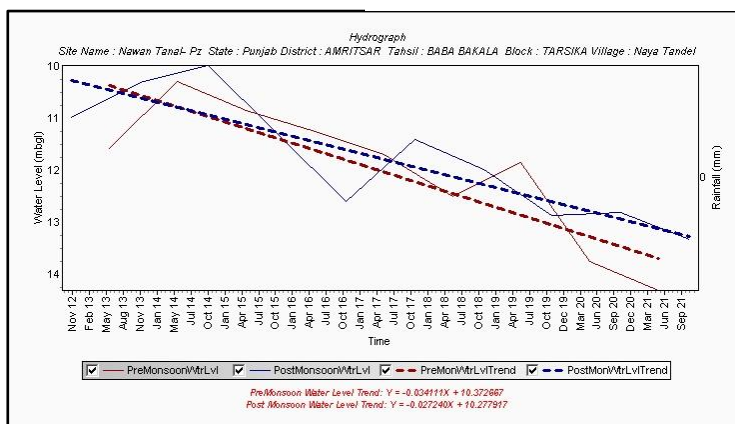
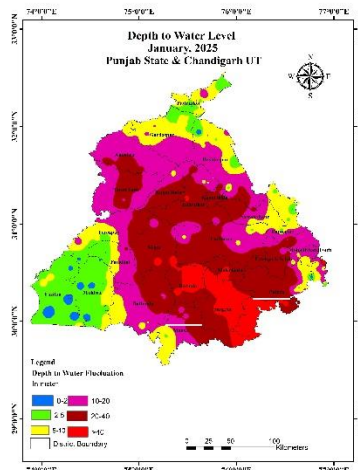
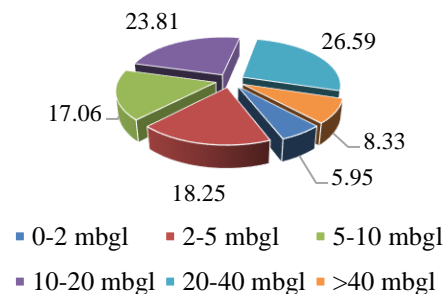


Percentage of Wells In Different Water Level Ranges In Unconfined Aquifers (January, 2025)



ABSTRACT

Ground water level Scenario during January 2025 highlighting the findings, status of ground water level in different aquifers and its seasonal, annual and decadal comparison.

CGWB, NORTH WESTERN REGION, CHANDIGARH

GROUND WATER LEVEL BULLETIN

PUNJAB STATE AND CHANDIGARH UT

1.0 INTRODUCTION

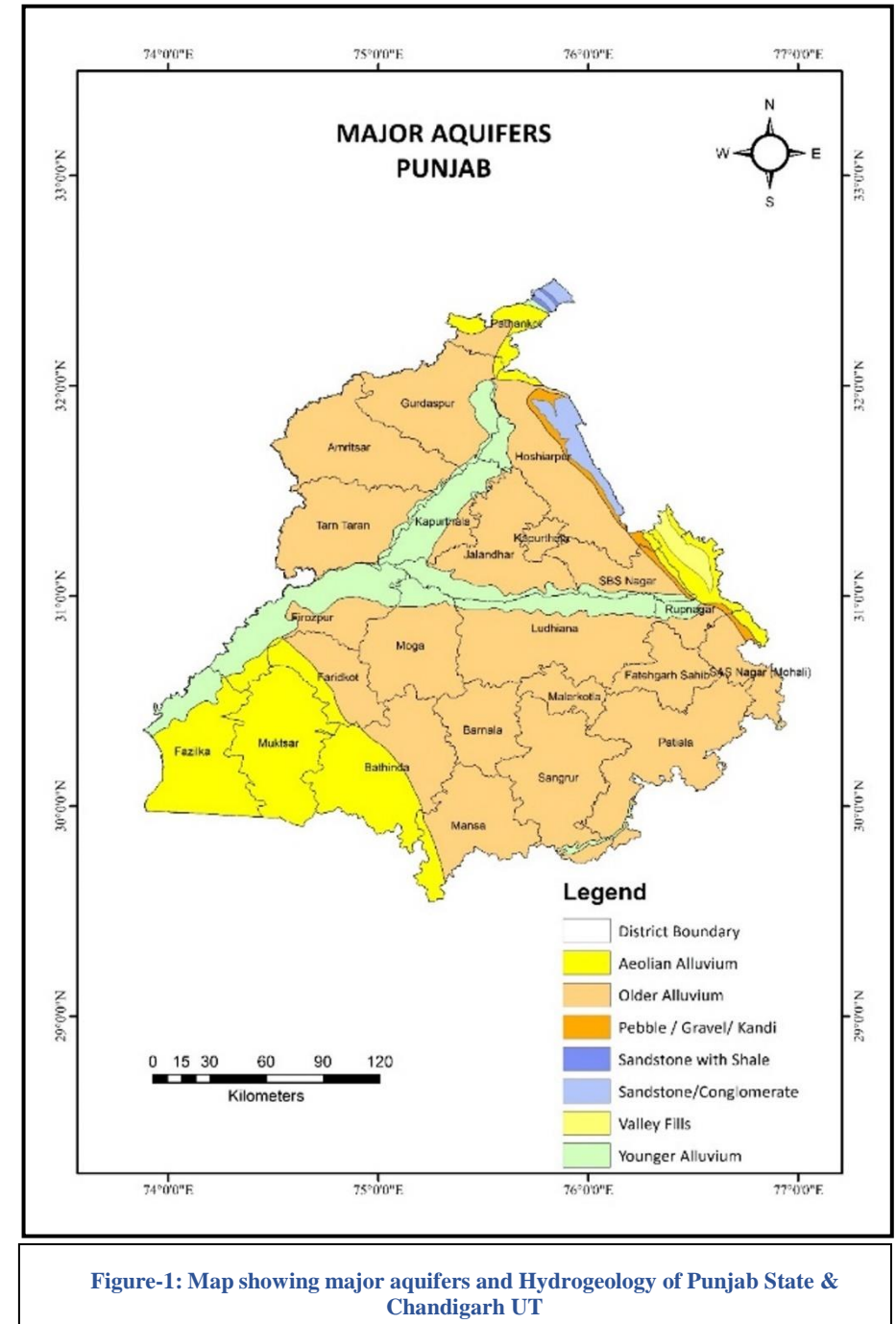
Groundwater bulletin is prepared by CGWB depicting changes in groundwater regime of the country through different seasons. It is an effort to obtain information on groundwater levels through representative monitoring wells. The important attributes of groundwater regime monitoring are groundwater level.

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, June, August and November. The regime monitoring started in the year 1969 by Central Groundwater Board. A network of 1874 observation wells called **National Hydrograph Network Stations (NHNS)**, as on 30.04.2024, located all over the country is being monitored.

2.0 STUDY AREA

The Punjab State is located between North latitudes $29^{\circ} 32'$ and $32^{\circ} 28'$ and East longitudes $73^{\circ} 50'$ and $77^{\circ} 00'$. The total geographical area of the state is 50476 sq. km. It is surrounded by the states of Himachal Pradesh in the northeast, Jammu and Kashmir in the north and Haryana and Rajasthan in the south and southwest respectively. The State has a flat alluvial plain except a narrow belt along the southwestern parts where stable sand dunes are seen dotting the landscape. The area occupied by the mountains (Himalayan foothills) in northeast, is about 1243 sq km. Perennial Rivers Sutlej, Beas, Ravi and ephemeral river Ghaggar drain the state. It has a vast network of canal system. With the inception of canals, the fertile land of the State started converting into green fields and experienced spectacular achievement in agricultural production with emphasis on cultivation of paddy and high yielding varieties of crops, as a consequence demand for water increased manifold resulting in over exploitation of ground water resources.



