

सरकारी उपयोग के लिए FOR OFFICIAL USE ONLY तकनीकी रिपोर्ट श्रृंखला Technical Report Series SWR/RP/GWYB/23-24/52

# गोवा राज्य की भूजल वर्ष पुस्तिका (2022-2023) GROUND WATER YEAR BOOK OF GOA (2022-2023)





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#### **EXECUTIVE SUMMARY**

Central Ground Water Board, an apex Organization under Ministry of Water Resources, Government of India, is carrying out the monitoring of ground water levels all over the country for generating a sound database so that the changes in ground water regime could be scientifically studied, analysed and strategies for its optimal utilization can be planned.

The behaviour of ground water table during the ground water year 2022-23 in Goa State has to be studied by monitoring a set of dug wells and purpose-built piezometers during the months of **May 2022, August 2022, November 2022 and January 2023**. During May 22 to Nov 22, Central Ground Water Board, South Western Region, monitored **89 dug wells and 44 piezometers**, total **133** monitoring stations in Goa state. As of January 2023, Central Ground Water Board, South Western Region, monitored **83 dug wells and 45 piezometers**, total **128** monitoring stations to study the ground water scenario of Goa State.

The present compilation relates to the year 2022-23. It provides information pertaining to water levels of the phreatic and Fractured aquifer. Thematic maps depicting the ground water scenario of aquifers is furnished and discussed in this report. In addition, the fluctuations in water level and piezometric surface between different time frames have been analysed and presented. Various thematic maps presented reflect the effect of rainfall received during the period of study and the long-term behaviour of water level according to ground water recharge and draft conditions obtained in various agro-climatic zones. The data on seasonal rainfall are furnished to correlate the effect of the rainfall on water levels.

In general, the water levels are deep in the month of May and a rising trend of water levels during November (Post-monsoon period) was observed. Water level fluctuation takes place during August, November and January depending on the monsoon rainfall and level of groundwater development.

During the pre-monsoon period, the depth to water levels of 2 -5 m bgl and 5 to 10 mbgl are more prevalent in the State during pre-monsoon period. Depth to water level 10-20 m bgl is noticed in isolated pockets in some parts of the state.

During the post-monsoon period, the depth to water level over major part of the State lies within 10 m bgl in 92% of wells analysed, while 8% of wells show depth to water level more than 10 m bgl are noticed in the state.

## GROUNDWATER YEAR BOOK OF GOA STATE (2022-23)

#### **1.1 INTRODUCTION**

Central Ground Water Board, South Western Region, Bangalore, is monitoring water levels in the State of Goa from the established network of **133 monitoring stations**, as a part of 'Ground Water Regime Monitoring'. This monitoring is done four times in a water year during May, August, November and January for water level. Water samples from these stations are collected once in a year during the month of **May** in a year to assess the ground water quality.

The State of Goa located between 14°53'54" and 15°48'00" north latitudes and 73°40'33" and 74°20'13" east longitudes is situated on the western coast of peninsular India. It is bounded in the north by Maharashtra State, in the East and South by Karnataka State and in the west by the Arabian Sea. The State has a total geographical area of 3702 Sq. km., which is administratively divided into two districts with 12 taluks. The taluk wise distribution of Ground water monitoring stations being monitored by the Region is given in **Table 1.** 

SI.No.	Taluk	Geographical Area (Sq. km)*	No. of Ground water monitoring stations
		District: North Goa	
1	Tiswadi	213.6	6
2	Bardez	264.0	16
3	Pernem	251.7	15
4	Bicholim	277.2	13
5	Satari	517.7	15
6	Ponda	259.4	7
		District: South Goa	
7	Sanguem	506	11
8	Cancona	352.0	15
9	Dharbandora	368.8	19
10	Quepem	318.3	4
11	Salcete	292.9	19
12	Mormugao	109.1	3

Table 1: District wise distribution of Ground water monitoring stations

\* Source: Statistical Pocket Book of Goa 1993-94, Directorate of Planning, Statistics and Evaluation, Government of Goa

#### **1.2 PHYSIOGRAPHY**

Goa State forms part of coastal tract of the west coast of India. Physiographically the Goa State is divided into four morphological units namely, **1.** Coastal plains with dominant Marie land forms on the west, followed successively towards the east **2**. Vast etch plain. **3.** Low dissected denudation hills and table land and **4.** Deeply dissected high Western Ghats denudational hills occurring all along the eastern part of Goa rising to a maximum of 832m above MSL. The Alluvial landforms are limited in aerial extent.

#### **1.3 DRAINAGE**

The State of Goa is drained by the west flowing rivers, Terekhol, Chapora, Mandovi and Zuari. The Sahyadri hill ranges in the east form the main watershed. The streams originating here flow in westerly and northwesterly direction to join the Arabian Sea. Major portion of the State is drained by the two rivers, viz. Mandovi and Zuari. The river Terekhol forms the northern boundary of Goa State and separates it from the Maharashtra State. The other smaller rivers draining the State are the rivers Chapora, Baga, Saleri, Sal, Talpona and Galgibaga **(Table 2)**. Primarily the underlying rocks govern the drainage system in the area. The drainage pattern is generally dentritic type. The major river Zuari follows the major NW synclinal axis. The river valleys are 'V' shaped in the western high hill ranges, but broadens in central midlands and become 'U' shaped in the low lands and coastal plains **(Plate I)**.

Drainage Basin	Ar	ea	Taluks
/ Sub Basin			
	Sq. km	%	
Terekhol	71	1.93	Pernem
Chapora	255	6.88	Pernem, Bicholim, Bardez
Baga	50	1.35	Bardez
Mandovi	1580	42.68	Bicholim, Bardez, Satari, Sanguem, Tiswadi & Ponda
			Tiswadi, Ponda, Salcete, Quepem, Mormugao
Zuari	973	26.28	Sanguem & Cancona
Sal	301	8.13	Mormugao, Salcete, Quepem, & Cancona
Saleri	149	4.03	Quepem, & Cancona
Talpona	233	6.29	Cancona & Sanguem
Galgibaga	90	2.43	Cancona
Total	3702	100%	



Plate I Drainage System of Goa state (Major drainage)

#### **1.4 Geological Conditions**

Major part of the Goa State is underlain by rocks of Precambrian age comprising of banded biotite gneisses, Meta volcanics, phyllites, biotite and chlorite schists, greywacke, conglomerate (tilloid), pink phyllites with associated banded ferruginous quartzite and chart breccia. These rocks are intruded by ultra basic, basic sills and dykes, followed by granites and pegmatites. Dolerite dykes and quartz veins form the youngest intrusives in the area.

The Deccan Trap basalts of Late Cretaceous to Early Eocene age occupy a small portion in the northeastern part in the high altitudes.

Almost all formations in the state have undergone lateritisation to various degrees depending upon the climate and rock type. The lateritisation is more pronounced in the coastal areas than in the hilly regions Phyllites, Schists and Meta volcanics are more susceptible to lateritisation and the gneissic / granitic rocks are least susceptible. In general the thickness of laterites varies from about 3 to 30 mts. Laterites are highly porous due to the process of leaching and weathering. Hence they have very good capacity to hold and transmit groundwater. Groundwater in laterites occurs under phreatic conditions.

Major portion of the state is occupied mainly by crystalline rocks and consolidated and metamorphosed sedimentaries, which do not possess primary porosity. Secondary porosity introduced through weathering, fracturing and jointing, produces the void spaces to hold and transmit ground water. Groundwater in these rocks occurs under water table conditions in the weathered zone and under semi confined and confined conditions in the deeper fractured zone.

Beach sands along the coast and alluvium along major rivers have limited occurrence and the ground water occurs in the primary porosity under water table conditions (Plate II).

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Plate II Geology of Goa State

#### 2.CLIMATE AND RAINFALL

The State has a tropical-maritime monsoonal type climate with distinct aerographic influence. The climate is equable and humid throughout the year. Due to the maritime climate the diurnal variation in temperature is not much. The months of January and February are dry with clear skies and generally pleasant. May is the hottest month with temperature around **30°C** and January the coolest month with temp **25°C**.

#### 2.1 Rainfall

Rain occurs during the monsoon period from June to September. Over 90 percent of annual rainfall occurs during monsoon period. The balance of 10 percent occurs during the pre monsoon period from March to May and post monsoon period from October to December. However the rainy period extends from May to November.

The analysis of Rainfall data for the period of **1970 to 2000** from 12 stations over the Goa state indicates that the monsoon rainfall is in the order of 3460mm (90 % of annual rainfall), 218.1mm (6%) during post monsoon period of October to December and 102.5(4%) are from January to May months. The overall annual rainfall over the Goa state based on 30 years rainfall data is of 3483.3mm. The minimum rainfall of **2611.7mm** is recorded at **Mormugao** station falls in South Goa district and maximum of **5090mm** is in **Sanguem** station also from South Goa.

The annual normal rainfall in North Goa ranges from **2766.9mm** at Panaji along the west coast and highest at Valpoi in the east (Ghats section) indicating rainfall increases from west to east. Average rainfall in North Goa is 3400.1mm. Similarly in South Goa it ranged 2611.7 mm at Mormugao in west coast and maximum at Sanguem in the east again ghat section indicating that the rainfall increases from west to east. The overall annual normal rainfall in south Goa is **3733.13mm**.

The months of June (840.7mm) and July (1246.9mm) are the wettest months with around 2187.6mm (62.80% of annual normal rainfall) rainfall in two months. Rainfall during the months of January and February is negligible. Valpoi in the north Goa and Sanguem in the south Goa, both in the interior hilly areas, are wettest places in the state. Isohyetal Map of Goa state for the period 1970 to 2000 has been presented in **Plate III** Normal monthly rainfall of in respect of 12 stations of Goa state is presented in **Table 3**.

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Station	JAN	FEB	Winter	MAR	APR	ΜΑΥ	Pre Mon	JUN	JUL	AUG	SEP	SW Mon	ост	NOV	DEC	NE mon	ANNUAL
PERNEM	1.0	0.3	1.3	0.8	13.6	69.5	83.9	923.8	1220.8	623.3	277.7	3045.6	146.4	34.0	2.9	183.3	3314.1
MAPUSA	1.1	0.2	1.3	0.2	15.8	89.8	105.8	870.0	1009.3	538.9	276.0	2694.2	127.5	33.8	2.6	163.9	2965.3
BICHOLIM	1.0	0.2	1.2	0.1	10.0	64.4	74.5	957.5	1264.9	659.6	312.1	3194.1	196.7	50.0	3.6	250.3	3520.1
PONDA	1.2	0.1	1.3	0.3	21.0	91.0	112.3	1072.6	1358.0	691.2	323.3	3445.1	177.4	46.4	2.7	226.5	3785.2
VALPOI	1.4	0.1	1.5	0.9	13.7	92.3	106.9	955.5	1486.3	849.0	378.4	3669.2	216.6	51.2	4.1	271.9	4049.5
COLEM	1.4	0.3	1.7	1.7	19.8	111.5	133.0	1075.2	1800.1	1091.7	516.7	4483.7	266.3	60.8	5.3	332.4	4950.8
MARGAO	1.3	0.4	1.7	0.1	16.4	86.8	103.3	913.1	1054.4	505.8	257.2	2730.5	117.8	40.1	3.9	161.8	2997.3
QUEPEM	0.2	0.3	0.5	0.0	12.2	93.1	105.3	960.9	1378.2	712.7	320.2	3372.0	165.0	56.4	0.3	221.7	3699.5
SANGUEM	0.6	0.0	0.6	1.6	11.5	78.9	92.0	1010.5	1537.2	774.7	391.6	3714.0	215.0	64.5	3.9	283.4	5090.0
CANACONA	0.6	0.0	0.6	0.4	16.2	96.2	112.8	902.0	1025.0	537.4	293.2	2757.6	130.1	41.2	7.2	178.5	3049.5
PANAJI	1.7	0.1	1.8	0.7	18.4	86.6	105.7	869.4	923.4	456.2	252.7	2501.7	118.9	35.8	3.0	157.7	2766.9
MORMUGOA	1.8	0.0	1.8	0.4	20.3	81.3	102.0	777.8	905.1	412.9	225.9	2321.7	138.7	42.6	4.9	186.2	2611.7
MEAN	1.1	0.2	1.3	0.6	15.7	86.2	102.5	940.7	1246.9	954.3	318.7	3460.6	168.0	46.4	3.7	218.1	3483.3

### Table 3: Monthly Normal Rainfall of Goa State



#### Plate III Normal Monsoon Rainfall of Goa State(1970-2000)

#### 3. LOCATION MAP OF MONITORING STATIONS OF GOA STATE-

As of January 2023, Central Ground Water Board, South Western Region, monitored **83 dug wells and 45 piezometers** to study the ground water scenario of Goa State. Location Map of DW and Piezometers is presented in **Plate-IV**.



