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Government of India
Ministry of Water Resources
Central Ground Water Board

GROUND WATER YEAR BOOK
GOA STATE
2017-18

CENTRAL GROUND WATER BOARD

SOUTH WESTERN REGION

BANGALORE

FOREWORD

Groundwater is a dynamic and replenishable precious natural resource; it requires to be monitored regularly and also to be appraised of the changes that are taking place in its regime. In this regard, Central Ground Water Board collects the groundwater level and quality data from the Water Level Monitoring stations. The water levels are monitored four times a year during the months of May, August, November and January. The samples for determination of the quality of the groundwater are collected once a year during the month of May. This report consists of the ground water level for the year 2017-18 and chemical quality data collected during the year 2017. Maps showing the depth to groundwater level in different parts of Goa and the changes observed in the water level in the last one-year and last one decade are included and discussed in the report. The report also consists of the discussions on distribution and variation of rainfall for normal period. Chemical quality of groundwater on the basis of the samples collected during May 2017 and the interpretation of the data is included in the report.

The water level data has been compiled and interpreted by D.Dhayamalar, Sc 'D', Rakhi U.R., Sc 'B' and Dr. Lubna Kouser, AH. The water quality data has been compiled and interpreted by Dr.K.Ravichandran Sc-D, *Lalitha. B.H. STA (Chem.) and* Dr. Sailee Bhange, STA(Ch). *A lot of effort has been put in by various personnel of SWR, Bangalore and WKSU Belgaum office for the collection of field data. The water samples were analysed by the Regional Chemical Laboratory to bring out the aspects of groundwater. Dr.M.A.Farooqi Sc. 'D' of Report Processing section has carried out the necessary processing of the report to bring the report to the final stage.*

It is hoped that the information contained in this yearbook will be useful for planners, administrators and other user agencies associated with development and management of water resources in the state.

(Dr.A.Subburaj)
Head of Office

ABSTRACT

Goa state has a geographical area of 3702 Sq.km divided into 2 districts with 11 taluks. The Central Ground Water Board has collected water level data of the phreatic aquifer from 103 National Hydrograph Network Stations during the months of May, August, November 2017 and January 2018. This report contains the analysis and interpretation of the data.

Thematic maps depicting the groundwater scenario during this period are prepared and discussed. Average annual rainfall is of the order of 320cm, increasing from 270cm in the west (on the coast) to 400cm in the east. Similarly rainfall decreases from south to north along the coast as well as interiors. While the annual rainfall in the North Goa district averages 316cm it is 330cm in the south Goa district. The months of June and July are the wettest months with around 100cm rainfall each month. Rainfall during the months of January and February is negligible. Valpoi in the north Goa and Quepem in the south Goa, both in the interior hilly areas, are the wettest places in the state.

The premonsoon depth to water level recorded in the State reveals that about 91% of the wells have water level less than 10 mbgl and the rest show in the range of 10-20 mbgl. The depth to water level recorded in the State of Goa during premonsoon season ranged from 1.10 mbgl to 16.08 mbgl. It is seen that out of 79 stations analyzed during the month, 15% wells have water level less than 2 mbgl, 43% wells have 2 to 5 mbgl water level, 33% wells have 5 to 10 mbgl water level, 9% wells have 10 to 20 mbgl water level. The water level in the range of 2 to 5 and 5 to 10 m bgl is the general water level in the state. Water level in the range of 10 to 20 mbgl is seen in Pernem, Bardez, Bicholim, Tiswadi, Sanquem, Salcete, Quepem and Canacona taluks.

During postmonsoon season about 93% of the wells recorded less than 10 mbgl water level and the remaining 7% wells have water level 10-20 mbgl. The depth to water level recorded in the State of Goa during postmonsoon season ranged from 0.10 mbgl to 15.31 mbgl. It is seen that out of 81 stations analyzed 22% wells have less than 2 mbgl water levels, 46% wells have 2 to 5 mbgl water levels, 25% wells have 5 to 10 mbgl water level and the remaining 7% wells have 10 to 20 mbgl water level. The water level in the range of 2 to 5 m bgl is the general water level in the state. Depth to water level in the range of < 2 mbgl of water level is observed as patches in almost all taluks except Sanguem taluk. Water level more than 10 mbgl is observed as patches in of Canacona, Berdez, Bicholim and Tiswadi taluks of Goa State.

Results of chemical analysis of the samples show that 97% of the samples are suitable for domestic, irrigation and industrial purposes.

GROUND WATER YEAR BOOK GOA STATE 2017-18

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GROUND WATER YEAR BOOK
GOA STATE 2017-18

1. GENERAL FEATURES

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 103 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 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 11 taluks. The taluk wise distribution of Ground water monitoring stations being monitored by the Region is given in **Table 1.1.**

Table 1.1: 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	13
3	Pernem	251.7	9
4	Bicholim	238.8	10
5	Satari	495.1	11
6	Ponda	292.8	6
District: South Goa			
7	Sanguem	873.7	18
8	Cancona	352.0	10
9	Quepem	318.3	5
10	Salcete	292.9	13
11	Mormugao	109.1	2

** 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.Costal 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 1.2)**. 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 **(Fig. 1.1)**.

Table 1.2: 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 **(Fig. 1.2)**.

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.