The State has been divided into four main divisions viz. Jalandhar, Patiala, Ferozpur and Faridkot, which are further sub-divided into 23 districts, which are further divided into 77 sub-divisions /tehsils and 146 community development.

The State forms a part of vast Indo-Genetic alluvial plain. Physiographically, the State can be divided into seven distinct units, which run parallel to each other.

I Hilly area: Siwalik Hills on the north and northeastern part.

II Eroded hills with flat land (Plateau): forms top of hills.

III Intermountain valleys

IV Piedmont area: (Kandi zone) immediately southwest of hills.

3.0 GROUND WATER LEVEL MONITORING

The Central Ground Water Board, North Western Region, has established 521 Ground water observation wells in Punjab State and Union Territory of Chandigarh for monitoring water level. As on 31.3.2024 there were 498 Ground Water Observation Wells of CGWB in Punjab which include 114 dug wells and 384 piezometers for monitoring shallow & deeper aquifers in Punjab. There are 23 observation wells in Chandigarh, 1 dug wells and 22 Piezometers for monitoring shallow & deeper aquifers.

About 80% of the Ground water observation wells fall in the canal command areas of various canal systems, the areas falling out of the major command is part of Pathankot, Hoshiarpur, Nawanshahr, Ropar and SAS Nagar districts, parts of Gurdaspur, Jalandhar and Ludhiana districts. The district wise details of Ground water observation wells are given in Table 1 and location of these Ground water observation wells is shown in Figure 2.

V. Sirowal Zone: lies further southwest of Kandi area which merges with the alluvium of Ravi, Beas, Sutlej and Ghaggar rivers. 2

VI. Alluvial plains:

- Active/recent flood plains include meanders and present flood plains.
- Abandoned flood plains include terraces of rivers, abandoned during Recent age.
- Bar upland areas: Higher elevated land which remained beyond the reach of rivers but are composed of ancient river channels deposits (older alluvium) plains.

VII. Sand Dunes: Covering southwest part

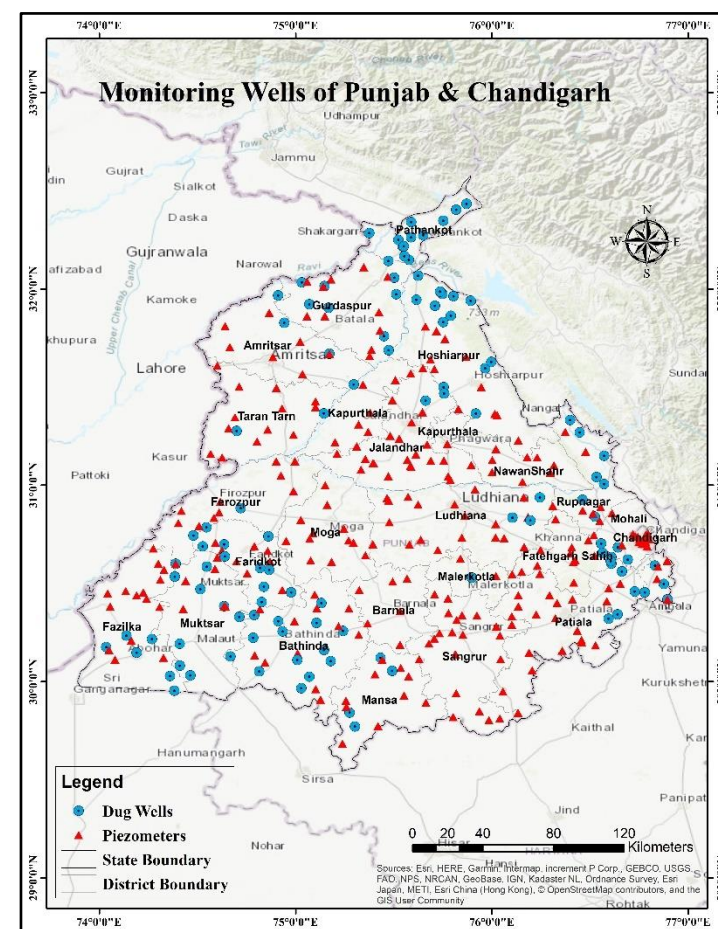


Figure- 2: Map showing locations of monitoring wells (NHNS) in Punjab

S. No.	District	Dug Well	Tube Well	Total
1	Amritsar	3	14	17
2	Barnala	0	7	7
3	Bathinda	14	20	34
4	Faridkot	11	10	21
5	Fatehgarh Sahib	3	19	22
6	Fazilka	7	18	25
7	Firozpur	2	19	21
8	Gurdaspur	10	21	31
9	Hoshiarpur	13	17	30
10	Jalandhar	2	43	45
11	Kapurthala	0	18	18
12	Ludhiana	3	31	34
13	Mansa	4	15	19
14	Moga	0	14	14
15	Muktsar	7	7	14
16	Pathankot	13	0	13
17	Patiala	4	32	36
18	Rupnagar	7	8	15
19	Sangrur	1	32	33
20	Sas Nagar	8	11	19
21	Sbs Nagar	0	9	9
22	Tarn Taran	2	19	21
23	Chandigarh UT	1	22	23
Grand Total		115	406	521

Table 1: District-wise distribution of water level monitoring stations

4.0 GROUND WATER LEVEL SCENARIO (JANUARY, 2025)

4.1 SHALLOW AQUIFER (UNCONFINED)

4.1.1 DEPTH TO WATER LEVEL

Depth To Water Level in Unconfined Aquifer (January, 2025)

The behavioral pattern of water level in January 2025 along with depth to water level map (Fig.3) is discussed below.

The depth to water level lies between 0.27 mbgl in Faridkot district and 60.36 mbgl in Hoshiarpur district. Very shallow water levels of 0-2 m (causing water logging) occur in 0.86% of wells and 5.9% area of the state in isolated patches in Muktsar, Fazilka & Hoshiarpur districts. Shallow water levels of 2-5 m have been observed in 12.58% of the wells and 18.25% of the total area that lies in south western parts of state i.e. Muktsar, Fazilka, Faridkot and parts of Gurdaspur, Pathankot and Rupnagar districts. These are mainly canal command areas and use canal water for their agricultural needs. The water levels between 5-10 m are observed in Fazilka, Faridkot, Muktsar, Ferozepur, Bathinda, Mansa, Gurdaspur, Pathankot, Hoshiarpur, SBS Nagar, Patiala and Rupnagar districts. About 16.07% of wells and 17.06% of the area fall in this range. Moderately Deep water levels (10-20 m) are observed in 27.91% wells covering about 23.81% area of the State Pathankot, Gurdaspur, Amritsar, SBS Nagar, Hoshiarpur, Jalandhar, Tarn Taran, Kapurthala, Moga, Ludhiana, Fazilka, Ferozpur, Faridkot, Bathinda, Mansa, Rupnagar & SAS Nagar districts. Deep water levels (20-40 m) are observed in parts of Amritsar, Taran taran, Jalandhar, Kapurthala, SBS Nagar, Hoshiarpur, Bathinda, Mansa, Moga, Ludhiana, Fatehgarh Sahib, Patiala, Sangrur, Barnala and SAS Nagar districts and observed in 35.10% wells covering about 26.59% area of the state. Very deep water levels (>40 m) are observed in 7.47% wells as patches in Sangrur, Barnala, Malerkotla and Moga districts covering 8.33% area of the State.