#### Plate-IV Location Map of Monitoring stations of Goa state

#### 4. DEPTH TO WATER LEVEL

The depth of water level of May 2022, August 2022, November 2022 and January 2023 are presented.

#### MAY 2022:

The statement showing the distribution of ground water monitoring wells along with depth to water level of phreatic aquifer in different depth ranges is presented in **Table-4** and **Plate-V** depicts the ground water scenario in May 2022. Salient features of the depth to water level scenario during May 2022 are given below.

- A perusal of the water level data reveals that the depth to water level ranged from 2.20 m bgl (Salcele taluk) to 14.90 m bgl (Sanguem 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 in **86.4** % of wells analysed, while **13.6** % of wells show depth to water level more than 10 m bgl.
- 3. Depth to water level of less than 2 m bgl has been recorded in 0% of wells analysed.
- 4. Depth to water level in the range of 2 to 5 m bgl has been recorded in **47%** of wells analysed and noted in all the taluks except Tiswadi.
- 5. Depth to water level in the range of 5 to 10 m bgl has been recorded in **39.4%** of wells analysed and noted in all the taluks except Mormugao taluk.
- Depth to water level in the range of 10 to 20 m bgl has been observed in 13.6% of wells analysed and noted as isolated Tiswadi, Sattari, Sanguem, Salcete and Bardez taluks.

Table-4 DEPTH TO WATER LEVEL (MAY 2022)														
		No of			N	o/Pe	ercent	age of	f Wells mbgl) i	show n the	ing Dept range of	h to w	ater ta	ble
S.No	Taluk Name	Wells analysed	Min	Max	0-2	%	2-5	%	5-10	%	10-20	%	20	%
1	Tiswadi	2	6	11.74	0	0	0	0	1	50	1	50	0	0
2	Sattari	6	4.35	10.56	0	0	2	40	2	40	1	20	0	0
3	Sanguem	13	4.10	14.90	0	0	3	23.1	6	46.2	4	30.8	0	0
4	Salcete	7	2.20	12.75	0	0	4	57.1	2	28.6	1	14.3	0	0
5	Quepem	2	2.70	6.50	0	0	1	50.0	1	50	0	0	0	0
6	Ponda	5	2.30	7.80	0	0	3	60.0	2	40	0	0	0	0
7	Pernem	7	2.23	7.90	0	0	3	42.9	4	57.1	0	0	0	0
8	Marmugao	1	3.75	3.75	0	0	1	100	0	0	0	0	0	0
9	Canacona	7	3.95	8.10	0	0	4	57.1	3	42.9	0	0	0	0
10	Bicholim	5	3.55	7.00	0	0	2	40	3	60	0	0	0	0
11	Bardez	12	2.40	14.10	0	0	8	66.7	2	16.7	2	16.7	0	0
	Total	66	2.20	14.90	0	0	31	47	26	39.4	9	13.6	0	0



Plate-V: Depth to Water level Map of May 2022

Depth to piezometric surface has been recorded from piezometers spread all over the State. The statement showing depth to piezometric surface is given in **Table-5** and **Plate-VI** depicts the Piezometric ground water scenario in May 2022. Salient features of the depth to piezometric surface during **May 2022** are given below;

- The depth to piezometric surface ranged from 1.15 m bgl (Tiswadi taluk) to 25.75 m bgl (Bicholim taluk) in Goa State.
- 66.6% of wells have recorded depth to piezometric surface within 10 m bgl and
  33.4% of wells show depth to piezometric surface more than 10 m bgl.
- 3. Depth to piezometric surface of less than 2 m bgl has been recorded in **3.3%** of wells analysed and this has been noted in Tiswadi taluk.
- 4. Depth to piezometric surface in the range of 2 to 5 m bgl has been recorded in **23.3%** of wells analysed and noted in Tiswadi, Sattari, Salcete, Pernem and Bardez taluks.
- 5. Depth to piezometric surface in the range of 5 to 10 m bgl has been recorded in **40 %** of wells analysed and noted in all taluks except Tiswadi and Ponda.
- Depth to piezometric surface in the range of 10 to 20 m bgl has been observed in 26.7% of wells analysed and noted in all taluks except Tiswadi, Sanguem and Salcete taluks.
- 7. Depth to piezometric surface in the range of more than 20 m bgl has been noted in 6.7% of wells analysed and noticed in Bicholim and Ponda taluks.

	Table-5: DEPTH TO PIEZOMETRIC SURFACE (MAY 2022)														
	Taluk	No. of Wells	Min	Max	No	. / Per	centage	of Wel	lls Shov the	ving De Range	epth to of	Water	Table (mbgl) in		
S.No	Name	Analysed			0-2	%	2-5	%	5-10	%	10- 20	%	20	%	
1	Tiswadi	2	1.15	4.93	1	50	1	50	0	0	0	0	0	0	
2	Sattari	4	4.85	19.08	0	0	1	25	1	25	2	50	0	0	
3	Sanguem	2	6.40	9.52	0	0	0	0	2	100	0	0	0	0	
4	Salcete	5	2.06	5.84	0	0	3	60	2	40	0	0	0	0	
5	Ponda	2	17.10	21.68	0	0	0	0	0	0	1	50	1	50	
6	Pernem	5	3.20	15.08	0	0	1	20	3	60	1	20	0	0	
7	Canacona	3	9.46	11.93	0	0	0	0	1	33.3	2	66.7	0	0	
8	Bicholim	4	6.41	25.75	0	0	0	0	2	50	1	25	1	25	
9	Bardez	3	2.87	16.20	0	0	1	33.3	1	33.3	1	33.3	0	0	
	Total	30	1.15	25.75	1	3.3	7	23.3	12	40	8	26.7	2	6.7	



Plate-VI: Depth to Piezometric Surface Map of May 2022

#### AUGUST 2022:

The statement showing the distribution of ground water monitoring wells along with depth to water level of phreatic aquifer in different depth ranges is presented in **Table-6** and **Plate-VII** depicts the ground water scenario in **August 2022.** Salient features of the depth to water level scenario during **August 2022** are given below.

- A perusal of the water level data reveals that the depth to water level ranged from
  0.56 m bgl (Bardez taluk) to 16.75 m bgl (Canacona taluk).
- The salient feature of the analysis is that the depth to water level over major part of the State lies within 10 m bgl in 96.2% of wells analysed, while 3.8% of wells show depth to water level more than 10 m bgl.
- 3. Depth to water level of less than 2 m bgl has been recorded in **28.7%** of wells analysed and noted in all taluks except Mormugao taluk.
- 4. Depth to water level in the range of 2 to 5 m bgl has been recorded in **47.5%** 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 **20%** of wells analysed and noted in Bardez, Canacona, Pernem, Ponda, Salcete and Sanguem taluks.
- 6. Depth to water level in the range of 10 to 20 m bgl has been observed in **3.8%** of wells analysed and noted as isolated Bicholim and Canacona taluks.

	Table-6  DEPTH TO WATER LEVEL (AUGUST 2022)													
		No of Wells				No/Perce	entage of	f Wells she	owing Dep	th to wate	r table (mbg	l) in the ra	inge of	
S.No	Taluk Name	analysed	Min	Max	0-2	%	2-5	%	5-10	%	10-20	%	>20	%
1	Tiswadi	4	0.84	4.76	1	25	3	75	0	0	0	0	0	0
2	Sattari	10	1.25	3.60	5	50	5	50	0	0	0	0	0	0
3	Sangeum	14	0.94	9.92	2	14.3	5	35.7	7	50	0	0	0	0
4	Salcete	9	0.90	6.52	2	22.2	5	55.6	2	22.2	0	0	0	0
5	Quepem	3	1.46	4.35	1	33.3	2	66.7	0	0	0	0	0	0
6	Ponda	5	1.92	6.16	1	20	2	40	2	40	0	0	0	0
7	Pernem	9	1.02	7.25	4	44.4	3	33.3	2	22.2	0	0	0	0
8	Marmugoa	1	3	3	0	0	1	100	0	0	0	0	0	0
9	Canacona	7	1.67	16.75	1	14.3	3	42.9	1	14.3	2	28.6	0	0
10	Bicholim	7	1.50	12.08	2	28.6	4	57.1	0	0	1	14.3	0	0
11	Bardez	11	0.56	7.05	4	36.4	5	45.5	2	18.2	0	0	0	0
	Total	80	0.56	16.75	23	28.7	38	47.5	16	20	3	3.8	0	0



Plate-VII Depth to water level Map of August 2022

Depth to piezometric surface has been recorded from piezometers spread all over the State. The statement showing depth to piezometric surface is given in **Table-7** and **Plate-VIII** depicts the ground water scenario in **August 2022**. Salient features of the depth to piezometric surface during **August 2022** are given below;

- The depth to piezometric surface ranged from 0.72 m bgl (Salcete taluk) to 18.56 m bgl (Sattari taluk) in Goa State.
- 76.4% of wells have recorded depth to piezometric surface within 10 m bgl and
  23.6% of wells show depth to piezometric surface more than 10 m bgl.
- Depth to piezometric surface of less than 2 m bgl has been recorded in 23.5% of wells analysed and this has been noted in Tiswadi, Sattari, Sanguem, Salcete and Pernem taluks.
- 4. Depth to piezometric surface in the range of 2 to 5 m bgl has been recorded in **35.4%** of wells analysed and noted in all taluks except Ponda.
- 5. Depth to piezometric surface in the range of 5 to 10 m bgl has been recorded in 17.6% of wells analysed and noted in Sanguem, Bicholim, Canacona and Ponda taluks.
- Depth to piezometric surface in the range of 10 to 20 m bgl has been observed in 23.5% of wells analysed and noticed in Sattari, Ponda, Bicholim and Pernem taluks.

Table-7 DEPTH TO PIEZOMETRIC SURFACE (AUGUST 2022)														
		No of				No/Percei	ntage of	Wells show	ving Dep	th to wate	er table (m	bgl) in th	e range of	
S.No	Taluk Name	Wells analysed	Min	Мах	0-2	%	2-5	%	5-10	%	10-20	%	>20	%
1	Tiswadi	3	1.16	3.10	2	66.7	1	33.3	0	0	0	0	0	0
2	Sattari	4	0.80	18.56	1	25	1	25	0	0	2	50	0	0
3	Sangeum	3	0.95	6.29	1	33.3	1	33.3	1	33.3	0	0	0	0
4	Salcete	5	0.72	3.91	2	40	3	60	0	0	0	0	0	0
5	Ponda	2	7.56	13.65	0	0	0	0	1	50	1	50	0	0
6	Pernem	5	1.25	11.42	2	40	1	20	0	0	2	40	0	0
7	Canacona	5	2.87	8.53	0	0	2	40	3	60	0	0	0	0
8	Bicholim	4	2.84	17.74	0	0	2	50	0	0	2	50	0	0
9	Bardez	3	4.05	16.34	0	0	1	33.3	1	33.3	1	33.3	0	0
	Total	34	0.72	18.56	8	23.5	12	35.3	8	17.6	8	23.6	0	0



Plate-VIII: Depth to Piezometric Surface Map of August 2022

#### November 2022:-

The statement showing the distribution of ground water monitoring wells along with depth to water level of phreatic aquifer in different depth ranges is presented in **Table-8** and **Plate-IX** depicts the ground water scenario in **November 2022**. Salient features of the depth to water level scenario during **November 2022** are given below.

