



सरकारी उपयोग के लिए

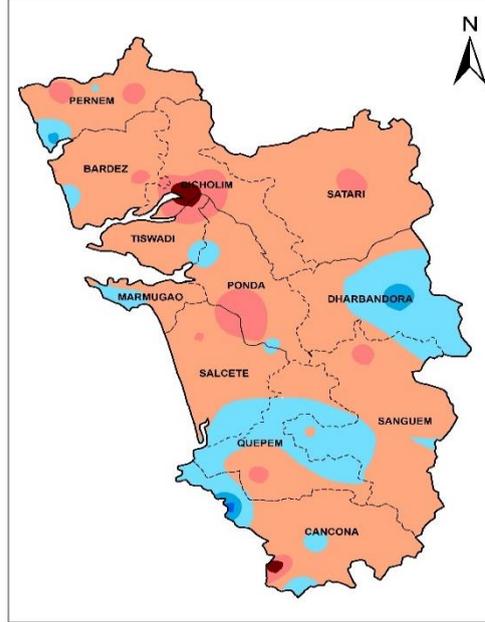
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तकनीकी रिपोर्ट श्रृंखला

Technical Report Series

SWR/RP/GWYB/22-23/55

गोवा राज्य की भूजल वर्ष पुस्तिका
(2021-2022)
GROUND WATER YEAR BOOK OF GOA
(2021-2022)



भारत सरकार /Government of India

जल शक्ति मंत्रालय/ Ministry of Jal Shakthi

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केन्द्रीय भूजल बोर्ड /Central Ground Water Board

दक्षिण पश्चिम क्षेत्र /South Western Region

बंगलुरु /Bangalore

SEPTEMBER 2022

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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 2021-2022 in Goa State has to be studied by monitoring a set of dug wells and purpose-built piezometers during the months of May 2021, August 2021, November 2021 and January 2022. During May 2021 water level monitoring has not done due to covid 19 lockdown. So 5 years average water is calculated and analyzed for these seasons. As of January 2022, Central Ground Water Board, South Western Region, monitors 87 dug wells and 44 piezometers to study the ground water scenario of Goa State.

The present compilation relates to the year 2021-2022. It provides information pertaining to water levels and also chemical quality of the phreatic aquifer. Thematic maps depicting the ground water scenario along with geochemical quality are 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 average depth to water levels of 2 -5 m bgl and 5 to 10 mbgl are more prevalent in the State during pre-monsoon period. Shallow water levels of less than 2 mbgl are noticed as isolated patches in Goa State. 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 90% of wells analysed, while 10% of wells show depth to water level more than 10 m bgl are noticed in the state.

Results of chemical analysis of water samples collected during May 2019 are also discussed for understanding the spatial variation of EC, Chloride, Fluoride and Nitrate concentration in the phreatic aquifer system of the state of Goa.

GROUNDWATER YEARBOOK OF GOA STATE (2021-2022)

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 131 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**.

Table 1: District wise distribution of Ground water monitoring stations

Sl.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

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

1.2 PHYSIOGRAPHY

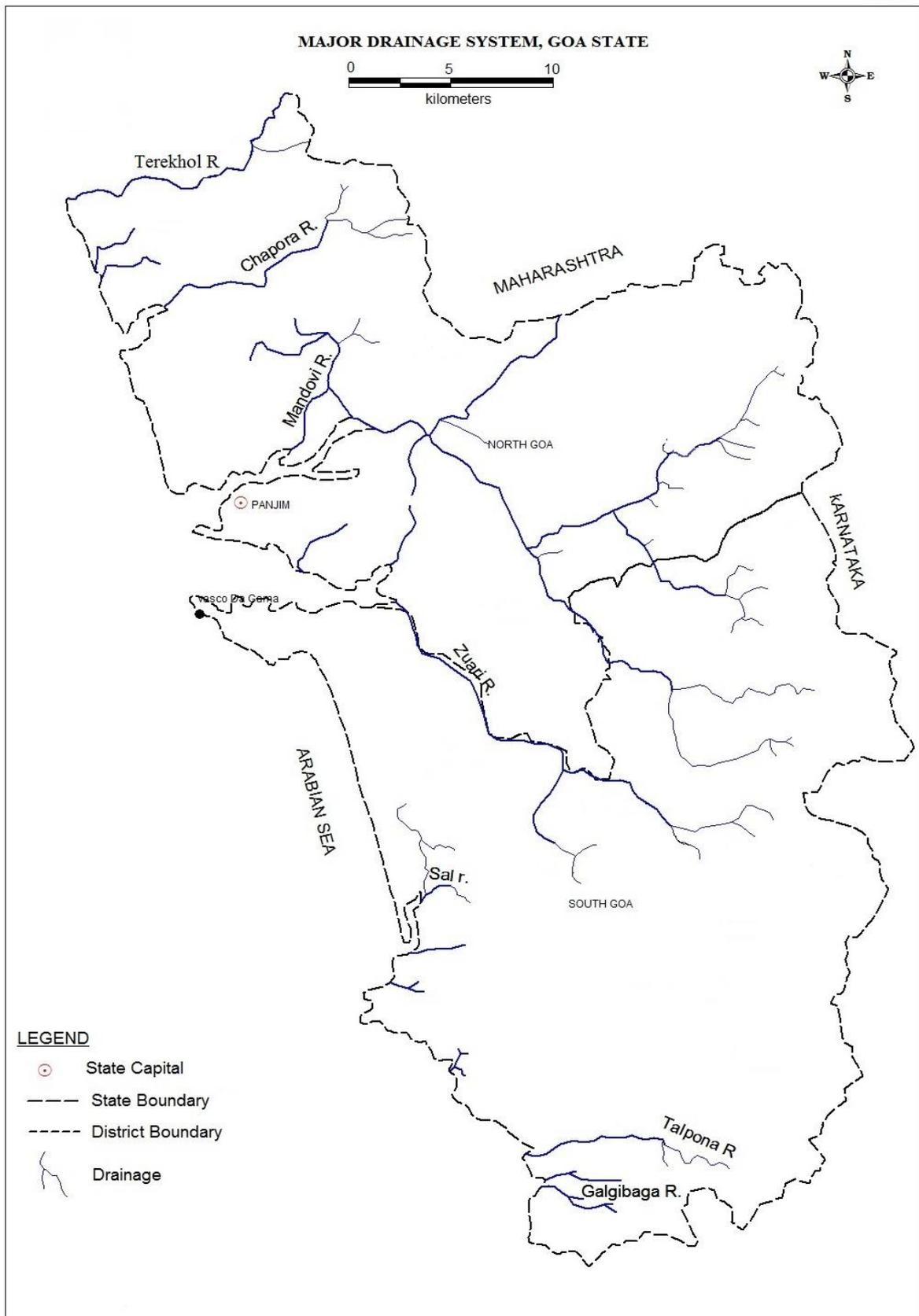
Goa State forms part of coastal tract of the west coast of India. Physiographically the Goa State is divided into four morphological units namely, 1. Coastal plains with dominant Marine land forms on the west, followed successively towards the east 2. Vast etch plain. 3. Low dissected denudation hills 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 dendritic 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**).

Table 2: Details of the Major/Minor river Basin area in Goa State

Drainage Basin / Sub Basin	Area		Taluks
	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
Zuari	973	26.28	Tiswadi, Ponda, Salcete, Quepem, Mormugao 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		



1.4 Geological Conditions

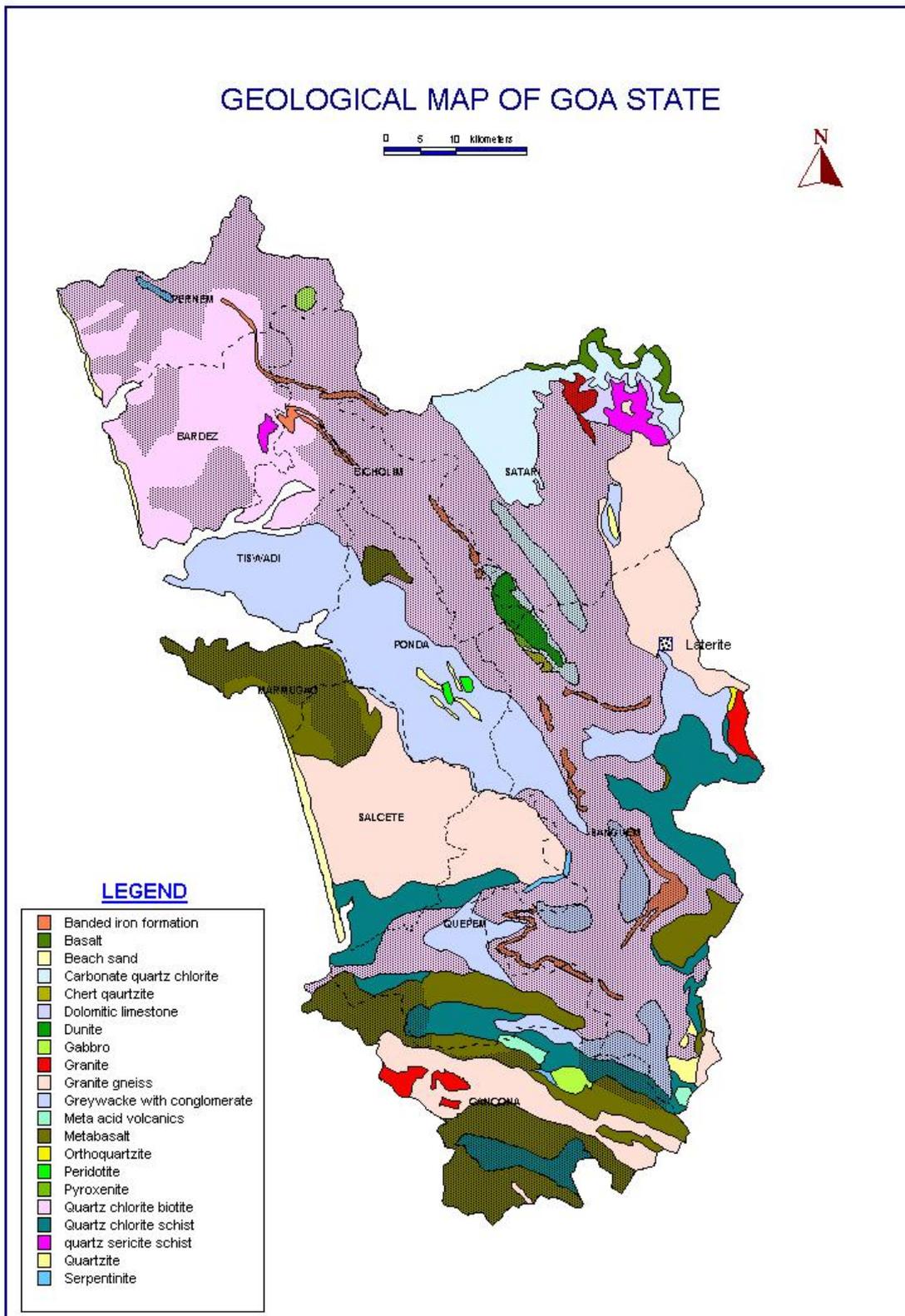
Major part of the Goa State is underlain by rocks of Precambrian age comprising of banded biotite gneisses, Meta volcanics, phyllites, biotite and chlorite schists, greywacke, conglomerate (tilloid), pink phyllites with associated banded ferruginous quartzite and chart breccia. These rocks are intruded 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)**.



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.

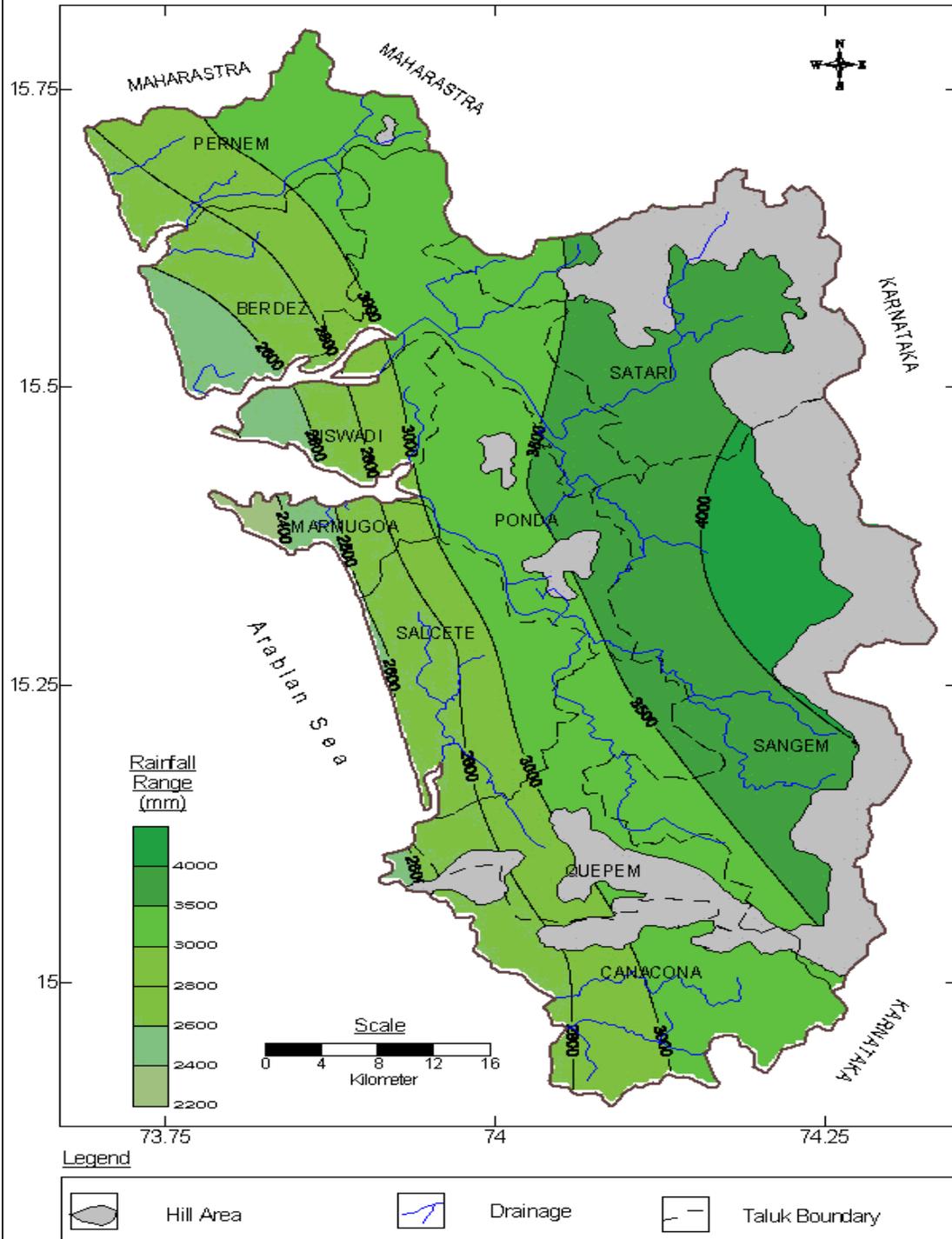
The annual normal rainfall in North Goa ranges from 2766.9 at Panaji along the west coast and highest at Valpoi in the east (Ghats section) indicating rainfall increases from west to east. Average rainfall in North Goa is 3400.1mm. Similarly in South Goa it ranged 2611.7 mm at Mormugao in west coast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

Table 3: Monthly Normal Rainfall of Goa State

Station	JAN	FEB	Winter	MAR	APR	MAY	Pre Mon	JUN	JUL	AUG	SEP	SW Mon	OCT	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

**NORMAL MONSOON (JUNE - SEPTEMBER) RAINFALL
(1970-2000) GOA STATE**



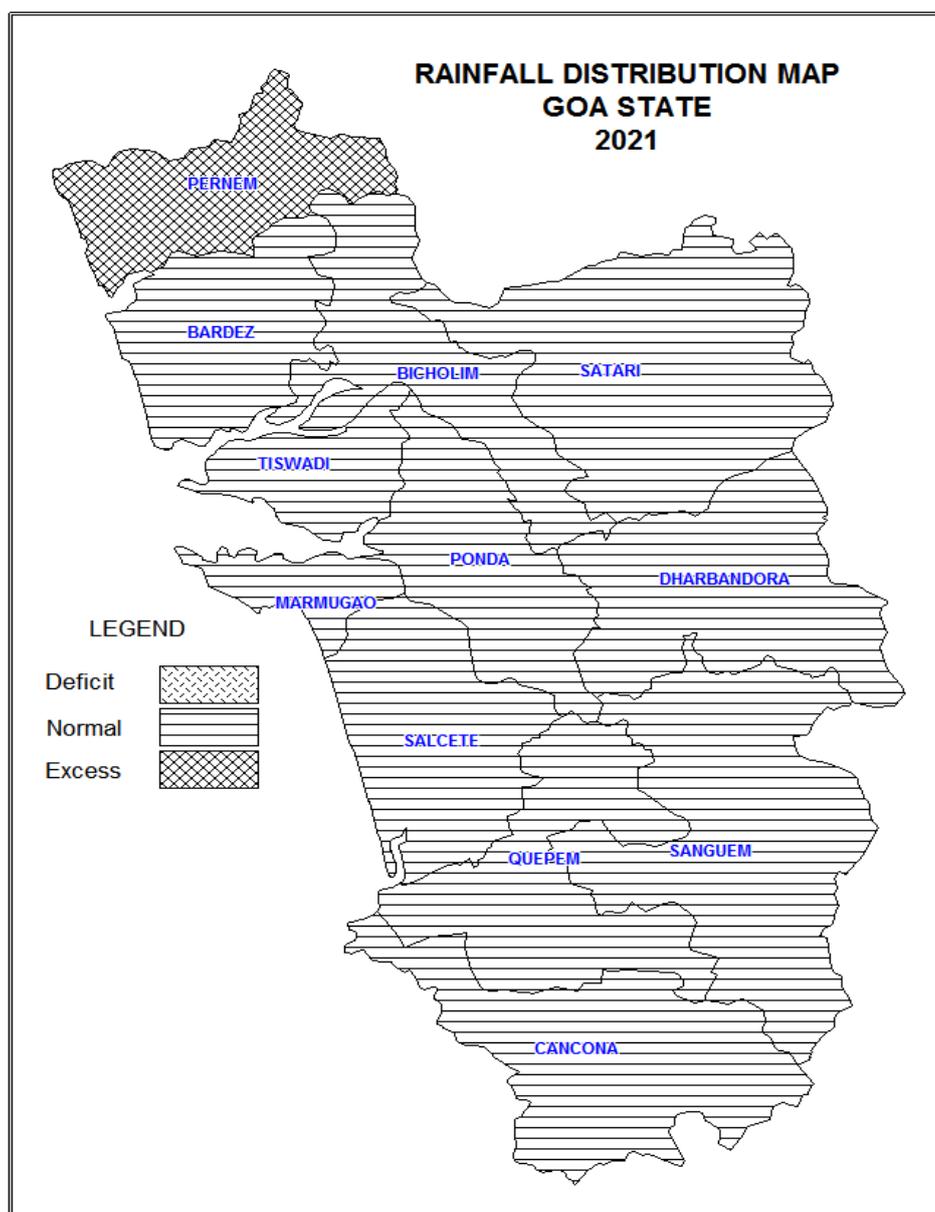
Annual rainfall 2021 (January to December – 2021)

The actual average rainfall received in the State during the year 2021 is 3509 mm, 4 per cent more than the normal rainfall of 3368 mm and which fell under the Normal category. At taluk level, out of 12 districts in the State, 1 districts had excess rainfall and in the remaining 11 districts it is Normal. So, State as a whole fell under the 'Normal' category.