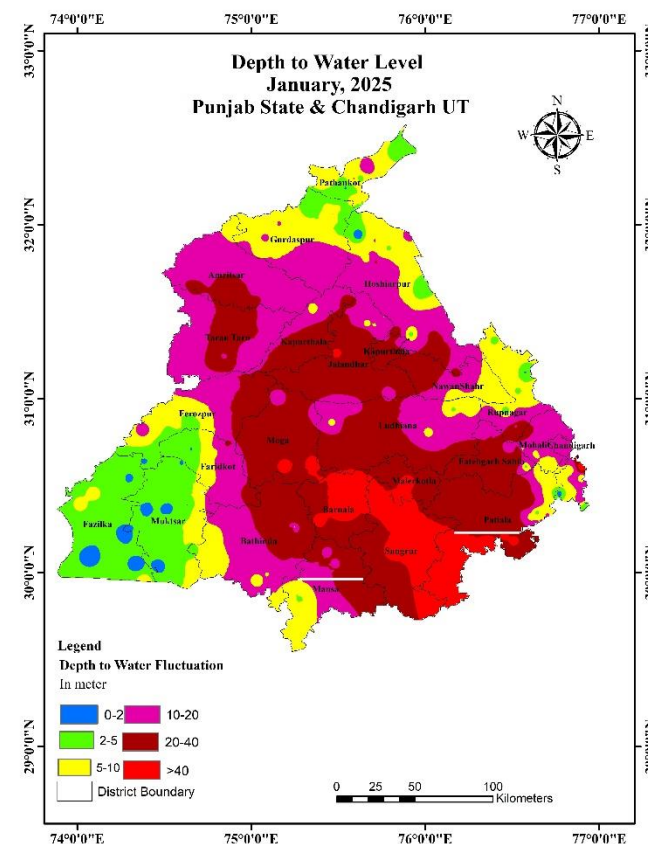


Figure-3: Depth to Water Level Map Unconfined Aquifer, January 2025

Percentage of Wells In Different Water Level Ranges In Unconfined Aquifers (January, 2025)

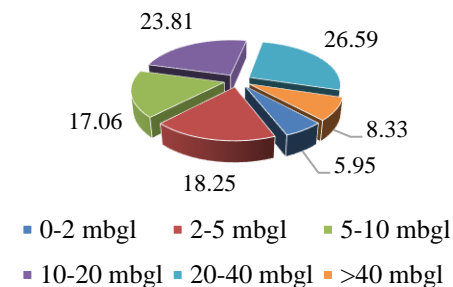


Figure-4: Percentage of wells in different water level ranges in unconfined aquifer.

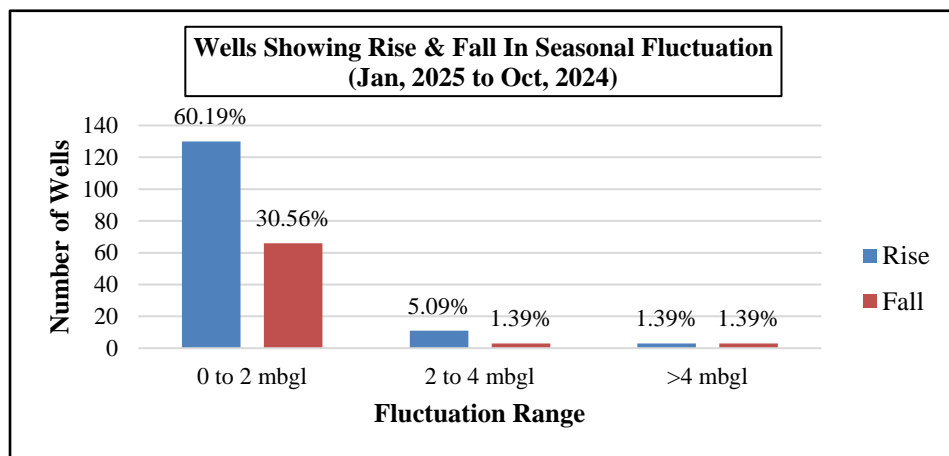


Figure-5: Percentage of wells showing rise and fall in WL in unconfined aquifer(Jan 2025 to Oct 2024)

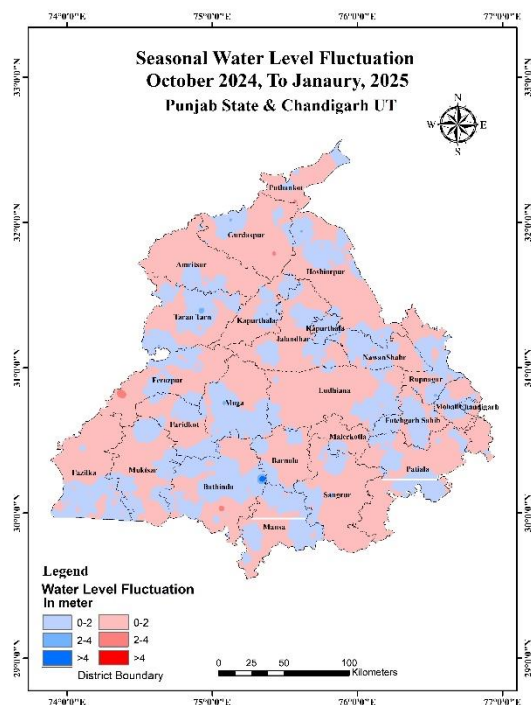


Figure-6: Seasonal water level fluctuation in unconfined Aquifer (Oct 2024 to Jan 2025)

4.1.2 SEASONAL FLUCTUATION IN WATER LEVEL

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

Water level data of January 2025 when compared with previous measurement data i.e. October 2024 is termed as seasonal water level fluctuations. The behavioral pattern of this seasonal fluctuation is discussed below. The map depicting seasonal water level fluctuations is shown in Fig.6.

Rise in Water Levels:

The water level rise has been recorded in 66.67% of wells monitored and covering 59.31% area of the State. Water level rise in the range of 0-2 m is observed in 60.19% of wells and 59.17% of the area. Water level rise 2-4m is observed in 5.09% of the wells & 0.12% area. Water level rise of >4m is observed in 1.39% wells and in 0.03% area as isolated patches in Bathinda District.

Fall in Water Levels:

The seasonal fluctuation shows that there is a general decline of water levels in 33.33% of wells monitored and covering 40.69% area of the State. The decline has been observed in all districts except some isolated patches scattered over the state. Water level decline in the range of 0-2 m is observed in 30.56% of wells and 59.17% of area. Water level decline in the range of 2-4 m is observed in 1.39% of wells and 0.08% of area. Water level decline of >4m is observed in 1.39% of wells and less than 1% of area as isolated patches in Kapurthala, Bathinda, Muktsar, Pathankot & Faridkot districts.

