A comparison of water level shows that a rise in the water level is recorded in **67%** of wells analyzed, while **33%** recorded fall. The Annual fluctuation in piezometric level of Deeper aquifer has been plotted in **Plate XIII**. 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 **67%** of wells
   analysed and observed in all taluks.
2. Fall in water level in the range of 0-2 m has been observed in **31%** of wells analysed and noted in all the taluks. Major part of Bardez, Bicholim, satari, Tiswadi, Salcete, Quepem, Sangeum and Canacona taluks.
3. Fall in water level in the range of 2-4 m has been observed in **2%** of wells analysed and noted in all the taluks. Major part of Bardez, and Quepem,



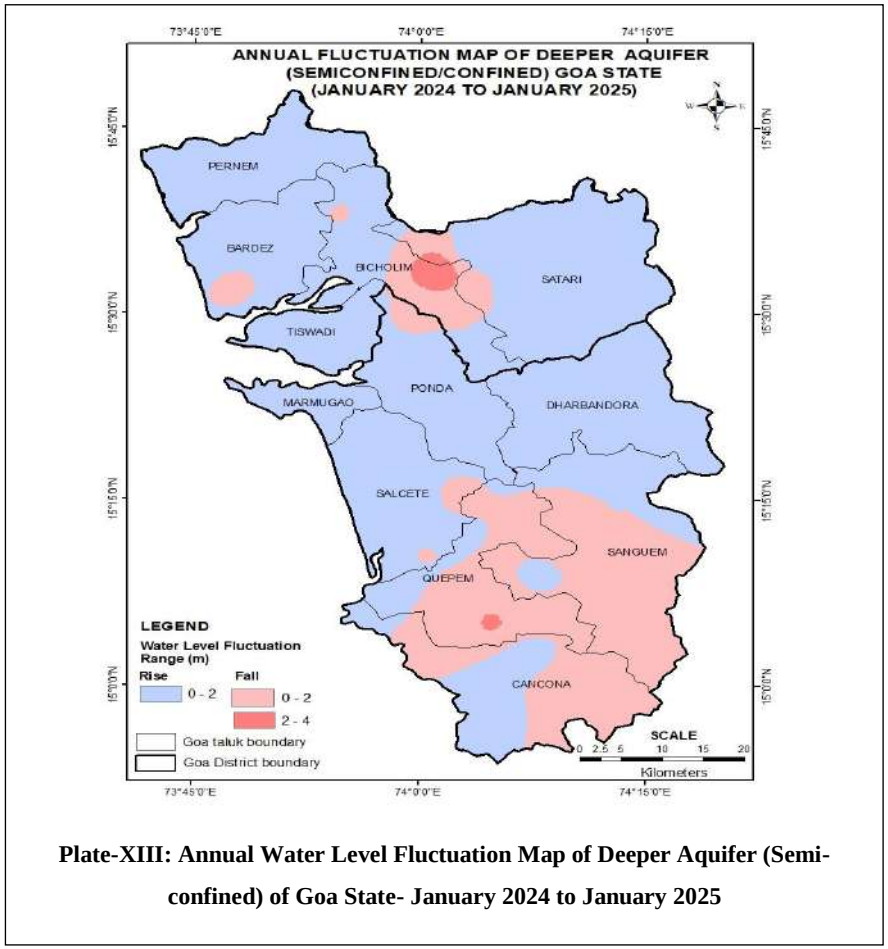


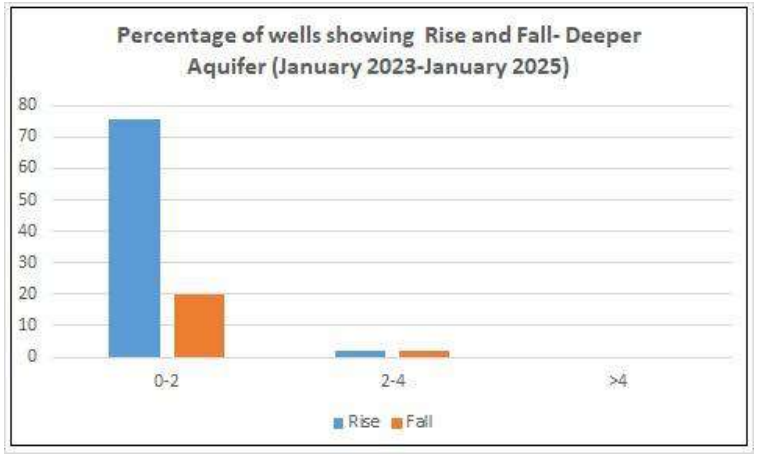
Plate-XIII: Annual Water Level Fluctuation Map of Deeper Aquifer (Semi-confined) of Goa State- January 2024 to January 2025

5.2.3 Annual Fluctuation in Water Level

Annual Fluctuation of Piezometric Level in Semi confined Aquifer (January 2023 to January 2025)