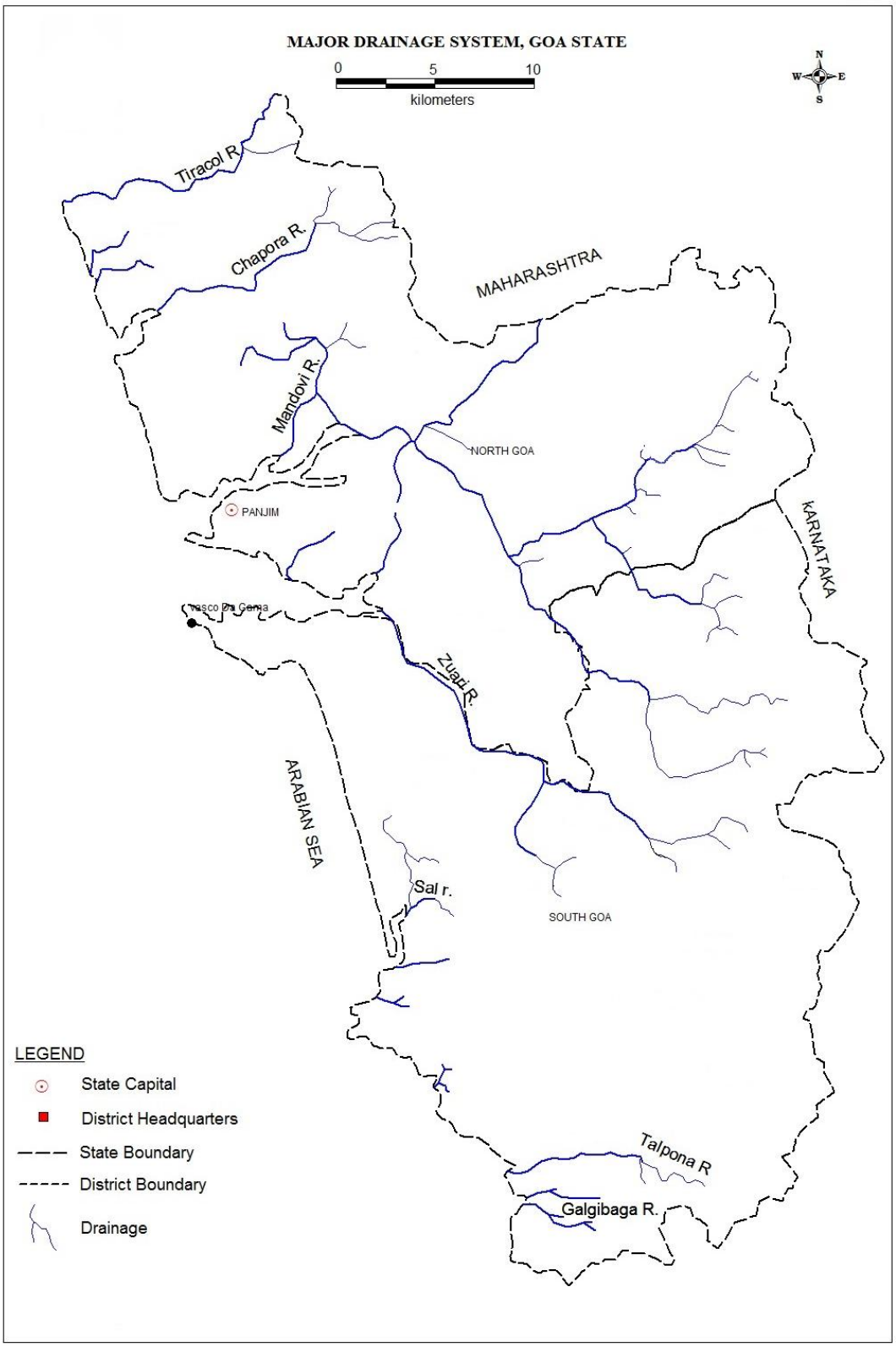

Fig 1.1: Major Drainage System, Goa State

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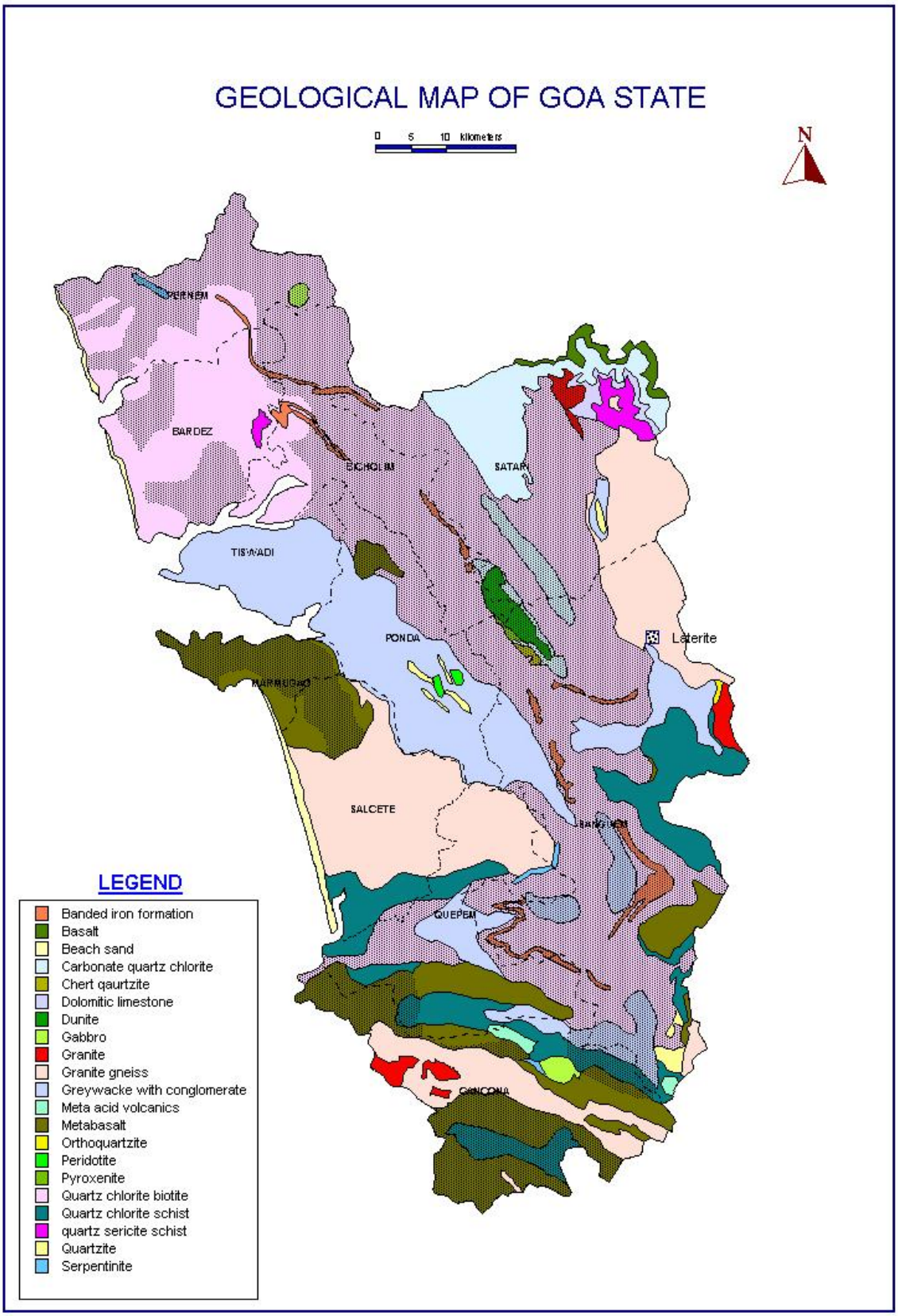


Fig 1.2: Geology Map of Goa State

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 2766.9 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 **Fig. 2.1** and the Isohyetal Map monsoon rainfall is in **Fig. 2.2**. Normal monthly rainfall of in respect of 12 stations of Goa State is presented in **Annexure - II**.

Fig 2.1

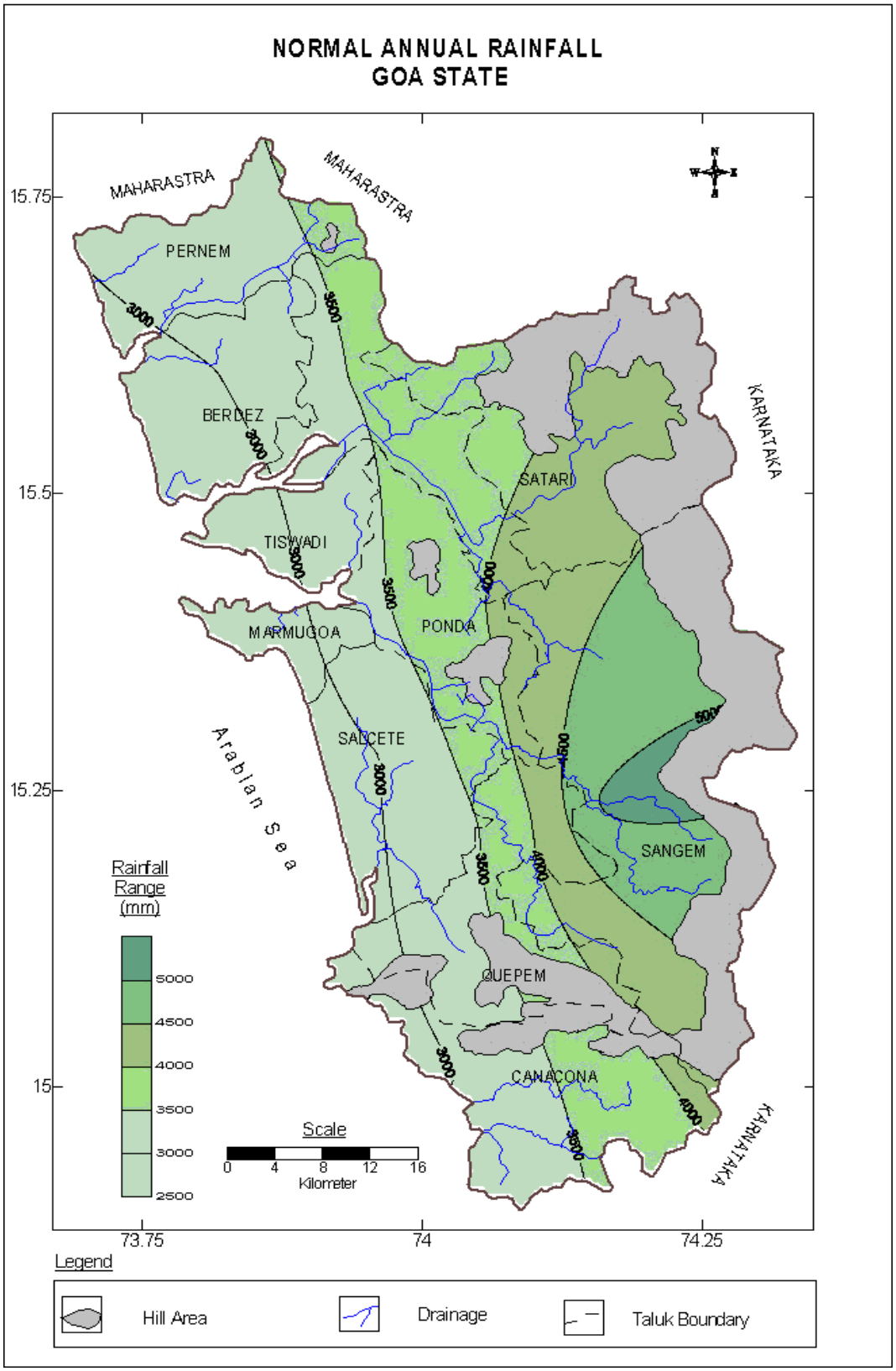


Fig. 2.1: Isohyetal Map of Goa State for the period 1970 to 2000

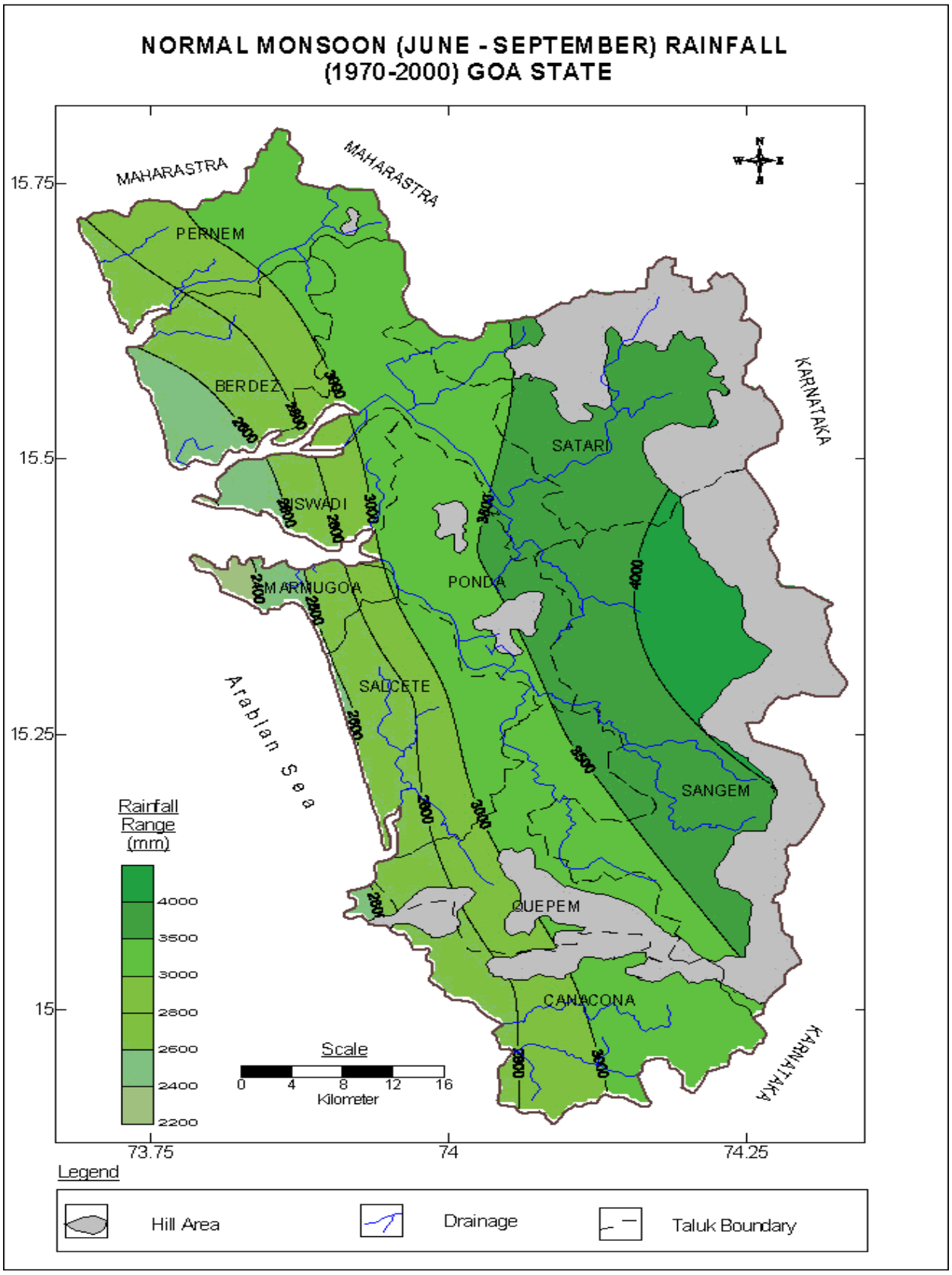


Fig. 2.2: Normal Monsoon Rainfall of Goa State

3. GROUND WATER LEVELS IN GOA DURING WATER YEAR 2017 -18

Central Ground Water Board, South Western Region, Bangalore has a network of 103 Ground Water Monitoring stations in Goa under the Programme 'Ground Water Regime Monitoring' of the Board which works out to one Ground Water Monitoring Stations in 36 Sq. Km.