Taluk-wise cumulative rainfall and percentage departure from its normal for the year 2021 is given in **Table-4** and district-wise rainfall distribution is presented in **Plate IV**.

Table-4: TALUK-Wise Cumulative Rainfall and Departure During
2021 Annual Period

District	Taluk	Normal	Actual	%Dep	Class
GOA NORTH	BARDEZ	2984	3298	11	Normal
GOA NORTH	BICHOLIM	3602	3798	5	Normal
GOA NORTH	PERNEM	3244	3973	22	Excess
GOA NORTH	SATARI	4217	3655	-13	Normal
GOA NORTH	TISWADI	2903	3448	19	Normal
SOUTH GOA	CANCONA	3000	3364	12	Normal
SOUTH GOA	DHARBANDORA	3363	3603	7	Normal
SOUTH GOA	MARMUGAO	3050	3119	2	Normal
SOUTH GOA	PONDA	3363	3603	7	Normal
SOUTH GOA	QUEPEM	3878	3407	-12	Normal
SOUTH GOA	SALCETE	3119	3164	1	Normal
SOUTH GOA	SANGUEM	3692	3670	-1	Normal
GOA STATE		3368	3509	4	Normal



3. DEPTH TO WATER LEVEL

Due to covid-19 lockdown water level monitoring was not carried out in the State during May 2020 and 2021. So 5 years average water level is analyzed.

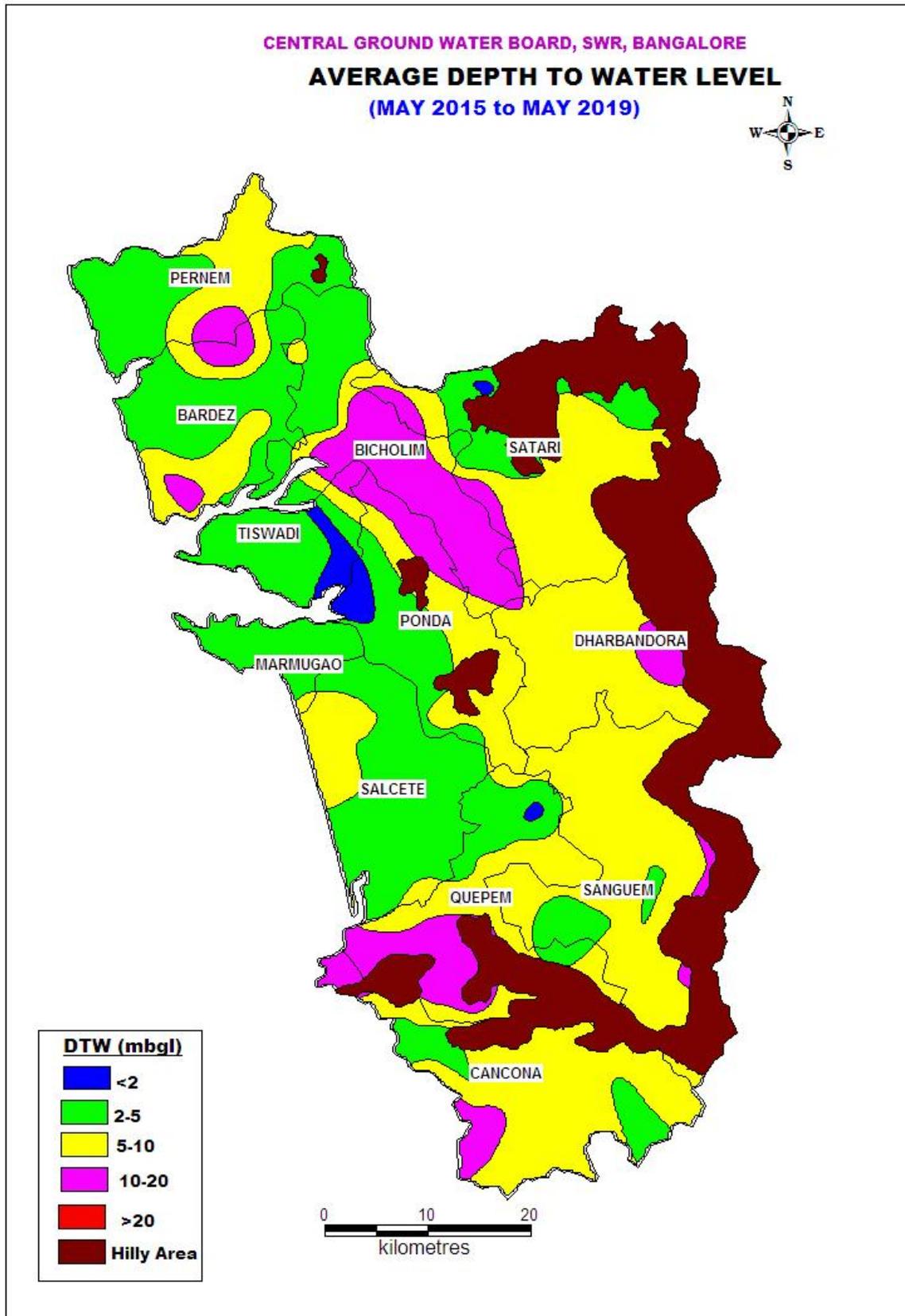
Average Water Level May (2015 to 2019)

The statement showing the distribution of ground water monitoring wells along with average depth to water level of phreatic aquifer in different depth ranges is presented in **Table-5** and **Plate-V** depicts the ground water scenario in May 2015 to May 2019. Salient features of the average depth to water level scenario are given below.

1. A perusal of the water level data reveals that the depth to water level ranged from 1.66 m bgl (Quepem taluk) to 19.11 m bgl (Bicholim 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 89% of wells analysed, while 11% 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 5% of wells analysed and noted in Bardez, Ponda, Quepem, Satari and Tiswadi 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 except Dharbandora taluk.
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 Mormugao and Tiswadi taluks.
6. Depth to water level in the range of 10 to 20 m bgl has been observed in 11% of wells analysed and noted as isolated Bardez, Bicholim, Canacona, Dharbandora, Quepem Salcete and Sanguem taluks.

Table-5: AVERAGE DEPTH TO WATER LEVEL (MAY 2015-2019)

S.No	Taluk Name	No of Wells analysed	Min	Max	No/Percentage of Wells showing Depth to water table (mbgl) in the range of											
					0-2	%	2-5	%	5-10	%	10-20	%	20-40	%	> 40	%
1	Bardez	13	1.97	14.18	1	7.7	8	61.5	2	15.4	2	15.4	0	0	0	0
2	Bicholim	9	2.83	19.11	0	0	3	33.3	3	33.3	3	33.3	0	0	0	0
3	Cancona	10	4.16	14.87	0	0	4	40	5	50	1	10	0	0	0	0
4	Dharbandora	5	5.27	13.94	0	0	0	0	4	80	1	20	0	0	0	0
5	Mormugao	1	3.07	3.07	0	0	1	100	0	0	0	0	0	0	0	0
6	Pernem	9	2	7.46	0	0	6	66.7	3	33.3	0	0	0	0	0	0
7	Ponda	5	1.83	6.84	1	20	2	40	2	40	0	0	0	0	0	0
8	Quepem	5	1.66	15.95	1	20	2	40	1	20	1	20	0	0	0	0
9	Salcete	12	2.28	13.23	0	0	7	58.3	4	33.3	1	8.3	0	0	0	0
10	Sanguem	12	2.73	11.97	0	0	2	16.7	9	75	1	8.3	0	0	0	0
11	Satari	10	1.88	9.11	1	10	5	50	4	40	0	0	0	0	0	0
12	Tiswadi	3	1.67	4.85	1	33.3	2	66.7	0	0	0	0	0	0	0	0
	Total	94	1.66	19.11	5	5	42	45	37	39	10	11	0	0	0	0



AVERAGE DEPTH TO PIEZOMETRIC SURFACE

Average Depth to piezometric surface has been recorded from piezometers spread all over the State in hard rock areas. The statement showing average depth to piezometric surface during May 2015 to May 2019 is given in **Table 6**. Salient features of the average depth to piezometric surface are given below;

1. The depth to piezometric surface ranged from 0.5 m bgl (Mormugao taluk) to 21.6 m bgl (Dharbandora taluk) in Goa State.
2. 63% of wells have recorded depth to piezometric surface within 10 m bgl and 37% 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 9% of wells analysed and this has been noted in Mormugao, Salcete and Tiswadi taluks.
4. Depth to piezometric surface in the range of 2 to 5 m bgl has been recorded in 24% of wells analysed and noted in Bardez, Pernem, Sanguem, Tiswadi and Salcete taluks.
5. Depth to piezometric surface in the range of 5 to 10 m bgl has been recorded in 30 % of wells analysed and noted in Bardez, Bicholim, Canacona, Dharbandora, Pernem, Salcete and Satari taluks.
6. Depth to piezometric surface in the range of 10 to 20 m bgl has been observed in 30% of wells analysed and noted in Bardez, Bicholim, Canacona, Dharbandora, Pernem, Ponda, Quepem and Satari taluks.
7. Depth to piezometric surface in the range of 20 to 40 m bgl has been noted in 7 % of wells analysed and noticed in Bardez, Dharbandora and Ponda taluks.

Table 6: AVERAGE DEPTH TO PIEZOMETRIC SURFACE (MAY (2015-2019))

S.No	Taluk Name	No. of Wells Analysed	Min	Max	No. / Percentage of Wells Showing Depth to Water Table (mbgl) in the Range of											
					0-2	%	2-5	%	5-10	%	10-20	%	20-40	%	> 40	%
1	Bardez	5	2.78	20.8	0	0	1	20	2	40	1	20	1	20	0	0
2	Bicholim	3	5.24	12.7	0	0	0	0	2	66.7	1	33.3	0	0	0	0
3	Cancona	5	7.96	12.6	0	0	0	0	2	40	3	60	0	0	0	0
4	Dharbandora	4	6.19	21.6	0	0	0	0	2	50	1	25	1	25	0	0
5	Mormugao	1	0.5	0.5	1	100	0	0	0	0	0	0	0	0	0	0
6	Pernem	8	2.79	16.2	0	0	2	25	2	25	4	50	0	0	0	0
7	Ponda	2	16.88	21.2	0	0	0	0	0	0	1	50	1	50	0	0
8	Quepem	1	15.44	15.4	0	0	0	0	0	0	1	100	0	0	0	0
9	Salcete	8	1.97	6.69	1	12.5	5	62.5	2	25	0	0	0	0	0	0
10	Sanguem	2	4.6	4.96	0	0	2	100	0	0	0	0	0	0	0	0
11	Satari	4	5.06	19.9	0	0	0	0	2	50	2	50	0	0	0	0
12	Tiswadi	3	0.8	4.36	2	66.7	1	33.3	0	0	0	0	0	0	0	0
	Total	46	0.5	21.6	4	9	11	24	14	30	14	30	3	7	0	0

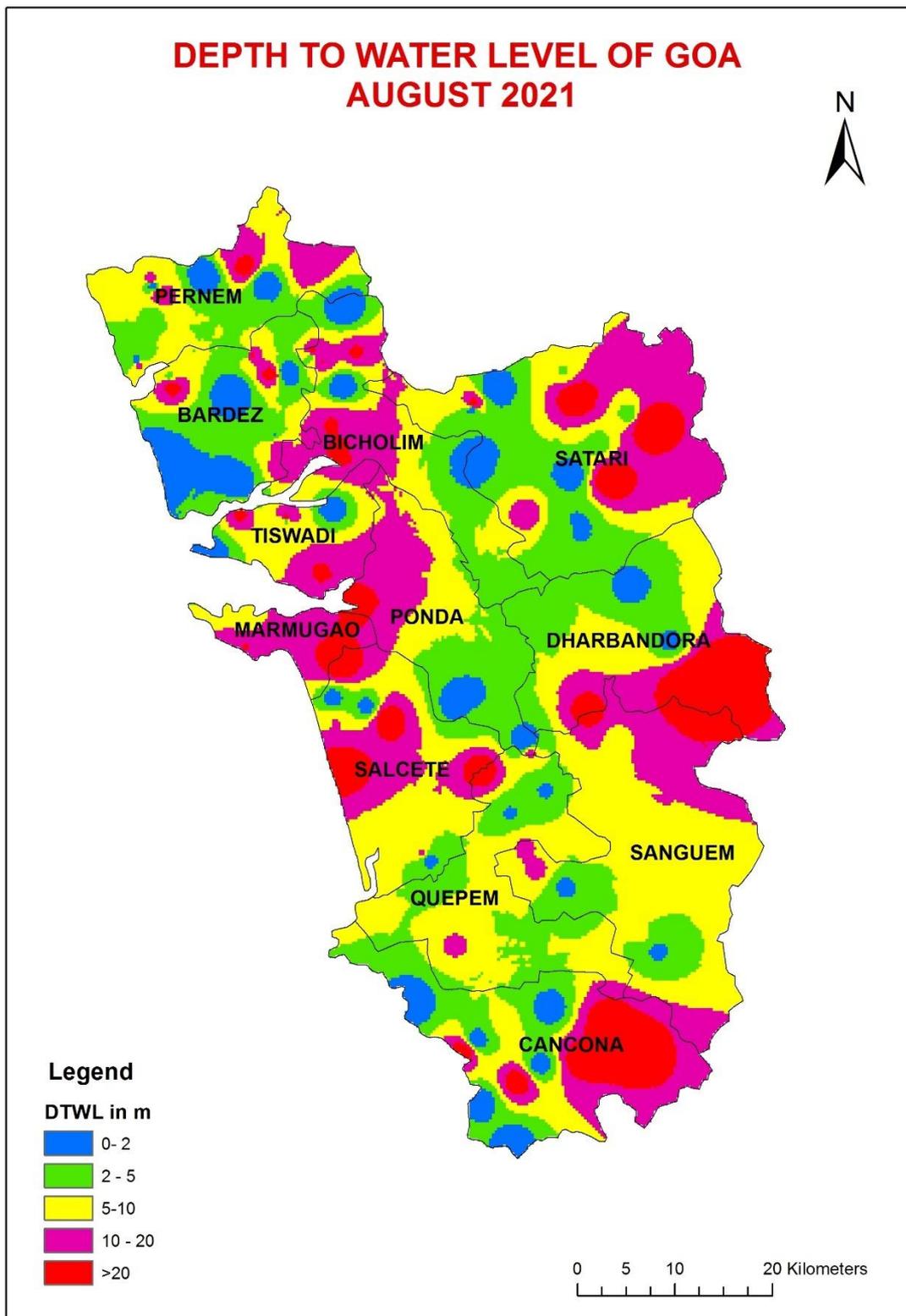
AUGUST 2021:

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-7** and **Plate-VI** depicts the ground water scenario in August 2021. Salient features of the depth to water level scenario during August 2021 are given below.

1. A perusal of the water level data reveals that the depth to water level ranged from 0.94 m bgl (Salcete taluk) to 15.84 m bgl (Canacona taluk).
2. The salient feature of the analysis is that the depth to water level over major part of the State lies within 10 m bgl in 94% of wells analysed, while 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 20% of wells analysed and noted in all taluks except Tiswadi and Mormugao taluks.
4. Depth to water level in the range of 2 to 5 m bgl has been recorded in 51% 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 23% of wells analysed and noted in, Bicholim, 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 6% of wells analysed and noted as isolated Sanguem, Bardez, Bicholim and Berdez taluks.

Table-7: DEPTH TO WATER LEVEL (AUGUST 2021)

S.No	Taluk Name	No of Wells analysed	Min	Max	No/Percentage of Wells showing Depth to water table(mbgl) in the range of									
					0-2	%	2-5	%	5-10	%	10-20	%	>20	%
1	Tiswadi	4	2.21	3.65	0	0	4	100	0	0	0	0	0	0
2	Sattari	10	1.41	4.93	2	20	8	80	0	0	0	0	0	0
3	Sangeum	14	1.05	10.41	2	14.3	4	28.6	7	50	1	7.1	0	0
4	Salcete	9	0.94	6.57	3	33.3	4	44.4	2	22.2	0	0	0	0
5	Quepem	3	1.66	4.07	2	66.7	1	33.3	0	0	0	0	0	0
6	Ponda	5	1.87	6.18	1	20	1	20	3	60	0	0	0	0
7	Pernem	9	1.22	8.10	2	22.2	5	55.6	2	22.2	0	0	0	0
8	Marmugoa	1	3.10	3.10	0	0	1	100	0	0	0	0	0	0
9	Canacona	7	1.80	15.84	1	14.3	3	42.9	1	14.3	2	28.6	0	0
10	Bicholim	7	1.85	14.19	1	14.3	3	42.9	2	28.6	1	14.3	0	0
11	Bardez	12	1.15	11.10	2	16.7	7	58.3	2	16.7	1	8.3	0	0
	Total	81	0.94	15.84	16	20	41	51	19	23	5	6	0	0



DEPTH TO PIEZOMETRIC SURFACE

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-8**. Salient features of the depth to piezometric surface during August 2021 are given below;

1. The depth to piezometric surface ranged from 0.09 m bgl (Salcete taluk) to 17.59 m bgl (Bicholim taluk) in Goa State.
2. 74% of wells have recorded depth to piezometric surface within 10 m bgl and 26% 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 26% of wells analysed and this has been noted in Tiswadi, Sanguem, Salcete, Pernem, Canacona, Bicholim and Bardez taluks.
4. Depth to piezometric surface in the range of 2 to 5 m bgl has been recorded in 34% 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 14 % of wells analysed and noted in Bicholim, Canacona, Satari and Ponda taluks.
6. Depth to piezometric surface in the range of 10 to 20 m bgl has been observed in 26% of wells analysed and noticed in Satari, Ponda, Bicholim, Pernem and Bardez taluks.