- A perusal of the water level data reveals that the depth to water level ranged from
  1.22m bgl (Salcete taluk) to 12.93m bgl (Bardez taluk).
- The salient feature of the analysis is that the depth to water level over major part of the State lies within 10 m bgl in 92% of wells analysed, while 8% of wells show depth to water level more than 10 m bgl.
- 3. Depth to water level of less than 2 m bgl has been recorded in **8%** of wells analysed and noted in Tiswadi, Salcete, Pernem, Canacona and Bardez taluks.
- 4. Depth to water level in the range of 2 to 5 m bgl has been recorded in **45%** 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 **39%** of wells analysed and noted in all the taluks except Bicholim,Mormugao and Quepem taluks.
- Depth to water level in the range of 10 to 20 m bgl has been observed in 8% of wells analysed and noted as isolated Bardez and Sanguem taluks.

Table-8: Depth to Water Level (November 2022)														
		No of Wells				No/Perco	entage	of Wells s	showing	Depth to	water tabl	e (mbgl)	in the ran	ge of
S.No	Taluk Name	analysed	Min	Мах	0-2	%	2-5	%	5-10	%	10-20	%	>20	%
1	Bardez	10	1.90	12.93	1	10	4	40	3	30	2	20	0	0
2	Bicholim	2	3.60	3.80	0	0	2	100	0	0	0	0	0	0
3	Pernem	5	1.30	5.08	1	20	3	60	1	20	0	0	0	0
4	Ponda	3	3.58	7.28	0	0	1	33	2	67	0	0	0	0
5	Sattari	10	2.12	7.80	0	0	5	50	5	50	0	0	0	0
6	Tiswadi	3	1.44	5.43	1	33	1	33	1	33	0	0	0	0
7	Canacona	6	1.88	9.11	1	17	2	33	3	50	0	0	0	0
8	Quepem	2	2.23	3.20	0	0	2	100	0	0	0	0	0	0
9	Salcete	8	1.22	7.65	1	13	4	50	3	38	0	0	0	0
10	Sangeum	14	2.74	11.50	0	0	4	29	7	50	3	21	0	0
11	Marmugao	1	3.92	3.92	0	0	1	100	0	0	0	0	0	0
	Total	64	1.22	12.93	5	8	29	45	25	39	5	8	0	0



Plate-IX Depth to Water level Map of November 2022

Depth to piezometric surface has been recorded from piezometers spread all over the State. The statement showing depth to piezometric surface is given in **Table-9** and **Plate-X** depicts the ground water scenario in **November 2022.** Salient features of the depth to piezometric surface during **November 2022** are given below;

- The depth to piezometric surface ranged from 1.15m bgl (Salcete taluk) to 25.10m bgl (Bicholim taluk) in Goa State.
- 2. **70%** of wells have recorded depth to piezometric surface within 10 m bgl and **30%** of wells show depth to piezometric surface more than 10 m bgl.
- 3. Depth to piezometric surface of less than 2 m bgl has been recorded in **10%** of wells analysed and this has been noted in Salcete and Tiswadi taluks.
- 4. Depth to piezometric surface in the range of 2 to 5 m bgl has been recorded in **27.5%** of wells analysed and noted in all taluks except Ponda, Quepem and Bicholim.
- Depth to piezometric surface in the range of 5 to 10 m bgl has been recorded in 32.5% of wells analysed and noted in all taluks except Ponda, Toswasi and Quepem.
- Depth to piezometric surface in the range of 10 to 20 m bgl has been observed in 27.5% of wells analysed and noted in all taluks except Tiswadi, Salcete and Canocona.
- Depth to piezometric surface in the range of >20m bgl has been observed in 2.5% of wells analysed and noted in Bicholim Taluk.

Table-9: Depth to Piezometric Surface (November 2022)														
		No of Wells				No/Perc	entage	e of Wells	showing	Depth to	o water tak	ole (mbgl)	) in the ran	ge of
S.No	Taluk Name	analysed	Min	Max	0-2	%	2-5	%	5-10	%	10-20	%	>20	%
1	Tiswadi	3	1.68	4.54	2	66.66	1	33.33	0	0	0	0	0	0
2	Sattari	4	2.97	20	0	0	1	25	1	25	2	50	0	0
3	Sangeum	3	2.52	10.06	0	0	1	33.33	1	33.33	1	33.33	0	0
4	Salcete	7	1.15	5.65	2	28	3	44	2	28	0	0	0	0
5	Ponda	2	15.57	17.67	0	0	0	0	0	0	2	100	0	0
6	Pernem	6	2.68	13.78	0	0	3	50	1	16	2	34	0	0
7	Canacona	5	3.60	9.67	0	0	1	20	4	80	0	0	0	0
8	Bicholim	4	9.7	25.10	0	0	0	0	2	50	1	25	1	25
9	Bardez	5	2.6	20.76	0	0	1	20	2	40	2	40	0	0
10	Quepem	1	14	14	0	0	0	0	0	0	1	100	0	0
	Total	40	1.15	25.10	4	10	11	27.5	13	32.5	11	27.5	1	2.5



Plate-X Depth to Water level Map of November 2022

#### January 2023:-

The statement showing the distribution of ground water monitoring wells along with depth to water level of phreatic aquifer in different depth ranges is presented in **Table-10** and **Plate-XI** depicts the ground water scenario in **January 2023**. Salient features of the depth to water level scenario during **January 2023** are given below.

- A perusal of the water level data reveals that the depth to water level ranged from
  1.60 m bgl (Tiswadi taluk) to 16.31 m bgl (Canacona taluk).
- The salient feature of the analysis is that the depth to water level over major part of the State lies within 10 m bgl in 88% of wells analysed, while 12% of wells show depth to water level more than 10 m bgl.
- 3. Depth to water level of less than 2 m bgl has been recorded in **4%** of wells analysed and noted in 4 taluks such as Pernem, Salcete and Tiswadi taluks.
- 4. Depth to water level in the range of 2 to 5 m bgl has been recorded in **43%** 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 36% of wells analysed and noted in all the taluks except Bicholim,Quepem and Mormugao taluk.
- 6. Depth to water level in the range of 10 to 20 m bgl has been observed in **17%** of wells analysed and noted as isolated Salcete, Canacona, Bardez, Sattari and Sanguem taluks.

Table-10: Depth to Water Level (January 2023)														
		No of Wells			No/Percentage of Wells showing Depth to water table (mbgl) in the range of									
S.No	Taluk Name	analysed	Min	Мах	0-2	%	2-5	%	5-10	%	10-20	%	>20	%
1	BARDEZ	12	2.23	13.05	0	0	6	50	3	25	3	25	0	0
2	BICHOLIM	2	3.60	3.78	0	0	2	100	0	0	0	0	0	0
3	PERNEM	6	1.94	8.40	1	17	3	50	2	33	0	0	0	0
4	PONDA	4	4.84	8.09	0	0	1	25	3	75	0	0	0	0
5	SATARI	10	2.50	14.65	0	0	4	40	5	50	1	10	0	0
6	TISWADI	3	1.60	5.90	1	33	1	33	1	33	0	0	0	0
7	CANACONA	10	2.47	16.31	0	0	5	50	2	20	3	30	0	0
8	QUEPEM	2	2.26	3.21	0	0	2	100	0	0	0	0	0	0
9	SALCETE	8	1.68	10.54	1	13	2	25	4	50	1	13	0	0
10	SANGUEM	14	3.21	11.63	0	0	4	29	6	43	4	29	0	0
11	Marmugao	1	3.6	3.6	0	0	1	100	0	0	0	0	0	0
	Total	72	1.60	16.31	3	4	31	43	26	36	12	17	0	0



Plate-XI Depth to Water level Map of January 2023

Depth to piezometric surface has been recorded from piezometers spread all over the State. The statement showing depth to piezometric surface is given in **Table-11** and **Plate-XII** depicts the ground water scenario in January **2023**. Salient features of the depth to piezometric surface during **January 2023** are given below;

- The depth to piezometric surface ranged from 1m bgl (Tiswadi taluk) to 24.16m bgl (Bicholim taluk) in Goa State.
- 67% of wells have recorded depth to piezometric surface within 10 m bgl and 33% of wells show depth to piezometric surface more than 10 m bgl.
- 3. Depth to piezometric surface of less than 2 m bgl has been recorded in **10%** of wells analysed and this has been observed in Salcete and Tiswadi taluks.
- 4. Depth to piezometric surface in the range of 2 to 5 m bgl has been recorded in **18%** of wells analysed and this has been observed in Tiswadi, Sattari, Sanguem, Bardez, Salcete and Pernem taluks.
- 5. Depth to piezometric surface in the range of 5 to 10 m bgl has been recorded in **39%** of wells analysed and observed in all taluks except Quepem, Ponda and Tiswadi taluks.
- 6. Depth to piezometric surface in the range of 10 to 20 m bgl has been observed in **26%** of wells analysed and noted in all except Tiswadi and Salcete taluks.
- Depth to piezometric surface in the range of above 20 m bgl has been observed in 7% of wells analysed and noted 3 taluks such as Sattari, Bardez and Bicholim.



Plate-XII Depth to Water level Map of January 2023
	Table-11: Depth to Piezometric Surface (January 2023)													
		No of Wells				No/Perc	entag	e of Wells	showing	g Depth to	o water tal	ole (mbgl	) in the ra	nge of
S.No	Taluk Name	analysed	Min	Max	0-2	%	2-5	%	5-10	%	10-20	%	>20	%
1	Tiswadi	3	1	4.98	2	66.66	1	33.33	0	0	0	0	0	0
2	Sattari	4	4.28	20.43	0	0	1	25	1	25	1	25	1	25
3	Sangeum	3	4.28	11.04	0	0	1	33.33	1	33.33	1	33.33	0	0
4	Salcete	7	1.57	5.64	2	28.5	2	28.5	3	43	0	0	0	0
5	Ponda	2	15.25	19.64	0	0	0	0	0	0	2	100	0	0
6	Pernem	6	2.85	14.95	0	0	1	16,66	3	60	2	33.33	0	0
7	Canacona	5	5.26	10.81	0	0	0	0	4	80	1	20	0	0
8	Bicholim	3	9.95	24.16	0	0	0	0	1	33.33	1	33.33	1	33.33
9	Bardez	5	2.6	20.76	0	0	1	20	2	40	1	20	1	20
10	Quepem	1	14.46	14.46	0	0	0	0	0	0	1	100	0	0
	Total	39	1	24.16	4	10	7	18	15	39	10	26	3	7

#### 5. FLUCTUATION OF WATER LEVEL:-

#### MAY 2019 & MAY 2022:-

The statement showing the distribution of ground water monitoring wells falling in different ranges of fluctuation is presented in **Table-12**. A comparison of ground water level between May 2019 and May 2022 shows that a **fall** in the water level is recorded in **47%** of wells analysed, while **53%** recorded **rise.** The fluctuation in water level has been plotted in **Plate XIII.** 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 given below.