The above network comprises of 103 stations, which are predominantly domestic dug wells and are monitored four times a year during the months of January, May, August and November for water levels and once a year for quality during the month of May. These wells are monitored between 1st to 10th during the month of January and November and between 20th and 30th during the month of May and August. General details of Goa State Ground Water Monitoring Stations are furnished in **Annexure I**.

3.1 Depth to Ground Water Levels:

Monitoring of Ground Water Monitoring stations in Goa was carried out during May, August, November 2017 and January 2018. The analysis/findings are as below:

Depth to Water Level, May 2017

The depth to water level recorded in the State of Goa during May 2017 ranged 1.10 mbgl to 16.08 mbgl. It is seen that out of 79 stations analyzed during the month, 15 % wells have less than 2 mbgl water levels, 43% wells have 2 to 5 mbgl water levels, 33% wells have 5 to 10 mbgl water level and the remaining 9 % wells have 10 to 20 mbgl water level **(Table 3.1)**.

A map showing the depth to water level in the ranges of <2, 2 to 5, 5 to10 and 10 to 20 mbgl is enclosed as **Fig 3.1**. Water level of less than 2 mbgl is observed in parts of Pernem, Berdez, Ponda, Marmugao, Salcete, Tiswadi, Satari and Bicholim taluks as small isolated patches. Depth to water level in the range of 2 to 5 mbgl and 5 to 10 mbgl is observed as major part in the state covering almost all the taluks in the State. Depth to water level more than 10 mbgl noticed as small patches in Pernem, Bardez, Bicholim, Tiswadi, Sanquem, Salcete, Quepem and Canacona taluks.

Depth to Water Level, August 2017

The depth to water level recorded in the State of Goa during August 2017 ranged from 0.13 mbgl to 12.30 mbgl. It is seen that out of 78 stations analyzed during the month, 51% wells have water level less than 2 mbgl, 36% wells have 2 to 5 mbgl water level, 10% wells have 5 to 10 mbgl water level and 3% wells have 10 to 20 mbgl water level **(Table 3.2)**.

Table 3.1

Taluk wise Well Frequency for Different Ranges of Depth to Water Level

Month / Year: May-2017

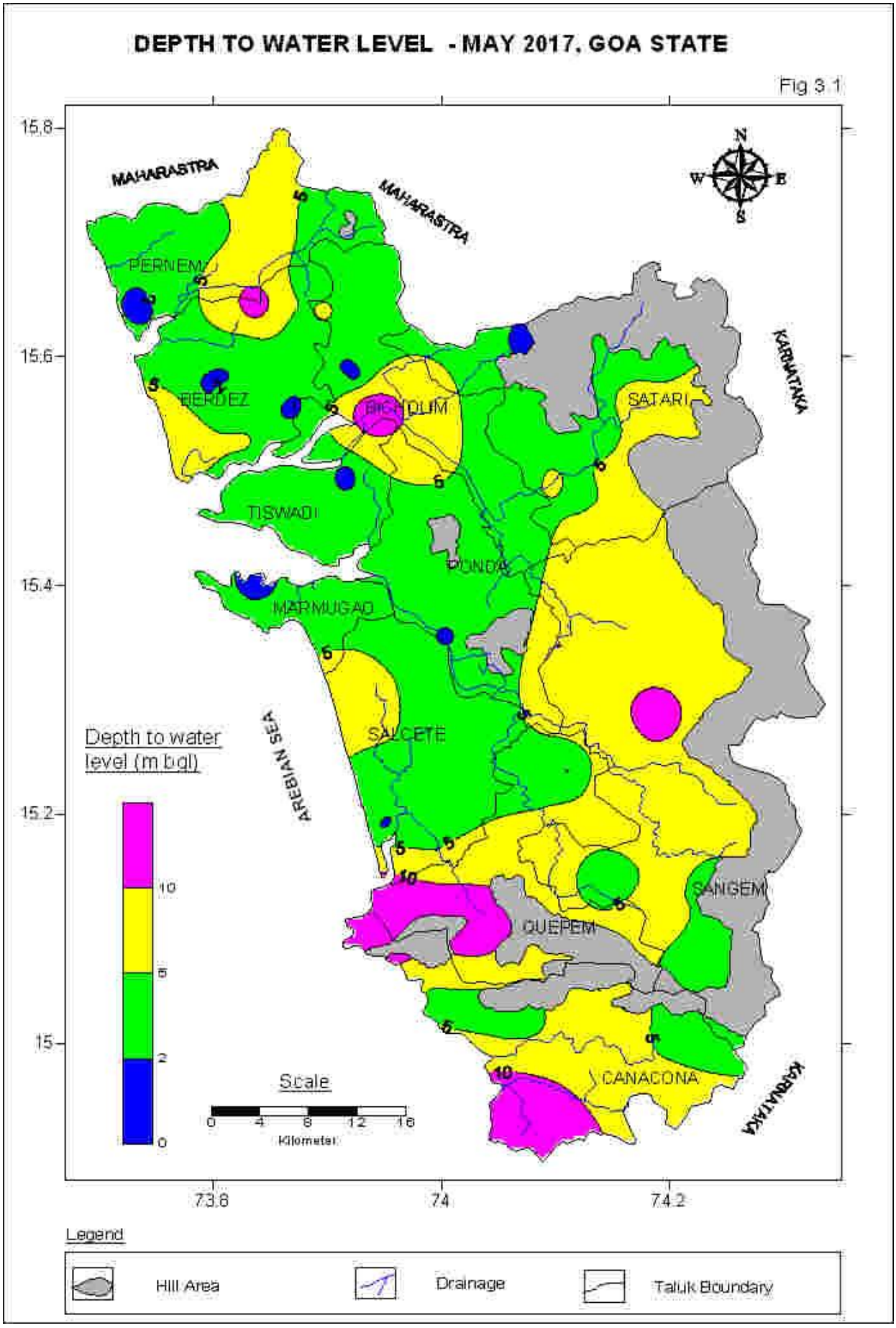
Taluk	No of WL measured	D.T.W. (m bgl)		0 - 2 (m)		2 - 5 (m)		5 - 10 (m)		10 - 20 (m)		> 20 (m)	
		Min.	Max.	No.	%	No.	%	No.	%	No.	%	No.	%
Tiswadi	4	1.10	8.45	1	25.0	1	25.0	2	50.0	0	0.0	0	0.0
Sattari	10	1.58	6.89	1	10.0	7	70.0	2	20.0	0	0.0	0	0.0
Sangeum	11	2.24	12.31	0	0.0	2	18.2	7	63.6	2	18.2	0	0.0
Salcete	10	1.38	13.32	2	20.0	3	30.0	4	40.0	1	10.0	0	0.0
Quepem	4	1.67	16.08	1	25.0	1	25.0	1	25.0	1	25.0	0	0.0
Ponda	4	1.68	7.00	1	25.0	2	50.0	1	25.0	0	0.0	0	0.0
Pernem	9	1.53	7.53	1	11.1	6	66.7	2	22.2	0	0.0	0	0.0
Marmugoa	1	3.05	3.05	0	0.0	1	100.0	0	0.0	0	0.0	0	0.0
Canacona	8	2.74	15.00	0	0.0	5	62.5	2	25.0	1	12.5	0	0.0
Bicholim	7	1.63	15.50	1	14.3	3	42.9	2	28.6	1	14.3	0	0.0
Bardez	11	1.10	13.07	4	36.4	3	27.3	3	27.3	1	9.1	0	0.0
Total	79			12	15.2	34	43.0	26	32.9	7	8.9	0	0.0

Table 3.2

Taluk wise Well Frequency for Different Ranges of Depth to Water Level

Month / Year : Aug-2017

Taluk	No of WL measured	D.T.W. (m bgl)		0 - 2 (m)		2 - 5 (m)		5 -10 (m)		10 - 20 (m)		> 20 (m)	
		Min.	Max.	No.	%	No.	%	No.	%	No.	%	No.	%
Tiswadi	4	0.53	2.95	3	75.0	1	25.0	0	0.0	0	0.0	0	0.0
Sattari	10	0.60	2.98	6	60.0	4	40.0	0	0.0	0	0.0	0	0.0
Sangeum	13	0.44	8.36	3	23.1	6	46.2	4	30.8	0	0.0	0	0.0
Salcete	9	0.86	7.62	6	66.7	2	22.2	1	11.1	0	0.0	0	0.0
Quepem	3	0.67	1.64	3	100.0	0	0.0	0	0.0	0	0.0	0	0.0
Ponda	5	0.80	4.45	3	60.0	2	40.0	0	0.0	0	0.0	0	0.0
Pernem	9	0.63	6.82	4	44.4	3	33.3	2	22.2	0	0.0	0	0.0
Marmugoa	1	2.26	2.26	0	0.0	1	100.0	0	0.0	0	0.0	0	0.0
Canacona	7	0.30	12.30	3	42.9	3	42.9	0	0.0	1	14.3	0	0.0
Bicholim	6	0.73	10.10	2	33.3	3	50.0	0	0.0	1	16.7	0	0.0
Bardez	11	0.13	6.22	7	63.6	3	27.3	1	9.1	0	0.0	0	0.0
Total	78			40	51.3	28	35.9	8	10.3	2	2.6	0	0.0


DEPTH TO WATER LEVEL - MAY 2017, GOA STATE
Fig 3.1
MAHARASTRA
MAHARASTRA
PERNEM
BICHOLIM
SATARI
KARNATAKA
TISWADI
PONDA
MARMUGAO
SALCETE
ARABIAN SEA
SANGEM
QUEPEM
CANACONA
KARNATAKA
Depth to water level (m bgl)
10
5
2
0
Scale
0 4 8 12 16
Kilometer
15.8
15.6
15.4
15.2
15
73.8
74
74.2
Legend
Hill Area
Drainage
Taluk Boundary

A map showing the depth to water level in the ranges of <2, 2 to 5, 5 to10 and 10 to 20 mbgl is enclosed as **Fig. 3.2**. Water level in the range of less than 2 mbgl and 2 to 5 mbgl are observed in almost all taluks of Goa State. 5 to 10 mbgl is observed in Pernem, Bicholim, Tiswadi, Sangem, Quepem, Ponda and Canacona taluk. Depth more than 10 mbgl is observed as small patches in Cancona taluk of Goa State.