Table-8: DEPTH TO PIEZOMETRIC SURFACE (AUGUST 2021)

S.No	Taluk Name	No of Wells analysed	Min	Max	No/Percentage of Wells showing Depth to water table (mbgl) in the range of									
					0-2	%	2-5	%	5-10	%	10-20	%	>20	%
1	Tiswadi	3	0.55	2.68	2	66.7	1	33.3	0	0	0	0	0	0
2	Sattari	4	3.35	16.57	0	0	1	25	1	25	2	50	0	0
3	Sangeum	3	0.81	4.64	2	66.7	1	33.3	0	0	0	0	0	0
4	Salcete	5	0.09	3.75	3	60	2	40	0	0	0	0	0	0
5	Ponda	2	7.50	14.06	0	0	0	0	1	50	1	50	0	0
6	Pernem	6	1.62	12.05	1	16.7	2	33.3	0	0	3	50	0	0
7	Canacona	5	1.91	7.95	1	20	2	40	2	40	0	0	0	0
8	Bicholim	4	4.75	17.59	0	0	1	25	1	25	2	50	0	0
9	Bardez	3	3.52	17.45	0	0	2	66.7	0	0	1	33.3	0	0
	Total	35	0.09	17.59	9	26	12	34	5	14	9	26	0	0

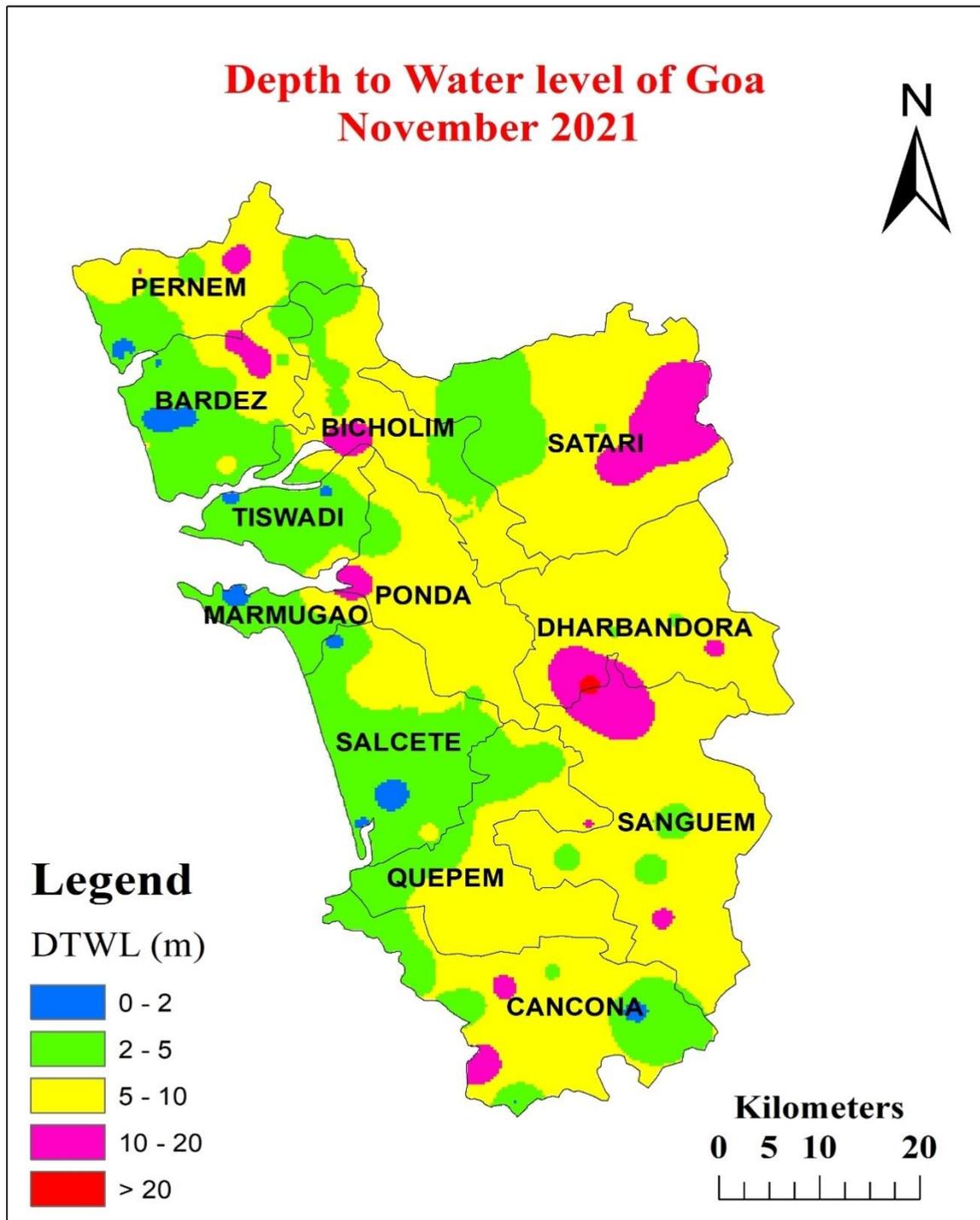
November 2021

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-9** and **Plate-VII** depicts the ground water scenario in November 2021. Salient features of the depth to water level scenario during November 2021 are given below.

1. A perusal of the water level data reveals that the depth to water level ranged from 1.10m bgl (Pernem taluk) to 15.76m bgl (Canacona taluk).
2. The salient feature of the analysis is that the depth to water level over major part of the State lies within 10 m bgl in 90% of wells analysed, while 10% 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 9% 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 49% 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 32% of wells analysed and noted in all the taluks except Mormugao and Quepem taluks.
6. Depth to water level in the range of 10 to 20 m bgl has been observed in 10% of wells analysed and noted as isolated Bardez, Bicholim, Cancona and Sanguem taluks.

Table-9: Depth to Water Level (November 2021)

S.No	Taluk Name	No of Wells analysed	Min	Max	No/Percentage of Wells showing Depth to water table (mbgl) in the range of									
					0-2	%	2-5	%	5-10	%	10-20	%	>20	%
1	Tiswadi	4	1.64	8.43	1	25	2	50	1	25	0	0	0	0
2	Sattari	9	2.14	6.40	0	0	5	55.6	4	44.4	0	0	0	0
3	Sangeum	14	3.48	11.32	0	0	4	28.6	7	50	3	21.4	0	0
4	Salcete	9	1.43	6.97	1	11	5	55.6	3	33.3	0	0	0	0
5	Quepem	3	2.04	5	0	0	3	100	0	0	0	0	0	0
6	Ponda	5	2.07	7.28	0	0	2	40	3	60	0	0	0	0
7	Pernem	9	1.10	8.46	1	11	6	66.7	2	22.2	0	0	0	0
8	Marmugoa	1	3.32	3.32	0	0	1	100	0	0	0	0	0	0
9	Canacona	8	1.40	15.76	2	25	3	37.5	1	12.5	2	25	0	0
10	Bicholim	7	2.38	15.17	0	0	3	42.9	3	42.9	1	14.3	0	0
11	Bardez	12	1.54	13.14	2	16.7	6	50	2	16.7	2	16.7	0	0
	Total	81	1.10	15.76	7	9	40	49	26	32	8	10	0	0



DEPTH TO PIEZOMETRIC SURFACE

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-10**: Salient features of the depth to piezometric surface during November 2021 are given below;

1. The depth to piezometric surface ranged from 0.51 m bgl (Bardez taluk) to 22.58 m bgl (Bicholim taluk) in Goa State.
2. 72% of wells have recorded depth to piezometric surface within 10 m bgl and 28% 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 19% of wells analysed and this has been noted in Canacona, Bardez, Salcete and Tiswadi taluks.
4. Depth to piezometric surface in the range of 2 to 5 m bgl has been recorded in 31% of wells analysed and noted in all taluks except Ponda and Bicholim.
5. Depth to piezometric surface in the range of 5 to 10 m bgl has been recorded in 22 % of wells analysed and noted in all taluks except Ponda, Pernem and Berdez.
6. Depth to piezometric surface in the range of 10 to 20 m bgl has been observed in 22% of wells analysed and noted in all taluks except Tiswadi, Salcete and Canacona.
7. Depth to piezometric surface in the range of >20m bgl has been observed in 6% of wells analysed and noted in Salcete, Bicholim Taluks.

Table-10: Depth to Piezometric Surface (November 2021)

S.No	Taluk Name	No of Wells analysed	Min	Max	No/Percentage of Wells showing Depth to water table (mbgl) in the range of									
					0-2	%	2-5	%	5-10	%	10-20	%	>20	%
1	Tiswadi	3	1.48	4.48	2	66.7	1	33.3	0	0	0	0	0	0
2	Sattari	4	2.92	20.08	0	0	1	25	1	25	1	25	1	25
3	Sangeum	3	4.71	10.68	0	0	1	33.3	1	33.3	1	33.3	0	0
4	Salcete	6	0.97	5.14	3	50	2	33.3	1	16.7	0	0	0	0
5	Ponda	2	14.9 2	15.59	0	0	0	0	0	0	2	100	0	0
6	Pernem	5	2.33	13.76	0	0	3	60	0	0	2	40	0	0
7	Canacona	5	1.40	9.64	1	20	1	20	3	60	0	0	0	0
8	Bicholim	4	6	22.58	0	0	0	0	2	50	1	25	1	25
9	Bardez	4	0.51	17.49	1	25	2	50	0	0	1	25	0	0
	Total	36	0.51	22.58	7	19	11	31	8	22	8	22	2	6

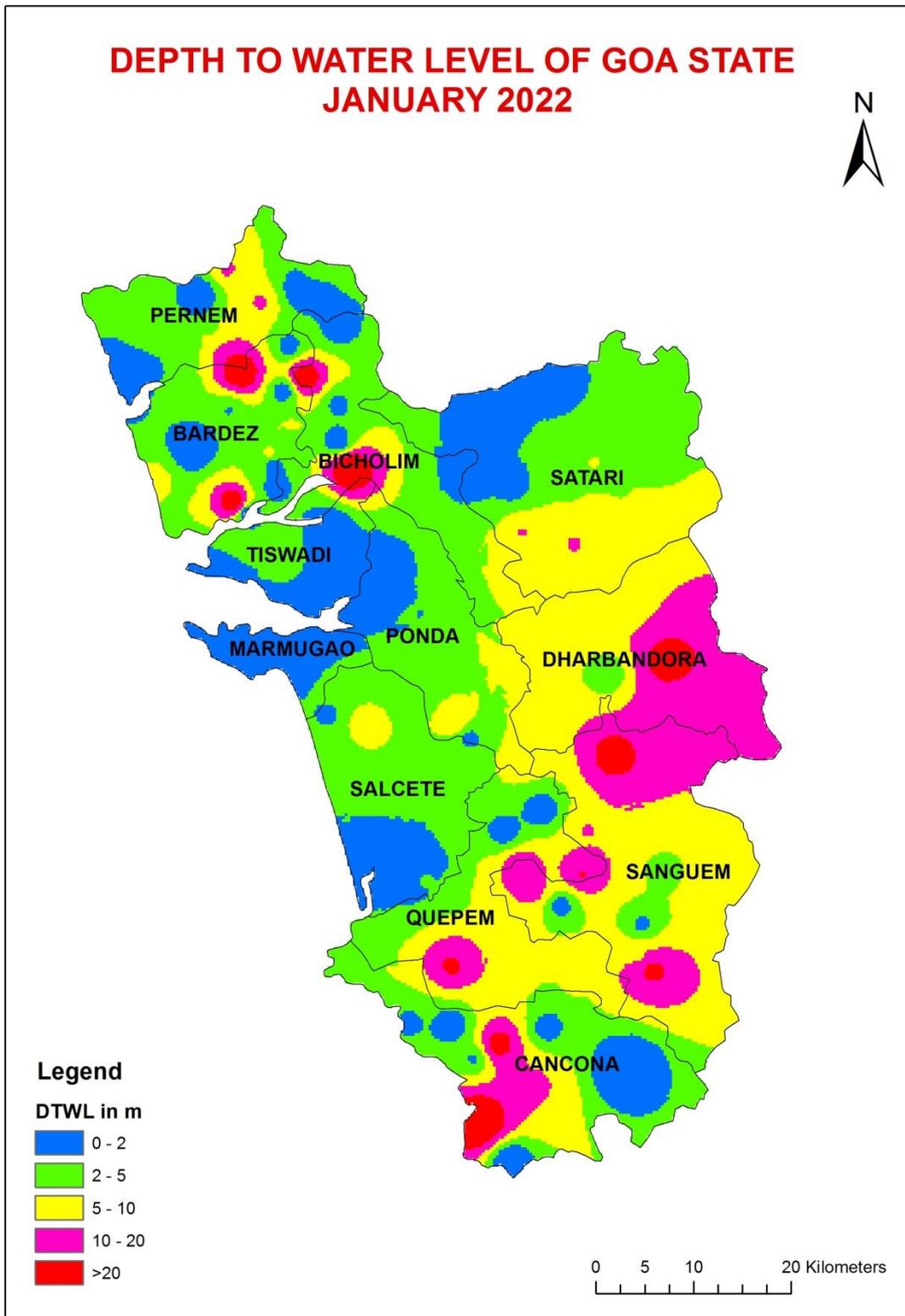
January 2022

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-11** and **Plate-VIII** depict the ground water scenario in January 2022. Salient features of the depth to water level scenario during January 2022 are given below.

1. A perusal of the water level data reveals that the depth to water level ranged from 1.58 m bgl (Pernem taluk) to 15.78 m bgl (Canacona taluk).
2. The salient feature of the analysis is that the depth to water level over major part of the State lies within 10 m bgl in 84% of wells analysed, while 16% 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 5% of wells analysed and noted in 4 taluks such as Pernem, Salcete, Tiswadi and Canacona 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 Mormugao taluk.
6. Depth to water level in the range of 10 to 20 m bgl has been observed in 16% of wells analysed and noted as isolated Salcete, Canacona, Bicholim, Bardez and Sanguem taluks.

Table-11: Depth to Water Level (January 2022)

S.No	Taluk Name	No of Wells analysed	Min	Max	No/Percentage of Wells showing Depth to water table (mbgl) in the range of									
					0-2	%	2-5	%	5-10	%	10-20	%	>20	%
1	Tiswadi	4	1.91	9.10	1	25	1	25	2	50	0	0	0	0
2	Sattari	10	2.52	8.52	0	0	5	50	5	50	0	0	0	0
3	Sangeum	14	3.70	11.70	0	0	3	21	6	42.9	5	35.7	0	0
4	Salcete	9	1.70	10.60	1	11	4	44	3	33.3	1	11.1	0	0
5	Quepem	3	2.65	6.15	0	0	2	66.7	1	33.3	0	0	0	0
6	Ponda	5	2.21	7.65	0	0	2	40	3	60	0	0	0	0
7	Pernem	9	1.58	8.10	1	11	3	33.3	5	55.6	0	0	0	0
8	Marmugoa	1	3.74	3.74	0	0	1	100	0	0	0	0	0	0
9	Canacona	9	1.60	15.78	1	11	5	55.6	1	11.1	2	22.2	0	0
10	Bicholim	7	3.05	15.52	0	0	3	42.9	2	28.6	2	28.6	0	0
11	Bardez	12	2.14	13.90	0	0	7	58.3	2	16.7	3	25	0	0
	Total	83	1.58	15.78	4	5	36	43	30	36	13	16	0	0



DEPTH TO PIEZOMETRIC SURFACE

Depth to piezometric surface has been recorded from piezometers spread all over the State in hard rock areas. The statement showing depth to piezometric surface is given in **Table-12**. Salient features of the depth to piezometric surface during January 2022 are given below;

1. The depth to piezometric surface ranged from 0.98 m bgl (Tiswadi taluk) to 24.85 m bgl (Bicholim taluk) in Goa State.
2. 68% of wells have recorded depth to piezometric surface within 10 m bgl and 32% 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 11% of wells analysed and this has been observed in Bardez, Salcete and Tiswadi taluks.
4. Depth to piezometric surface in the range of 2 to 5 m bgl has been recorded in 14% of of wells analysed and this has been observed in Sattari, Bardez, Salcete and Pernem taluks.
5. Depth to piezometric surface in the range of 5 to 10 m bgl has been recorded in 43% of wells analysed and observed in all taluks except 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 Bicholim, Canacona, Pernem, Ponda, Sanguem and Satari taluks.
7. Depth to piezometric surface in the range of above 20 m bgl has been observed in 6% of wells analysed and noted 2 taluks such as Bardez and Bicholim.

Table-12: Depth to Piezometric Surface (January 2022)

S.No	Taluk Name	No of Wells analysed	Min	Max	No/Percentage of Wells showing Depth to water table (mbgl) in the range of									
					0-2	%	2-5	%	5-10	%	10-20	%	>20	%
1	Tiswadi	3	0.98	4.88	2	66.7	1	33.3	0	0	0	0	0	0
2	Sattari	4	3.85	18.56	0	0	1	25	1	25	2	50	0	0
3	Sangeum	3	6.55	11.48	0	0	0	0	2	66.7	1	33.3	0	0
4	Salcete	5	1.87	5.34	1	20	2	40	2	40	0	0	0	0
5	Ponda	2	16.27	19.90	0	0	0	0	0	0	2	100	0	0
6	Pernem	6	2.63	14.65	0	0	1	16.7	3	50	2	33.3	0	0
7	Canacona	4	8.71	10.59	0	0	0	0	3	75	1	25	0	0
8	Bicholim	4	6.33	24.85	0	0	0	0	2	50	1	25	1	25
9	Bardez	4	1.40	20.55	1	25	0	0	2	50	0	0	1	25
	Total	35	0.98	24.85	4	11	5	14	15	43	9	26	2	6

4. FLUCTUATION OF WATER LEVEL

AUGUST 2020 (AVERAGE 2015-2019) TO AUGUST 2021

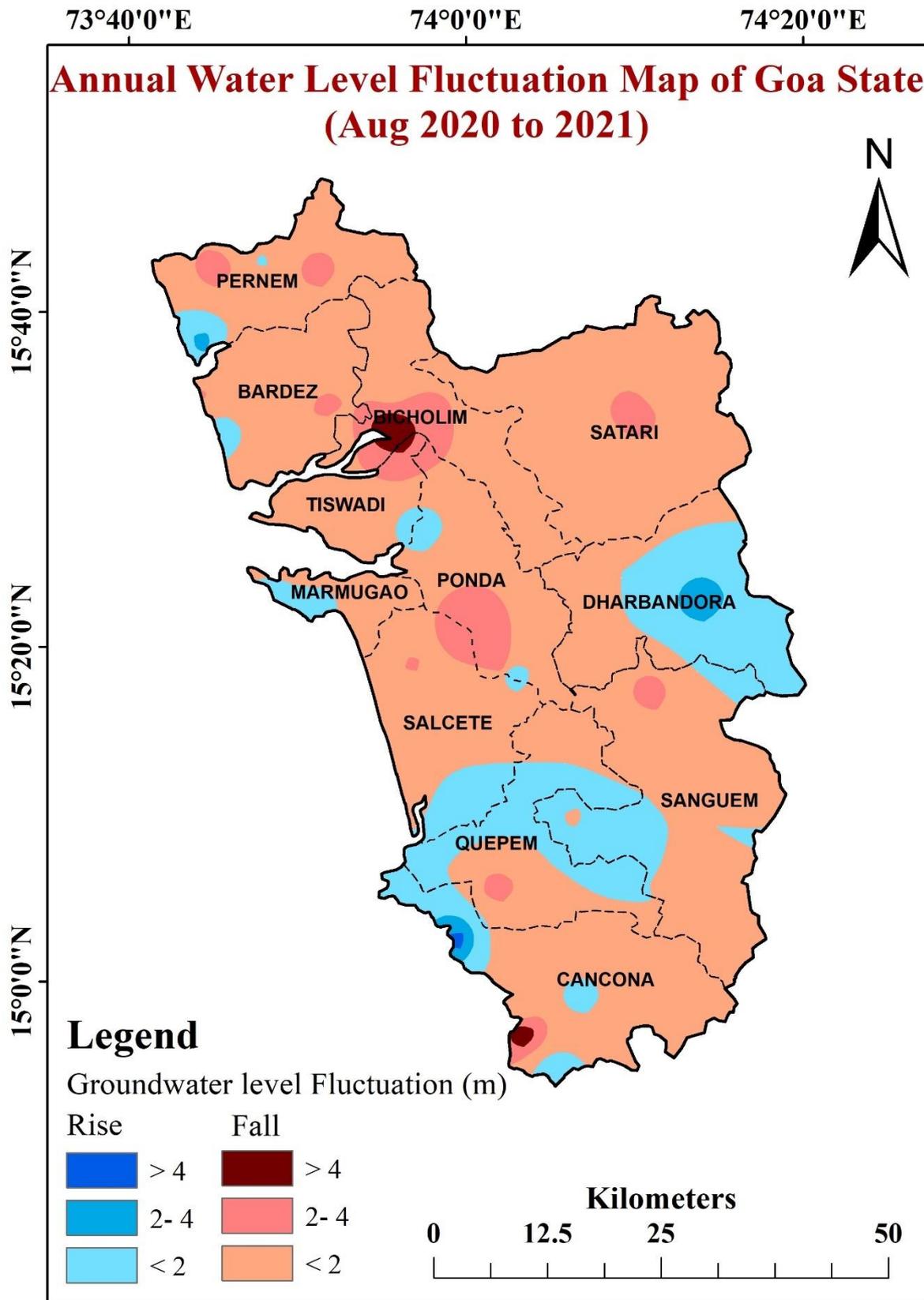
Due to covid-19 lockdown restrictions, water level monitoring was not carried out in the State during August 2020. So last 5 years average of water levels (2015-2019) is considered to represent ground water scenario of August 2020 compared with respect to Aug 2021. The statement showing the distribution 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 24% of wells analyzed, while 76% recorded fall. The fluctuation in water level has been plotted in **Plate IX**.