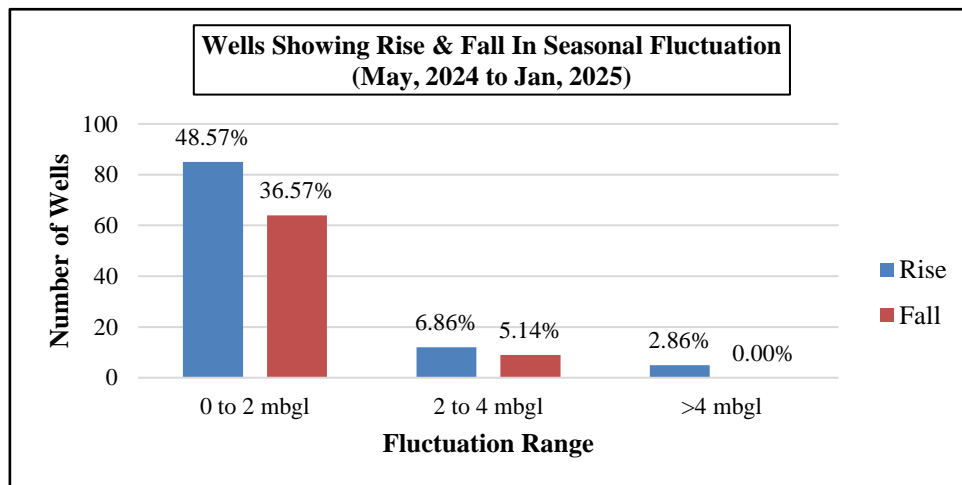


Figure-7: Percentage of wells showing rise and fall in WL in unconfined aquifer(May 2024 to January 2025)

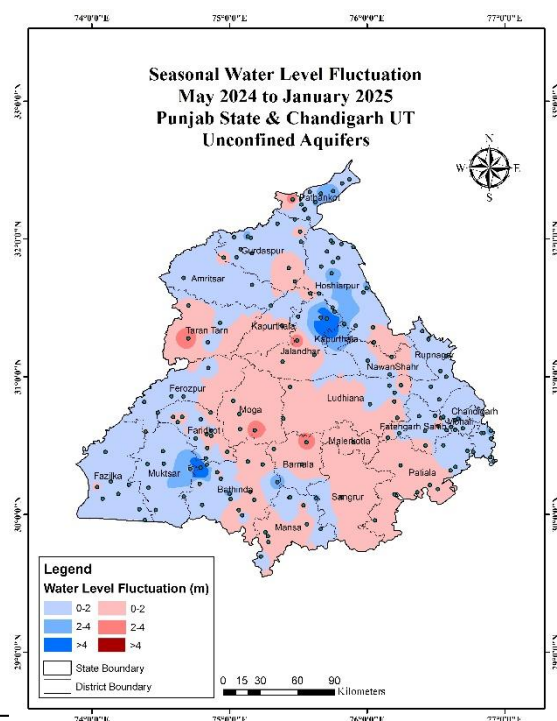


Figure-8: Seasonal water level fluctuation in unconfined Aquifer (May 2024 to Jan 2025)

4.1.2 SEASONAL FLUCTUATION IN WATER LEVEL

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

Water level data of January 2025 when compared with previous measurement data i.e. May 2024 is termed as seasonal water level fluctuations. The behavioral pattern of this seasonal fluctuation is discussed below. The map depicting seasonal water level fluctuations is shown in Fig.7.

Rise in Water Levels:

The water level rise has been recorded in 58.29% of wells monitored and covering 54.76% area of the State. Water level rise in the range of 0-2 m is observed in 48.57% of wells and 50.13% of the area. Water level rise 2-4m is observed in 6.86% of the wells & 3.71% area. Water level rise of >4m is observed in 2.86% wells and in less than 1% area as isolated patches in Bathinda District.

Fall in Water Levels:

The seasonal fluctuation shows that there is a general decline of water levels in 41.71% of wells monitored and covering 45.24% area of the State. The decline has been observed in all districts except some isolated patches scattered over the state. Water level decline in the range of 0-2 m is observed in 37.57% of wells and 44.17% of area. Water level decline in the range of 2-4 m is observed in 5.14% of wells and 1.08% of area. Water level decline of >4m is observed in none of the wells and area.

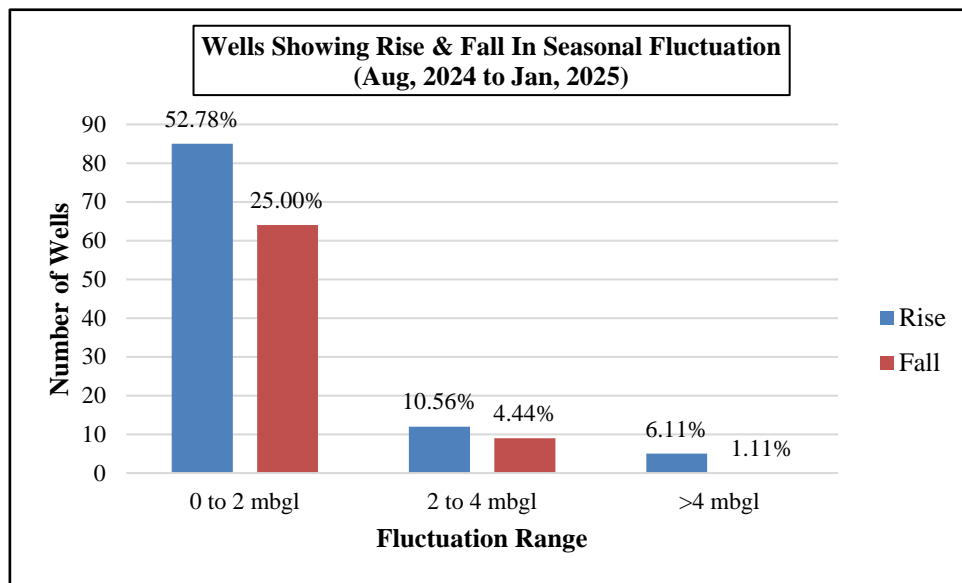
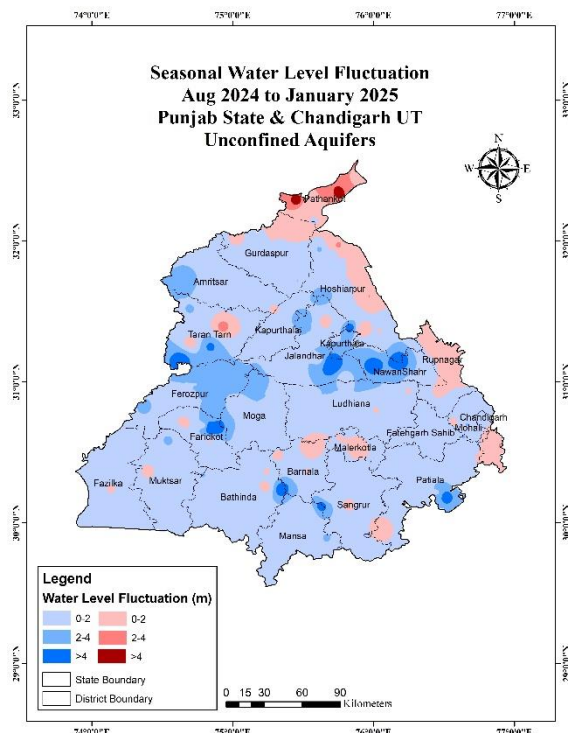


Figure-9: Percentage of wells showing rise and fall in WL in unconfined aquifer(August 2024 to January 2025)



**Figure-10: Seasonal water level fluctuation in unconfined Aquifer
(August 2024 to January 2025)**

4.1.2 SEASONAL FLUCTUATION IN WATER LEVEL

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

Water level data of January 2025 when compared with previous measurement data i.e. August 2024 is termed as seasonal water level fluctuations. The behavioral pattern of this seasonal fluctuation is discussed below. The map depicting seasonal water level fluctuations is shown in Fig.9.