Depth to Water Level, November 2017

The depth to water level recorded in the State of Goa during November 2017 ranged from 0.10 mbgl to 15.34 mbgl. It is seen that out of 81 stations analyzed during the month, 22% wells have water level less than 2 mbgl, 46% wells have 2 to 5 mbgl water level, 25% wells have 5 to 10 mbgl water level and 7% wells have 10 to 20 mbgl water level **(Table 3.3)**.

A map showing the depth to water level in the ranges of <2, 2 to 5, 5 to10 and 10 to 20 mbgl is enclosed as **Fig. 3.3**. Water level in the range of less than 2 mbgl is observed as small patches in all the taluks except Sanquem and 2 to 5 mbgl are observed in almost all taluks of Goa State. Water level in the range of 5 to 10 mbgl is observed in parts of Pernem, Berdez, Bicholim, Salcete, Sangeum, Satari, Quepem, Ponda and Canacona taluk. Depth to water level more than 10 mbgl is observed as small patches in Canacona, Berdez, Bicholim and Tiswadi taluks of Goa State.

Depth to Water Level, January 2018

The depth to water level recorded in the State of Goa during January 2018 ranged from 0.94 m bgl to 15.44 m bgl. It is seen that out of 85 stations analyzed during the month, 9% wells have water level less than 2 mbgl, 50% wells have 2 to 5 mbgl water level, 33% wells have 5 to 10 mbgl water level and 8% wells have 10 to 20 m bgl water level **(Table 3.4)**.

A map showing the depth to water level in the ranges of <2, 2 to 5, 5 to10 and 10 to 20 m bgl is enclosed as **Fig.3.4**. Water level in the range of less than 2 m bgl is observed as small patches in Tiswari, Sattari, Salcete, Ponda, Pernem and Bardez taluks and 2 to 5 m bgl are observed in almost all taluks of Goa State. Water level in the range of 5 to 10 m bgl is observed in parts of all taluks except Quepem and Marmugoa. Depth to water level more than 10 m bgl is observed as small patches in Sangeum, Canacona, Bicholim and Berdez taluks of Goa State.

3.2 Fluctuations in Ground Water Levels

Analysis of fluctuation / rise and fall of ground water levels measured during the different periods was carried out. Pre monsoon water levels measured during May 2017 are compared with water levels during August 2017, November 2017 and January 2018 to know the Seasonal Fluctuation

Table 3.3

Taluk wise Well Frequency for Different Ranges of Depth to Water Level

Month / Year: November-2017

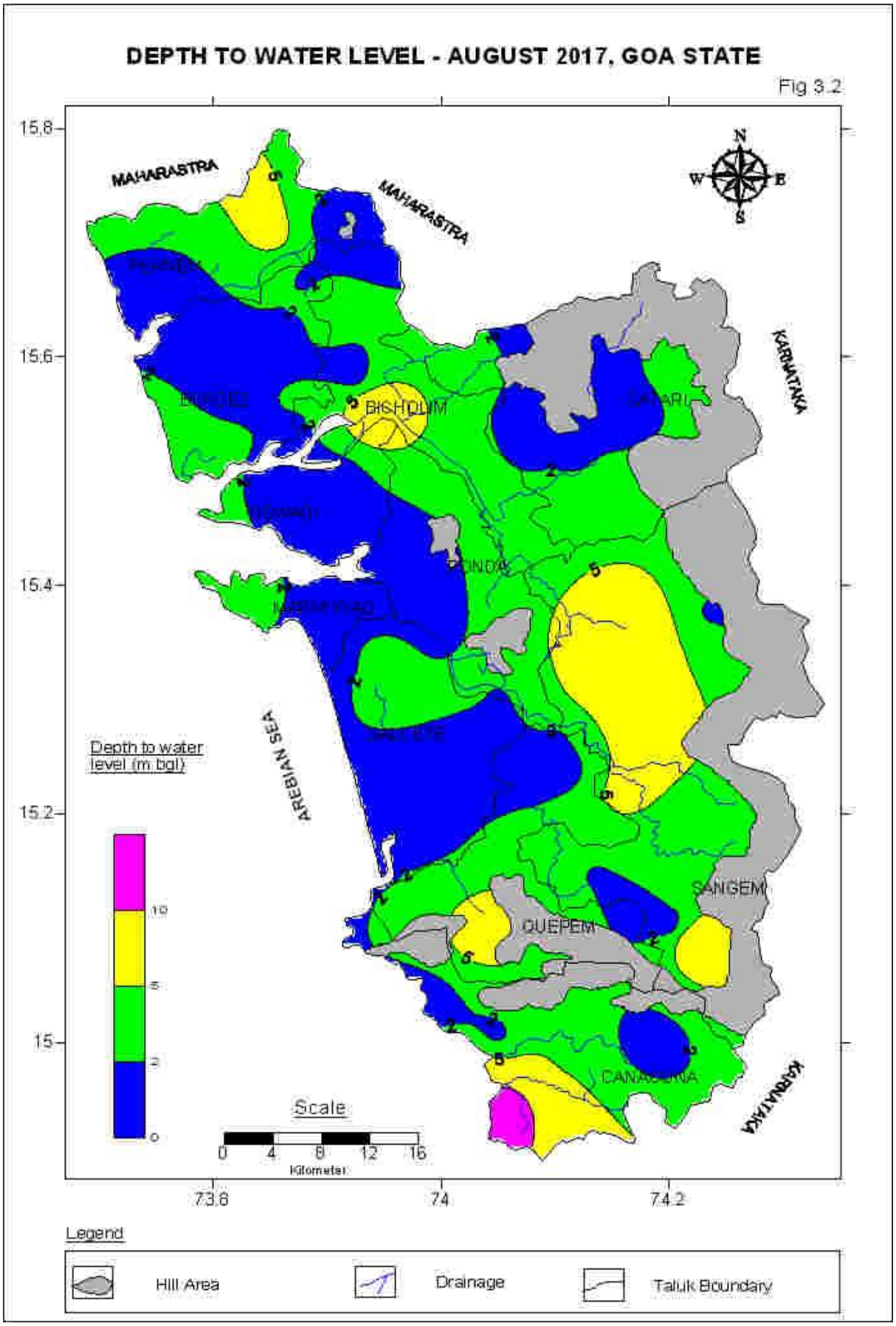
Taluk	No of WL measured	D.T.W. (m bgl)		0 - 2 (m)		2 - 5 (m)		5 - 10 (m)		10 - 20 (m)		> 20 (m)	
		Min.	Max.	No.	%	No.	%	No.	%	No.	%	No.	%
Tiswadi	4	1.09	7.75	2	50.0	1	25.0	1	25.0	0	0.0	0	0.0
Sattari	10	1.26	7.25	1	10.0	7	70.0	2	20.0	0	0.0	0	0.0
Sangeum	13	2.64	10.15	0	0.0	5	38.5	7	53.8	1	7.7	0	0.0
Salcete	9	0.78	5.92	4	44.4	3	33.3	2	22.2	0	0.0	0	0.0
Quepem	3	1.51	3.90	1	33.3	2	66.7	0	0.0	0	0.0	0	0.0
Ponda	5	1.30	6.50	2	40.0	1	20.0	2	40.0	0	0.0	0	0.0
Pernem	9	0.73	7.63	1	11.1	6	66.7	2	22.2	0	0.0	0	0.0
Marmugoa	1	1.85	1.85	1	100.0	0	0.0	0	0.0	0	0.0	0	0.0
Canacona	9	0.10	15.34	1	11.1	4	44.4	1	11.1	3	33.3	0	0.0
Bicholim	6	1.21	14.70	1	16.7	4	66.7	0	0.0	1	16.7	0	0.0
Bardez	12	1.17	12.85	4	33.3	4	33.3	3	25.0	1	8.3	0	0.0
Total	81		18	22.2	37	45.7	20	24.7	6	7.4	0	0.0	