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 22% of wells analysed and observed in all taluks except Mormugao and Quepem taluks.
2. Rise in the water level in the range of 2-4 m has been observed in 1% of wells analysed and observed in Tiswadi taluk.
3. Rise in the water level in the range of >4 m has been observed in 1% of wells analysed and observed in Bicholim taluk.
4. The fall in water level in the range of 0-2 m has been observed in 71% of wells analysed and noted in almost all taluks.
5. Fall in the water level in the range of 2-4 m has been observed in 4% of wells analysed and observed in Bardez, Bicholim and Tiswadi taluk.
6. The fall in water level more than 4 m has been observed in 1% of wells analysed and noted in Ponda taluk.

Table-13 : Taluk wise categorisation of water level fluctuation (Aug 2020-Aug 2021)

S.No	District Name	No of wells analysed	Fall_Range of Fluctuation (m)						Rise_Range of Fluctuation (m)					
			0-2		2-4		>4		0-2		2-4		>4	
			No of wells	%	No of wells	%	No of wells	%	No of wells	%	No of wells	%	No of wells	%
1	Bardez	12	3	25	0	0	0	0	8	66.7	1	1.3	0	0
2	Bicholim	7	1	14.3	0	0	1	1.3	4	57.1	1	1.3	0	0
3	Canacona	7	1	14.3	0	0	0	0	6	85.7	0	0	0	0
4	Mormugoa	1	0	0	0	0	0	0	1	100	0	0	0	0
5	Pernem	9	1	11.1	0	0	0	0	8	88.9	0	0	0	0
6	Ponda	5	1	20	0	0	0	0	3	60.0	0	0	1	1.3
7	Quepem	2	0	0	0	0	0	0	2	100	0	0	0	0
8	Salcete	9	1	11.1	0	0	0	0	8	88.9	0	0	0	0
9	Sanguem	14	6	42.9	0	0	0	0	8	57.1	0	0	0	0
10	Sattari	9	3	33.3	0	0	0	0	6	66.7	0	0	0	0
11	Tiswadi	4	0	0	1	1.3	0	0	2	50	1	1.3	0	0
	Total	79	17	22	1	1	1	1	56	71	3	4	1	1



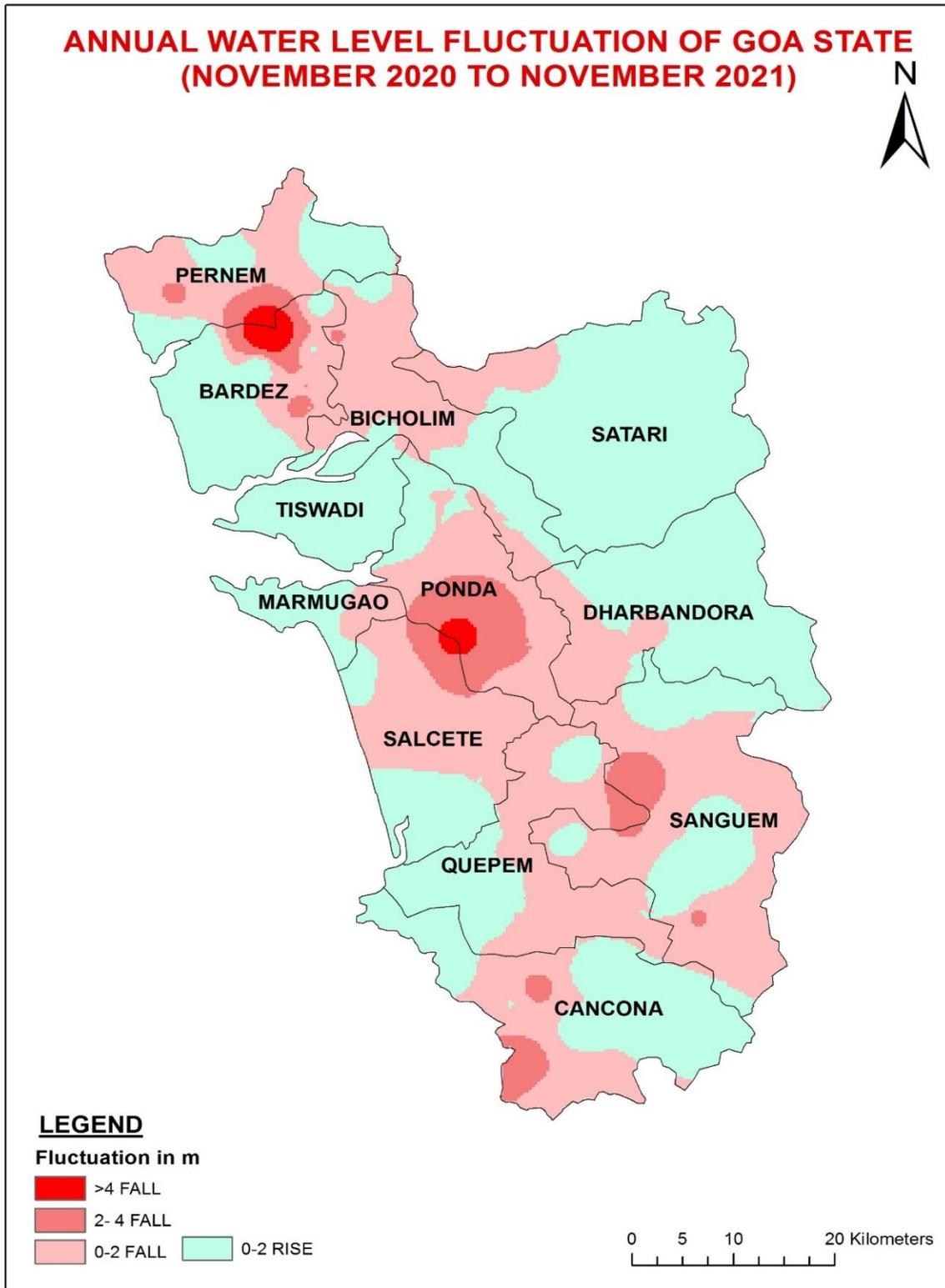
November 2020 & November 2021

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 13% of wells analysed, while 87% recorded fall. The fluctuation in water level has been plotted in **Plate X**. 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 75% 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 9% of wells analysed and noted in Bicholim, Canacona, Pernem and Sanguem taluks.
3. The fall in water level more than 4 m has been observed in 3% of wells analysed and noted in Bardez and Ponda taluks.
4. Rise in the water level in the range of 0-2 m has been observed in 10% of wells analysed and observed in Bardez, Pernem, Quepem, Sanguem, Sattari and Tiswadi taluks.
5. Rise in the water level in the range of 2-4 m has been observed in 3% of wells analysed and observed in Bardez Taluk.

Table - 14: Taluk wise categorisation of water level fluctuation (Nov 2020-Nov 2021)

S.No	District Name	No of wells analysed	Fall_Range of Fluctuation (m)						Rise_Range of Fluctuation (m)					
			0-2		2-4		>4		0-2		2-4		>4	
			No of wells	%	No of wells	%	No of wells	%	No of wells	%	No of wells	%	No of wells	%
1	Bardez	12	8	66.7	0	0	1	8.3	1	8.3	2	16.7	0	0
2	Bicholim	7	6	85.7	1	14.3	0	0	0	0	0	0	0	0
3	Canacona	8	6	75	2	25	0	0	0	0	0	0	0	0
4	Mormugoa	1	1	100	0	0	0	0	0	0	0	0	0	0
5	Pernem	9	6	66.7	1	11.1	0	0	2	22.2	0	0	0	0
6	Ponda	3	2	66.7	0	0	1	33.3	0	0	0	0	0	0
7	Quepem	2	1	50	0	0	0	0	1	50	0	0	0	0
8	Salcete	8	8	100	0	0	0	0	0	0	0	0	0	0
9	Sanguem	14	9	64.3	3	21.4	0	0	2	14.3	0	0	0	0
10	Sattari	7	6	85.7	0	0	0	0	1	14.3	0	0	0	0
11	Tiswadi	4	3	75	0	0	0	0	1	25	0	0	0	0
	Total	75	56	75	7	9	2	3	8	10	2	3	0	0



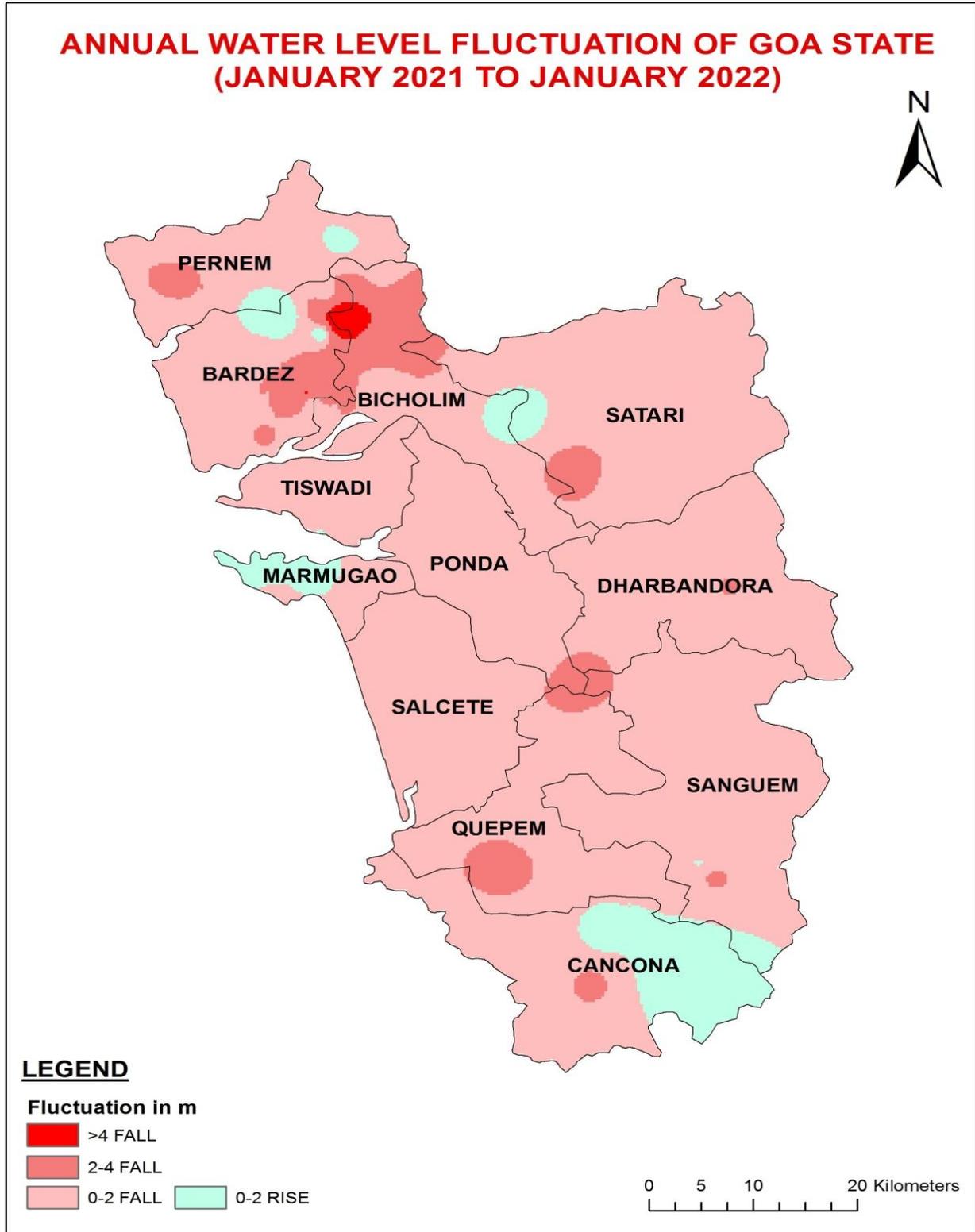
January 2020 & January 2021

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 11% of wells analysed, while 89% recorded fall. The fluctuation in water level has been plotted in **Plate- XI** 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 84% of wells analysed and noticed in taluks.
2. The fall in water level in the range of 2-4 m has been observed in 4% of wells analysed and observed in Bicholim and Quepem taluks.
3. The fall in water level in the range of more than 4m has been observed in 1% of wells analysed and noted in Bicholim taluk.
4. Rise in the water level in the range of 0-2 m has been observed in 11% of wells analysed and noticed in Bardez, Canacona, Pernem, Salcete and Sattari taluks.

Table- 15. Taluk wise categorisation of water level fluctuation (Jan 2021-Jan 2022)

S.No	Taluk Name	No of wells analysed	Fall_Range of Fluctuation (m)						Rise_Range of Fluctuation (m)					
			0-2m		2-4m		>4m		0-2m		2-4m		>4m	
			No of wells	%	No of wells	%	No of wells	%	No of wells	%	No of wells	%	No of wells	%
1	Bardez	11	9	81.8	0	0	0	0	2	18.2	0	0	0	0
2	Bicholim	7	4	57.1	2	28.6	1	14.3	0	0	0	0	0	0
3	Canacona	8	6	75	0	0	0	0	2	25	0	0	0	0
4	Mormugoa	1	1	100	0	0	0	0	0	0	0	0	0	0
5	Pernem	8	7	87	0	0	0	0	1	12.5	0	0	0	0
6	Ponda	4	4	100	0	0	0	0	0	0	0	0	0	0
7	Quepem	3	2	66.7	1	33.3	0	0	0	0	0	0	0	0
8	Salcete	7	6	85.7	0	0	0	0	1	14.3	0	0	0	0
9	Sanguem	13	13	100	0	0	0	0	0	0	0	0	0	0
10	Sattari	8	6	75	0	0	0	0	2	25	0	0	0	0
11	Tiswadi	4	4	100	0	0	0	0	0	0	0	0	0	0
	Total	74	62	84	3	4	1	1	8	11	0	0	0	0



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.

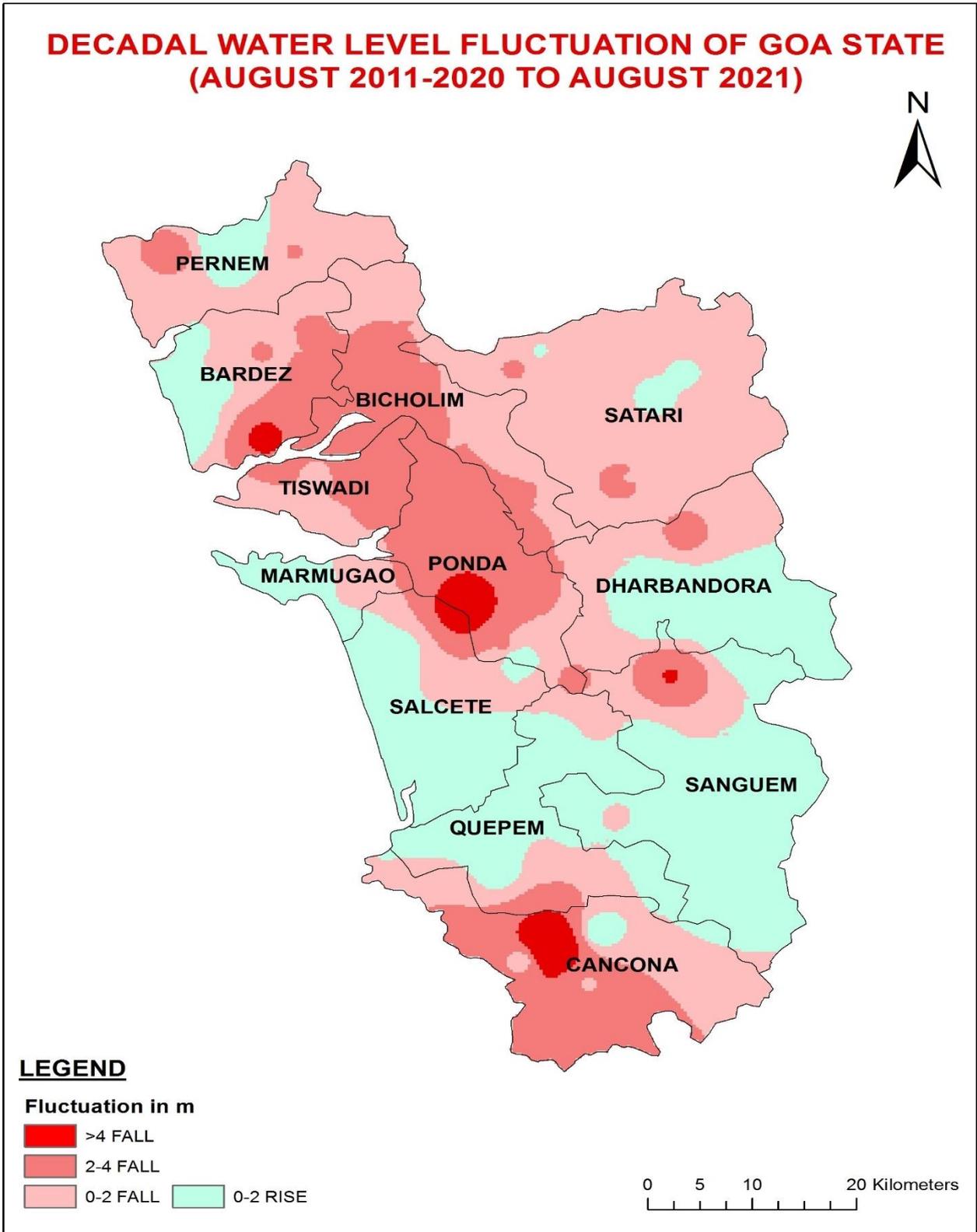
Mean Water Levels for the Period AUGUST (2011-2020) & AUGUST 2021:

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 - XII**. A comparison of water level shows that a fall in the water level is recorded in 92% of wells analysed, while 8% 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 84% 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 6% of wells analysed and noted in Bardez, Ponda and Sanguem taluks.
3. The fall in water level of more than 4 m is observed in 2% 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 8% of wells analysed, noted in Bardez, Pernem, Salcete, Sanguem and Tiswadi taluks.