Rise in Water Levels:

The water level rise has been recorded in 69.45% of wells monitored and covering 88.60% area of the State. Water level rise in the range of 0-2 m is observed in 52.78% of wells and 75.38% of the area. Water level rise 2-4m is observed in 10.55% of the wells & 11.50% area. Water level rise of >4m is observed in 6.11% wells and in 1.72% area as isolated patches in Bathinda District.

Fall in Water Levels:

The seasonal fluctuation shows that there is a general decline of water levels in 30.55% of wells monitored and covering 11.40% area of the State. The decline has been observed in all districts except some isolated patches scattered over the state. Water level decline in the range of 0-2 m is observed in 25.00% of wells and 10.30% of area. Water level decline in the range of 2-4 m is observed in 4.44% of wells and less than 1% of area. Water level decline of >4m is observed in 1.11% of wells and less than 1% of area as isolated patches in Kapurthala, Bathinda, Muktsar, Pathankot & Faridkot districts.

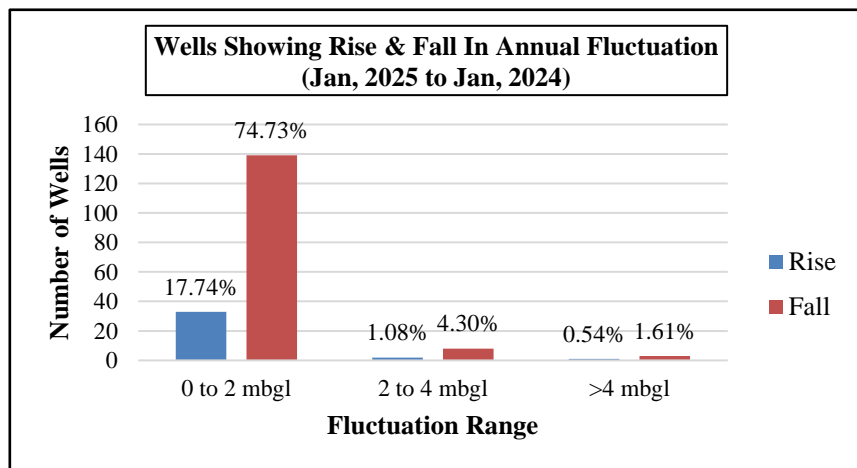


Figure-11: Percentage of wells showing rise and fall in WL in unconfined aquifer (Jan 2025 and Jan 2024)

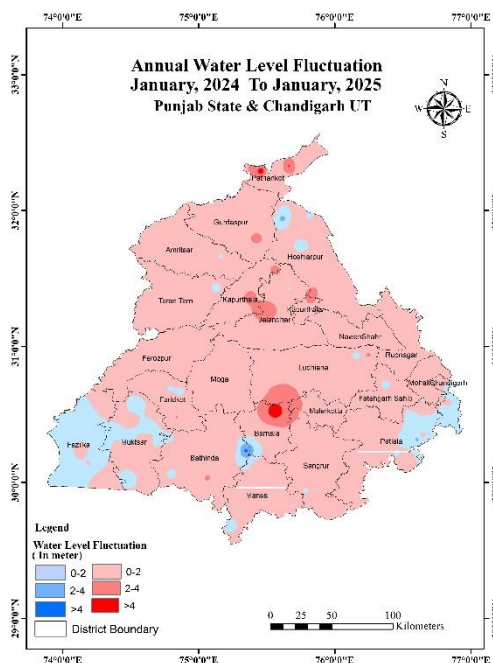


Figure-12: Annual water level fluctuation in unconfined aquifer (Jan 2024 & Jan 2025)

4.1.3 ANNUAL FLUCTUATION IN WATER LEVEL

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

In order to know the impact of rainfall and ground water withdrawal during last one year, annual water level fluctuations for period January 2025 and January 2024 are calculated. The behaviour of annual fluctuations is discussed in the following paragraph and depicted in Fig.11.

Rise in Water Levels:

The water level rise has been recorded in 19.36% of wells monitored and covering 10.09% area of the State. Water level rise in the range of 0-2 m is observed in 17.74% wells and 0% of area. Water level rise 2-4m is observed in 1.08 % wells and 10.07% of area. The water level rise of >4m is observed in 0.54% wells and less than 1% of area as isolated patches in Barnala & Bathinda districts.

Fall in Water Levels:

The annual fluctuation depicts general decline of water levels in 80.64% of wells monitored and covering 89.91% area of the State. The decline has been observed in all districts of the state. Water level decline the range of 0-2 m is observed in 74.73% of wells and 86.87% of the area. Water level decline in the range of 2-4 m is observed in 4.30% of wells and 2.85% of the area. Whereas, the water level decline of >4m is observed in 1.61% of wells and less than 1% of the area during the period, as isolated patches in Barnala district.

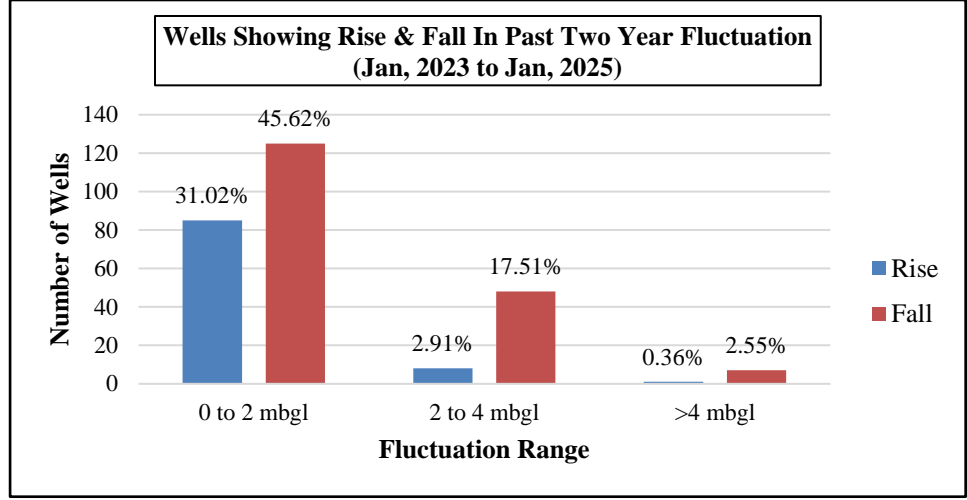


Figure-13: Percentage of wells showing rise and fall in WL in unconfined aquifers (Jan 2023 and Jan 2025)

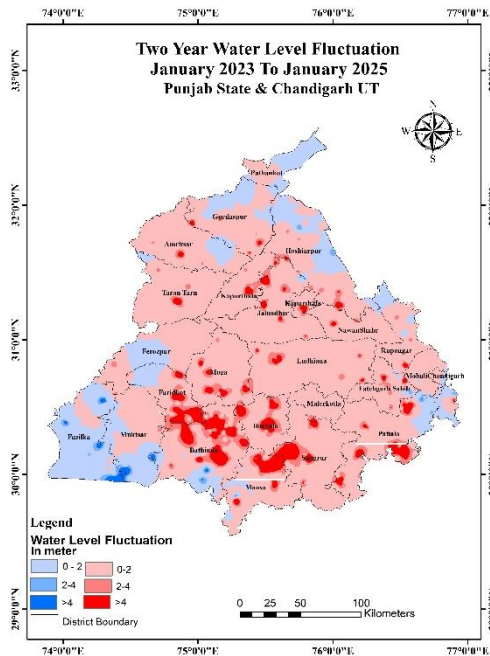


Figure-14: Water Level Fluctuation Map (Jan 2023 to Jan 2025)