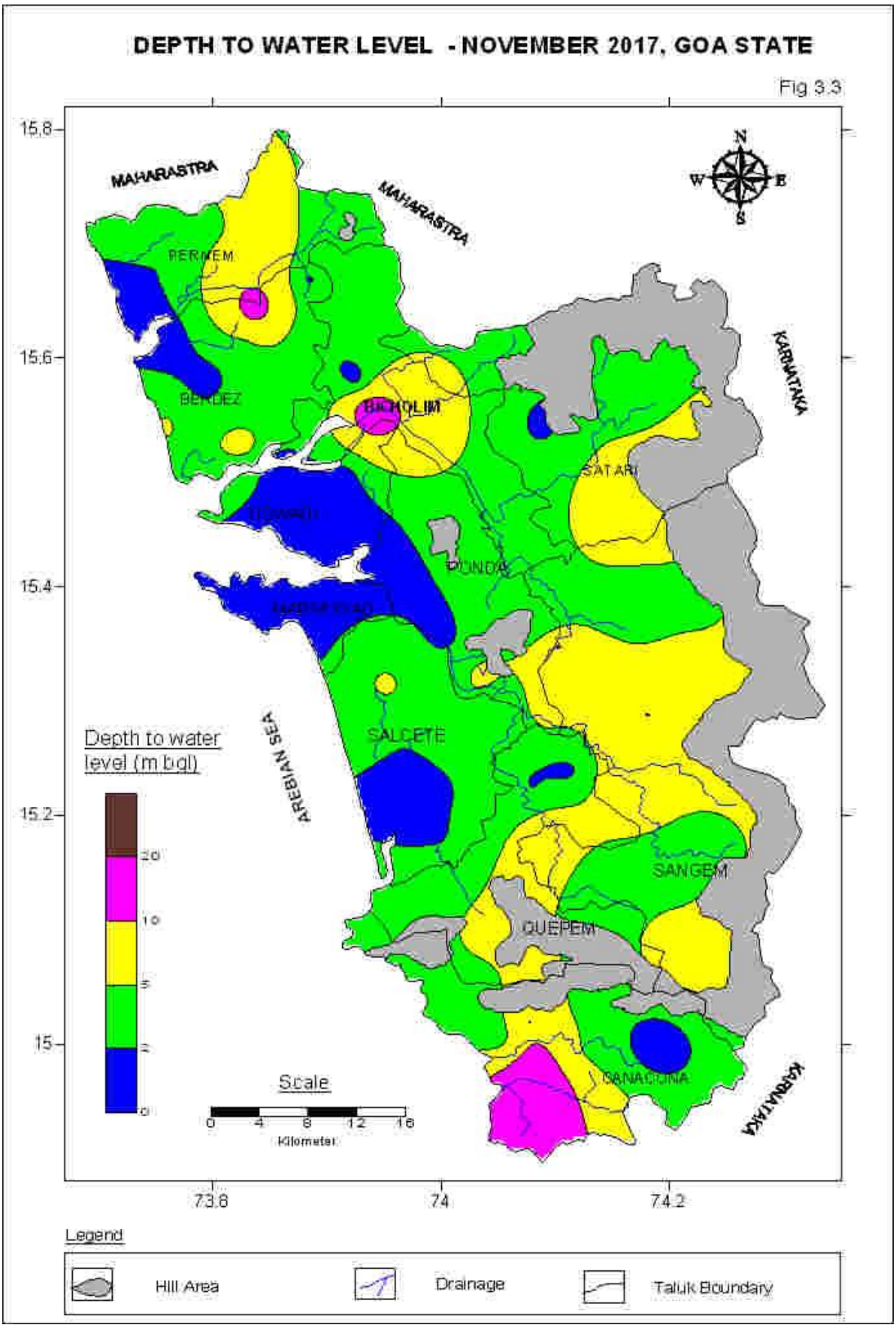
Table 3.4

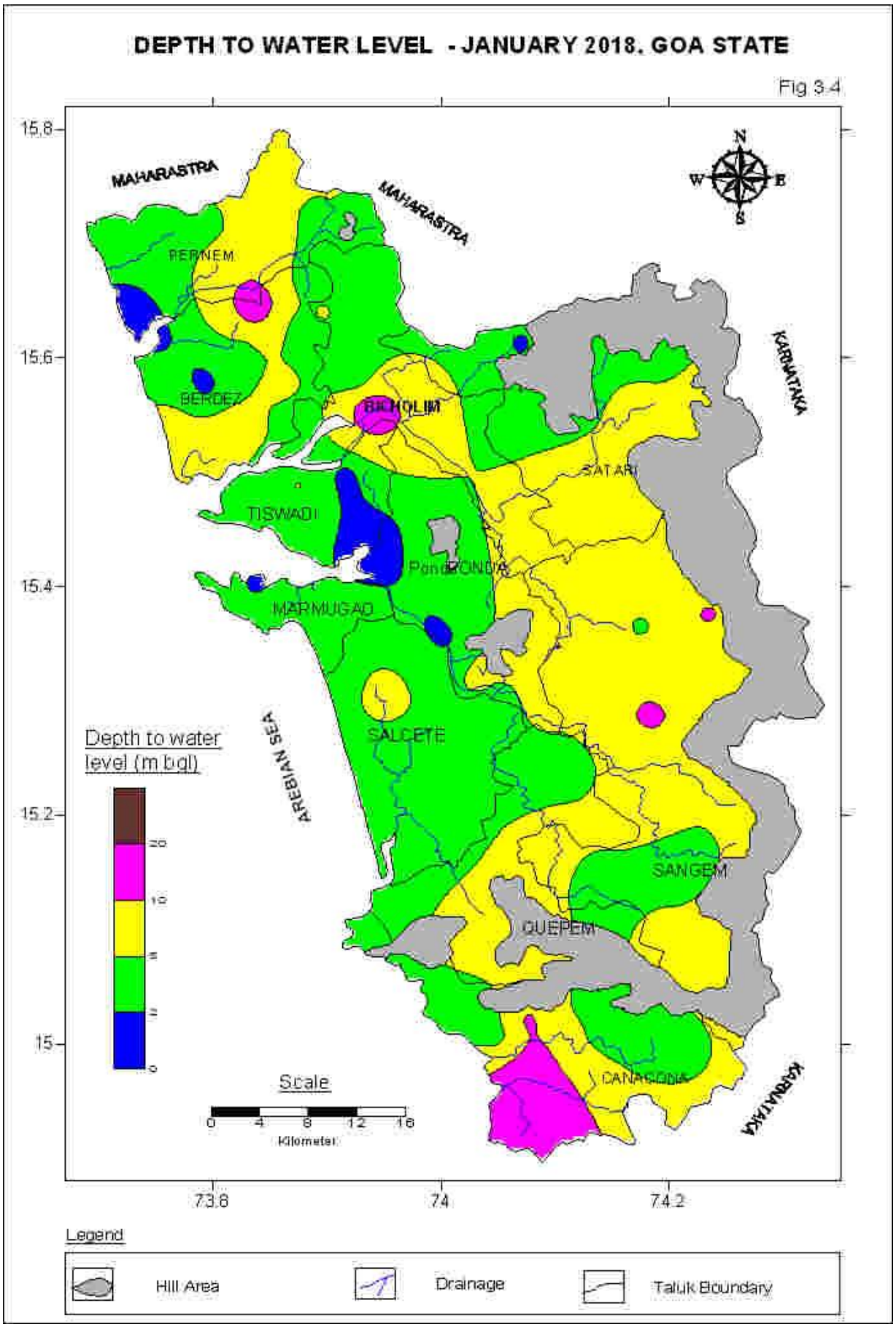
Taluk wise Well Frequency for Different Ranges of Depth to Water Level

Month / Year: January 2018

Taluk	No of WL measured	D.T.W. (m bgl)		0 - 2 (m)		2 - 5 (m)		5 -10 (m)		10 - 20 (m)		> 20 (m)	
		Min.	Max.	No.	%	No.	%	No.	%	No.	%	No.	%
Tiswadi	4	1.21	8.33	1	25.0	1	25.0	2	50.0	0	0.0	0	0.0
Sattari	10	1.85	7.79	1	10.0	5	50.0	4	40.0	0	0.0	0	0.0
Sangeum	15	2.61	10.78	0	0.0	4	26.7	9	60.0	2	13.3	0	0.0
Salcete	10	1.84	8.82	1	10.0	7	70.0	2	20.0	0	0.0	0	0.0
Quepem	3	2.14	4.72	0	0.0	3	100.0	0	0.0	0	0.0	0	0.0
Ponda	5	1.37	6.84	2	40.0	1	20.0	2	40.0	0	0.0	0	0.0
Pernem	9	0.94	7.43	1	11.1	6	66.7	2	22.2	0	0.0	0	0.0
Marmugoa	1	3.00	3.00	0	0.0	1	100.0	0	0.0	0	0.0	0	0.0
Canacona	9	2.54	15.44	0	0.0	5	55.6	1	11.1	3	33.3	0	0.0
Bicholim	7	2.68	14.79	0	0.0	3	42.9	3	42.9	1	14.3	0	0.0
Bardez	12	1.30	14.05	2	16.7	6	50.0	3	25.0	1	8.3	0	0.0
Total	85		8	9.4	42	49.4	28	32.9	7	8.2	0	0.0	


DEPTH TO WATER LEVEL - AUGUST 2017, GOA STATE
Fig 3.2
MAHARASTRA
MAHARASTRA
KARNATAKA
KARNATAKA
BISHOLIM
PONDA
SANGEM
QUEPEM
CANACONA
ARABIAN SEA
Depth to water level (m bgl)
Scale
Kilometer
Legend
Hill Area
Drainage
Taluk Boundary


DEPTH TO WATER LEVEL - NOVEMBER 2017, GOA STATE
Fig 3.3
15.8
15.6
15.4
15.2
15
73.8
74
74.2
MAHARASTRA
MAHARASTRA
KARNATAKA
KARNATAKA
PERNEM
BARDEZ
BICHOLIM
SATARI
PONDA
SALCETE
SANGEM
QUEPEM
SANGUEM
ARABIAN SEA
N
S
E
W
Depth to water level (m bgl)
20
10
5
2
0
Scale
0 4 8 12 16
Kilometer
Legend
Hill Area
Drainage
Taluk Boundary


DEPTH TO WATER LEVEL - JANUARY 2018, GOA STATE
Fig 3.4
MAHARASTRA
MAHARASTRA
KARNATAKA
KARNATAKA
PERNEM
BARDEZ
BICHOLIM
SATARI
TISWADI
PONDA
MARMUGAO
SALCETE
SANGEM
QUEPEM
CANACONA
ARABIAN SEA
Depth to water level (m bgl)
20
10
4
2
0
Scale
0 4 8 12 16
Kilometer
15.8
15.6
15.4
15.2
15
73.8
74
74.2
N
W
E
S
Legend
Hill Area
Drainage
Taluk Boundary

Water levels measured for a given month during consecutive years are compared to know the annual fluctuation. Further water levels of each measurement are compared with the mean water levels pertaining to the same months of the preceding decade to know the long term changes. The fluctuation details are given in **Annexure-IV**. Summary of the analysis is given below:

Change in Groundwater Level - May 2017 to August 2017

Water levels from 73 stations were compared to know the change in groundwater level in August 2017 as compared with May 2017 in the State of Goa. It is seen that out of 73 stations analyzed during the month, 67 stations (92%) have shown rise in water level and 6 stations (8%) have shown fall in water level **(Table 3.5)**.

Rise of water level in the range 0 to 2 m is observed in 33 wells accounting for 45% of the analyzed wells. Rise in water level in the range of 2 to 4 m and >4m is recorded in 21 wells (29%) and 13 wells (18%) respectively. Fall in water level in the range of 0 to 2 m is recorded in 6 stations accounting for 8% in analysed wells of Goa State.