Table-16: Taluk wise categorisation of water level fluctuation (Decadal mean 2011-2020 & Aug 2021)

S.No	District Name	No of wells analysed	Rise_Range of Fluctuation (m)						Fall_Range of Fluctuation (m)					
			0-2		2-4		>4		0-2		2-4		>4	
			No of wells	%	No of wells	%	No of wells	%	No of wells	%	No of wells	%	No of wells	%
1	Bardez	7	1	14.3	0	0	0	0	4	57.1	2	28.6	0	0
2	Bicholim	3	0	0	0	0	0	0	3	100	0	0	0	0
3	Canacona	6	0	0	0	0	0	0	5	83.3	0	0	1	16.7
4	Pernem	5	1	20	0	0	0	0	4	80	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	1	11.1	0	0	0	0	8	88.9	0	0	0	0
8	Sanguem	13	1	7.7	0	0	0	0	11	84.6	1	7.7	0	0
9	Sattari	9	0	0	0	0	0	0	9	100	0	0	0	0
10	Tiswadi	4	1	25	0	0	0	0	3	75	0	0	0	0
	Total	62	5	8	0	0	0	0	52	84	4	6	1	2



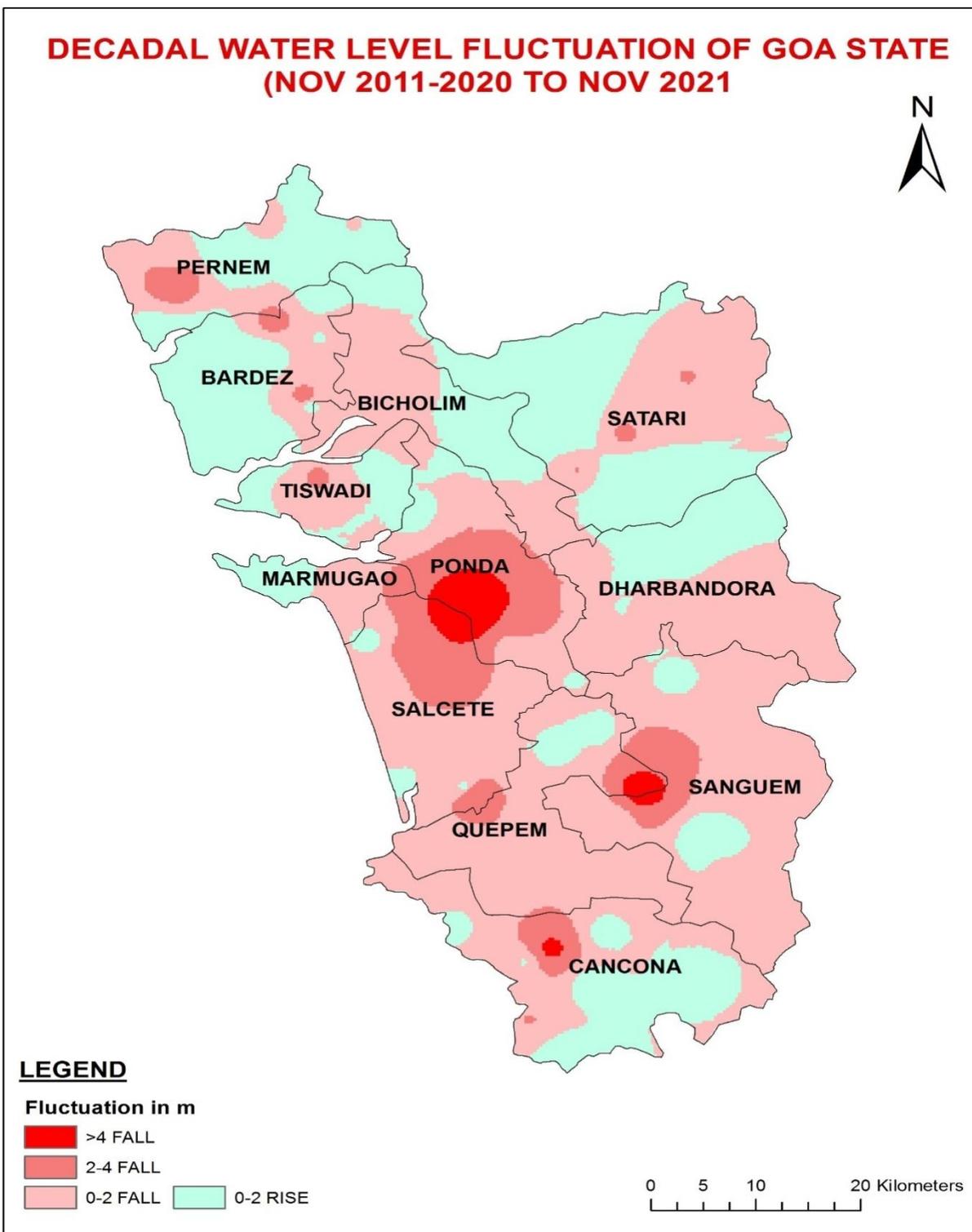
Mean Water Levels for the Period NOVEMBER 2011-2020 & NOVEMBER 2021:

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 - XIII**. A comparison of water level shows that a rise in the water level is recorded in 6% of wells analysed, while 94% 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 86% 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 7% of wells analysed and noted in Bardez, Canacona, Pernem, Quepem and Salcete taluks.
3. The fall in water level more than 4 m has been observed in 1% of wells analysed and noted in Ponda taluk.
4. Rise in the water level in the range of 0-2 m has been observed in 6% of wells analysed, noted in Bardez, Pernem and Sattari taluks.

Table - 17: Taluk wise categorization of water level fluctuation (Decadal mean 2011-2020 & Nov 2021)

S.No	Taluk Name	No of wells analysed	Rise_Range of Fluctuation (m)						Fall_Range of Fluctuation (m)					
			0-2		2-4		>4		0-2		2-4		>4	
			No of wells	%	No of wells	%	No of wells	%	No of wells	%	No of wells	%	No of wells	%
1	Bardez	12	1	8.3	0	0	0	0	10	83.3	1	8.3	0	0
2	Bicholim	7	0	0	0	0	0	0	7	100	0	0	0	0
3	Cancona	8	0	0	0	0	0	0	7	87.5	1	12.5	0	0
4	Mormugao	1	0	0	0	0	0	0	1	100	0	0	0	0
5	Pernem	9	2	22.2	0	0	0	0	6	66.7	1	11.1	0	0
6	Ponda	5	0	0	0	0	0	0	4	80	0	0	1	20
7	Quepem	3	0	0	0	0	0	0	3	100	0	0	0	0
8	Salcete	9	0	0	0	0	0	0	8	88.9	1	11.1	0	0
9	Sanguem	14	0	0	0	0	0	0	13	92.9	1	7.1	0	0
10	Satari	9	2	22.2	0	0	0	0	7	77.8	0	0	0	0
11	Tiswadi	4	0	0	0	0	0	0	4	100	0	0	0	0
	Total	81	5	6	0	0	0	0	70	86	5	7	1	1



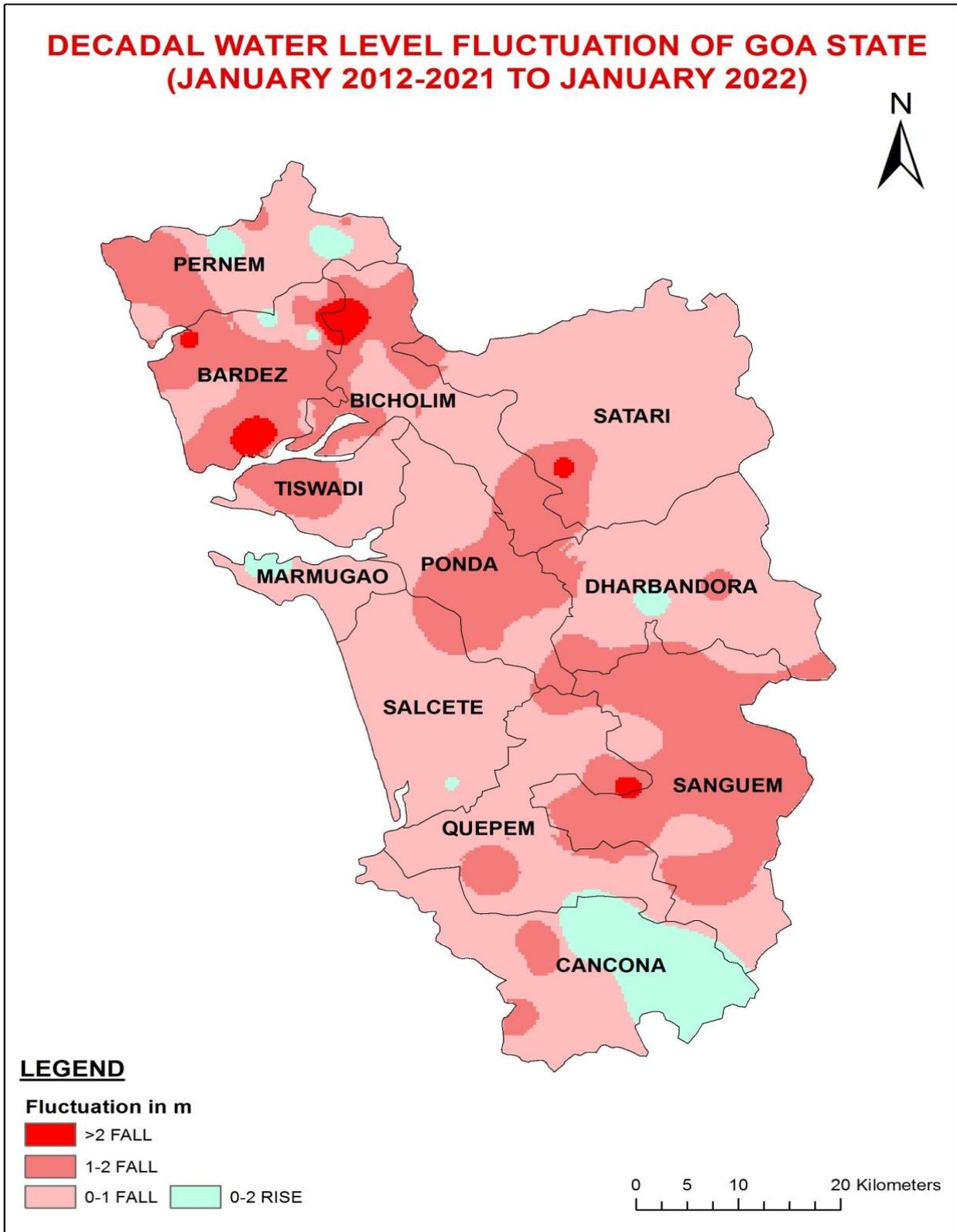
Mean Water Levels for the Period January 2012-2021 & January 2022:

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-XIV**. A comparison of water level shows that a rise in the water level is recorded in 10% of wells analysed, while 90% 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 81% 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 7% of wells analysed and observed in Bardez, Bicholim, Canacona, Ponda and Sanguem taluks.
3. The fall in water level in the range of >4 m has been observed in 2% of wells analysed and noted in Bardez and Bicholim taluks.
4. Rise in the water level in the range of 0-2 m has been observed in 9% of wells analysed, noted Bardez, Canacona, Pernem, Salcete and Sanguem taluks.
5. Rise in the water level in the range of 2-4 m has been observed in 1% of wells analysed, noted in Canacona taluk.

Table - 18: Taluk wise categorisation of water level fluctuation (Decadal mean 2012-2021 & Jan 2022)

S.No	Taluk Name	No of wells analysed	Rise_Range of Fluctuation (m)						Fall_Range of Fluctuation (m)					
			0-2m		2-4m		>4m		0-2m		2-4m		>4m	
			No of wells	%	No of wells	%	No of wells	%	No of wells	%	No of wells	%	No of wells	%
1	Bardez	12	2	16.7	0	0	0	0	8	66.7	1	8.3	1	8.3
2	Bicholim	7	0	0	0	0	0	0	4	57.1	2	28.6	1	14.3
3	Cancona	9	1	11.1	1	11.1	0	0	6	66.7	1	11.1	0	0
4	Mormugao	1	0	0	0	0	0	0	1	100	0	0	0	0
5	Pernem	9	2	22.2	0	0	0	0	7	77.8	0	0	0	0
6	Ponda	5	0	0	0	0	0	0	4	80	1	20	0	0
7	Quepem	3	0	0	0	0	0	0	3	100	0	0	0	0
8	Salcete	9	1	111.1	0	0	0	0	8	88.9	0	0	0	0
9	Sanguem	14	1	7.1	0	0	0	0	12	85.7	1	7.1	0	0
10	Satari	10	0	0	0	0	0	0	10	100	0	0	0	0
11	Tiswadi	4	0	0	0	0	0	0	4	100	0	0	0	0
	Total	83	7	9	1	1	0	0	67	81	6	7	2	2



5. HYDROCHEMISTRY

The quality of shallow groundwater in Goa state has been evaluated by sampling and analysis of water sample collected from Groundwater Monitoring wells. Due to covid-19 lockdown water level monitoring and water sample collection was not carried out in the State during May 2020 and 2021. So total 71 Groundwater Monitoring wells were monitored for water quality during May 2019 were representing pre-monsoon water quality. The summarized results of groundwater quality ranges are given in **Table-19**. The district-wise chemical analysis data of the samples are given in the **Annexure V**.

Table – 19: Summarized results of groundwater quality ranges, (May 2019)

S. No.	Parameters		Range	No. of sample	Percentage
1	Electrical Conductivity $\mu\text{s}/\text{cm}$ at 25°c	Fresh	< 750	70	98.5
		Moderate	751- 2250	01	1.5
		Slightly mineralized	2251- 3000	NIL	0.0
		Highly mineralized	> 3000	NIL	0.0
2	Chloride mg/L	Desirable limit	< 250	71	100.00
		Permissible limit	251-1000	NIL	0.00
		Beyond permissible limit	> 1000	NIL	0.00
3	Fluoride mg/L	Desirable limit	< 1.0	71	100
		Permissible limit	1.1- 1.5	NIL	0.00
		Beyond permissible limit	>1.5	NIL	0.00
4	Nitrate mg/L	Permissible limit	<45	67	93.00
		Beyond permissible limit	> 45	04	7.00

pH

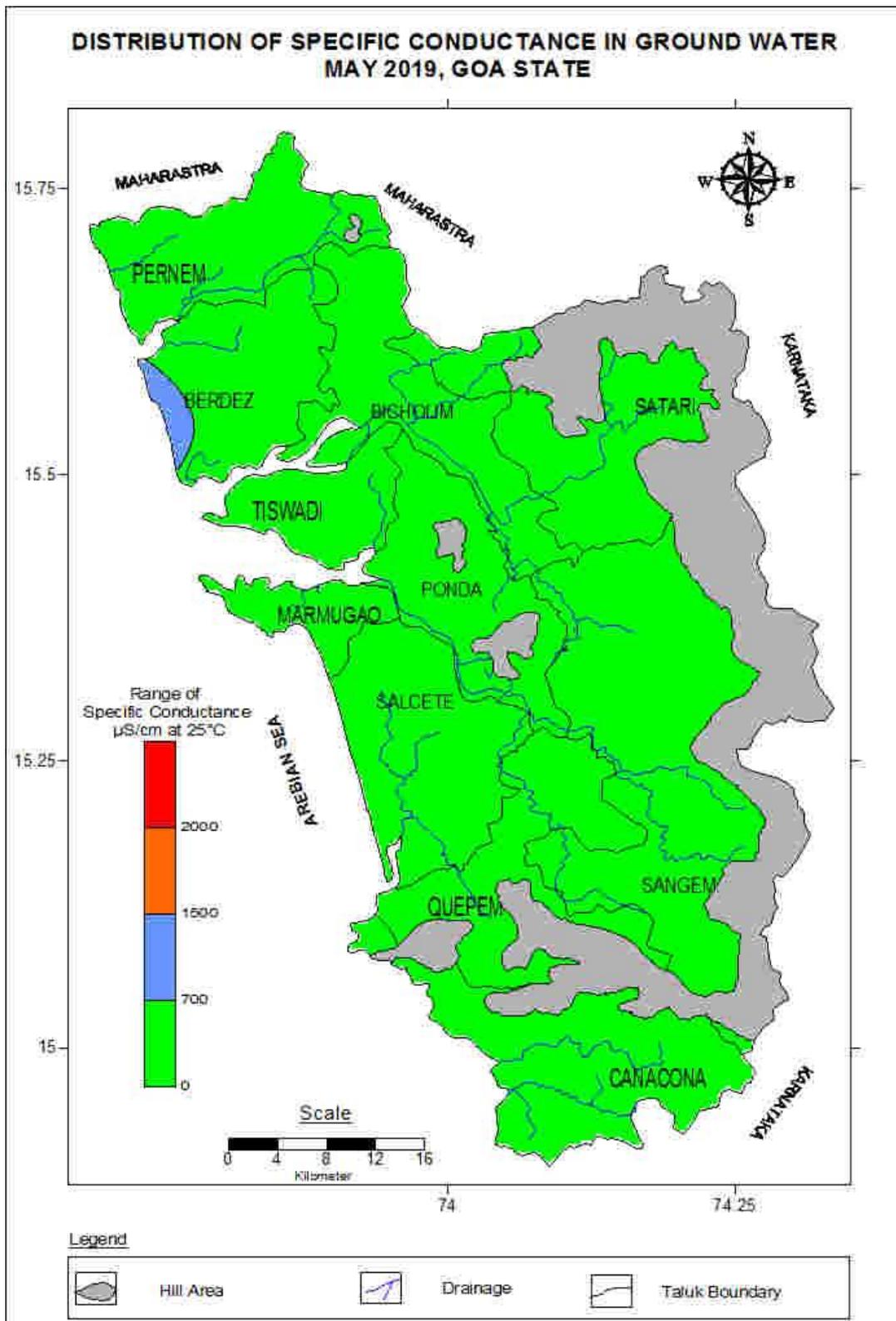
pH is the measure of hydrogen or hydroxyl ion concentration in water. The pH scale is used to predict whether the water is acidic or basic in nature. The pH scale ranges from 0 to 14, the midpoint 7 is taken as neutral and waters having pH < 7 is called acidic, and having pH > 7 is called basic. pH is an important parameter in water chemistry, because geochemical reactions such as oxidation-reduction, dissolution-precipitation are pH dependent. For example, mineral solubility is enhanced under acidic pH, whereas high pH leads to precipitation of minerals such as calcite. Consequently, water having acidic pH would be more corrosive and alkaline pH would lead to the deposition of minerals (encrustation).