4.1.4 PAST TWO YEAR FLUCTUATION IN WATER LEVEL

Past Two Year Fluctuation of Water Level in Unconfined Aquifer (January 2023 to January 2025)

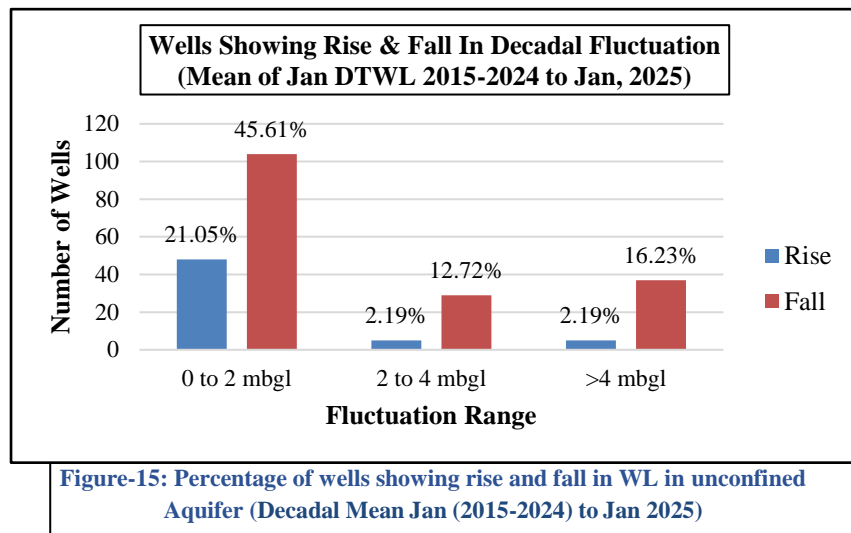
In order to know the impact of rainfall and ground water withdrawal during last two years, past two year water level fluctuations for period January 2023 to January 2025 are calculated. The behaviour of annual fluctuations is discussed in the following paragraph and depicted in Fig.13.

Rise in Water Levels

The water level rise has been recorded in 34.29% of wells monitored and covering 18.09% area of the State. Water level rise in the range of 0-2 m is observed in 31.02% wells and 17.20% of area. Water level rise 2-4m is observed in 2.91% wells and less than 1% of area. The water level rise of >4m is observed in 0.36% wells and less than 1% of area as isolated patches in Muktsar, Fazilka & Bathinda districts.

Fall in Water Levels

The annual fluctuation depicts general decline of water levels in 65.71% of wells monitored and covering 81.91% area of the State. The decline has been observed in all districts of the state. Water level decline the range of 0-2 m is observed in 45.62% of wells and 72.11% of the area. Water level decline in the range of 2-4 m is observed in 17.51% of wells and 5.50% of the area. Whereas, the water level decline of >4m is observed in 2.55% of wells and 4.31% of the area during the period, as isolated patches in Moga, Faridkot, Bathinda, Barnala, Malerkotla, Mansa and Sangrur districts.



4.1.5 DECADAL FLUCTUATION IN WATER LEVEL

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

Changes in water level behaviour since last one decade are determined using decadal mean data. Water level mean of past one decade (2015-2024) for each ground water observation well is computed and compared with the respective water level data of January 2025. The behaviour of water level over the period under reference is discussed in paragraph below along with Fig.15.

Rise in Water Levels:

The decadal mean fluctuations show that rise in 25.43% of observation wells monitored covering about 18.95% area of the state. Water level rise in the range of 0-2 m is observed in 21.05% of wells and 16.30% of the area. Water level rise of 2-4m is observed in 2.19% of wells and 1.95% of the area. Water level rise of >4m is observed in 2.19% of wells and less than 1% of the state area as isolated patches in Kapurthala & Fazilka districts.

Fall in Water Levels:

The decadal mean fluctuations show that decline in 74.57% of observation wells monitored covering about 81.05% area of the state. The decline has been observed in all districts of the state. The decline of 0-2 m has been observed in about 45.61% of wells and 43.60% of area. Water level decline of 2-4 m is observed in 12.72% of the wells and 17.31% of the area. Water level decline of >4m is observed in 16.23% of the wells and 20.14% of area during the period, in Barnala, Sangrur, Malerkotla, Moga, SBS Nagar, Jalandhar, Kapurthala, Patiala and Bathinda districts.

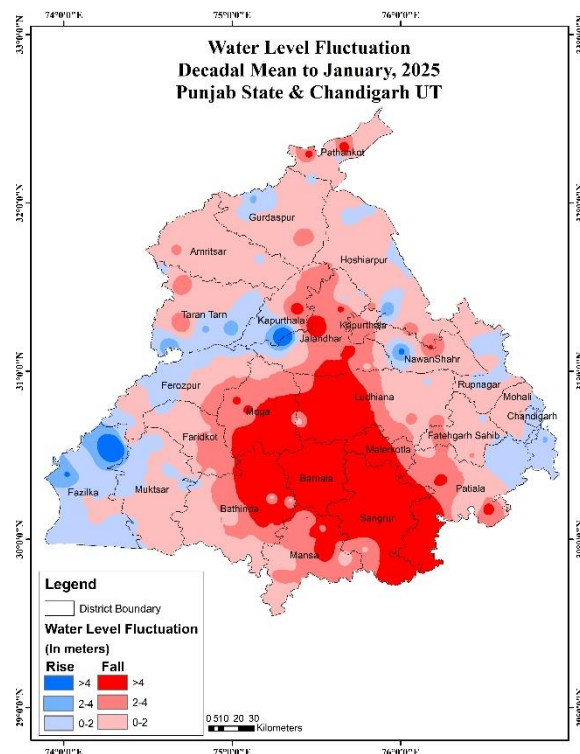


Figure-16: Water level fluctuation in unconfined Aquifer(Decadal Mean Jan (2015-2024) to Jan 2025)

Percentage of Wells In Different Water Level Ranges In Confined Aquifers (January, 2025)

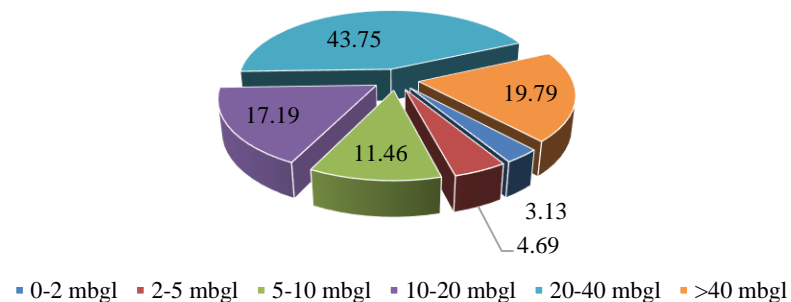
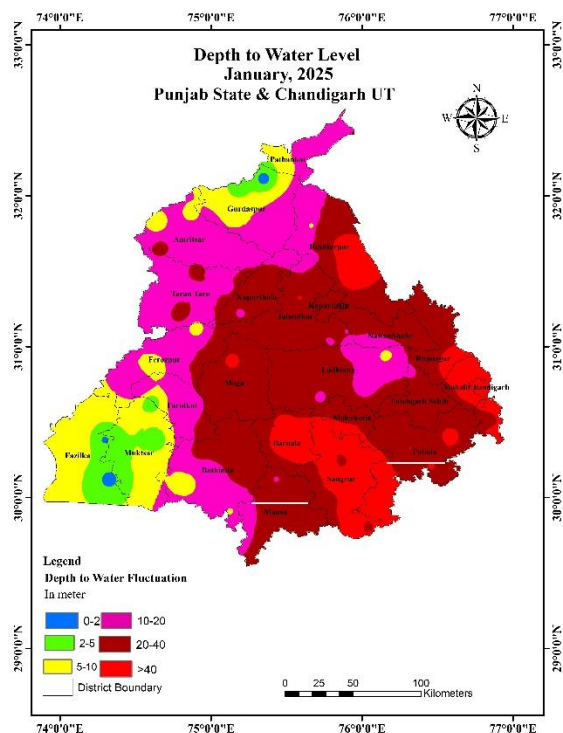


Figure-17: Percentage of wells in different water level ranges in Confined/Semi-Confined aquifer in January 2025.