A map depicting the change in groundwater level in August 2017 as compared to May 2017, showing rise/fall in the ranges of 0 to 2 m, 2 to 4 m and >4 m is enclosed as **Fig. 3.5**. The water level rise in the range of 0 to 2 m and 2 to 4 m is the general trend of the Goa State and is observed in almost all the taluks. More than 4 m rise is observed in Tiswadi, Satari, Bicholim, Canacona, Marmugao, Salcete, Sanguem and Quepem taluks. Fall in water level of 0-2 m is observed in Pernem, Berdez, Ponda, Salcete and Canacona taluks.

Change in Groundwater Level - May 2017 to November 2017

Water levels from 75 stations were compared to know the change in groundwater level in November 2017 as compared with May 2017. It is seen that out of 75 stations analyzed during the month, 53 stations (71%) have shown rise in water level and 22 stations (29%) have shown fall in water level in the range 0 to 2 m is observed in 40 wells accounting for 54% of the analyzed wells. Rise in water level in the range of 2 to 4 m and >4m is recorded in 9 wells (12%) and 4 wells (5%) respectively. Fall in water level in the range of 0 to 2 m is recorded in 19 wells stations accounting for 25% of the analysed wells. Fall in water level in the range of 2 to 4 m and >4m is recorded in 2 wells (3%) and 1 well (1%) respectively in analysed **(Table 3.6)**.

A map depicting the change in groundwater level in November 2017 as compared to May 2017, showing rise/fall in the ranges of 0 to 2 m, 2 to 4 m and >4 m is enclosed as **Fig. 3.6**. The water level rise in the range of 0 to 2 m is the general trend of the Goa State and is observed in almost all the taluks. The water level rise in the range of 2 to 4 m is observed in parts of Berdez, Tiswadi, Salcete, Marmagoa, Quepem and Canacona taluks. More than 4 m rise is observed in Canacona

Table 3.5

Taluk wise Categorization of Water Level Fluctuation

(May-2017 to August-2017)

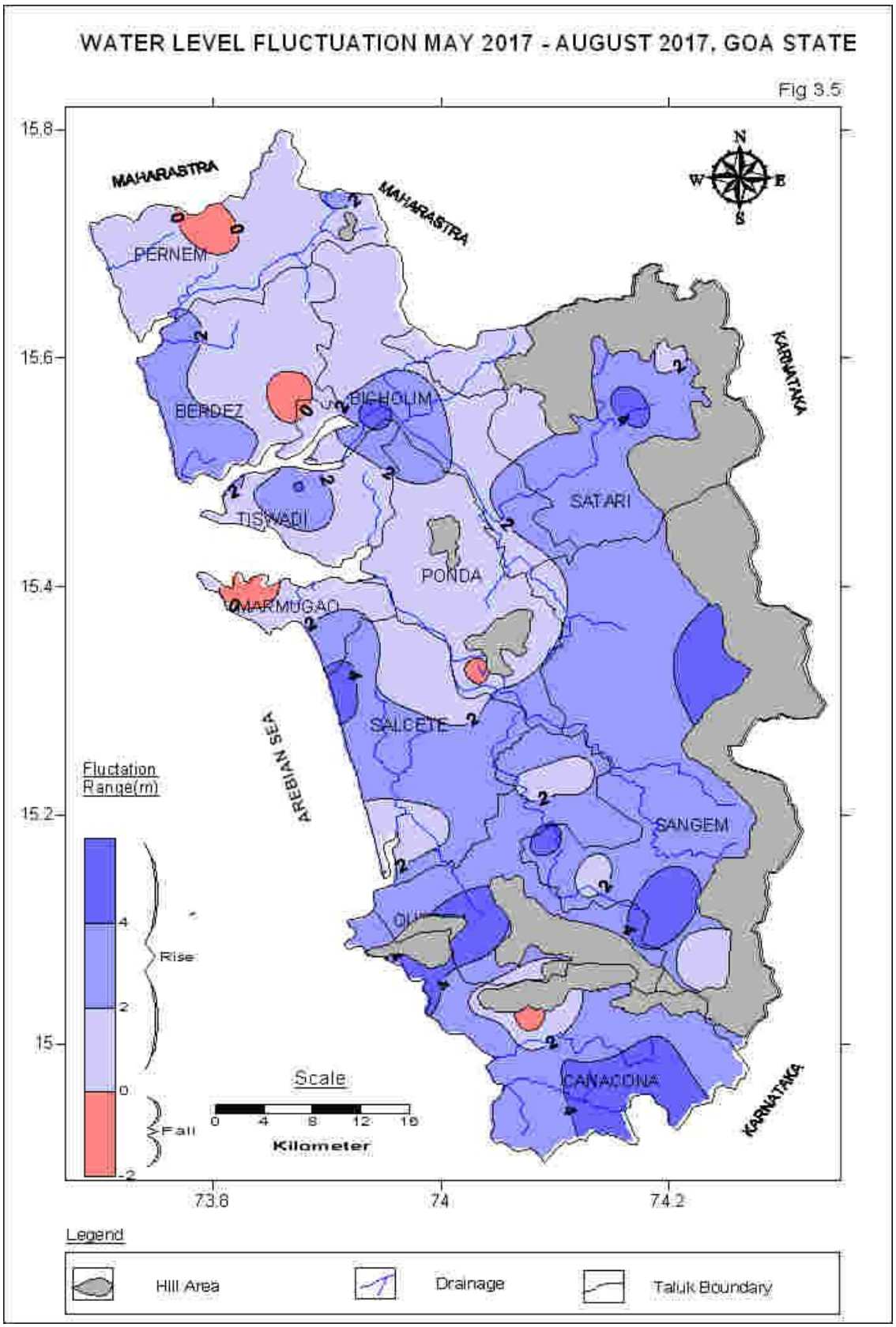
Taluk	Number of Station Analysed	Fall in m						Rise in m					
		0 -2	%	2-4	%	> 4	%	0-2	%	2-4	%	>4	%
Bardez	10	1	10.0	0	0.0	0	0.0	5	50.0	4	40.0	0	0.0
Bicholim	6	0	0.0	0	0.0	0	0.0	4	66.7	1	16.7	1	16.7
Canacona	7	1	14.3	0	0.0	0	0.0	1	14.3	2	28.6	3	42.9
Marmugoa	1	0	0.0	0	0.0	0	0.0	1	100.0	0	0.0	0	0.0
Pernem	9	1	11.1	0	0.0	0	0.0	7	77.8	1	11.1	0	0.0
Ponda	4	1	25.0	0	0.0	0	0.0	1	25.0	2	50.0	0	0.0
Quepem	3	0	0.0	0	0.0	0	0.0	2	66.7	1	33.3	0	0.0
Salcete	9	1	11.1	0	0.0	0	0.0	3	33.3	2	22.2	3	33.3
Sangeum	10	0	0.0	0	0.0	0	0.0	2	20.0	5	50.0	3	30.0
Sattari	10	0	0.0	0	0.0	0	0.0	6	60.0	3	30.0	1	10.0
Tiswadi	4	0	0.0	0	0.0	0	0.0	2	50.0	0	0.0	2	50.0
Total	73	5	6.8	0	0.0	0	0.0	34	46.6	21	28.8	13	17.8

Table 3.6

Taluk wise Categorization of Water Level Fluctuation

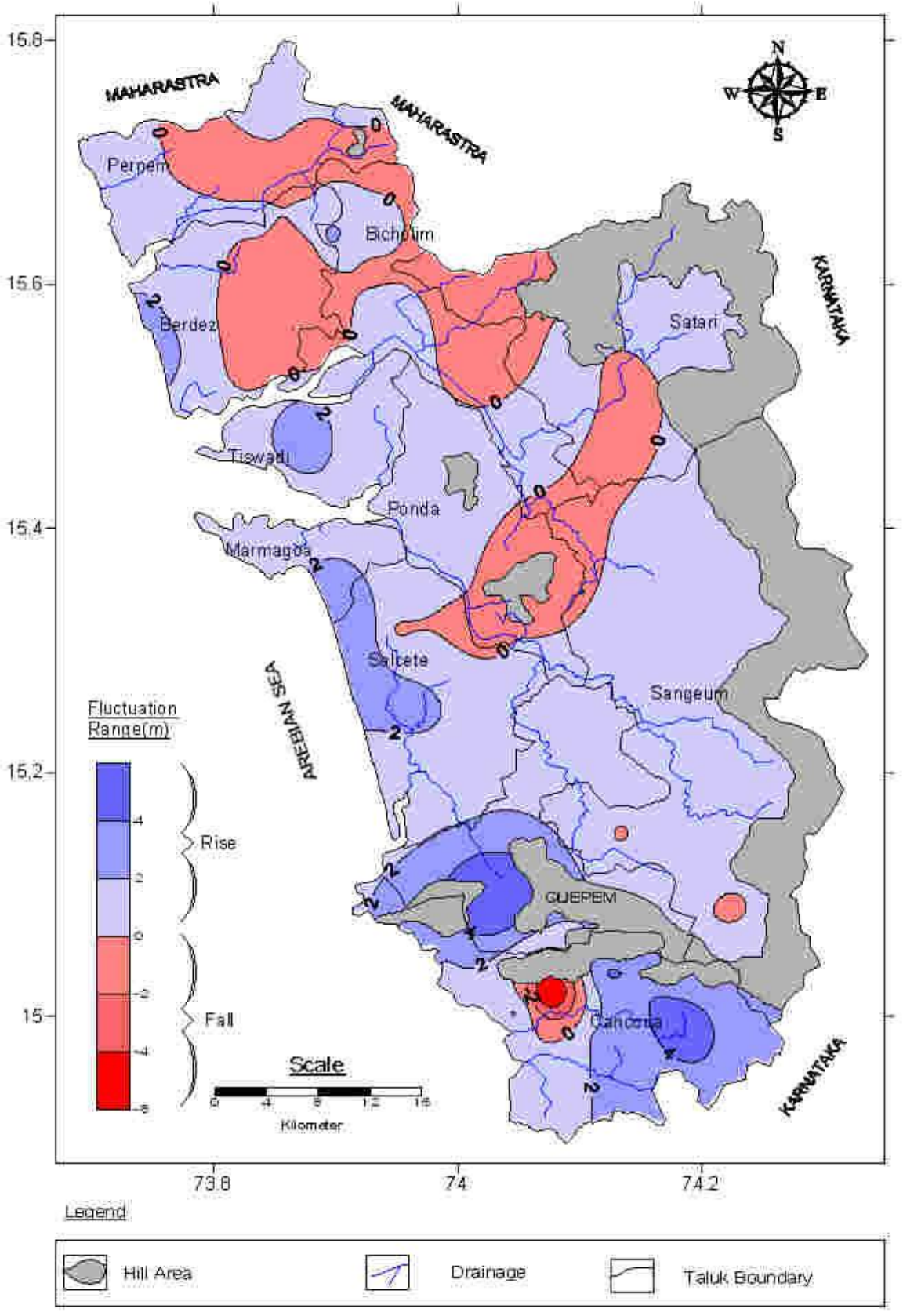
(May 2017 to November 2017)