- 1. Rise in the water level in the range of 0-2 m has been observed in **39** % of wells analysed and observed in all taluks except Marmugao.
- 2. Rise in the water level in the range of 2-4 m has been observed in 6% of wells analysed and observed in Bardez, Pernem and Ponda taluk.
- 3. Rise in the water level in the range of >4 m has been observed in 2 % of wells analysed and observed in Salcete taluk.
- 4. The fall in water level in the range of 0-2 m has been observed in **47** % of wells analysed and noted in all the taluks.
- 5. The fall in water level in the range of 2-4 m has been observed in **4%** of wells analysed and noted in Sanguem taluk.
- The fall in water level more than 4 m has been observed in 2% of wells analysed and noted in Sanguem taluk.

	Table-12 Taluk wise categorisation of water level fluctuation (MAY 2019-MAY 2022)   Bise Bange of Eluctuation (m)       Fall Bange of Eluctuation (m)													
			F	Rise_Ra	nge of Fl	uctuati	on (m)			Fall_Ra	inge of Flu	ctuatio	n (m)	
		No. of	0-2		2-4	4	>4	1	0-	2	2-4		>4	
S.No	Taluk Name	Wells analysed	No of wells	%	No of wells	%	No of wells	%	No of wells	%	No of wells	%	No of wells	%
1	Bardez	10	6	60	1	10	0	0	3	30	0	0	0	0
2	Bicholim	4	1	25	0	0	0	0	3	75	0	0	0	0
3	Canacona	3	2	66.7	0	0	0	0	1	33.3	0	0	0	0
4	Marmugao	1	0	0	0	0	0	0	1	100	0	0	0	0
5	Pernem	6	2	33.3	1	16.7	0	0	3	50	0	0	0	0
6	Ponda	4	1	25	1	25	0	0	2	50	0	0	0	0
7	Quepem	2	1	50	0	0	0	0	1	50	0	0	0	0
8	Salcete	7	4	57	0	0	1	14.3	2	28.6	0	0	0	0
9	Sangeum	10	1	10	0	0	0	0	6	60	2	20	1	10
10	Sattari	4	2	50	0	0	0	0	2	50	0	0	0	0
11	Tiswadi	2	1	50	0	0	0	0	1	50	0	0	0	0
	Total	53	21	39	3	6	1	2	25	47	2	4	1	2



# Plate-XIII Water Level Fluctuation of May 2019 to May 2022

### AUGUST 2021 & AUGUST 2022:-

The statement showing the distribution of ground water monitoring wells falling in different ranges of fluctuation is presented in **Table-13**. A comparison of water level shows that a **rise** in the water level is recorded in **59%** of wells analyzed, while **41%** recorded **fall**. The fluctuation in water level has been plotted in **Plate XIV**. 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 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 except Mormugao and Pernem taluks.
- Rise in the water level in the range of 2-4 m has been observed in 2% of wells analysed in Bardez..
- 3. Rise in the water level in the range of >4 m has been observed in 2% 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 35% of wells analysed and noted in almost all taluks except Bicholim and Sattari.
- 5. Fall in the water level in the range of 2-4 m has been observed in **4%** of wells analysed and observed in Pernem and Canacona taluk.
- The fall in water level more than 4 m has been observed in 2% of wells analysed and noted in Canacona taluk.

		Table-13	Taluk	wise cat	egorisati	on of	water l	evel fl	uctuatior	n (Aug 2	2021-Aug	; 2022)				
				Rise_Ra	nge of Flu	ctuati	on (m)		I	Fall_Ra	nge of Flu	ctuatio	on (m)			
		No. of	0	-2	2-4		>4	Ļ	0-2		2-4		>4			
		Wells	No of		No of		No of		No of		No of		No of			
S.No	Taluk Name	analysed	wells	%	wells	%	wells	%	wells	%	wells	%	wells	%	Rise	Fall
1	Bardez	11	8	72.7	1	9.1	1	9.1	1	9.1	0	0	0	0	10	1
2	Bicholim	7	7	100	0	0	0	0	0	0	0	0	0	0	7	0
3	Canacona	7	1	14	0	0	0	0	3	49	2	28	1	9	1	6
4	Marmugoa	1	0	0	0	0	0	0	1	100	0	0	0	0	0	1
5	Pernem	9	0	0	0	0	0	0	8	88.9	1	11.1	0	0	0	9
6	Ponda	5	2	40	0	0	0	0	3	60	0	0	0	0	2	3
7	Quepem	3	2	66.7	0	0	0	0	1	33.3	0	0	0	0	2	1
8	Salcete	9	5	55.6	0	0	0	0	4	44.4	0	0	0	0	5	4
9	Sanguem	14	7	50	0	0	0	0	7	50	0	0	0	0	7	7
10	Sattari	10	10	100	0	0	0	0	0	0	0	0	0	0	10	0
11	Tiswadi	4	2	50	0	0	0	0	2	50	0	0	0	0	2	2
	Total	80	44	55	1	2	1	2	30	35	3	4	1	2	46	34



Plate-XIV Water Level Fluctuation of August 2021 to August 2022

#### NOVEMBER 2021 & NOVEMBER 2022:-

The statement showing the distribution of ground water monitoring wells falling in different ranges of fluctuation is presented in **Table-14**. A comparison of water level shows that a **rise** in the water level is recorded in **30%** of wells analysed, while **70%** recorded **fall**. The fluctuation in water level has been plotted in **Plate XV.** 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 given below.

- 1. The fall in water level in the range of 0-2 m has been observed in **64.8%** of wells analysed and noted in all taluks.
- 2. The fall in water level in the range of 2-4 m has been observed in **3.5%** of wells analysed and noted in Bardez and Canacona taluk.
- 3. The fall in water level in the range of >4 m has been observed in **1.7%** of wells analysed and noted in Canacona taluk.
- 4. Rise in the water level in the range of 0-2 m has been observed in **30%** of wells analysed and observed in all taluks except Quepem and Bicholim taluks.

	Table-14: Taluk wise categorisation of water level fluctuation (Nov 2021-Nov 2022)   Rise Range of Fluctuation (m)   Fall Range of Fluctuation (m)													
				Rise_R	ange of F	luctuatio	on (m)			Fall_Ra	nge of Fl	uctuatio	on (m)	
			0.	-2	2-4	4	>4	l	0-	2	2-4		>4	
S.No	Taluk Name	No of wells analysed	No of wells	%	No of wells	%	No of wells	%	No of wells	%	No of wells	%	No of wells	%
1	Bardez	9	1	11	0	0	0	0	7	78	1	11	0	0
2	Bicholim	2	0	0	0	0	0	0	2	100	0	0	0	0
3	Pernem	5	2	40	0	0	0	0	3	60	0	0	0	0
4	Ponda	3	2	67	0	0	0	0	1	33	0	0	0	0
5	Sattari	9	2	22	0	0	0	0	7	78	0	0	0	0
6	Tiswadi	3	1	33	0	0	0	0	2	67	0	0	0	0
7	Canacona	5	1	20	0	0	0	0	2	40	1	20	1	20
8	Quepem	2	0	0	0	0	0	0	2	100	0	0	0	0
9	Salcete	8	1	12	0	0	0	0	7	88	0	0	0	0
10	Sangeum	12	7	58	0	0	0	0	5	42	0	0	0	0
	Total	58	17	30	0	0	0	0	38	64.8	2	3.5	1	1.7



Plate-XV Water Level Fluctuation of November 2021 to November 2022

### JANUARY 2022 TO JANUARY 2023

The statement showing the distribution of ground water monitoring wells falling in different ranges of fluctuation is presented in **Table-15**. A comparison of water level shows that a **rise** in the water level is recorded in **56%** of wells analysed, while **44%** recorded **fall**. The fluctuation in water level has been plotted in **Plate XVI**. 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 given below.

- 1. The fall in water level in the range of 0-2 m has been observed in **38%** of wells analysed and noticed in taluks.
- 2. The fall in water level in the range of 2-4 m has been observed in **3%** of wells analysed and observed in Canacona taluk.
- 3. The fall in water level in the range of more than 4m has been observed in **3%** of wells analysed and noted in Sattari and Canacona taluk.
- 4. Rise in the water level in the range of 0-2 m has been observed in **43%** of wells analysed and noticed in all taluks.
- 5. Rise in the water level in the range of 2-4m has been observed in **8%** of wells analysed and noticed in Bardez and Sanguem taluk.
- 6. Rise in the water level more than 4m has been observed in **5%** of wells analysed and noticed in Bardez and Sanguem taluk.

	٦	Table-15: Tal	uk wise	categori	sation o	of water	level flu	uctuatio	on (Jan 2	2022-Ja	n 2023)			
				Rise_R	ange of F	luctuatio	on (m)			Fall_Ra	nge of Fl	uctuatio	on (m)	
			0-2	2m	2-4	m	>4	m	0-2	m	2-4r	n	>4n	n
S.No	Taluk Name	No of wells analysed	No of wells	%	No of wells	%	No of wells	%	No of wells	%	No of wells	%	No of wells	%
1	BARDEZ	9	5	55.55	2	22.22	1	11.11	1	11.11	0	0	0	0
2	BICHOLIM	2	1	50	0	0	0	0	1	50	0	0	0	0
3	PERNEM	6	2	33	0	0	0	0	4	67	0	0	0	0
4	PONDA	3	1	33.33	0	0	0	0	2	66.66	0	0	0	0
5	SATARI	10	6	60	0	0	0	0	3	30	0	0	1	10
6	TISWADI	2	1	50	0	0	0	0	1	50	0	0	0	0
7	CANACONA	10	2	20	0	0	0	0	5	50	2	20	1	10
8	QUEPEM	2	1	50	0	0	0	0	1	50	0	0	0	0
9	SALCETE	7	3	43	0	0	0	0	4	57	0	0	0	0
10	SANGUEM	14	7	50	3	25	2	12.5	2	12.5	0	0	0	0
	Total	65	29	43	5	8	3	5	24	38	2	3	2	3



Plate- XVI Water Level Fluctuation of January 2022 to January 2023

# FLUCTUATION BETWEEN DECADAL MEAN WATER LEVEL & WATER LEVEL

The fluctuation of water level recorded during the particular period with respect to decadal means indicate the impact of ground water development and ground water recharge during the decade. Positive fluctuation indicates improved recharge over and above ground water development and negative fluctuation indicates increased ground water development over and above the recharge.

### Mean Water Levels for the Period MAY (2012-2021) & MAY 2022:

The statement showing the distribution of ground water monitoring wells falling in different ranges of fluctuation is presented in **Table-16**. The fluctuation in water level has been plotted in **Plate XVII**. A comparison of water level shows that a **fall** in the water level is recorded in **61%** of wells analysed, while **39%** recorded **rise**. Salient features of the comparison of water levels are given below.

- Rise in the water level in the range of 0-2 m has been observed in **30%** of wells analysed, noted in all taluks except Mormugao taluk.
- 2. Rise in the water level in the range of 2-4 m has been observed in **6%** of wells analysed, noted in Salcete, Sanguem and Sattari taluk.
- 3. Rise in the water level in the range of more than m has been observed in **3%** of wells analysed, noted in Salcete taluk.
- 4. The fall in water level in the range of 0-2 m has been observed in **59.5%** of wells analysed and noted in all taluks.
- 5. The fall in water level in the range of 2-4 m is observed in **1.5%** of wells analysed and noted in Tiswadi taluk.