A comparison of water level shows that a rise in the water level is recorded in **78%** of wells analyzed, while **22%** recorded fall. The Annual fluctuation in piezometric level of Deeper aquifer has been plotted in **Plate XIV**. 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 **76%** of wells
   analysed and observed in all taluks.
2. Rise in the water level in the range of 0-2 m has been observed in **2%** of wells
   analysed and observed in Sanguem and Darbondara taluk.
3. Fall in water level in the range of 0-2 m has been observed in **20%** of wells analysed and noted in all the taluks. Major part of Bardez, Bicholim, Pernem, Ponda, Salcete and Sangeum taluks.
4. Fall in water level in the range of 2-4 m has been observed in **2%** of wells



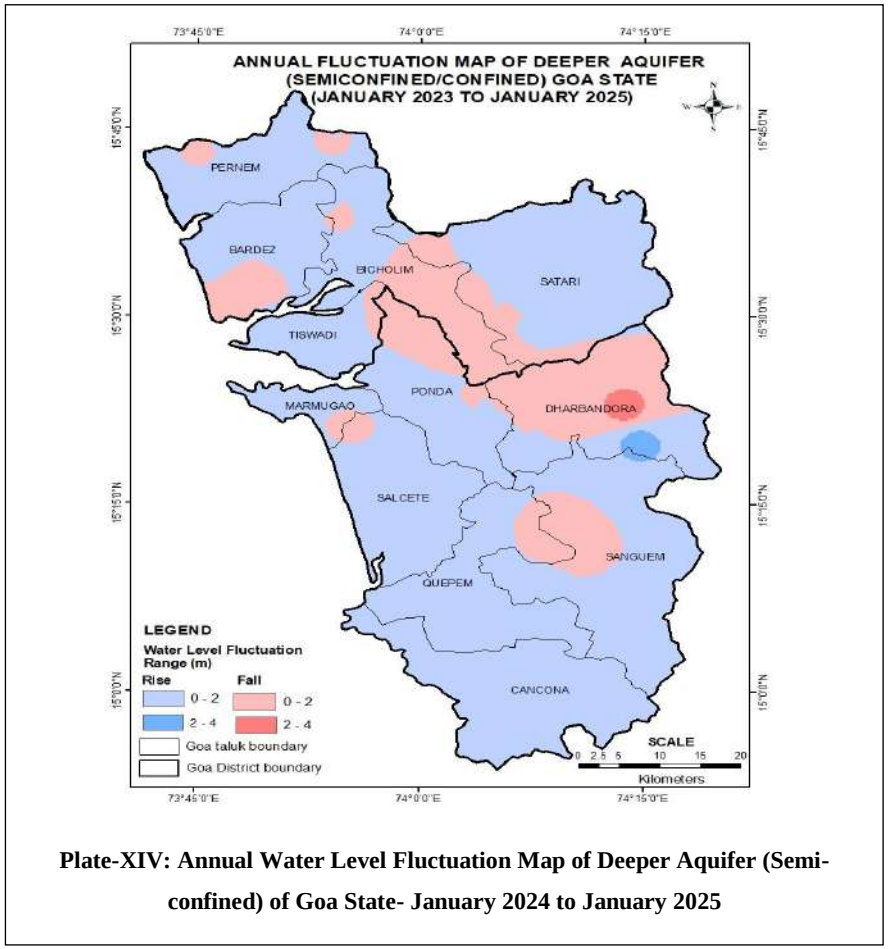


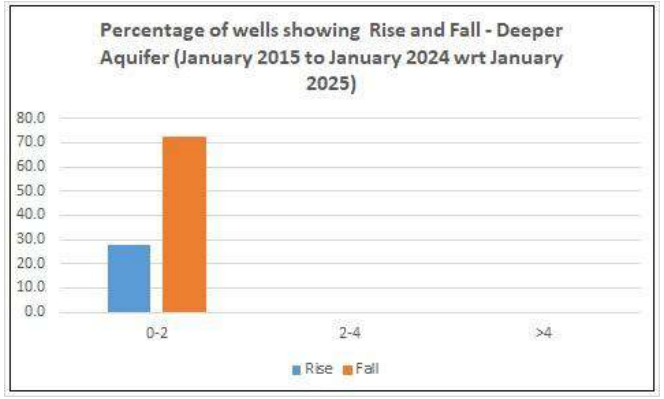
Plate-XIV: Annual Water Level Fluctuation Map of Deeper Aquifer (Semi-confined) of Goa State- January 2024 to January 2025

5.2.4 Decadal Fluctuation in Piezometric Level

Decadal Fluctuation of Piezometric in Semi-confined Aquifer (Decadal Mean January (2015-2024) to January 2025)

A comparison of water level shows that a rise in the water level is recorded in **28%** of wells analysed, while **72%** recorded fall. The Decadal fluctuation of water level of Deeper aquifer has been plotted in **Plate XV**. Major part of the state shows fall of water level with in 2 m. 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 **28%** of wells analysed and noted in Bardez, Bicholim, Canacona, Pernem, Ponda, Quepem, Sangeum, and Sattari taluks.
2. Fall in water level in the range of 0-2 m has been observed in **76%** of wells analysed and noted in all the taluks.