Taluk	Number of Station Analysed	Fall in m						Rise in m					
		0-2	%	2-4	%	>4	%	0 -2	%	2-4	%	>4	%
Bardez	11	3	27.3	1	9.1	0	0.0	6	54.5	1	9.1	0	0.0
Bicholim	6	2	33.3	0	0.0	0	0.0	3	50.0	1	16.7	0	0.0
Canacona	8	0	0.0	0	0.0	1	12.5	3	37.5	2	25.0	2	25.0
Marmugoa	1	0	0.0	0	0.0	0	0.0	1	100.0	0	0.0	0	0.0
Pernem	9	4	44.4	0	0.0	0	0.0	5	55.6	0	0.0	0	0.0
Ponda	4	0	0.0	1	25.0	0	0.0	3	75.0	0	0.0	0	0.0
Quepem	3	0	0.0	0	0.0	0	0.0	3	100.0	0	0.0	0	0.0
Salcete	9	2	22.2	0	0.0	0	0.0	3	33.3	3	33.3	1	11.1
Sangeum	10	2	20.0	0	0.0	0	0.0	7	70.0	0	0.0	1	10.0
Sattari	10	6	60.0	0	0.0	0	0.0	3	30.0	1	10.0	0	0.0
Tiswadi	4	0	0.0	0	0.0	0	0.0	3	75.0	1	25.0	0	0.0
Total	75	19	25.3	2	2.7	1	1.3	40	53.3	9	12.0	4	5.3


WATER LEVEL FLUCTUATION MAY 2017 - AUGUST 2017, GOA STATE
Fig 3.5
MAHARASTRA
MAHARASTRA
PERNEM
BARDEZ
BICHOLIM
TISWADI
PONDA
SATARI
KARNATAKA
MARMUGAO
SALCETE
ARABIAN SEA
SANGEM
CANACONA
KARNATAKA
N
W
E
S
15.8
15.6
15.4
15.2
15
73.8
74
74.2
Fluctation Range(m)
4
2
0
-2
Rise
Fall
Scale
0 4 8 12 16
Kilometer
Legend
Hill Area
Drainage
Taluk Boundary

WATER LEVEL FLUCTUATION, MAY 2017 - NOVEMBER 2017, GOA STATE

Fig - 3.6



and Quepem taluks. Fall in water level of 0-2 m is observed in Pernem, Berdez, Bicholim, Satari, Ponda, Salcete, Sanquem and Canacona taluks. Fall of 2 to 4 m and >4 m is observed in Canacona taluk of Goa state

Change in Groundwater Level - May 2017 to January 2018

Water levels from 76 stations were compared to know the change in groundwater level in January 2018 as compared with May 2017. It is seen that out of 76 stations analyzed during the month, 40 stations (52.6%) have shown rise in water level and 36 stations (47.4%) have shown fall in water level **(Table 3.7)**.

Rise of water level in the range 0 to 2 m is observed in 35 wells accounting for 46.1% of the analyzed wells. Rise in water level in the range of 2 to 4 m and >4m is recorded in 4 wells (5.3%) and 1 well (1.3%) respectively. Fall in water level in the range of 0 to 2 m is recorded in 31 wells stations accounting for 40.8% of the analyzed wells. Fall in water level in the range of 2 to 4 m and >4m is recorded in 4 wells (5.3%) and 1 well (1.3%) respectively in analyzed.

A map depicting the change in groundwater level in January 2018 as compared to May 2017, showing rise/fall in the ranges of 0 to 2 m, 2 to 4 m and >4 m is enclosed as **Fig.3.7**. The water level rise in the range of 0 to 2 m is the general trend of the Goa State and is observed in almost all the taluks. The water level rise in the range of 2 to 4 m is observed in parts of Canacona, Salcete, and Sangeum taluks. More than 4 m rise is observed in Salcete taluk. Fall in water level of 0 to 2 m is observed in all taluks except Canacona, Ponda and Marmugoa. Fall of 2 to 4 m is observed in Bardez, Bicholim, Ponda taluks and >4 m is observed only in Canacona taluk of Goa state.

Change in Groundwater Level, May 2016 to May 2017

Water levels from 74 stations were compared to know the change in groundwater level in May 2017 as compared with May 2016 in the State of Goa. On the whole 59 wells accounting for 80% of the analysed wells have recorded a rise in water level during May 2017 as compared with the period May 2016. The remaining 15wells (20%) have recorded fall in water level **(Table 3.8)**.

In the rise category, the rise of water level in the range 0-2 m is observed in 47 wells accounting for 64% of the analyzed wells. Rise in water level in the range of 2 to 4 m is recorded in 9 wells (12%) and more than 4 m is recorded in 3 wells (4%) respectively. In the fall category, 15 wells (20%) have recorded a fall in the range of 0 to 2m.

A map showing the change in groundwater level in May 2017 as compared to May 2016, showing rise/fall in the ranges of 0 to 2 m, 2 to 4 m and >4 m is enclosed as **Fig 3.8**. Major part of the state showing rise in water level in the range of 0 to 2 m. 2-4 m of rise is observed in Bardez, Bicholim,

Table 3.7

Taluk wise Categorization of Water Level Fluctuation

(May 2017 to January 2018)

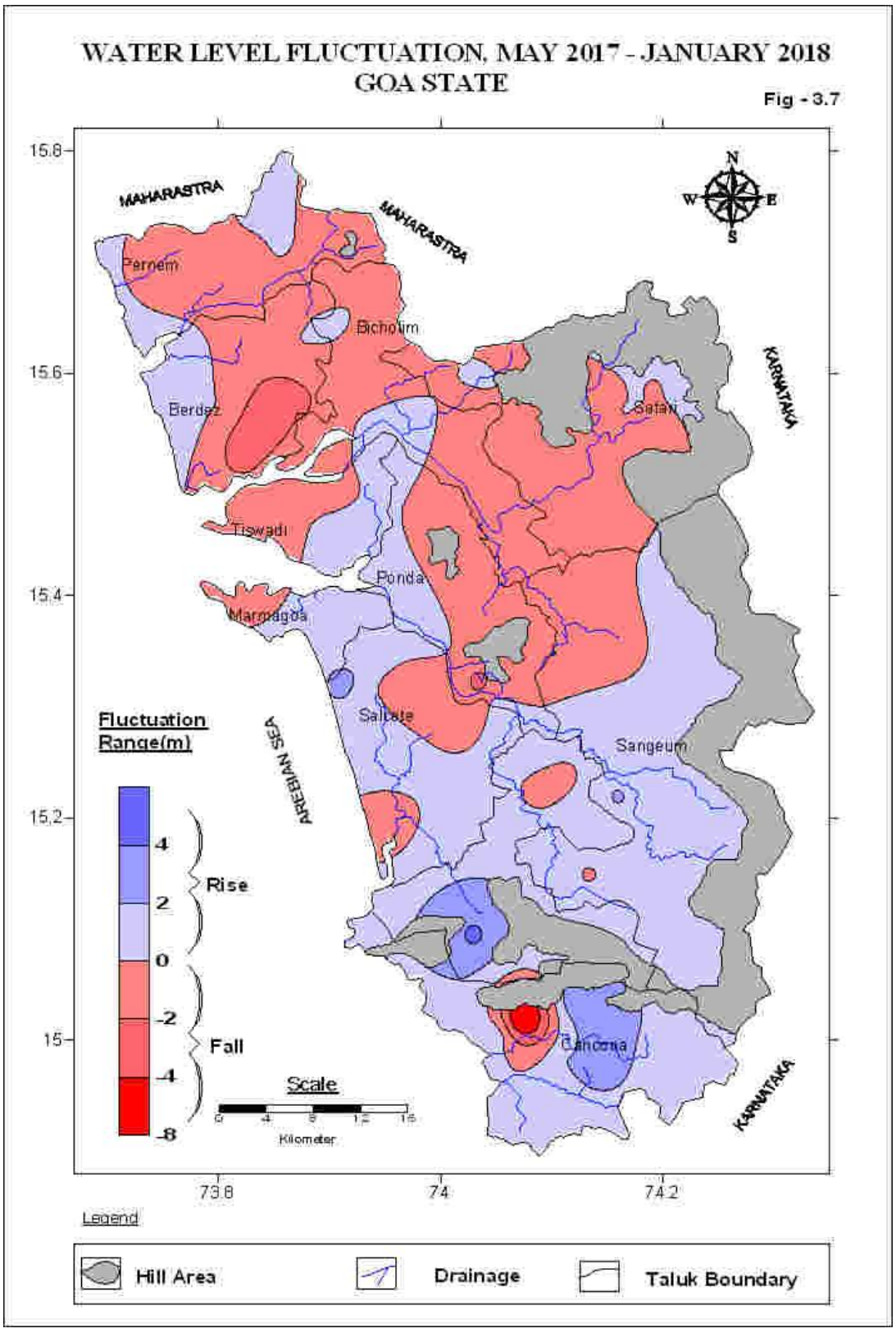
Taluk	Number of Station Analysed	Fall in m						Rise in m					
		0 -2	%	2 - 4	%	>4	%	0-2	%	2-4	%	>4	%
Bardez	11	5	45.5	2	18.2	0	0.0	4	36.4	0	0.0	0	0.0
Bicholim	7	4	57.1	1	14.3	0	0.0	2	28.6	0	0.0	0	0.0
Canacona	8	0	0.0	0	0.0	1	12.5	6	75.0	1	12.5	0	0.0
Marmugoa	1	0	0.0	0	0.0	0	0.0	1	100.0	0	0.0	0	0.0
Pernem	9	6	66.7	0	0.0	0	0.0	3	33.3	0	0.0	0	0.0
Ponda	4	0	0.0	1	25.0	0	0.0	3	75.0	0	0.0	0	0.0
Quepem	3	2	66.7	0	0.0	0	0.0	1	33.3	0	0.0	0	0.0
Salcete	9	3	33.3	0	0.0	0	0.0	4	44.4	1	11.1	1	11.1
Sangeum	10	1	10.0	0	0.0	0	0.0	7	70.0	2	20.0	0	0.0
Sattari	10	8	80.0	0	0.0	0	0.0	2	20.0	0	0.0	0	0.0
Tiswadi	4	2	50.0	0	0.0	0	0.0	2	50.0	0	0.0	0	0.0
Total	76	31	40.8	4	5.3	1	1.3	35	46.1	4	5.3	1	1.3