In the shallow groundwater of the state, the pH ranged between 6.72 and 9.73. Analysis of the data shows that a major part of state has pH 7 to 8.3. Based on the NHS 2019 data, in about 8% of the area the groundwater pH is between 8.3 and 9.60. The occurrence of pH <7 are sporadic and is insignificant. No pattern of spatial variation is observed with respect to the distribution of pH. In recharge areas, where fresh rainwater gets recharged, groundwater without much dissolution is characterized by low EC values. It increases along groundwater flow path, because of the utilization of H⁺ ions for mineral dissolution leading to the formation of bicarbonate ions with increase of alkalinity.

Electrical Conductivity

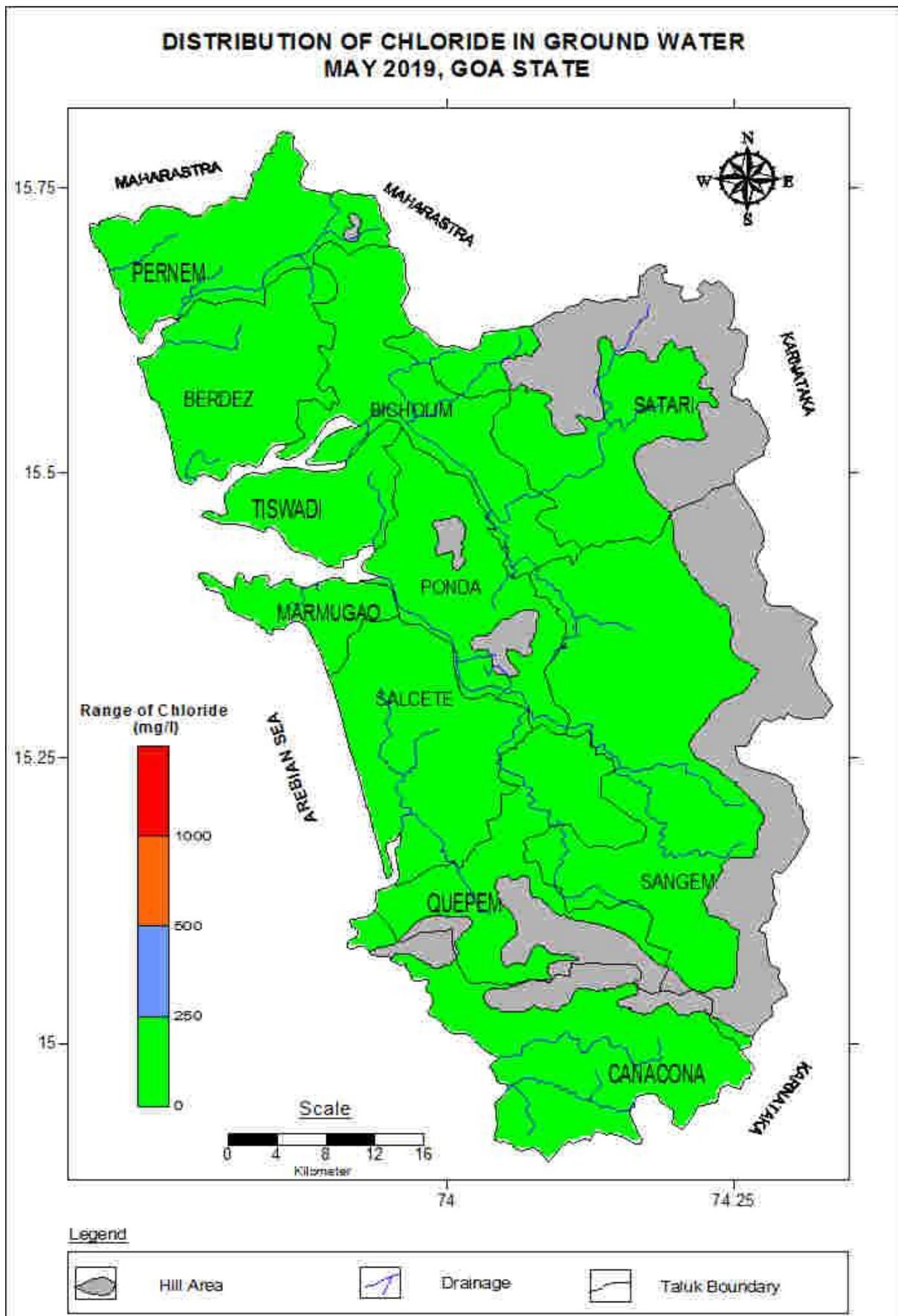
Electrical conductivity (EC) is the indicator of the total mineral content of water and hence it indicates the total dissolved solids (TDS) present in water. TDS of water determines its usefulness to various uses of water. Generally water having TDS <500 mg/L is good for drinking and other domestic uses. However, in the absence of alternative sources TDS up to 2000 mg/L may be used for drinking purposes, however with TDS > 2000 mg/L, palatability decreases. The distribution of EC in the shallow groundwater of Goa state is shown **in Plate XV**.

Electrical conductivity ranged between 121 and 930 $\mu\text{s}/\text{cm}$ at 25°C with an average of 317 $\mu\text{s}/\text{cm}$ at 25°C during May 2019. In general, the groundwater quality in the state is fresh in about 98.5 % of the Groundwater Monitoring wells as indicated by the EC value less than 750 $\mu\text{s}/\text{cm}$ at 25°C. In about 1.5 % of the Groundwater Monitoring wells, the EC is between 751-2250 $\mu\text{s}/\text{cm}$ at 25°C indicating that the groundwater is moderate quality.



Chloride

Chloride is one of the major anion in groundwater. The high mobility of the ion and the high solubility of chloride salts make the chloride ions present in waters. Moreover, chloride ions do not take part in any of the geochemical (or) biochemical reactions, hence it can be used as a good indicator of groundwater pollution. Over 500 mg/L it imports saline taste to drinking water. BIS specified 250 mg/L as the desirable and 1000 mg/L as the permissible limit in the absence of alternate sources for drinking water. Chloride concentration ranged between 11 and 99 mg/l with an average concentration of 24 mg/l during May 2019. The chloride content is less than the desirable limit of 250 mg/L in the entire sample analysed. The spatial distribution of chloride concentration in groundwater of Goa state is shown in **Plate-XVI**.



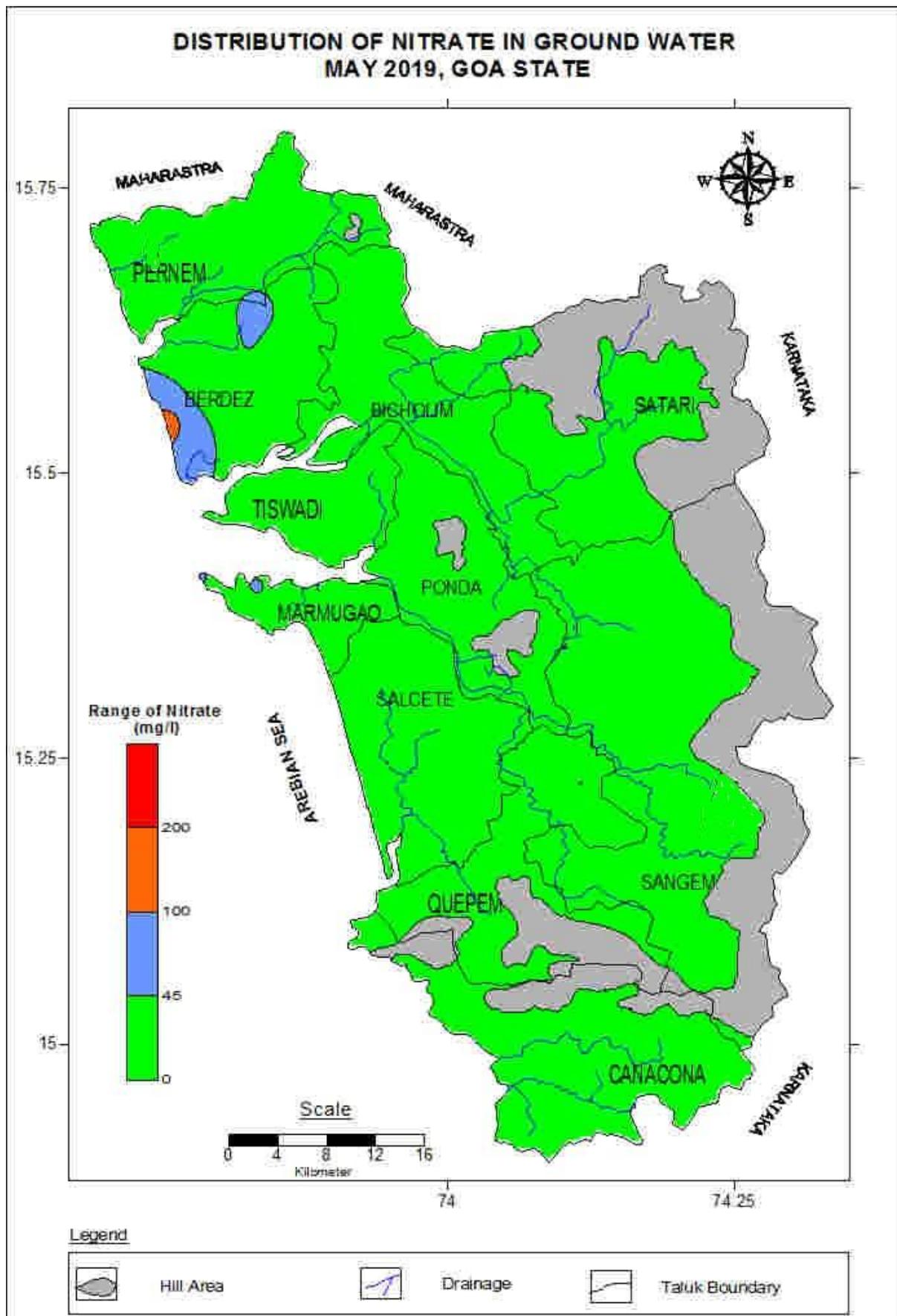
Nitrate (NO₃)

Nitrate is one of the major indicators of anthropogenic sources of pollution. The negative charge and high mobility favors its persistence in nature and transport along the groundwater flow path. Nitrate is the ultimate oxidized product of all nitrogen containing matter and its occurrence in groundwater can be fairly attributed to infiltration of water through soils containing animal waste and fertilizer. A large proportion of this nitrogen gets converted into nitrate which, being soluble in water and not retained by soils, gets leached into water bodies. As the lithogenic sources of nitrogen are very rare, its presence in groundwater is almost due to anthropogenic activity.

NO₃ is an oxidizing agent and is readily oxidizes haemoglobin (Hb) in to methaemoglobin (MeHb) a blue coloured pigment and gets reduced to NO₂. The oxidized Hb impairs seriously the oxygen carrying capacity of the blood and thus causes hypoxia, which may have fatal consequences in anaemic individuals and infants under 8 weeks of age. The MeHb formed in the infant blood gives a characteristic bluish to the skin and mucous membrane, thus giving the name "Blue Baby Syndrome". This condition is particularly important in the case of infants because the infant and the foetal – Hb, which is $\alpha_2\gamma_2$ type has greater affinity for oxygen (O₂) than adult Hb which is $\alpha_2\beta_2$ type. Thus the Me-Hb formed in the foetal blood severely impairs the oxygen carrying capacity of the blood in infants, causing the blue baby disease.

In addition to methemoglobinemia, excess nitrate may cause oral cancer, cancer of the colon, rectum and other gastrointestinal cancers, Alzheimer's disease, vascular dementia, absorptive, secretive functional disorders of the intestinal mucosa, changes in the maturation, differentiation and apoptosis in intestinal crypts, multiple sclerosis, reduced casein digestion, development of tolerance (lowering of response) to nitrate drugs and recurrent stomatitis in human beings. Nitrate may gets reduced to Nitrite (NO₂) in the intestinal tracts, which may further react with amino acids to form nitrosoamines which are potential carcinogens. Consumption of high nitrate containing water may cause adverse effect on the cardiovascular system and central nervous system. BIS specified 45mg/L as the as the permissible limit for drinking water.

Nitrate concentration ranged between 0 and 122 mg/l with an average concentration of 9 mg/L during May 2019. The Nitrate content is less than 45mg/L in about 93 % of the sample analyzed and 7 % of sample shows more than 45 mg/L which are from North Goa district. The distribution of nitrate in shallow groundwater is shown as contour map **in Plate XVII.**



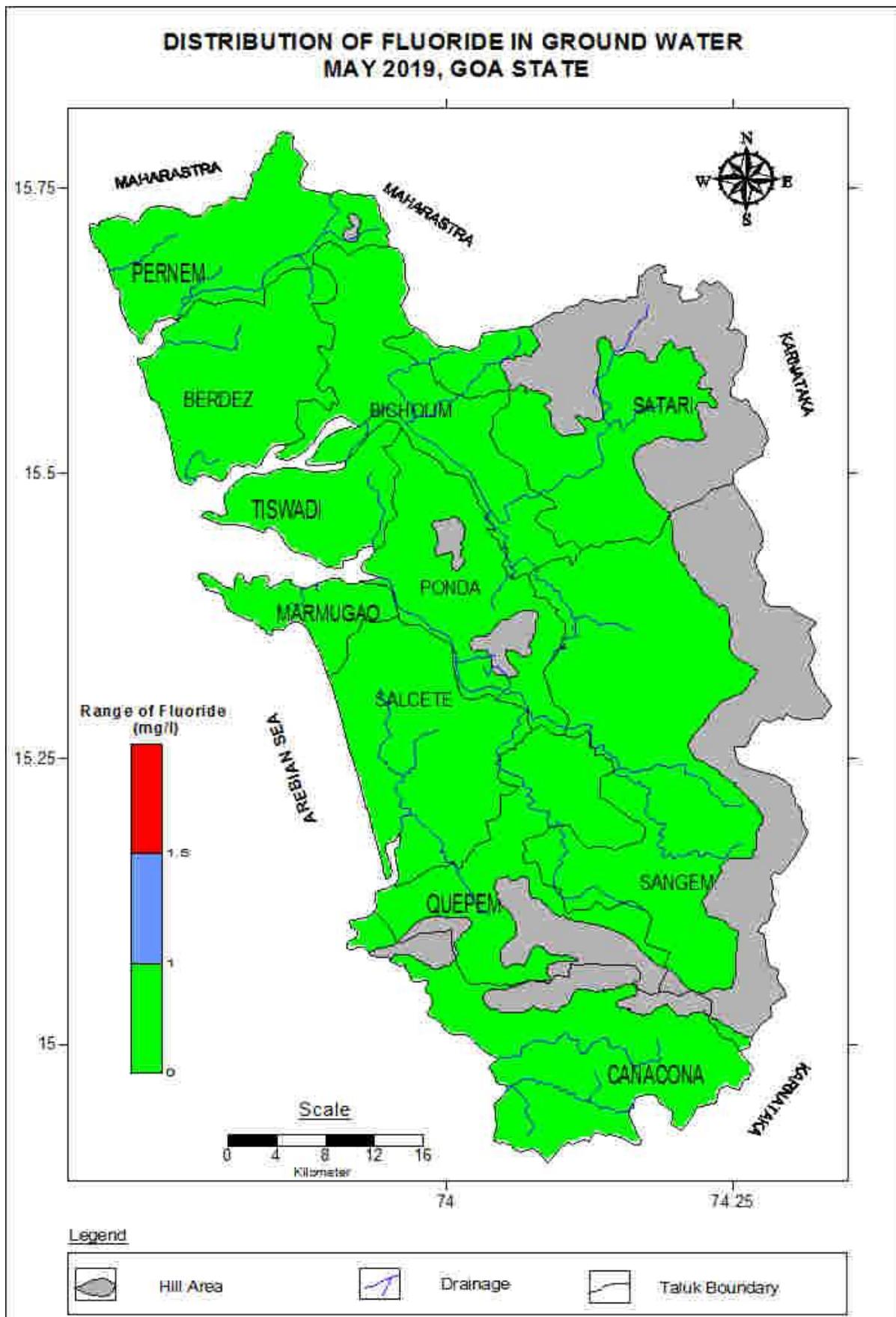
Fluoride

Fluoride is the most electronegative element and highly reactive, thus combining with all other elements to form covalent fluorides. Fluoride exists naturally in all waters derived from the dissolution of fluoride containing minerals. Surface water generally has low fluoride while groundwater may have high concentrations of fluoride as has been found in many parts of the world.

The formation of high fluoride groundwaters is principally governed by climate, composition of bedrock and hydrogeology. Areas with semi arid climate, crystalline, igneous bedrock, and alkaline soils are the most affected. The common fluoride bearing minerals are Fluorspar (CaF_2), Cryolite (Na_3AlF_6), Fluorapatite ($\text{Ca}_{10}\text{F}_2(\text{PO}_4)_6$), Amphiboles such as hornblende. Fluoride is an impurity commonly found in phosphatic fertilizers used in the agriculture. Accumulation of fluoride in the soils eventually results in leaching by percolation into the groundwater aquifer and thereby increases the concentration of fluoride level.

It is generally accepted that minor amounts of fluoride is beneficial for teeth and bones. Around 1.0 mg/L greatly reduces the incidence of dental carries. At a levels over 1.5 mg/L, fluoride can cause a mottled discolouring and malformation of teeth. Very high concentration of fluoride can produce skeletal change. Hence, BIS specified 1.0 mg/L as the desirable limit and 1.5 mg/L as the permissible limit in the absence of alternate sources for drinking water.

Fluoride concentration ranged between 0.01 and 0.88 mg/L with an average concentration of 0.51 mg/L during May 2019. The Fluoride content is less than 1.5 mg/L in all the 71 samples collected from National Hydrograph stations. Distribution of fluoride is shown in Plate-XVIII.



V. CONCLUSIONS

The behaviour of ground water table during May 2021 to January 2022 in Goa State has been studied by monitoring the dug wells tapping phreatic aquifers. As water level is not monitored during May, average water level of 5 years is calculated and analyzed. The data on water levels was analysed in detail and salient features are as under.

- 89% of wells have recorded depth to water level within 10 m bgl during pre-monsoon period (May 2015 to 2019), whereas during post-monsoon period (November 2020), about 94% of wells recorded water level less than 10 m bgl.
- 94% of wells have recorded depth to water level within 10m bgl during August 2021 and 84% during January 2022.
- 24% of wells have recorded rise in water levels and 76% of wells recorded fall in water levels during August 2021 in comparison to August 2020.
- 13% of wells have recorded rise in water levels and 87% of wells recorded fall in water levels during November 2021 in comparison to November 2020.
- 11% of wells have recorded rise in water levels and 89% of wells recorded fall in water levels during January 2022 in comparison to January 2021.
- 8% of wells have recorded rise in water levels and 92 % of wells have recorded fall in water level during August 2021 wrt respective decadal means.
- 10% of wells have recorded rise in water levels and 90 % of wells have recorded fall in water level 6% of wells have recorded rise in water levels and 94 % of wells have recorded fall in water level during November 2021 wrt respective decadal means during January 2022 wrt respective decadal means.
- Fall in water levels may be due to localised over extraction of ground water.
- In general, the groundwater quality in the state is fresh in about 98.5 % of the Groundwater Monitoring wells as indicated by the EC value less than 750 $\mu\text{s}/\text{cm}$ at 25°C. In about 1.5 % of the Groundwater Monitoring wells, the EC is more than 3000 $\mu\text{s}/\text{cm}$ at 25°C indicating that the groundwater is highly mineralized.
- The chloride content is less than 250 mg/L in the entire sample analysed.
- The Fluoride content is less than 1.5 mg/L in all the 71 samples collected from Ground Water Level Monitoring stations.