4.2 DEEPER AQUIFER (CONFINED/ SEMI-CONFINED)

4.2.1 DEPTH TO PIEZOMETRIC LEVEL

The behavioral pattern of water level in January 2025 along with depth to water level map (Fig. 17) is discussed here. Very shallow water levels of 0-2 m (causing water logging) does occur in 3.13% of the wells and less than 1% of the state's area. Shallow water levels of 2-5 m have been observed in 4.10% of the wells and 17.04% of the total area. The water levels between 5-10 m are about 11.46% of wells and 11.67% of the area fall in this range. Moderately Deep-water levels (10-20 m) are observed in 17.19% wells covering about 26.89% area of the State. Deep water levels (20-40 m) are observed in 43.75% wells covering about 44.67% area of the state. Very deep-water levels (>40 m) are observed in 19.79% of the wells covering 12.40% area of the State.



Figure

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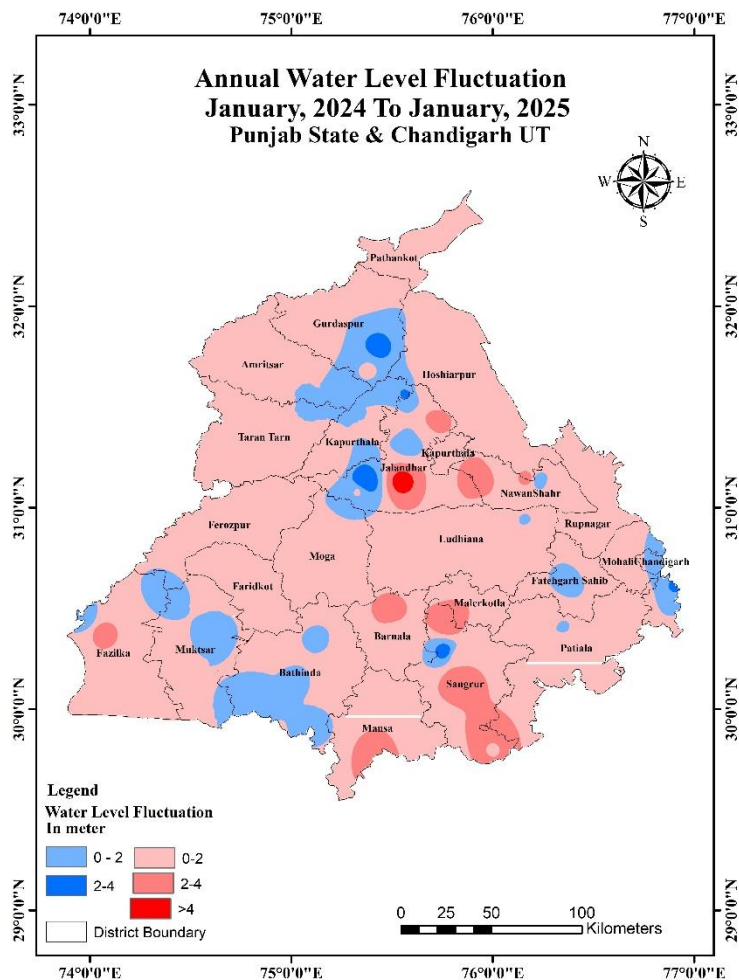


Figure-19: Annual water level fluctuation in Confined/Semi-Confined aquifer (January 2024 and January 2025)

4.2.2 ANNUAL FLUCTUATION IN WATER LEVEL

Annual Fluctuation of Water Level in Confined Aquifer (January 2024 to January 2025)

In order to know the impact of rainfall and ground water withdrawal during last one-year, annual water level fluctuations for period January 2024 to January 2025 for the confined aquifers and semi-confined aquifers are calculated. The behavior of annual fluctuations is discussed in the following paragraph and depicted in Fig 19.

Rise in Water Levels:

The water level rise has been recorded in 67.38% area of the State. Water level rise in the range of 0-2 m is observed in 53.97% of area. Water level rise 2-4m is observed in 13.41% of area.

Fall in Water Levels:

The annual fluctuation depicts general decline of water levels in 32.62% area of the State. The decline has been observed in most of the districts of the state. Water level decline the range of 0-2 m is observed in 26.82% of the area. Water level decline in the range of 2-4 m is observed in 5.61% of the area. Whereas, the water level decline of >4m is observed in less than 1% of the area during the period, as isolated patches in Moga, Barnala, Jalandhar and Kapurthala districts.

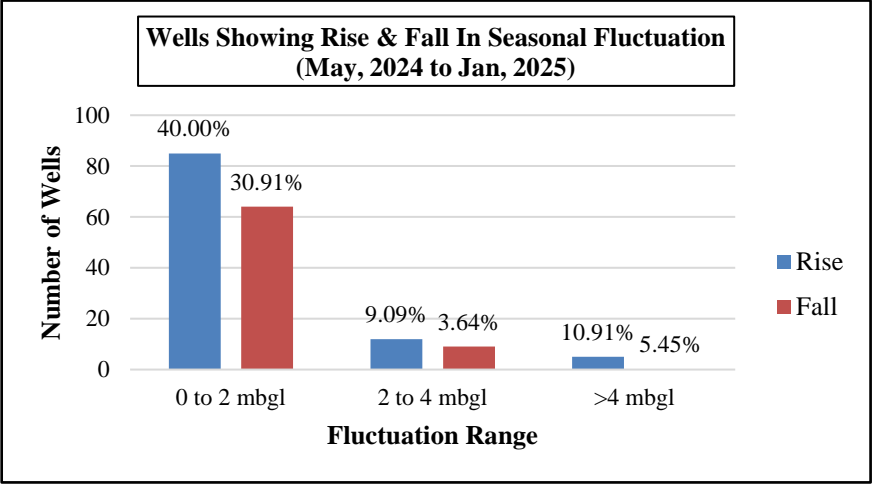


Figure-20: Percentage of wells showing rise and fall in WL in Confined aquifer(May 2024 to January 2025)

4.2.3 SEASONAL FLUCTUATION IN WATER LEVEL

Seasonal Fluctuation of Water Level in Confined Aquifer (May 2024 to January 2025)

In order to know the impact of rainfall and ground water withdrawal during last seasonal period, seasonal water level fluctuations for period May 2024 to January 2025 for the confined aquifers and semi-confined aquifers are calculated. The behavior of seasonal fluctuations is discussed in the following paragraph and depicted in Fig 20.