	Table-16 Taluk wise categorisation of water level fluctuation (Decadal mean 2012-2021 & MAY 2022)															
S.No	Taluk Name	No of wells	F	Rise_Ra	nge of Flu	ctuati	on (m)			Fall_Ra	nge of Fl	uctuat	ion (m)		Rise	Fall
		anaiyseu	0-2	2	2-4		>4		0-2	2	2-4	1	>4			
			No of wells	%	No of wells	%	No of wells	%	No of wells	%	No of wells	%	No of wells	%		
1	Bardez	10	2	20	0	0	0	0	8	80	0	0	0	0	2	8
2	Bicholim	5	1	20	0	0	0	0	4	80	0	0	0	0	1	4
3	Canacona	7	4	57.1	0	0	0	0	3	42.9	0	0	0	0	4	3
4	Marmugao	1	0	0	0	0	0	0	1	100	0	0	0	0	0	1
5	Pernem	7	1	14.3	0	0	0	0	6	85.7	0	0	0	0	1	6
6	Ponda	5	1	20	0	0	0	0	4	80	0	0	0	0	1	4
7	Quepem	2	1	50	0	0	0	0	1	50	0	0	0	0	1	1
8	Salcete	7	3	43	2	28	1	14.5	1	14.5	0	0	0	0	6	1
9	Sangeum	13	4	30.8	1	7.7	0	0	8	61.5	0	0	0	0	5	8
10	Sattari	5	2	20	1	10	1	10	1	10	0	0	0	0	4	1
11	Tiswadi	2	0	0	0	0	0	0	1	50	1	50	0	0	0	2
	Total	64	19	30	4	6	2	3	38	59.5	1	1.5	0	0	25	39



Plate – XVII Decadal Water Level Fluctuation of May 2012- 2021 to May 2022

### Mean Water Levels for the Period AUGUST (2012-2021) & AUGUST 2022:

The statement showing the distribution of ground water monitoring wells falling in different ranges of fluctuation is presented in **Table-17**. The fluctuation in water level has been plotted in **Plate XVIII**. A comparison of water level shows that a **fall** in the water level is recorded in **64.97%** of wells analysed, while **35.03%** recorded **rise**. Salient features of the comparison of water levels are given below.

- 1. The fall in water level in the range of 0-2 m has been observed in **58.07%** of wells analysed and noted in all taluks.
- 2. The fall in water level in the range of 2-4 m has been observed in **5.2%** of wells analysed and noted in Canacona taluk.
- 3. The fall in water level of more than 4 m is observed in **1.7%** of wells analysed and noted in Canacona taluk.
- 4. Rise in the water level in the range of 0-2 m has been observed in **33.33%** of wells analysed, noted in all taluks except Canacona, Ponda and Quepem taluks
- 5. Rise in the water level in the range of 2-4 m has been observed in **1.7%** of wells analysed noted in Bardez taluk.

	Table-17 Taluk wise categorisation of water level fluctuation (Decadal mean 2012-2021 & Aug 2022)													
				Rise_Ra	nge of Fluo	tuation	(m)			Fall_R	ange of Flu	uctuatio	n (m)	
			0-2	2	2-4	ļ	>4	ŀ	0-2		2-4	ŀ	>4	
S.No	Taluk Name	No of wells analysed	No of wells	%	No of wells	%	No of wells	%	No of wells	%	No of wells	%	No of wells	%
1	Bardez	6	2	33.33	1	16.67	0	0	3	50	0	0	0	0
2	Bicholim	2	1	50	0	0	0	0	1	50	0	0	0	0
3	Canacona	6	0	0	0	0	0	0	3	50	2	33.33	1	16.7
4	Pernem	5	2	40	0	0	0	0	3	60	0	0	0	0
5	Ponda	4	0	0	0	0	0	0	3	75	1	25	0	0
6	Quepem	2	0	0	0	0	0	0	2	100	0	0	0	0
7	Salcete	9	3	33.3	0	0	0	0	6	66.7	0	0	0	0
8	Sanguem	13	4	30.8	0	0	0	0	9	69.2	0	0	0	0
9	Sattari	8	6	75	0	0	0	0	2	25	0	0	0	0
10	Tiswadi	2	1	50	0	0	0	0	1	50	0	0	0	0
	Total	57	19	33.33	1	1.7	0	0	33	58.07	3	5.2	1	1.7



Plate – XVIII Decadal Water Level Fluctuation of August 2012- 2021 to August 2022

# Mean Water Levels for the Period NOVEMBER 2012-2021 & NOVEMBER 2022:

The statement showing the distribution of ground water monitoring wells falling in different ranges of fluctuation is presented in **Table-18**. The fluctuation in water level has been plotted in **Plate XIX**. A comparison of water level shows that a **rise** in the water level is recorded in **8%** of wells analysed, while **92%** recorded **fall**. Salient features of the comparison of water levels are given below.

- 1. The fall in water level in the range of 0-2 m has been observed in **76%** of wells analysed and noted in all taluks.
- 2. The fall in water level in the range of 2-4 m has been observed in **13%** of wells analysed and noted in all taluk except Pernem, Bicholim, Sattari and Quepem taluks.
- 3. The fall in water level more than 4 m has been observed in **3%** of wells analysed and noted in Ponda and Canacona taluk.
- 4. Rise in the water level in the range of 0-2 m has been observed in **8%** of wells analysed, noted in Pernem and Sanguem taluks.

	Table-18: 1	Faluk wise cat	tegorisat	ion of v	water lev	el flu	ctuation	(Dec	adal me	an 2012	-2021 &	Nov 20	22)	
				Rise_Ra	nge of Flu	ictuatio	on (m)			Fall_R	ange of I	Fluctuatio	on (m)	
			0-:	2	2-4		>4	•	0-	2	2-	4	>	4
S.No	Taluk Name	No of wells analysed	No of wells	%	No of wells	%	No of wells	%	No of wells	%	No of wells	%	No of wells	%
1	Bardez	10	0	0	0	0	0	0	8	80	2	20	0	0
2	Bicholim	2	0	0	0	0	0	0	2	100	0	0	0	0
3	Pernem	5	1	20	0	0	0	0	4	80	0	0	0	0
4	Ponda	3	0	0	0	0	0	0	1	33.33	1	33.33	1	33.33
5	Sattari	10	0	0	0	0	0	0	10	100	0	0	0	0
6	Tiswadi	3	0	0	0	0	0	0	2	67	1	33	0	0
7	Canacona	6	0	0	0	0	0	0	3	50	2	33	1	17
8	Quepem	2	0	0	0	0	0	0	2	100	0	0	0	0
9	Salcete	8	0	0	0	0	0	0	7	88	1	12	0	0
10	Sangeum	14	4	29	0	0	0	0	9	64	1	7	0	0
	Total	63	5	8	0	0	0	0	48	76	8	13	2	3



Plate – XIX Decadal Water Level Fluctuation of November 2012- 2021 to November 2022

### Mean Water Levels for the Period January (2013-2022) & January 2023:

The statement showing the distribution of ground water monitoring wells falling in different ranges of fluctuation is presented in **Table-19**. The fluctuation in water level has been plotted in **Plate XX**. A comparison of water level shows that a **rise** in the water level is recorded in 19% of wells analysed, while 81% recorded **fall.** Salient features of the comparison of water levels are given below.

- 1. The fall in water level in the range of 0-2 m has been observed in **68.5%** of wells analysed and noticed in taluks.
- The fall in water level in the range of 2-4 m has been observed in 11% of wells analysed and observed in all taluk except Bicholim, Pernem, Sattari and Quepem taluk.
- 3. The fall in water level in the range of more than 4m has been observed in **1.5%** of wells analysed and noted in Canacona taluk.
- Rise in the water level in the range of 0-2 m has been observed in 12% of wells analysed and noticed in all taluks except Bicholim, Ponda, Tiswadi, Quepem and Salcete taluks.
- 5. Rise in the water level in the range of 2-4m has been observed in **4%** of wells analysed and noticed in Sanguem taluk.
- Rise in the water level more than 4m has been observed in 3% of wells analysed and noticed in Sanguem taluk.

	Table-19: Taluk wise categorisation of water level fluctuation (Decadal mean 2013-2022 & Jan 2023)   Rise Range of Fluctuation (m)   Fall Range of Fluctuation (m)													
				Rise_R	ange of Fluc	tuation	(m)			Fall_Ra	ange of Flu	ctuation	ı (m)	
			0-2	m	2-4n	า	>4m		0-2	m	2-4n	n	>4n	1
S.No	Taluk Name	No of wells analysed	No of wells	%	No of wells	%	No of wells	%	No of wells	%	No of wells	%	No of wells	%
1	BARDEZ	12	1	8	0	0	0	0	9	75	2	17	0	0
2	BICHOLIM	2	0	0	0	0	0	0	2	100	0	0	0	0
3	PERNEM	6	1	17	0	0	0	0	5	83	0	0	0	0
4	PONDA	4	0	0	0	0	0	0	3	75	1	25	0	0
5	SATARI	10	1	10	0	0	0	0	9	90	0	0	0	0
6	TISWADI	3	0	0	0	0	0	0	2	67	1	33	0	0
7	CANACONA	10	2	20	0	0	0	0	5	50	2	20	1	10
8	QUEPEM	2	0	0	0	0	0	0	2	100	0	0	0	0
9	SALCETE	8	0	0	0	0	0	0	7	88	1	12	0	0
10	SANGUEM	14	3	21	3	21	2	14	5	37	1	7	0	0
	Total	71	8	12	3	4	2	3	49	68.5	8	11	1	1.5



Plate – XX Decadal Water Level Fluctuation of January 2013- 2022 to January 2023

# 6. HYDROGRAPHS







## 7. CONCLUSIONS

The behaviour of ground water table during **May 2022 to January 2023** in Goa State has been studied by monitoring the dug wells tapping phreatic aquifers. The data on water levels was analysed in detail and salient features are as under.

- 86.4% of wells have recorded depth to water level within 10 m bgl during premonsoon period (May 2022), whereas during post-monsoon period (November 2022) about 92% of wells recorded water level less than 10 m bgl.
- 88% of wells have recorded depth to water level within 10m bgl during January 2023 and 96.2% during August 2022.
- 66.6% of wells have recorded depth to water level of Piezometric Surface is within 10 m bgl during pre-monsoon period (May 2022), whereas during post-monsoon period (November 2022) about 70% of wells recorded water level less than 10 m bgl.
- 67% of wells have recorded depth to water level of Piezometric Surface is within 10m bgl during January 2023 and 76.4 % during August 2022.
- 53% of wells have recorded rise in water levels and 47% of wells recorded fall in water levels during May 2022 in comparison to May 2021.
- 59% of wells have recorded rise in water levels and 41% of wells recorded fall in water levels during August 2022 in comparison to August 2021.
- 30% of wells have recorded rise in water levels and 70% of wells recorded fall in water levels during November 2022 in comparison to November 2021.
- 56% of wells have recorded rise in water levels and 44% of wells recorded fall in water levels during January 2023 in comparison to January 2022.
- 39% of wells have recorded rise in water levels and 61 % of wells have recorded fall in water level during May 2022 wrt respective decadal means.
- 35% of wells have recorded rise in water levels and 65 % of wells have recorded fall in water level during August 2022 wrt respective decadal means.
- 8% of wells have recorded rise in water levels and 92 % of wells have recorded fall in water level during November 2022 wrt respective decadal means.
- 19% of wells have recorded rise in water levels and 81 % of wells have recorded fall in water level during January 2023 wrt respective decadal means.
- Fall in water levels may be due to localised over extraction of ground water.