- The Nitrate content is less than 45mg/L in about 93 % of the sample analysed and 7 % of sample shows more than 45 mg/L which are from North Goa district.

VI. ACKNOWLEDGEMENT

The authors express their gratitude to. Shri.N.Jyothi Kumar, Sc., E Regional Director, Central Ground Water Board, South Western Region, Bangalore, for his constant encouragement throughout the task of compilation and analysis of voluminous data. They express their gratitude to him for the keen interest evinced by him in the report as also for the suggestions offered by him vis-à-vis some aspects for improving their lucidity, which have enhanced not only the form but also the contents of the final report. The authors also profusely thank the hard and arduous work put in by various field officers who diligently collected data and water samples from the field, which forms the base for this report. The authors profoundly thank the huge contribution made by the Officers and staff of the Water Quality Laboratory who have analysed the large number of water samples and interpreted the analysis results thereof. The authors would be failing in their duty if they do not acknowledge the unstinting cooperation offered by their various colleagues who have contributed in a major way in bringing out this report.

Annexure I: Water level data of Goa State MAY- Average WL (2015-2019)			
District	Site Type	Site Name	Average WL May (2015-2019)
North Goa	Bore Well	Adavapal	5.46
North Goa	Bore Well	Ajosi	4.36
North Goa	Bore Well	Aldona	15.92
North Goa	Bore Well	Asapur	6.04
North Goa	Bore Well	Betki	16.88
North Goa	Bore Well	Colvale	15.43
North Goa	Bore Well	Kasar Pal	9.47
North Goa	Bore Well	Kirl Pirna	9.35
North Goa	Bore Well	Korgoan	11.35
North Goa	Bore Well	Krilwada	1.54
North Goa	Bore Well	Madakai	21.18
North Goa	Bore Well	Mayam	5.24
North Goa	Bore Well	Mola	0.80
North Goa	Bore Well	Morjum	2.79
North Goa	Bore Well	Narve	12.67
North Goa	Bore Well	Parsekarwada	16.21
North Goa	Bore Well	Sanqulim	21.63
North Goa	Bore Well	Sawantwada	4.95
North Goa	Bore Well	Silolieum	5.14
North Goa	Bore Well	Tivim	20.79
North Goa	Bore Well	Varkhand	14.88
North Goa	Dug Well	Adavapal	5.58

North Goa	Dug Well	Alto Betim Porvorim	7.93
North Goa	Dug Well	Amberem	7.19
North Goa	Dug Well	Anjuna Beach	11.72
North Goa	Dug Well	Bayalwadikeri(querim)	1.88
North Goa	Dug Well	Bhamber(Nanoda Cross)	4.89
North Goa	Dug Well	Bhujpal	4.72
North Goa	Dug Well	Bicholim(pz)	15.76
North Goa	Dug Well	Bori	2.63
North Goa	Dug Well	Britona	1.97
North Goa	Dug Well	Calangute	8.32
North Goa	Dug Well	Charayode	4.62
North Goa	Dug Well	Colval	14.18
North Goa	Dug Well	Devulawada Narve	16.65
North Goa	Dug Well	Dhatwado Vante	8.01
North Goa	Dug Well	Gavalebhat, Chimbhel(kirl)	4.85
North Goa	Dug Well	Hasaravanni Vaipal	2.73
North Goa	Dug Well	Haspur	5.18
North Goa	Dug Well	Honda	3.67
North Goa	Dug Well	Jambhul Batt(mayam Lake)	3.19
North Goa	Dug Well	Karanjhalen	3.00
North Goa	Dug Well	Khadki(harijanwada)	9.11
North Goa	Dug Well	Khotodem	5.75
North Goa	Dug Well	Korgaon	4.61
North Goa	Dug Well	Kundel Dassolwada	1.83
North Goa	Dug Well	Mankem	4.14

North Goa	Dug Well	Mapuca	3.61
North Goa	Dug Well	Morji	2.00
North Goa	Dug Well	Morlem	3.57
North Goa	Dug Well	Mulgaon Shivalkherwad	3.08
North Goa	Dug Well	Nagargoan	7.05
North Goa	Dug Well	Nagjhar	7.46
North Goa	Dug Well	Olaulim	5.44
North Goa	Dug Well	Panchawadi(pz)	6.84
North Goa	Dug Well	Parra	2.22
North Goa	Dug Well	Pernem	3.14
North Goa	Dug Well	Pirna	3.45
North Goa	Dug Well	Pomburpa Palmar	2.90
North Goa	Dug Well	Sal	2.83
North Goa	Dug Well	Salwardhar Dumun	2.87
North Goa	Dug Well	Sawanthwada(mandrem)	3.48
North Goa	Dug Well	Shiroda	6.05
North Goa	Dug Well	Shivoli (brahmanwada)	3.30
North Goa	Dug Well	Sirsaim	3.81
North Goa	Dug Well	Surla(pz)	19.11
North Goa	Dug Well	Uguem(ugawe)	3.40
North Goa	Dug Well	Valpoi	5.16
North Goa	Dug Well	Velha Goa	1.67
South Goa	Bore Well	Aven	10.25
South Goa	Bore Well	Bogmola	0.50
South Goa	Bore Well	Canabonulim	5.07

South Goa	Bore Well	Carmona	6.69
South Goa	Bore Well	Cavelosim	3.58
South Goa	Bore Well	Chandavar	4.45
South Goa	Bore Well	Chinchinim	2.68
South Goa	Bore Well	Collem	6.19
South Goa	Bore Well	Dabel	12.64
South Goa	Bore Well	Dovorlim	4.83
South Goa	Bore Well	Kalay	4.96
South Goa	Bore Well	Manora Rai	4.85
South Goa	Bore Well	Meidawada	11.80
South Goa	Bore Well	Molem	9.39
South Goa	Bore Well	Morlem	5.06
South Goa	Bore Well	Nanoda	19.93
South Goa	Bore Well	Paddi Quiescend	15.44
South Goa	Bore Well	Patnem	7.96
South Goa	Bore Well	Ponquini	9.40
South Goa	Bore Well	Severdem	14.82
South Goa	Bore Well	Thane	9.79
South Goa	Bore Well	Verna	1.97
South Goa	Bore Well	Yedda	10.44
South Goa	Dug Well	Agonda Desaiwada	4.16
South Goa	Dug Well	Akamol Ambavalli	4.34
South Goa	Dug Well	Bagmola	3.07
South Goa	Dug Well	Ballynuvhen	6.25
South Goa	Dug Well	Barodi Velni (betul)	3.40

South Goa	Dug Well	Betalbatti	6.51
South Goa	Dug Well	Bhati	4.90
South Goa	Dug Well	Bolkharnem	6.75
South Goa	Dug Well	Canacona	4.73
South Goa	Dug Well	Chikalim	2.28
South Goa	Dug Well	Collem(kolamba)	8.80
South Goa	Dug Well	Cuncalim	2.87
South Goa	Dug Well	Cuncalim(pz)	5.33
South Goa	Dug Well	Daptamol Lolien	14.87
South Goa	Dug Well	Darbandahra(pz)	9.69
South Goa	Dug Well	Deulwada Kolamba	2.73
South Goa	Dug Well	Fathorda Margao(pz)	3.75
South Goa	Dug Well	Ghadiawada	1.66
South Goa	Dug Well	Guddemal	11.97
South Goa	Dug Well	Gulem Velipwada	3.88
South Goa	Dug Well	Hattipal Poinguinem	8.43
South Goa	Dug Well	Jambavli	9.14
South Goa	Dug Well	Kalay	9.86
South Goa	Dug Well	Kapsa	6.15
South Goa	Dug Well	Kaveslium	3.54
South Goa	Dug Well	Majorda Bpada Curilo	5.58
South Goa	Dug Well	Malkarnem	7.26
South Goa	Dug Well	Mashe	4.39
South Goa	Dug Well	Molem	13.94
South Goa	Dug Well	Navelim	4.70

South Goa	Dug Well	Netrolim	9.94
South Goa	Dug Well	Padi	13.23
South Goa	Dug Well	Polem(polen)	5.34
South Goa	Dug Well	Ponquini	8.99
South Goa	Dug Well	Quepem	2.98
South Goa	Dug Well	Revona	8.01
South Goa	Dug Well	Shrishtal Gaondongar	7.26
South Goa	Dug Well	Sristal	7.23
South Goa	Dug Well	Suktali (molem)	5.27
South Goa	Dug Well	Themchewada	8.70
South Goa	Dug Well	Vadam	5.03
South Goa	Dug Well	Vichundrem	7.59
South Goa	Dug Well	Yedda	4.96

Annexure II: Water level data of Groundwater monitoring wells in Goa (August 2021)			
District	Village	Well Type	Water Level
North Goa	Calangute	Dug well	3.19
North Goa	Alto Betim Porvorim	Dug well	6.27
North Goa	Sirsaim	Dug well	3
North Goa	Mapuca	Dug well	2.95
North Goa	Parra	Dug well	1.4
North Goa	Anjuna Beach	Dug well	9.51
North Goa	Shivoli (brahmanwada)	Dug well	1.15
North Goa	Britona	Dug well	2.28
North Goa	Colval	Dug well	11.1
North Goa	Pirna	Dug well	2.21
North Goa	Pomburpa Palmar	Dug well	3.7
North Goa	Salwardhar Dumun	Dug well	3.15
North Goa	Sal	Dug well	2.53
North Goa	Mulgaon Shivalkherwad	Dug well	2.86
North Goa	Adavapal	Dug well	5.65
North Goa	Olaulim	Dug well	5.15
North Goa	Devulawada Narve	Dug well	14.19
North Goa	Jambhul Batt(mayam Lake)	Dug well	1.85
North Goa	Dhatwado Vante	Dug well	2.89
North Goa	Uguem(ugawe)	Dug well	3.79
North Goa	Morji	Dug well	1.22
North Goa	Pernem	Dug well	2.75
North Goa	Nagjhar	Dug well	8.1

North Goa	Korgaon	Dug well	4.65
North Goa	Sawanthwada(mandrem)	Dug well	1.65
North Goa	Amberem	Dug well	7
North Goa	Haspur	Dug well	4.55
North Goa	Hasaravanni Vaipal	Dug well	2.5
North Goa	Shiroda	Dug well	6.18
North Goa	Panchawadi(pz)	Dug well	5.35
North Goa	Mankem	Dug well	2.57
North Goa	Bori	Dug well	5.4
North Goa	Kundel Dassolwada	Dug well	1.87
North Goa	Bayalwadikeri(querim)	Dug well	2.28
North Goa	Morlem	Dug well	3.95
North Goa	Honda	Dug well	2.73
North Goa	Valpoi	Dug well	3.35
North Goa	Khadki(harijanwada)	Dug well	4.7
North Goa	Bhamber(Nanoda Cross)	Dug well	3.58
North Goa	Nagargoan	Dug well	1.41
North Goa	Bhujpal	Dug well	1.95
North Goa	Charayode	Dug well	2.39
North Goa	Khotodem	Dug well	4.93
North Goa	Velha Goa	Dug well	2.21
North Goa	Karanjhalen	Dug well	2.3
North Goa	Gavalebhat, Chimbhel(kirl)	Dug well	3.65
NORTH GOA	VARKHAND(Govt.Primary School)	Bore well	12.65
NORTH GOA	HASSAPUR (Govt. Primary School)	Bore well	4.24

NORTH GOA	SILOLIEUM (Government Hospital)	Bore well	4.46
NORTH GOA	AROPORA (Govt. Primary School)	Bore well	GL
NORTH GOA	MORJUM (GOVT. PRIMARY SCHOOL)	Bore well	2.22
NORTH GOA	SAWANTWADA (Govt. Primary School)	Bore well	3.92
NORTH GOA	MOLA (GOVT. PRIMARY SCHOOL)	Bore well	1.15
NORTH GOA	AJOSI (Neura) Panchayat Land Near Community Hall	Bore well	3.28
NORTH GOA	KRILWADA (Govt. Primary School)	Bore well	1.33
NORTH GOA	KORGOAN (Govt.Primary.School)	Bore well	10.84
NORTH GOA	MORLEM (Panchayat Office)	Bore well	3.95
NORTH GOA	COLVALE (Government Hospital)	Bore well	12.4
NORTH GOA	THANE (Panchayat Office)	Bore well	5.85
NORTH GOA	NANODA (Police Training Centre)	Bore well	17.71
NORTH GOA	SANVORDAM (PANCHAYAT OFFICE)	Bore well	11.46
NORTH GOA	KIRL PIRNA (Govt. Primary School)	Bore well	4.92
NORTH GOA	ADAVAPAL (Government Hospital)	Bore well	4.12
NORTH GOA	TIVIM (GOVT. PRIMARY SCHOOL)	Bore well	18.05
NORTH GOA	MAYAM (GOVT. PRIMARY SCHOOL)	Bore well	5.35
NORTH GOA	NARVE (GOVT. PRIMARY SCHOOL)	Bore well	11.72
NORTH GOA	SANQULIM (Government Hospital)	Bore well	18.19
NORTH GOA	KASAR PAL (Govt.High School)	Bore well	8.9
NORTH GOA	BETKI (Government Hospital)	Bore well	14.66
NORTH GOA	MADAKAI (IDC)	Bore well	8.1
South Goa	Shrishtal Gaondongar	Dug well	3.98

South Goa	Canacona	Dug well	2.27
South Goa	Agonda Desaiwada	Dug well	2.9
South Goa	Hattipal Poinguinem	Dug well	6.3
South Goa	Daptamol Loliem	Dug well	15.84
South Goa	Polem(polen)	Dug well	1.8
South Goa	Sristal	Dug well	10.19
South Goa	Bagmola	Dug well	3.1
South Goa	Ghadiawada	Dug well	1.66
South Goa	Quepem	Dug well	1.72
South Goa	Kapsa	Dug well	4.07
South Goa	Majorda Bpada Curilo	Dug well	2.34
South Goa	Ballynuvhen	Dug well	5.64
South Goa	Cuncalim(pz)	Dug well	4.75
South Goa	Kavesliem	Dug well	1.81
South Goa	Chikalim	Dug well	0.94
South Goa	Mashe	Dug well	3.41
South Goa	Betalbatti	Dug well	2.4
South Goa	Cuncalim	Dug well	1.25
South Goa	Padi	Dug well	6.57
South Goa	Bolkharnem	Dug well	5.41
South Goa	Molem	Dug well	1.9
South Goa	Deulwada Kolamba	Dug well	2.6
South Goa	Netrolim	Dug well	9.15
South Goa	Malkarnem	Dug well	8.28
South Goa	Vichundrem	Dug well	1.05

South Goa	Vadam	Dug well	3.35
South Goa	Suktali (molem)	Dug well	4.4
South Goa	Kalay	Dug well	10.41
South Goa	Themchewada	Dug well	6.84
South Goa	Bhati	Dug well	3.2
South Goa	Guddemal	Dug well	7.05
South Goa	Jambavli	Dug well	6.61
South Goa	Revona	Dug well	5.8
South Goa	Collem(kolamba)	Dug well	3.37
SOUTH GOA	DABEL (Govt. Primary School)	Bore well	7.17
SOUTH GOA	YEDDA (Govt. Primary School)	Bore well	3.46
SOUTH GOA	AVEN(GOVT.HIGH SCHOOL)	Bore well	4.66
SOUTH GOA	PONQUINI (Govt. Primary School)	Bore well	8.55
SOUTH GOA	PATNEM (Govt. Primary School)	Bore well	2.51
SOUTH GOA	CHINCHINIM (Govt. Hospital)	Bore well	0.51
SOUTH GOA	CHANDVAR (Govt. Hospital)	Bore well	1.92
SOUTH GOA	MANORA RAI (Govt. Primary School)	Bore well	4.35
SOUTH GOA	KAVELOSIM (Govt. Primary School)	Bore well	1.31
SOUTH GOA	CANABONULIM (Panchayat Office)	Bore well	3.79
SOUTH GOA	VERNA (PANCHAYAT OFFICE)	Bore well	0.96
SOUTH GOA	QUIESCOND (Govt.Primary.School)	Bore well	9.17
SOUTH GOA	COLLEM (Government Hospital)	Bore well	2.49
SOUTH GOA	MEIDAWADA (Govt. Primary School)	Bore well	5.24
SOUTH GOA	MOLEM (PANCHAYAT OFFICE)	Bore well	1.41

Annexure III: Water level data of Groundwater monitoring wells Goa (November 2021)

District	Village	Well type	Water Level
North Goa	Calangute	Dug well	5.09
North Goa	Alto Betim Porvorim	Dug well	4.19
North Goa	Sirsaim	Dug well	3.62
North Goa	Mapuca	Dug well	3.16
North Goa	Parra	Dug well	1.54
North Goa	Anjuna Beach	Dug well	13.14
North Goa	Shivoli (brahmanwada)	Dug well	1.62
North Goa	Britona	Dug well	2.47
North Goa	Colval	Dug well	11.61
North Goa	Pirna	Dug well	2.25
North Goa	Pomburpa Palmar	Dug well	3.7
North Goa	Salwardhar Dumun	Dug well	3.52
North Goa	Alto Betim Porvorim	Dug well	6.27
North Goa	Sal	Dug well	3.14
North Goa	Mulgaon Shivalkherwad	Dug well	3.65
North Goa	Adavapal	Dug well	6.1
North Goa	Olaulim	Dug well	5.29
North Goa	Devulawada Narve	Dug well	15.17
North Goa	Jambhul Batt(mayam Lake)	Dug well	2.38
North Goa	Dhatwado Vante	Dug well	6.27
North Goa	Uguem(ugawe)	Dug well	4.32
North Goa	Morji	Dug well	1.1
North Goa	Pernem	Dug well	2.94

North Goa	Nagjhar	Dug well	8.46
North Goa	Korgaon	Dug well	4.78
North Goa	Sawanthwada(mandrem)	Dug well	4.34
North Goa	Amberem	Dug well	7.78
North Goa	Haspur	Dug well	4.82
North Goa	Hasaravanni Vaipal	Dug well	2.48
North Goa	Shiroda	Dug well	7.28
North Goa	Panchawadi(pz)	Dug well	6.95
North Goa	Mankem	Dug well	4.5
North Goa	Bori	Dug well	6.38
North Goa	Kundel Dassolwada	Dug well	2.07
North Goa	Bayalwadikeri(querim)	Dug well	2.77
North Goa	Morlem	Dug well	4.48
North Goa	Honda	Dug well	3.1
North Goa	Valpoi	Dug well	5.71
North Goa	Khadki(harijanwada)	Dug well	6.4
North Goa	Bhamber(Nanoda Cross)	Dug well	5.25
North Goa	Nagargoan	Dug well	4.6
North Goa	Bhujpal	Dug well	2.14
North Goa	Khotodem	Dug well	6.4
North Goa	Velha Goa	Dug well	1.64
North Goa	Karanjhalen	Dug well	2.64
North Goa	Gavalebhat, Chimbhel(kirl)	Dug well	4.15
North Goa	Varkhand	Bore well	13.76
North Goa	Silolieum	Bore well	4.88