Rise in Water Levels:

The water level rise has been recorded in 60% of wells and 65.89% area of the State. Water level rise in the range of 0-2 m is observed in 49.02% of area. Water level rise 2-4m is observed in 14.75% of area while rise of more than 4 meters is observed in 2.12% area of the state.

Fall in Water Levels:

The annual fluctuation depicts general decline of water levels in 40% of wells and 34.11% area of the State. The decline has been observed in most of the districts of the state. Water level decline the range of 0-2 m is observed in 3.29% of the area. Water level decline in the range of 2-4 m is observed in 4.29% of the area. Whereas, the water level decline of >4m is observed in 26.54% of the area during the period, as isolated patches in Moga, Barnala, Jalandhar and Kapurthala districts.

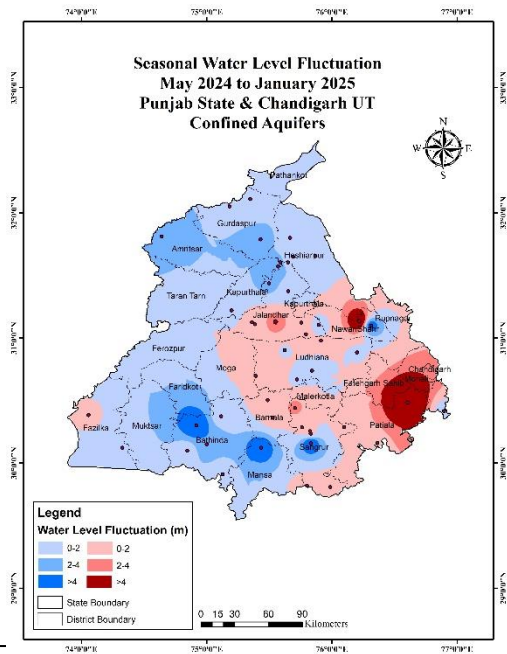


Figure-21: Annual water level fluctuation in Confined/Semi-Confined aquifer (January 2024 and January 2025)

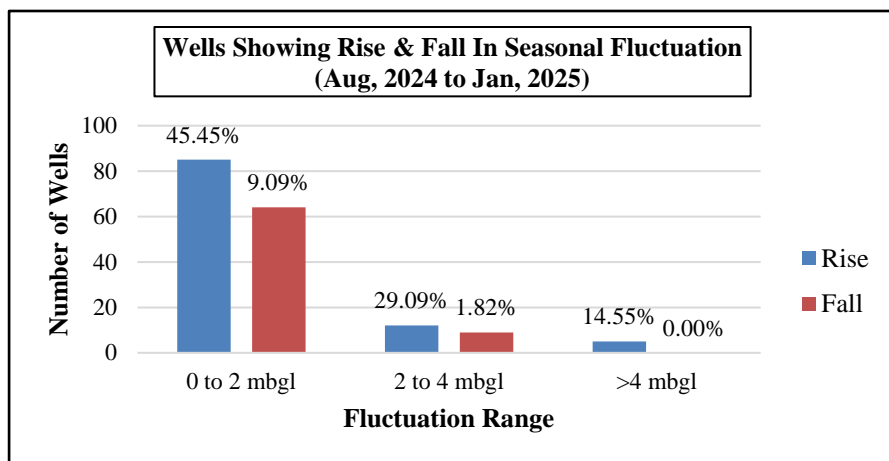


Figure-22: Percentage of wells showing rise and fall in WL in Confined aquifer(Aug 2024 to January 2025)

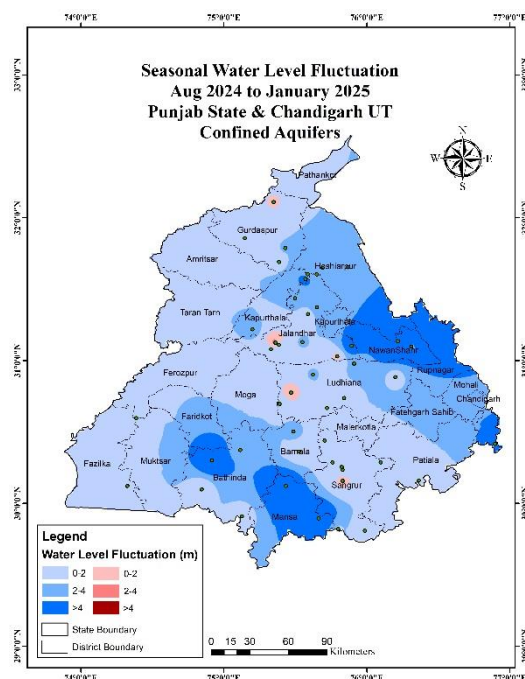


Figure-23: Annual water level fluctuation in Confined/Semi-Confined aquifer (January 2024 and January 2025)

4.2.4 SEASONAL FLUCTUATION IN WATER LEVEL

Seasonal Fluctuation of Water Level in Confined Aquifer (Aug 2024 to January 2025)

In order to know the impact of rainfall and ground water withdrawal during last seasonal period, seasonal water level fluctuations for period August 2024 to January 2025 for the confined aquifers and semi-confined aquifers are calculated. The behavior of seasonal fluctuations is discussed in the following paragraph and depicted in Fig 22.

Rise in Water Levels:

The water level rise has been recorded in 89.09% of wells and 99.31% area of the State. Water level rise in the range of 0-2 m is observed in 58.21% of area. Water level rise 2-4m is observed in 28.39% of area while rise of more than 4 meters is observed in 12.71% of area of state.

Fall in Water Levels:

The annual fluctuation depicts general decline of water levels in 10.91% of wells and 0.69% area of the State. Water level decline the range of 0-2 m is observed in none of the area. Water level decline in the range of 2-4 m is observed in less than 1% of the area. Whereas, the water level decline of >4m is observed in less than 1% of the area during the period.

5.0 Recommendations to improve decline in Groundwater

The declining trend of ground water level in Punjab can be improved by Demand and Supply-Side Interventions for Water Conservation which are as given below:

1. Demand Side Interventions

- i. Change in Paddy Variant – Switching from PUSA-44 (150 days maturity) to PR-126 (117 days maturity) can save 25% of groundwater.
- ii. Use of AI and Tensiometers – AI-based irrigation and tensiometers help optimize water usage, reducing irrigation needs from 1102 mm/acre to 820 mm/acre.
- iii. Reduction of Standing Water Column – Lowering the water column from 145 cm to 120 cm in rice cultivation reduces water consumption.

2. Supply Side Interventions

- i. Artificial recharge structures in government buildings can aid groundwater conservation. Lining of Unlined Channels – Converting unlined irrigation channels to lined ones can reduce groundwater overdraft.
- ii. Underground Pipelines – Expanding underground pipeline coverage can decrease groundwater development.
- iii. Canal Water for Irrigation – Maximizing canal water usage can improve groundwater recharge and reduce dependence on groundwater.
- iv. Artificial Recharge in Paleochannels – Excavating ponds and constructing recharge trenches in paleochannels can enhance groundwater recharge.
- v. Reuse of Wastewater – Treating and reusing pond water through the 3-pond system or Thapar model, with solar-powered lifting, helps conserve groundwater.
- vi. Construction of Injection Wells – Injection wells at minor canal outlets can use surplus canal water to recharge groundwater; a pilot project is already underway at Lehal Canal.
- vii. Rainwater Harvesting – Installing rainwater harvesting