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An	inexure-I : Wate	er level data of G	Groundwater monitoring	wells in Goa (M	lay 2022)
SN					Water
	District	Well No	Location	Well Type	Level
1	South Goa	PzGoa1001	Dabel	Bore Well	11.93
2	South Goa	PzGoa1002	Yedda	Bore Well	10.18
3	South Goa	PzGoa1005	Ponquini	Bore Well	9.46
4	South Goa	PzGoa1007	Chinchinim	Bore Well	2.44
5	South Goa	PzGoa1008	Chandavar	Bore Well	2.63
6	South Goa	PzGoa1010	Manora Rai	Bore Well	5.62
7	South Goa	PzGoa1013	Canabonulim	Bore Well	5.84
8	South Goa	PzGoa1014	Verna	Bore Well	2.06
9	South Goa	PzGoa1018	Collem	Bore Well	6.40
10	South Goa	PzGoa1021	Molem	Bore Well	9.52
11	North Goa	PzGoa1023	Varkhand	Bore Well	15.08
12	North Goa	PzGoa1026	Silolieum	Bore Well	5.36
13	North Goa	PzGoa1027	Aropora	Bore Well	2.87
14	North Goa	PzGoa1028	Morjum	Bore Well	3.20
15	North Goa	PzGoa1029	Sawantwada	Bore Well	5.38
16	North Goa	PzGoa1030	Mola	Bore Well	1.15
17	North Goa	PzGoa1031	Ajosi	Bore Well	4.93
18	North Goa	PzGoa1033	Korgoan	Bore Well	5.46
19	South Goa	PzGoa1034	Morlem	Bore Well	4.85
20	South Goa	PzGoa1036	Thane	Bore Well	9.50
21	South Goa	PzGoa1037	Nanoda	Bore Well	19.08
22	South Goa	PzGoa1038	Severdem	Bore Well	15.10
23	North Goa	PzGoa1040	Adavapal	Bore Well	5.32

24	North Goa	PzGoa1041	Aldona	Bore Well	16.20
25	North Goa	PzGoa1043	Mayam	Bore Well	6.41
26	North Goa	PzGoa1044	Narve	Bore Well	12.70
27	North Goa	PzGoa1045	Sanqulim	Bore Well	25.75
28	North Goa	PzGoa1046	Kasar Pal	Bore Well	9.79
29	North Goa	PzGoa1047	Betki	Bore Well	17.10
30	North Goa	PzGoa1048	Madakai	Bore Well	21.68
31	North Goa	48E1D1	Uguem(ugawe)	Dug Well	4.30
32	North Goa	48E2C1	Morji	Dug Well	2.23
33	North Goa	48E2D1	Pernem	Dug Well	4.70
34	North Goa	48E2D10	Baga	Dug Well	3.75
35	North Goa	48E2D11	Calangute	Dug Well	8.50
36	North Goa	48E2D12	Alto Betim Porvorim	Dug Well	7.24
37	North Goa	48E2D2	Nagjhar	Dug Well	7.90
38	North Goa	48E2D3	Korgaon	Dug Well	5.46
39	North Goa	48E2D4	Sal	Dug Well	3.55
40	North Goa	48E2D5	Sirsaim	Dug Well	3.90
41	North Goa	48E2D6	Mulgaon Shivalkherwad	Dug Well	3.90
42	North Goa	48E2D7	Мариса	Dug Well	4.55
43	South Goa	48E3D5	Majorda Bpada Curilo	Dug Well	5.57
44	North Goa	48I2A4	Honda	Dug Well	4.35
45	North Goa	48I3A1	Khadki(harijanwada)	Dug Well	10.56
46	South Goa	48I3A2	Bolkharnem	Dug Well	4.50
47	South Goa	48I3A5	Molem	Dug Well	14.90
48	South Goa	48I3A6	Collem(kolamba)	Dug Well	11.74
49	North Goa	48I3A7	Shiroda	Dug Well	7.68

50	North Goa	48I3A8	Panchawadi(pz)	Bore Well	7.80
51	South Goa	48I4A1	Ghadiawada	Dug Well	2.70
52	South Goa	48I4A10	Shrishtal Gaondongar	Dug Well	5.85
53	South Goa	48I4A11	Gulem Velipwada	Dug Well	4.50
54	South Goa	48I4A12	Canacona	Dug Well	5.35
55	South Goa	48I4A7	Deulwada Kolamba	Dug Well	4.10
56	South Goa	48I4A9	Netrolim	Dug Well	11.60
57	South Goa	48I4D3	Agonda Desaiwada	Dug Well	4.65
58	South Goa	48J1A1	Hattipal Poinguinem	Dug Well	8.10
59	South Goa	48J1A3	Polem(polen)	Dug Well	3.95
60	North Goa	GAJY1301	Parra	Dug Well	2.40
61	North Goa	GAJY1302	Anjuna Beach	Dug Well	12.80
62	North Goa	GAJY1305	Gavalebhat, Chimbel(kirl)	Dug Well	6.00
63	North Goa	GAJY1307	Adavapal	Dug Well	6.37
64	North Goa	GAJY1308	Shivoli (brahmanwada)	Dug Well	3.45
65	North Goa	GAJY1309	Mankem	Dug Well	4.47
66	North Goa	GAJY1310	Bori	Dug Well	2.45
67	North Goa	GAJY1311	Bhujpal	Dug Well	4.80
68	North Goa	GAJY1312	Charayode	Dug Well	5.05
69	North Goa	GAJY1313	Khotodem	Dug Well	7.10
70	North Goa	GAMY1302	Olaulim	Dug Well	7.00
71	North Goa	GAMY1303	Colval	Dug Well	14.10
72	North Goa	GAMY1304	Pirna	Dug Well	4.00
73	South Goa	Jy1301	Malkarnem	Dug Well	6.35
74	South Goa	Jy1302	Vichundrem	Dug Well	8.00

75	South Goa	Jy1303	Vadam	Dug Well	4.60
76	South Goa	Jy1304	Yedda Dug Well		5.00
77	South Goa	Jy1305	Kaveslium Dug W		3.95
78	South Goa	Jy1309	Mashe Dug W		4.70
79	South Goa	Jy1310	Suktali (molem) Dug		5.30
80	South Goa	Jy1311	Kalay Dug Well		12.24
81	South Goa	Jy13114	Bhati	Dug Well	5.90
82	South Goa	Jy13116	Betalbatti	Dug Well	6.40
83	South Goa	Jy13117	Barodi Velni (betul)	Dug Well	2.53
84	South Goa	Jy13118	Cuncalim	Dug Well	2.20
85	South Goa	Jy13119	Padi	Dug Well	12.75
86	South Goa	Jy1312	Guddemal	Dug Well	11.60
87	South Goa	Jy13120	Jambavli	Dug Well	9.90
88	South Goa	Jy13121	Revona	Dug Well	8.95
89	South Goa	MY1402	Kapsa	Dug Well	6.50
90	North Goa	MY1403	Amberem	Dug Well	6.72
91	North Goa	MY1404	Kundel Dassolwada	Dug Well	2.30
92	North Goa	MY1405	Pomburpa Palmar	Dug Well	3.95
93	North Goa	MY1406	Salwardhar Dumun	Dug Well	3.80
94	North Goa	MY1408	Dhatwado Vante	Dug Well	6.87
95	North Goa	MY1409	Haspur	Dug Well	5.30
96	South Goa	MY1411	Bagmola	Dug Well	3.75

Annexure-II: Water level data of Groundwater monitoring wells in Goa (August 2022)						
SN	District	Well No	Location	Well Type	Water Level	
1	South Goa	PzGoa1002	Yedda	Bore Well	3.65	
2	South Goa	PzGoa1005	Ponquini	Bore Well	8.53	
3	South Goa	PzGoa1006	Patnem	Bore Well	2.87	
4	South Goa	PzGoa1010	Manora Rai	Bore Well	3.58	
5	South Goa	PzGoa1014	Verna	Bore Well	0.72	
6	South Goa	PzGoa1019	Meidawada	Bore Well	6.29	
7	South Goa	PzGoa1021	Molem	Bore Well	0.95	
8	North Goa	PzGoa1023	Varkhand	Bore Well	11.42	
9	North Goa	PzGoa1026	Silolieum	Bore Well	4.48	
10	North Goa	PzGoa1028	Morjum	Bore Well	1.92	
11	North Goa	PzGoa1029	Sawantwada	Bore Well	1.25	
12	North Goa	PzGoa1030	Mola	Bore Well	1.52	
13	South Goa	PzGoa1034	Morlem	Bore Well	0.80	
14	South Goa	PzGoa1036	Thane	Bore Well	4.15	
15	South Goa	PzGoa1037	Nanoda	Bore Well	18.56	
16	South Goa	PzGoa1038	Severdem	Bore Well	12.20	
17	North Goa	PzGoa1042	Tivim	Bore Well	16.34	
18	North Goa	PzGoa1043	Mayam	Bore Well	2.84	
19	North Goa	PzGoa1044	Narve	Bore Well	10.68	
20	North Goa	PzGoa1045	Sanqulim	Bore Well	17.74	
21	North Goa	PzGoa1048	Madakai	Bore Well	7.56	
22	North Goa	48E1D1	Uguem(ugawe)	Dug Well	2.83	
23	North Goa	48E2C1	Morji	Dug Well	1.02	
24	North Goa	48E2D1	Pernem	Dug Well	2.31	

25	North Goa	48E2D11	Calangute	Dug Well	4.64
26	North Goa	48E2D2	Nagjhar	Dug Well	7.25
27	North Goa	48E2D3	Korgaon	Dug Well	4.43
28	North Goa	48E2D4	Sal	Dug Well	1.86
29	North Goa	48E2D5	Sirsaim	Dug Well	2.10
30	North Goa	48E2D6	Mulgaon Shivalkherwad	Dug Well	2.25
31	North Goa	48E2D7	Мариса	Dug Well	2.24
32	North Goa	48E3D1	Velha Goa	Bore Well	0.84
33	North Goa	48E3D2	Karanjhalen	Dug Well	2.10
34	South Goa	48E3D5	Majorda Bpada Curilo	Dug Well	2.83
35	South Goa	48E3D6	Ballynuvhen	Dug Well	5.27
36	North Goa	48I2A2	Bayalwadikeri(querim)	Dug Well	1.25
37	North Goa	48I2A3	Morlem	Dug Well	2.83
38	North Goa	48I2A4	Honda	Dug Well	2.28
39	North Goa	48I2A5	Valpoi	Dug Well	1.67
40	North Goa	48I3A1	Khadki(harijanwada)	Dug Well	3.46
41	South Goa	48I3A2	Bolkharnem	Dug Well	4.34
42	South Goa	48I3A5	Molem	Dug Well	2.00
43	South Goa	48I3A6	Collem(kolamba)	Dug Well	4.40
44	North Goa	48I3A7	Shiroda	Dug Well	6.16
45	North Goa	48I3A8	Panchawadi(pz)	Bore Well	5.32
46	South Goa	48I4A1	Ghadiawada	Dug Well	1.46
47	South Goa	48I4A10	Shrishtal Gaondongar	Dug Well	3.90
48	South Goa	48I4A12	Canacona	Dug Well	2.75
49	South Goa	48I4A4	Quepem	Dug Well	2.28
50	South Goa	48I4A6	Cuncalim(pz)	Bore Well	4.71
51	South Goa	48I4A7	Deulwada Kolamba	Dug Well	2.64
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52	South Goa	48I4A9	Netrolim	Dug Well	8.92
53	South Goa	48I4D3	Agonda Desaiwada	Dug Well	3.00
54	South Goa	48J1A1	Hattipal Poinguinem	Dug Well	14.30
55	South Goa	48J1A2	Daptamol Lolien	Dug Well	16.75
56	South Goa	48J1A3	Polem(polen)	Dug Well	1.67
57	North Goa	GAJY1301	Parra	Dug Well	0.93
58	North Goa	GAJY1302	Anjuna Beach	Dug Well	7.05
59	North Goa	GAJY1303	Bhamber(Nanoda Cross)	Dug Well	3.60
60	North Goa	GAJY1304	Nagargoan	Dug Well	1.34
61			Gavalebhat,		
	North Goa	GAJY1305	Chimbel(kirl)	Dug Well	4.76
62	North Goa	GAJY1306	Sawanthwada(mandrem)	Dug Well	1.55
63	North Goa	GAJY1307	Adavapal	Dug Well	4.90
64	North Goa	GAJY1308	Shivoli (brahmanwada)	Dug Well	0.56
65	North Goa	GAJY1309	Mankem	Dug Well	3.00
66	North Goa	GAJY1310	Bori	Dug Well	4.75
67	North Goa	GAJY1311	Bhujpal	Dug Well	1.56
68	North Goa	GAJY1312	Charayode	Dug Well	1.42
69	North Goa	GAJY1313	Khotodem	Dug Well	2.42
70	North Goa	GAMY1301	Britona	Dug Well	1.92
71	North Goa	GAMY1302	Olaulim	Dug Well	2.90
72					
	North Goa	GAMY1303	Colval	Dug Well	6.54
73	North Goa	GAMY1304	Pirna	Dug Well	1.92
74	South Goa	Jy1301	Malkarnem	Dug Well	8.34
75	South Goa	Jy1302	Vichundrem	Dug Well	0.94