North Goa	Aropora	Bore well	0.51
North Goa	Morjum	Bore well	2.33
North Goa	Sawantwada	Bore well	4.34
North Goa	Mola	Bore well	1.48
North Goa	Ajosi	Bore well	4.48
North Goa	Krilwada	Bore well	1.95
North Goa	Korgoan	Bore well	11.13
North Goa	Kirl Pirna	Bore well	2.25
North Goa	Adavapal	Bore well	4.75
North Goa	Tivim	Bore well	17.49
North Goa	Mayam	Bore well	6
North Goa	Narve	Bore well	12.34
North Goa	Sanqulim	Bore well	22.58
North Goa	Kasar Pal	Bore well	9.46
North Goa	Betki	Bore well	15.59
North Goa	Madakai	Bore well	14.92
South Goa	Shrishtal Gaondongar	Dug well	4.67
South Goa	Canacona	Dug well	3.28
South Goa	Agonda Desaiwada	Dug well	3.55
South Goa	Hattipal Poinguinem	Dug well	6.92
South Goa	Daptamol Lolien	Dug well	15.76
South Goa	Polem(polen)	Dug well	1.98
South Goa	Yedda	Dug well	1.4
South Goa	Sristal	Dug well	12.25
South Goa	Bagmola	Dug well	3.32

South Goa	Ghadiawada	Dug well	2.04
South Goa	Quepem	Dug well	2.83
South Goa	Kapsa	Dug well	5
South Goa	Majorda Bpada Curilo	Dug well	3.1
South Goa	Ballynuvhen	Dug well	6.97
South Goa	Cuncalim(pz)	Dug well	6.43
South Goa	Kaveslium	Dug well	2.64
South Goa	Chikalim	Dug well	1.43
South Goa	Mashe	Dug well	3.8
South Goa	Betalbatti	Dug well	4.18
South Goa	Cuncalim	Dug well	2.14
South Goa	Padi	Dug well	6.69
South Goa	Bolkharnem	Dug well	5.1
South Goa	Molem	Dug well	8
South Goa	Deulwada Kolamba	Dug well	3.48
South Goa	Netrolim	Dug well	11.32
South Goa	Malkarnem	Dug well	10.2
South Goa	Vichundrem	Dug well	6.83
South Goa	Vadam	Dug well	3.59
South Goa	Suktali (molem)	Dug well	4.8
South Goa	Kalay	Dug well	11.18
South Goa	Themchewada	Dug well	9.6
South Goa	Bhati	Dug well	4.08
South Goa	Guddemal	Dug well	8.57
South Goa	Jambavli	Dug well	9.66

South Goa	Revona	Dug well	8.45
South Goa	Collem(kolamba)	Dug well	8.43
South Goa	Dabel	Bore well	9.64
South Goa	Yedda	Bore well	1.4
South Goa	Aven	Bore well	8.31
South Goa	Ponquini	Bore well	6.29
South Goa	Patnem	Bore well	3.23
South Goa	Chinchinim	Bore well	0.97
South Goa	Chandavar	Bore well	2.1
South Goa	Manora Rai	Bore well	5.14
South Goa	Cavelosim	Bore well	1.51
South Goa	Canabonulim	Bore well	3.98
South Goa	Verna	Bore well	1.45
South Goa	Collem	Bore well	6.21
South Goa	Meidawada	Bore well	10.68
South Goa	Molem	Bore well	4.71
South Goa	Morlem	Bore well	2.92
South Goa	Thane	Bore well	7.38
South Goa	Nanoda	Bore well	20.08
South Goa	Severdem	Bore well	14.22

Annexure IV: Water level data of Groundwater monitoring wells in Goa (January 2022)			
District	Village	Well type	Water Level
North Goa	Uguem(ugawe)	Dug well	4.3
North Goa	Morji	Dug well	1.58
North Goa	Pernem	Dug well	3.01
North Goa	Calangute	Dug well	6.85
North Goa	Alto Betim Porvorim	Dug well	13.49
North Goa	Nagjhar	Dug well	8.1
North Goa	Korgaon	Dug well	5.1
North Goa	Sal	Dug well	3.54
North Goa	Sirsaim	Dug well	3.38
North Goa	Mulgaon Shivalkherwad	Dug well	4.01
North Goa	Mapuca	Dug well	4.54
North Goa	Velha Goa	Dug well	1.91
North Goa	Karanjhalen	Dug well	3.1
North Goa	Bayalwadikeri(querim)	Dug well	2.52
North Goa	Morlem	Dug well	4.3
North Goa	Honda	Dug well	3.61
North Goa	Valpoi	Dug well	6.1
North Goa	Khadki(harijanwada)	Dug well	8.52
North Goa	Shiroda	Dug well	7.65
North Goa	Panchawadi(pz)	Dug well	7.35
North Goa	Parra	Dug well	2.14
North Goa	Anjuna Beach	Dug well	12.33

North Goa	Bhamber(Nanoda Cross)	Dug well	5.43
North Goa	Nagargoan	Dug well	6.23
North Goa	Gavalebhat, Chimbhel(kirl)	Dug well	5.72
North Goa	Sawanthwada(mandrem)	Dug well	5.18
North Goa	Adavapal	Dug well	13.49
North Goa	Shivoli (brahmanwada)	Dug well	5.1
North Goa	Mankem	Dug well	4.1
North Goa	Bori	Dug well	5.42
North Goa	Bhujpal	Dug well	3.7
North Goa	Charayode	Dug well	4.01
North Goa	Khotodem	Dug well	6.87
North Goa	Britona	Dug well	2.5
North Goa	Olaulim	Dug well	6.52
North Goa	Colval	Dug well	13.9
North Goa	Pirna	Dug well	3.6
North Goa	Devulawada Narve	Dug well	15.52
North Goa	Jambhul Batt(mayam Lake)	Dug well	3.05
North Goa	Amberem	Dug well	8.09
North Goa	Kundel Dassolwada	Dug well	2.21
North Goa	Pomburpa Palmar	Dug well	3.88
North Goa	Salwardhar Dumun	Dug well	3.7
North Goa	Dhatwado Vante	Dug well	7.88
North Goa	Haspur	Dug well	5.37
North Goa	Hasaravanni Vaipal	Dug well	2.01
North Goa	Varkhand	Bore well	14.65

North Goa	Asapur	Bore well	5.78
North Goa	Silolieum	Bore well	5.23
North Goa	Aropora	Bore well	1.4
North Goa	Morjum	Bore well	2.63
North Goa	Sawantwada	Bore well	5.13
North Goa	Mola	Bore well	0.98
North Goa	Ajosi	Bore well	4.88
North Goa	Krilwada	Bore well	1.79
North Goa	Korgoan	Bore well	11.15
North Goa	Kirl Pirna	Bore well	8.06
North Goa	Adavapal	Bore well	5.18
North Goa	Tivim	Bore well	20.55
North Goa	Mayam	Bore well	6.33
North Goa	Narve	Bore well	12.58
North Goa	Sanqulim	Bore well	24.85
North Goa	Kasar Pal	Bore well	9.71
North Goa	Betki	Bore well	16.27
North Goa	Madakai	Bore well	19.9
South Goa	Majorda Bpada Curilo	Dug well	4.32
South Goa	Ballynuvhen	Dug well	7.38
South Goa	Bolkharnem	Dug well	6.98
South Goa	Molem	Dug well	11.7
South Goa	Collem(kolamba)	Dug well	9.1
South Goa	Ghadiawada	Dug well	2.65
South Goa	Shrishtal Gaondongar	Dug well	3.7

South Goa	Gulem Velipwada	Dug well	3.1
South Goa	Canacona	Dug well	4.42
South Goa	Quepem	Dug well	3.48
South Goa	Cuncalim(pz)	Dug well	5.15
South Goa	Deulwada Kolamba	Dug well	3.7
South Goa	Netrolim	Dug well	11.02
South Goa	Agonda Desaiwada	Dug well	4.27
South Goa	Hattipal Poinguinem	Dug well	8.2
South Goa	Daptamol Lolien	Dug well	15.78
South Goa	Polem(polen)	Dug well	2.5
South Goa	Malkarnem	Dug well	10.22
South Goa	Vichundrem	Dug well	7.6
South Goa	Vadam	Dug well	4.23
South Goa	Yedda	Dug well	1.6
South Goa	Kaveslium	Dug well	3.33
South Goa	Chikalim	Dug well	1.7
South Goa	Sristal	Dug well	11.7
South Goa	Mashe	Dug well	4.18
South Goa	Suktali (molem)	Dug well	4.87
South Goa	Kalay	Dug well	11.55
South Goa	Themchewada	Dug well	7.9
South Goa	Bhati	Dug well	5.65
South Goa	Betalbatti	Dug well	5.26
South Goa	Cuncalim	Dug well	2.25
South Goa	Padi	Dug well	10.6

South Goa	Guddemal	Dug well	10.11
South Goa	Jambavli	Dug well	9.75
South Goa	Revona	Dug well	8.68
South Goa	Kapsa	Dug well	6.15
South Goa	Bagmola	Dug well	3.74
South Goa	Dabel	Bore well	10.59
South Goa	Yedda	Bore well	8.78
South Goa	Aven	Bore well	8.71
South Goa	Ponquini	Bore well	9.3
South Goa	Chinchinim	Bore well	1.87
South Goa	Chandavar	Bore well	2.34
South Goa	Manora Rai	Bore well	5.34
South Goa	Canabonulim	Bore well	5.01
South Goa	Verna	Bore well	2.1
South Goa	Collem	Bore well	6.55
South Goa	Meidawada	Bore well	11.48
South Goa	Molem	Bore well	7.73
South Goa	Morlem	Bore well	3.85
South Goa	Thane	Bore well	7.97
South Goa	Nanoda	Bore well	18.56
South Goa	Severdem	Bore well	14.9

Annexure V: HYDROCHEMICAL DATA OF NATIONAL HYDROGRAPH STATIONS (NHS), GOA, MAY-2019

SL No	SITE_NAME	DISTRICT_NAME	Date of Collection	PH	EC	TH	Ca	Mg	Na	K	CO ₃	HCO ₃	Cl	SO ₄	NO ₃	F
					μS/cm	<.....mg/L.....>										
1	Keri	North Goa	01-06-2019	7.78	199	30	10	1	26	2	0	12	18	41	19	0.27
2	Morlem	North Goa	01-06-2019	8.03	191	25	6	2	24	1	0	31	18	33	1	0.43
3	Honda	North Goa	01-06-2019	7.14	186	33	6	4	29	1	0	31	18	49	0	0.62
4	Bhujpal	North Goa	01-06-2019	7.71	381	38	8	4	42	1	0	46	21	61	2	0.49
5	Charayode	North Goa	01-06-2019	7.78	446	65	16	6	52	2	0	76	21	93	3	0.25
6	Nagargoan	North Goa	01-06-2019	7.93	283	35	6	5	31	1	0	24	18	58	3	0.28
7	Bhamber(Nanoda Cross)	North Goa	01-06-2019	8.03	198	45	6	7	23	0	0	43	14	45	0	0.54
8	Khadki(harijanwada)	North Goa	01-06-2019	7.85	189	40	6	6	20	1	0	31	18	38	0	0.78
9	Khotodem	North Goa	01-06-2019	7.91	331	45	4	9	37	0	0	27	14	68	4	0.59
10	Dhatwado Vante	North Goa	01-06-2019	7.83	295	35	6	5	35	1	0	46	18	54	1	0.65
11	Jambhul Batt(mayam Lake)	North Goa	04-06-2019	7.52	337	45	10	5	27	3	0	37	18	44	7	0.74
12	Mulgaon Shivalkherwad	North Goa	04-06-2019	8.15	236	35	10	2	26	1	0	31	18	44	1	0.20
13	Parra	North Goa	02-06-2019	7.85	501	125	28	13	39	7	0	128	46	58	3	0.56

14	Calangute (Kalangot Beach)	North Goa	02-06-2019	7.69	930	200	42	23	85	10	0	85	99	113	122	0.37
15	Anjuna Beach	North Goa	02-06-2019	8.01	260	50	8	7	26	1	0	37	25	39	6	0.59
16	Silolium	North Goa	02-06-2019	7.83	504	120	28	12	46	5	0	140	25	87	1	0.42
17	Morji	North Goa	02-06-2019	7.79	626	70	12	10	57	2	0	49	28	120	2	0.20
18	Sawanthwada(mandrem)	North Goa	02-06-2019	8.15	201	35	8	4	21	1	0	37	18	33	0	0.01
19	Korgaon	North Goa	02-06-2019	8.19	198	35	6	5	21	1	0	31	18	36	0	0.33
20	Pernem	North Goa	02-06-2019	7.59	453	75	18	7	38	4	0	73	21	71	11	0.51
21	Uguem(ugawe)	North Goa	02-06-2019	8.20	227	30	8	2	22	3	0	24	21	29	5	0.77
22	Amberem	North Goa	02-06-2019	7.81	305	55	16	4	20	11	0	49	18	43	3	0.21
23	Nagjhar	North Goa	02-06-2019	8.24	342	40	4	7	32	2	0	24	21	58	11	0.54
24	Valpoi	North Goa	02-06-2019	7.89	264	25	8	1	31	1	0	18	18	54	1	0.30
25	Haspur	North Goa	02-06-2019	8.57	468	90	28	5	48	11	12	55	39	90	6	0.71
26	Colval	North Goa	03-06-2019	6.72	522	135	30	15	58	5	0	110	36	94	62	0.38
27	Pirna	North Goa	03-06-2019	6.95	121	20	4	2	15	1	0	18	14	20	1	0.54
28	Adavapal	North Goa	03-06-2019	7.75	231	35	6	5	21	1	0	31	14	38	4	0.17

29	Sal	North Goa	03-06-2019	7.93	227	35	10	2	20	8	0	24	18	46	3	0.32
30	Sirsaim	North Goa	03-06-2019	8.23	236	30	8	2	25	1	0	31	18	40	1	0.27
31	Mapuca	North Goa	03-06-2019	8.25	612	90	14	13	58	5	0	49	43	95	47	0.06
32	Olaulim	North Goa	03-06-2019	8.23	301	35	6	5	34	1	0	31	21	60	1	0.31
33	Pomburpa Palmar	North Goa	03-06-2019	8.24	396	50	8	7	46	1	0	37	32	72	13	0.55
34	Salwardhar Dumun	North Goa	03-06-2019	8.19	253	45	8	6	32	1	0	37	18	61	1	0.38
35	Britona	North Goa	03-06-2019	7.91	182	50	14	4	15	1	0	49	18	19	0	0.82
36	Gavalebhat, Chimbel(kirl)	North Goa	03-06-2019	8.24	243	40	6	6	25	2	0	31	25	33	6	0.57
37	Velha Goa	North Goa	03-06-2019	8.82	492	85	22	7	29	1	12	61	25	50	0	0.49
38	Karanjhalen	North Goa	03-06-2019	9.73	438	90	16	12	40	5	18	18	46	59	29	0.34
39	Chikalim	South Goa	05-06-2019	8.22	386	85	20	9	38	3	0	43	43	44	48	0.54
40	Bagmola	South Goa	05-06-2019	7.80	269	60	14	6	28	2	0	49	28	34	22	0.46
41	Ballynuvhen	South Goa	05-06-2019	7.75	234	50	14	4	28	1	0	67	25	25	6	0.54
42	Betalbatti	South Goa	05-06-2019	7.35	390	45	14	2	57	2	0	18	32	81	29	0.49
43	Cavellosim	South Goa	05-06-2019	8.10	367	65	24	1	43	2	0	61	43	57	9	0.88

44	Cuncalim	South Goa	05-06-2019	9.02	438	45	14	2	63	2	24	12	28	99	7	0.71
45	Agonda Desaiwada	South Goa	05-06-2019	7.70	479	50	18	1	68	6	0	55	28	98	7	0.55
46	Canacona	South Goa	05-06-2019	7.48	312	60	14	6	36	2	0	79	28	38	4	0.54
47	Padi	South Goa	05-06-2019	7.54	204	60	12	7	24	1	0	55	14	37	0	0.63
48	Sristal	South Goa	05-06-2019	7.76	331	60	18	4	43	1	0	79	18	71	1	0.64
49	Mashe	South Goa	01-06-2019	7.71	241	20	6	1	42	1	0	24	21	65	0	0.64
50	Polem(poleno)	South Goa	06-06-2019	8.31	443	140	22	21	38	4	24	122	39	30	1	0.42
51	Daptamol Loliem	South Goa	06-06-2019	7.71	285	25	6	2	42	0	0	24	18	66	1	0.72
52	Shrishtal Gaondongar	South Goa	06-06-2019	7.68	375	40	12	2	58	1	0	67	14	96	6	0.65
53	Netrolim	South Goa	06-06-2019	7.57	325	80	20	7	36	4	0	92	14	66	1	0.48
54	Vadam	South Goa	06-06-2019	8.27	253	30	6	4	42	0	0	12	14	76	4	0.72
55	Bhati	South Goa	06-06-2019	8.11	222	10	4	0	40	0	0	24	11	68	0	0.64
56	Deulwada Kolamba	South Goa	06-06-2019	7.57	274	50	8	7	36	2	0	55	14	57	1	0.67
57	Revona	South Goa	06-06-2019	7.74	269	50	12	5	30	4	0	37	25	41	15	0.52
58	Jambavli	South Goa	06-06-2019	7.53	264	35	8	4	42	1	0	31	14	66	2	0.51
59	Quepem	South Goa	06-06-2019	7.81	406	45	12	4	61	2	0	49	18	102	1	0.77

60	Ghadiawada	South Goa	07-06-2019	7.95	240	30	8	2	25	6	0	24	25	36	0	0.61
61	Kalay	South Goa	07-06-2019	8.27	251	30	8	2	31	1	0	31	25	36	2	0.52
62	Kapsa	South Goa	07-06-2019	7.97	479	85	18	10	54	9	0	61	39	71	23	0.69
63	Panchawadi(pz)	North Goa	07-06-2019	8.21	185	25	6	2	26	2	0	37	18	30	1	0.60
64	Guddemal	South Goa	07-06-2019	7.37	228	45	10	5	30	2	0	49	18	37	6	0.66
65	Shiroda	North Goa	07-06-2019	7.94	243	50	12	5	30	3	0	43	25	40	14	0.61
66	Mankem	North Goa	07-06-2019	7.83	270	45	6	7	40	4	0	37	25	58	0	0.67
67	Bori	North Goa	07-06-2019	7.83	279	30	8	2	46	1	0	37	18	66	7	0.55
68	Sukkal	North Goa	07-06-2019	7.94	214	20	4	2	37	1	0	37	14	52	1	0.58
69	Bolkharnem	South Goa	07-06-2019	7.59	176	30	6	4	23	2	0	31	14	36	5	0.64
70	Collem(kolamba)	South Goa	07-06-2019	8.27	194	20	6	1	32	1	0	37	14	45	0	0.47
71	Kundel Dassolwada	North Goa	07-06-2019	8.19	189	20	4	2	30	1	0	37	18	36	2	0.40

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