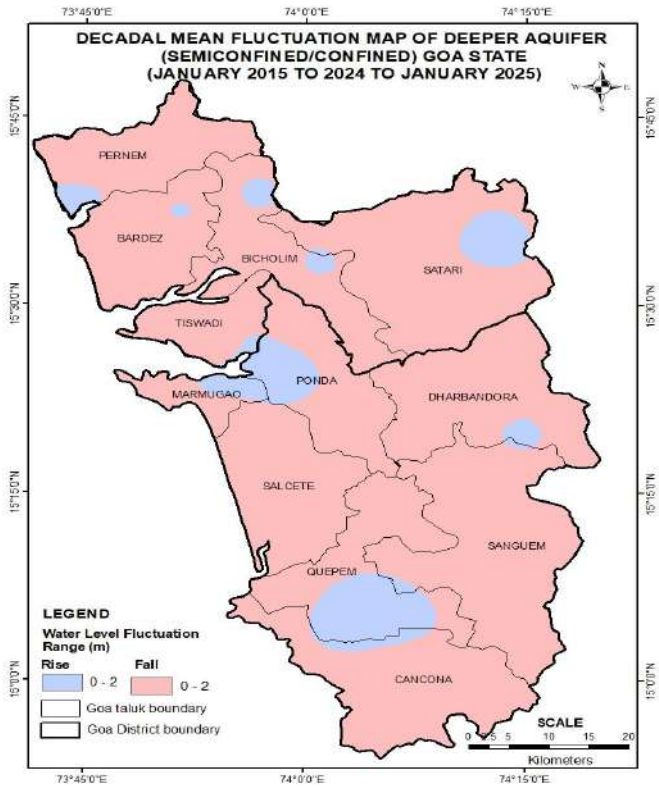


Plate XV: Decadal Mean Water Level Fluctuation Map of Deeper Aquifer (Semi-confined) of Goa State- January 2015-2024 to January 2025

6. SUMMARY

The behaviour of ground water table during **January 2025** 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.

8. Depth to water level of Shallow aquifer (Unconfined) over major part of the State covering the is within 10 m bgl in about **90%** of wells analysed, while **10%** of wells show depth to water level between 10 to 20 m bgl.
9. **87%** of wells have recorded seasonal rise in water levels of Shallow aquifer (Unconfined) and **13%** of wells have recorded fall in Seasonal water levels fluctuation during January 2025 in comparison to May 2024.
10. **44%** of wells have recorded seasonal rise in water levels of Shallow aquifer (Unconfined) and **56%** of wells have recorded fall in Seasonal water levels fluctuation during January 2025 in comparison to August 2024.
11. **12%** of wells have recorded seasonal rise in water levels of Shallow aquifer (Unconfined) and **88%** of wells have recorded fall in Seasonal water levels fluctuation during January 2025 in comparison to November 2024.
12. **76%** of wells have recorded annual rise in water levels of Shallow aquifer (Unconfined) and **24%** of wells have recorded fall in Seasonal water levels fluctuation during January 2025 in comparison to January 2024.
13. **67%** of wells have recorded annual rise in water levels of Shallow aquifer (Unconfined) and **33%** of wells have recorded fall in Seasonal water levels fluctuation during January 2025 in comparison to January 2024.
14. **78%** of wells have recorded annual rise in water levels of Shallow aquifer (Unconfined) and **22%** of wells have recorded fall in Annual water levels fluctuation during January 2025 in comparison to January 2023.

1. **67%** of wells have recorded annual rise in water levels of Shallow aquifer (Unconfined) and **33%** of wells have recorded fall in Annual water levels fluctuation during January 2025 in comparison to January 2023.
2. **28%** of wells have recorded decadal rise in water levels of Deeper aquifer (Semi-confined/Confined) and **72%** of wells recorded fall in water levels during January 2025 in comparison to decadal mean for the month of January (2015-2024
3. **23%** of wells have recorded decadal mean rise in water levels of Shallow aquifer (Unconfined) and **77%** of wells have recorded fall in water levels during January 2025 in comparison to decadal mean for the month of January (2015-2024).
4. **67%** of wells have recorded depth to water level of Deeper aquifer (Semi-confined/Confined) within 10 m bgl, while **33%** of wells show depth to water level of Deeper aquifer (Semi-confined/Confined) in more than 10 m bgl.
5. **92%** of wells have recorded seasonal rise in water levels of Deeper aquifer (Semi-confined/Confined) and 8**%** of wells have recorded fall in Seasonal water levels fluctuation during during January 2025 in comparison to May 2024.
6. **50%** of wells have recorded seasonal rise in water levels of Deeper aquifer (Semi-confined/Confined) and 50**%** of wells have recorded fall in Seasonal water levels fluctuation during during January 2025 in comparison to August 2024.
7. **14%** of wells have recorded seasonal rise in water levels of Deeper aquifer (Semi-confined/Confined) and 86**%** of wells have recorded fall in Seasonal water levels fluctuation during during January 2025 in comparison to November 2024.

7. 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 fixtures and low flow plumbing fixtures reduce the stress on groundwater. Low flow technology is normally used in faucets, aerator, shower heads and toilets.