76	South Goa	Jy1303	Vadam	Dug Well	3.62
77	South Goa	Jy1305	Kaveslium	Dug Well	2.08
78	South Goa	Jy1306	Chikalim	Dug Well	0.90
79	South Goa	Jy1307	Sristal	Dug Well	8.58
80	South Goa	Jy1309	Mashe	Dug Well	3.53
81	South Goa	Jy1310	Suktali (molem)	Dug Well	3.98
82	South Goa	Jy1311	Kalay	Dug Well	9.92
83	South Goa	Jy13113	Themchewada	Dug Well	6.86
84	South Goa	Jy13114	Bhati	Dug Well	3.74
85	South Goa	Jy13116	Betalbatti	Dug Well	3.51
86	South Goa	Jy13118	Cuncalim	Dug Well	1.44
87	South Goa	Jy13119	Padi	Dug Well	6.52
88	South Goa	Jy1312	Guddemal	Dug Well	6.46
89	South Goa	Jy13120	Jambavli	Dug Well	6.80
90	South Goa	Jy13121	Revona	Dug Well	5.22
91	North Goa	MY 1407	Devulawada Narve	Dug Well	12.08
92	North Goa	MY1401	Jambhul Batt(mayam Lake)	Dug Well	1.50
93	South Goa	MY1402	Kapsa	Dug Well	4.35
94	North Goa	MY1403	Amberem	Dug Well	5.96
95	North Goa	MY1404	Kundel Dassolwada	Dug Well	1.92
96	North Goa	MY1405	Pomburpa Palmar	Dug Well	2.85
97	North Goa	MY1406	Salwardhar Dumun	Dug Well	2.05
98	North Goa	MY1408	Dhatwado Vante	Dug Well	2.80
99	North Goa	MY1409	Haspur	Dug Well	1.25
100	North Goa	MY1410	Hasaravanni Vaipal	Dug Well	1.16
101	South Goa	MY1411	Bagmola	Dug Well	3.00

	Annexure-III: water level data of Groundwater monitoring wells in Goa (November 2022)							
SN					Water			
	District	Well No	Location	Well Type	Level			
1	North Goa	PzGoa1048	Madakai	Bore Well	17.67			
2	South Goa	PzGoa1010	Manora Rai	Bore Well	5.65			
3	North Goa	PzGoa1043	Mayam	Bore Well	6.13			
4	South Goa	PzGoa1019	Meidawada	Bore Well	10.06			
5	North Goa	PzGoa1030	Mola	Bore Well	1.85			
6	South Goa	PzGoa1021	Molem	Bore Well	2.52			
7	North Goa	PzGoa1028	Morjum	Bore Well	2.68			
8	South Goa	PzGoa1034	Morlem	Bore Well	2.97			
9	South Goa	PzGoa1037	Nanoda	Bore Well	20			
10	North Goa	PzGoa1044	Narve	Bore Well	15.35			
11	South Goa	PzGoa1006	Patnem	Bore Well	3.6			
12	South Goa	PzGoa1005	Ponquini	Bore Well	9.11			
13	North Goa	PzGoa1045	Sanqulim	Bore Well	25.1			
14	North Goa	PzGoa1029	Sawantwada	Bore Well	4.78			
15	South Goa	PzGoa1038	Severdem	Bore Well	14.11			
16	North Goa	PzGoa1026	Silolieum	Bore Well	4.88			
17	South Goa	PzGoa1036	Thane	Bore Well	7.57			
18	North Goa	PzGoa1042	Tivim	Bore Well	20.24			
19	North Goa	PzGoa1023	Varkhand	Bore Well	13.78			
20	South Goa	PzGoa1002	Yedda	Bore Well	7.87			
21	South Goa	PzGoa1003	Dabel	Bore Well	9.67			
22	South Goa	PzGoa1004	Aven	Bore Well	8.27			
23	South Goa	PzGoa1005	Chinchinim	Bore Well	1.15			

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24	South Goa	PzGoa1006	Chandvar	Bore Well	2.38
25	South Goa	PzGoa1007	Kavelosim	Bore Well	1.71
26	South Goa	PzGoa1008	Canabonulim	Bore Well	4.3
27	North Goa	PzGoa1009	Hassapur	Bore Well	5.19
28	North Goa	PzGoa1010	Aropora	Bore Well	1.52
29	North Goa	PzGoa1011	Josi(Neura) panchayat	Bore Well	4.54
30	North Goa	PzGoa1012	Krilwada	Bore Well	1.68
31	North Goa	PzGoa1013	Korgoan	Bore Well	11.1
32	North Goa	PzGoa1014	Dovorlim	Bore Well	5.38
33	North Goa	PzGoa1015	Quiescond	Bore Well	14
34	North Goa	PzGoa1016	Kirl pirna	Bore Well	7.43
35	North Goa	PzGoa1017	Adavapal	Bore Well	4.88
36	North Goa	PzGoa1018	Aldona	Bore Well	14.88
37	North Goa	PzGoa1019	Kasar pal	Bore Well	9.71
38	North Goa	PzGoa1020	Betki	Bore Well	15.57
39	North Goa	PzGoa1021	Collem	Bore Well	5.82
40	North Goa	GAJY1307	Adavapal	Dug Well	6.47
41	South Goa	48I4D3	Agonda Desaiwada	Dug Well	3.9
42	North Goa	MY1403	Amberem	Dug Well	7.58
43	North Goa	GAJY1302	Anjuna Beach	Dug Well	12
44	South Goa	MY1411	Bagmola	Dug Well	3.92
45	South Goa	48E3D6	Ballynuvhen	Dug Well	7.08
46	North Goa	48I2A2	Bayalwadikeri(querim)	Dug Well	3.62
47	South Goa	Jy13116	Betalbatti	Dug Well	4.42
48	North Goa	GAJY1303	Bhamber(Nanoda Cross)	Dug Well	5.38
49	South Goa	Jy13114	Bhati	Dug Well	4.58
50	North Goa	GAJY1311	Bhujpal	Dug Well	2.12
51	South Goa	48I3A2	Bolkharnem	Dug Well	5.61

52	North Goa	GAJY1310	Bori	Dug Well	6.02
53	North Goa	GAMY1301	Britona	Dug Well	2.49
54	North Goa	48E2D11	Calangute	Dug Well	6.23
55	South Goa	48I4A12	Canacona	Dug Well	3.41
56	North Goa	GAJY1312	Charayode	Dug Well	2.65
57	South Goa	Jy1306	Chikalim	Dug Well	1.22
58	South Goa	48I3A6	Collem(kolamba)	Dug Well	7.9
59	North Goa	GAMY1303	Colval	Dug Well	12.93
60	South Goa	Jy13118	Cuncalim	Dug Well	2.28
61	South Goa	48I4A6	Cuncalim(pz)	Bore Well	6.54
62	South Goa	48J1A2	Daptamol Lolien	Dug Well	17.24
63	South Goa	48I4A7	Deulwada Kolamba	Dug Well	3.7
64	North Goa	MY 1407	Devulawada Narve	Dug Well	15.35
65	North Goa	MY1408	Dhatwado Vante	Dug Well	5.22
66	North Goa	GAJY1305	Gavalebhat, Chimbel(kirl)	Dug Well	5.43
67	South Goa	48I4A1	Ghadiawada	Dug Well	2.23
68	South Goa	Jy1312	Guddemal	Dug Well	8.66
69	North Goa	MY1410	Hasaravanni Vaipal	Dug Well	2.94
70	North Goa	MY1409	Haspur	Dug Well	4.86
71	South Goa	48J1A1	Hattipal Poinguinem	Dug Well	16.04
72	North Goo	481244	Honda		2.2
	North Goa	4012A4	nonua		5.5
73	South Goa	Jy13120	Jambavli	Dug Well	9.54
74	North Goa	MY1401	Jambhul Batt(mayam Lake)	Dug Well	2.62
75	South Goa	Jy1311	Kalay	Dug Well	11.5
76	North Goa	48E3D2	Karanjhalen	Dug Well	2.81
77	South Goa	Jy1305	Kaveslium	Dug Well	2.66
78	North Goa	48I3A1	Khadki(harijanwada)	Dug Well	7.8

79	North Goa	GAJY1313	Khotodem	Dug Well	6.51
80	North Goa	48E2D3	Korgaon	Dug Well	5.08
81	North Goa	MY1404	Kundel Dassolwada	Dug Well	2.2
82	South Goa	48E3D5	Majorda Bpada Curilo	Dug Well	3.8
83	South Goa	Jy1301	Malkarnem	Dug Well	10
84	North Goa	GAJY1309	Mankem	Dug Well	3.58
85	North Goa	48E2D7	Mapuca	Dug Well	4.3
86	South Goa	Jy1309	Mashe	Dug Well	4.1
87	South Goa	48I3A5	Molem	Dug Well	5.52
88	North Goa	48E2C1	Morji	Dug Well	1.3
89	North Goa	48I2A3	Morlem	Dug Well	5.52
90	North Goa	48E2D6	Mulgaon Shivalkherwad	Dug Well	3.8
91	North Goa	GAJY1304	Nagargoan	Dug Well	4.65
92	North Goa	48E2D2	Nagjhar	Dug Well	8.35
93	South Goa	48I4A9	Netrolim	Dug Well	11.18
94	North Goa	GAMY1302	Olaulim	Dug Well	6.53
95	South Goa	Jy13119	Padi	Dug Well	7.65
96	North Goa	48I3A8	Panchawadi(pz)	Bore Well	7.05
97	North Goa	GAJY1301	Parra	Dug Well	1.9
98	North Goa	48E2D1	Pernem	Dug Well	3.09
99	North Goa	GAMY1304	Pirna	Dug Well	2.95
100	South Goa	48J1A3	Polem(polen)	Dug Well	1.88
101	North Goa	MY1405	Pomburpa Palmar	Dug Well	3.78
102	South Goa	48I4A4	Quepem	Dug Well	3.2
103	South Goa	Jy13121	Revona	Dug Well	6.46
104	North Goa	48E2D4	Sal	Dug Well	3.6
105	North Goa	MY1406	Salwardhar Dumun	Dug Well	3.54
106	North Goa	GAJY1306	Sawanthwada(mandrem)	Dug Well	3.45
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107	North Goa	48I3A7	Shiroda	Dug Well	7.28
108	South Goa	48I4A10	Shrishtal Gaondongar	Dug Well	5.26
109	North Goa	48E2D5	Sirsaim	Dug Well	3.7
110	South Goa	Jy1307	Sristal	Dug Well	10.98
111	South Goa	Jy1310	Suktali (molem)	Dug Well	4.76
112	South Goa	Jy13113	Themchewada	Dug Well	7.65
113	North Goa	48E1D1	Uguem(ugawe)	Dug Well	3.2
114	South Goa	Jy1303	Vadam	Dug Well	2.74
115	North Goa	48I2A5	Valpoi	Dug Well	5.48
116	North Goa	48E3D1	Velha Goa	Bore Well	1.44
117	South Goa	Jy1302	Vichundrem	Dug Well	6.9
118	North Goa	Jy1303	Shivoli(Shilolium)	Dug Well	1.98
119	South Goa	Jy1302	Yedda	Dug Well	0.15

Annexure-IV: Water level data of Groundwater monitoring wells in Goa									
	(January 2023)								
SN			(····),		Water				
	District	Well No	Location	Well Type	Level				
1	North			Bore Well					
-	Goa	PzGoa1040	Adavapal		5.27				
2	North		A	Bore Well	4.00				
	Goa	PzGoa1031	AJOSI		4.98				
3	North			Bore Well	15.05				
	Goa	PzGoa1041	Aldona		15.95				
4	North		A	Bore Well	2.0				
	Goa	PzGoa1027	Aropora		2.6				
5	North		<b>A</b> == 1000	Bore Well	F 02				
	Goa	PzGoa1024	Asapur		5.82				
6	South		Aven	Bore Well	0.74				
	Goa	PzGoa1004	Aven		8.74				
7	North		Datki	Bore Well	15.25				
	Goa	PzGoa1047	Веткі		15.25				
8	South		Canabanulim	Bore Well	F 22				
	Goa	PzGoa1013	Canabonuim		5.32				
9	South		Cavalasim	Bore Well	2 20				
	Goa	PzGoa1011	Cavelosim		2.28				
10	South		Chandavar	Bore Well	2 75				
	Goa	PzGoa1008	Chandavar		2.75				
11	South		Chinchinim	Bore Well	1.00				
	Goa	PzGoa1007	Chinchinim		1.98				
12	South		Collom	Bore Well	0 02				
	Goa	PzGoa1018	Colletti		0.95				
13	South		Dabal	Bore Well	10.01				
	Goa	PzGoa1001	Dabei		10.81				
14	South		Dovorlim	Bore Well	5 / 7				
	Goa	PzGoa1016	Devenim		5.47				
15	North		Kasar Pal	Bore Well	0 05				
	Goa	PzGoa1046			9.95				
16	North		Kirl Pirpa	Bore Well	8 62				
	Goa	PzGoa1039	NIII FIIIId		0.02				
17	North		Korgoan	Bore Well	11 28				
	Goa	PzGoa1033	Korgoan		11.20				
18	North		Krilwada	Bore Well	17				
	Goa	PzGoa1032	Kiiwada		1.7				
19	North		Madakai	Bore Well	19 64				
	Goa	PzGoa1048	Widdakar		15.04				
20	South		Manora Rai	Bore Well	5.64				
	Goa	PzGoa1010							
21	South		MAYAM (GOVT. PRIMARY	Bore Well	6.41				
	Goa		SCHOOL)						
22	South		Meidawada	Bore Well	11.04				
	Goa	PzGoa1019							
23	North		Mola	Bore Well	1				
	Goa	PzGoa1030							
24	South		Molem	Bore Well	4.28				
	Goa	PzGoa1021							

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25	5	North	D=C == 1028	Morjum	Bore Well	2.85
- 24	c	GOa	P2G0a1028		Dere Mall	
26	6	South Goa	PzGoa1034	Morlem	Bore Well	4.28
27	7	South Goa	PzGoa1037	Nanoda	Bore Well	20.43
28	8	North	PzGoa1044	Narve	Bore Well	12.6
20	9	South	120001044		Bore Well	
2.	5	Goa	PzGoa1017	Paddi Quiescend	bore wen	14.46
3(	n	South	120001017		Bore Well	
50	0	Goa	PzGoa1006	Patnem	bore wen	5.26
3	1	South			Bore Well	
5.	-	Goa	PzGoa1005	Ponquini	bore wen	9.3
31	2	North			Bore Well	
52	~	Goa	PzGoa1045	Sanqulim	2010 110	24.16
2:	3	North	120001010		Bore Well	
	5	Goa	PzGoa1029	Sawantwada	2010 110	5.16
34	4	South			Bore Well	
		Goa	PzGoa1038	Severdem		14.82
35	5	North			Bore Well	
	-	Goa	PzGoa1026	Silolieum		5.18
36	6	South			Bore Well	
	Ŭ	Goa	PzGoa1036	Thane		8.28
3	7				Bore Well	
		North		Tivim		20.76
		Goa	PzGoa1042			
38	8	North		Varkhand	Bore Well	14 95
		Goa	PzGoa1023	Varkhand		14.55
39	9	South		Verna	Bore Well	1 57
		Goa	PzGoa1014	venia		1.57
40	0	South		Vedda	Bore Well	8 82
		Goa	PzGoa1002	10000		0.02
42	1	North		Adayapal		5.6
		Goa	GAJY1307	Auavapai	Dug Well	5.0
42	2	South				4.0
		Goa	48I4D3	Agonda Desalwada	Dug Well	4.8
43	3	North				
	-	Goa	48F2D12	Alto Betim Porvorim	Dug Well	11.9
1	1	North	1022012		Dugweit	
	-	Goo	MV1402	Amberem	Dug Mall	7.96
41	-	North	10111405		Dug weil	
4	D	North	CA 11/4 2 2 2	Anjuna Beach	<b>_</b>	11.77
		Goa	GAJY1302	-	Dug Well	
46	6	South		Bagmola		3.6
		Goa	MY1411	248	Dug Well	0.0
47	7	South		Ballynuybon		7 36
		Goa	48E3D6		Dug Well	7.50
48	8	North				2 5
1		Goa	4812A2	вауаіwadikeri(querim)	Dug Well	2.5
49	9	South			Ŭ Ŭ	
		Goa	Jv13116	Betalbatti	Dug Well	5.23
50	0	North	-,		245 1101	
50	5	Goo	GA 1V1 202	Bhamber(Nanoda Cross)	DugMall	5.8
		GUd	0411202		Dug weil	

51	South Goa	Jy13114	Bhati	Dug Well	5.91
52	North Goa	GAJY1311	Bhujpal	Dug Well	3.6
53	South Goa	48I3A2	Bolkharnem	Dug Well	7
54	North Goa	GAJY1310	Bori	Dug Well	6.54
55	North Goa	GAMY1301	Britona	Dug Well	2.5
56	North Goa	48E2D11	Calangute	Dug Well	7.7
57	South Goa	48I4A12	Canacona	Dug Well	4.15
58	North Goa	GAJY1312	Charayode	Dug Well	4.93
59	South Goa	Jy1306	Chikalim	Dug Well	1.68
60	South Goa	48I3A6	Collem(kolamba)	Dug Well	3.21
61	North Goa	GAMY1303	Colval	Dug Well	13.05
62	South Goa	Jy13118	Cuncalim	Dug Well	2.18
63	South Goa	48I4A6	Cuncalim(pz)	Dug Well	5.38
64	South Goa	48J1A2	Daptamol Lolien	Dug Well	15.74
65	South Goa	48I4A7	Deulwada Kolamba	Dug Well	3.42
66	North Goa	MY 1407	Devulawada Narve	Dug Well	15.61
67	North Goa	MY1408	Dhatwado Vante	Dug Well	6.53
68	North Goa	GAJY1305	Gavalebhat, Chimbel(kirl)	Dug Well	5.9
69	South Goa	48I4A1	Ghadiawada	Dug Well	2.26
70	South Goa	Jy1312	Guddemal	Dug Well	10.34
71	South Goa	48I4A11	Gulem Velipwada	Dug Well	3.72
72	North Goa	MY1410	Hasaravanni Vaipal	Dug Well	2.5
73	North Goa	MY1409	Haspur	Dug Well	5.22
74	South Goa	48J1A1	Hattipal Poinguinem	Dug Well	16.31

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75	North		Honda		3 85
	Goa	48I2A4	попиа	Dug Well	5.65
76	South		Jambavli		10.53
	Goa	Jy13120	Juniouvii	Dug Well	10.55
77	North		Jambhul Batt(mayam		2.5
	Goa	MY1401	Lake)	Dug Well	
78	South	h.1011	Kalay		11.63
70	G09	JY1311		Dug Well	
/9	South	MV1402	Kapsa		6.05
80	North	10111402		Dug well	
00	Goa	48F3D2	Karanjhalen	Dug Wall	3.27
81	South	-01302		שמצ מעפוו	
01	Goa	lv1305	Kaveslium	Dug Well	3.54
82	North	.,			
	Goa	48I3A1	Khadki(harijanwada)	Dug Well	8.55
83	North				
	Goa	GAJY1313	Khotodem	Dug Well	7.1
84	North		Kanaan		F 22
	Goa	48E2D3	Korgaon	Dug Well	5.32
85	North		Kundel Dasselwada		2 21
	Goa	MY1404		Dug Well	2.21
86	South		Maiorda Bnada Curilo		51
	Goa	48E3D5		Dug Well	5.1
87	South		Malkarnem		10.42
	Goa	Jy1301		Dug Well	
88	North		Mankem	_	4.84
	Goa	GAJY1309		Dug Well	
89	North	405257	Мариса		3.6
00	GO9	48E2D7	·	Dug Well	
90	Goo	1/1200	Mashe		4.14
Q1	South	JY1309			
	Goa	481345	Molem	Dug Wall	4.38
92	North				
	Goa	48E2C1	Morji	Dug Well	1.94
93	North				
	Goa	48I2A3	Morlem	Dug Well	14.65
94	North		Mulgoon Chivallihamurad	<u> </u>	20
	Goa	48E2D6	wulgaon Shivaikherwad	Dug Well	3.0
95	North		Nagargoon		6 70
	Goa	GAJY1304	inagaiguall	Dug Well	0.78
96	North		Nagihar		84
	Goa	48E2D2	i vagji i al	Dug Well	0.4
97	South		Netrolim		11.46
	Goa	48I4A9		Dug Well	
98	North		Olaulim		7.1
	Goa	GAMY1302		Dug Well	
99	South		Dadi		10 54
	Goa	lv13110	Pdui		10.54
	Jua	3913113			1

100	North		Panchawadi(pz)		7.4
	Goa	48I3A8	i anenawaa(pz)	Dug Well	/
101	North		Parra		2.44
	Goa	GAJY1301		Dug Well	
102	North		Pernem		3.18
	Goa	48E2D1		Dug Well	
103	North		Pirna		3.6
	Goa	GAMY1304		Dug Well	
104	South		Polem(polen)		2.47
	Goa	48J1A3	, , , , , , , , , , , , , , , , , , ,	Dug Well	
105	North		Pomburpa Palmar		3.82
	Goa	MY1405	'	Dug Well	
106	South		Quepem		3.21
	Goa	48I4A4		Dug Well	
107	South		Revona		6.28
	Goa	Jy13121		Dug Well	
108	North		Sal		3.78
	Goa	48E2D4		Dug Well	
109	North		Salwardhar Dumun		3.78
	Goa	MY1406		Dug Well	
110	North		Sawanthwada(mandrem)		4.28
	Goa	GAJY1306	, , ,	Dug Well	
111	North		Shiroda		8.09
	Goa	48I3A7		Dug Well	
112	North		Shivoli (brahmanwada)		2.23
	Goa	GAJY1308	, , ,	Dug Well	
113	South		Shrishtal Gaondongar		5.65
	Goa	48I4A10	0	Dug Well	
114	North		Sirsaim		3.48
	Goa	48E2D5		Dug Well	
115	South		Sristal		11.62
	Goa	Jy1307		Dug Well	
116	South		Suktali (molem)		5.18
	Goa	Jy1310		Bore Well	
117	South		Themchewada		7.72
	Goa	Jy13113		Dug Well	
118	North	10-1	Uguem(ugawe)	Dug Well	4.1
	Goa	48E1D1	U (-U/	<b>a</b>	
119	South		Vadam	Dug Well	4.5
	Goa	Jy1303		<b>D</b>	
120	North	40:0 -	Valpoi	Dug Well	6.05
	Goa	4812A5	,	<b>a</b>	<u> </u>
121	North		Velha Goa	Dug Well	1.6
	Goa	48E3D1			_
122	South		Vichundrem		7.72
	Goa	Jy1302		Dug Well	
123	South		Yedda		4
	Goa	Jy1304		Dug Well	

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