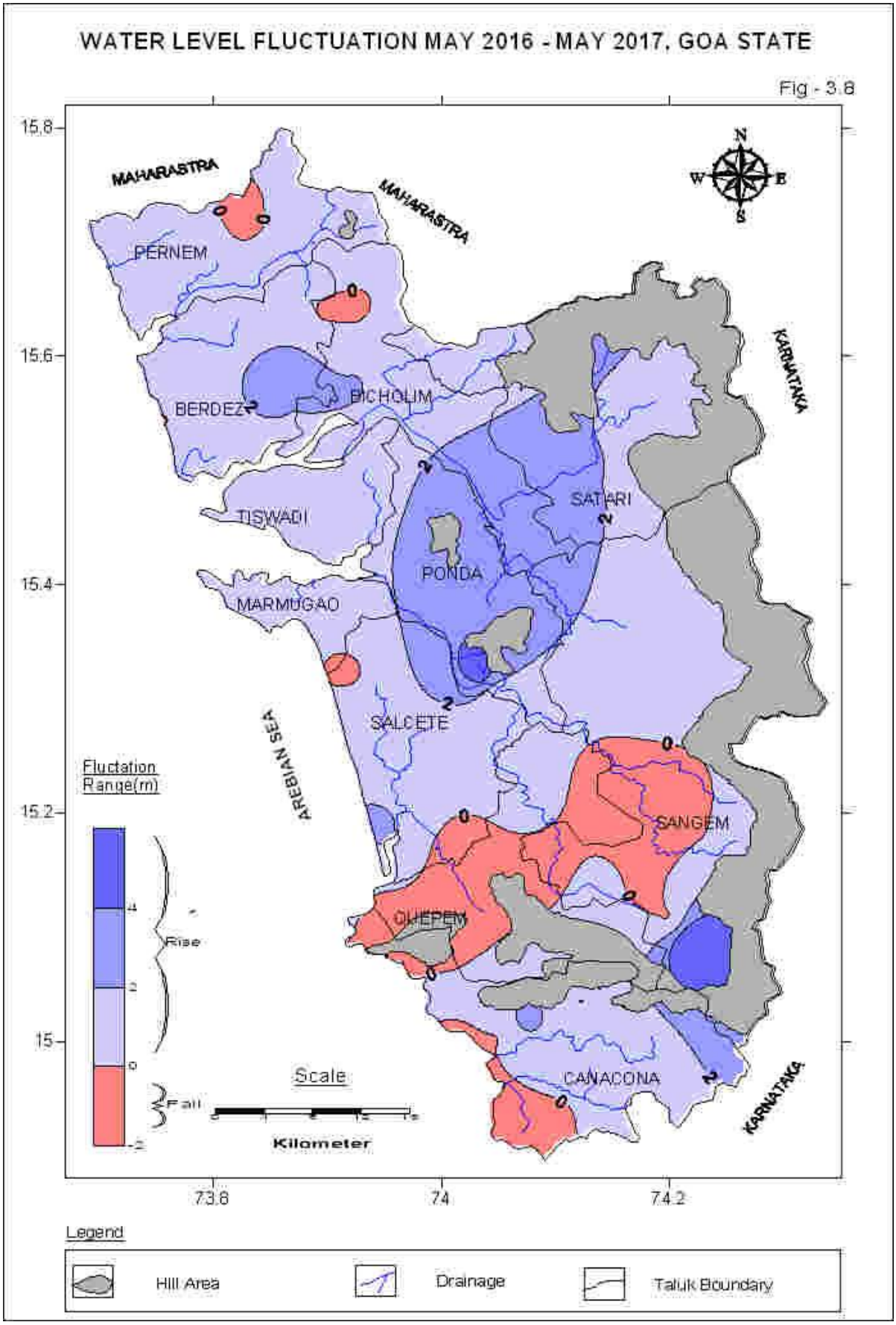
Table 3.8

Taluk wise Categorisation of Water Level Fluctuation

(May-2016 tO May-2017)

Taluk	Number of Station Analysed	Fall in m						Rise in m					
		0 -2	%	2 -4	%	>4	%	0- 2	%	2-4	%	>4	%
Bardez	10	1	10.0	0	0.0	0	0.0	8	80.0	1	10.0	0	0.0
Bicholim	6	1	16.7	0	0.0	0	0.0	2	33.3	2	33.3	1	16.7
Canacona	8	2	25.0	0	0.0	0	0.0	5	62.5	1	12.5	0	0.0
Marmugoa	1	0	0.0	0	0.0	0	0.0	1	100.0	0	0.0	0	0.0
Pernem	8	1	12.5	0	0.0	0	0.0	7	87.5	0	0.0	0	0.0
Ponda	3	0	0.0	0	0.0	0	0.0	2	66.7	0	0.0	1	33.3
Quepem	4	1	25.0	0	0.0	0	0.0	3	75.0	0	0.0	0	0.0
Salcete	10	4	40.0	0	0.0	0	0.0	5	50.0	1	10.0	0	0.0
Sangeum	10	5	50.0	0	0.0	0	0.0	4	40.0	0	0.0	1	10.0
Sattari	10	0	0.0	0	0.0	0	0.0	6	60.0	4	40.0	0	0.0
Tiswadi	4	0	0.0	0	0.0	0	0.0	4	100.0	0	0.0	0	0.0
Total	74	15	20.3	0	0.0	0	0.0	47	63.5	9	12.2	3	4.1


WATER LEVEL FLUCTUATION, MAY 2017 - JANUARY 2018
GOA STATE
Fig - 3.7
15.8
15.6
15.4
15.2
15
73.8
74
74.2
N
W
E
S
MAHARASTRA
MAHARASTRA
KARNATAKA
KARNATAKA
ARABIAN SEA
Pernem
Bicholim
Bardez
Satari
Tiswadi
Ponda
Marmagoa
Salcete
Sangeum
Canacona
Fluctuation Range(m)
4
2
0
-2
-4
-8
Rise
Fall
Scale
0
4
8
12
16
Kilometer
Legend
Hill Area
Drainage
Taluk Boundary


WATER LEVEL FLUCTUATION MAY 2016 - MAY 2017, GOA STATE
Fig - 3.8
MAHARASTRA
MAHARASTRA
KARNATAKA
KARNATAKA
PERNEM
BICHOLIM
BERDEZ
TISWADI
SATARI
PONDA
MARMUGAO
SALCETE
SANGEM
QUEPEM
CANACONA
ARABIAN SEA
N
W
E
S
15.8
15.6
15.4
15.2
15
73.8
74
74.2
Fluctation Range(m)
4
2
0
-2
Rise
Fall
Scale
Kilometer
Legend
Hill Area
Drainage
Taluk Boundary

Pernem, Tiswadi, Salcete, Ponda, Satari, Sangem Canacona and Quepem taluks. Rise in water level of >4 m is observed in Ponda and Sanquem taluks. Fall in water level in the range of 0-2 m is observed in Bicholim, Pernem, Salcete, Marmugoa, Sangem, Quepem and Canacona taluks.

Change in Groundwater Level - August 2016 to August 2017

Water levels from 77 stations were compared to know the change in groundwater level in August 2016 as compared with August 2017 in the State of Goa. It is seen from the table that 82% of the stations monitored have recorded a rise in water level during August 2017 as compared to August 2016 and 18% have shown fall in water level.

Rise in water level in the range of 0 to 2 m is observed in 57 wells accounting for 74%, 2 to 4 m is observed in 5 wells accounting for 7% and more than 4 m is observed in 1 well accounting for 1% of the analysed wells. Fall in water level in the range of 0 to 2 m is recorded in 11 wells accounting for 14%, 2 to 4 m is recorded in 2 wells accounting for 3% and greater than 4 m is recorded in 1 well accounting for 1% respectively of the analysed wells **(Table 3.9)**.

A map depicting the change in groundwater level in August 2017 as compared to August 2016, showing rise/fall in the ranges of <2 m, 2 to 4 m and >4 m is enclosed as **Fig. 3.9**. Rise in water level in the range of 0 to 2 m is observed in major parts of all taluks in Goa State. Rise in water level in the range of >2 m is observed as isolated patches in Bicholim, Berdez, Sanguem, Salcete and Canacona taluks. Fall in water level in the range of 0 to 2m is observed as isolated patches in almost all the taluks except Salcete and Bicholim in Goa State. While fall in water level of >2m is observed in parts of Sanguem and Quepem taluks. Fall in water level of >4m is observed in parts Sanguem taluk of Goa State.

Change in Groundwater Level - November 2016 to November 2017

Water levels from 78 stations were compared to know the change in groundwater level in November 2016 as compared with November 2017 in the State of Goa. It is seen from the table that 50 stations (64%) of the monitored wells have recorded a rise in water level during November 2017 as compared to November 2016 and 28 stations (36%) have shown fall in water level.

Rise in water level in the range of 0 to 2 m is observed in 48 wells accounting for 62%, 2 to 4 m is observed in 1 well accounting for 1% and more than 4 m is observed in 1 well accounting for 1% of the analysed wells. Fall in water level in the range of 0 to 2 m is recorded in 26 wells accounting for 33%, 2 to 4 m is recorded in 2 wells accounting for 3% of the analysed wells **(Table 3.10)**.

A map depicting the change in groundwater level in November 2017 as compared to November 2016, showing rise/fall in the ranges of <2 m, 2 to 4 m and >4 m is enclosed as **Fig. 3.10**. Rise in

Table 3.9

Talukwise Categorisation of Water Level Fluctuation

(August 2016 to August 2017)

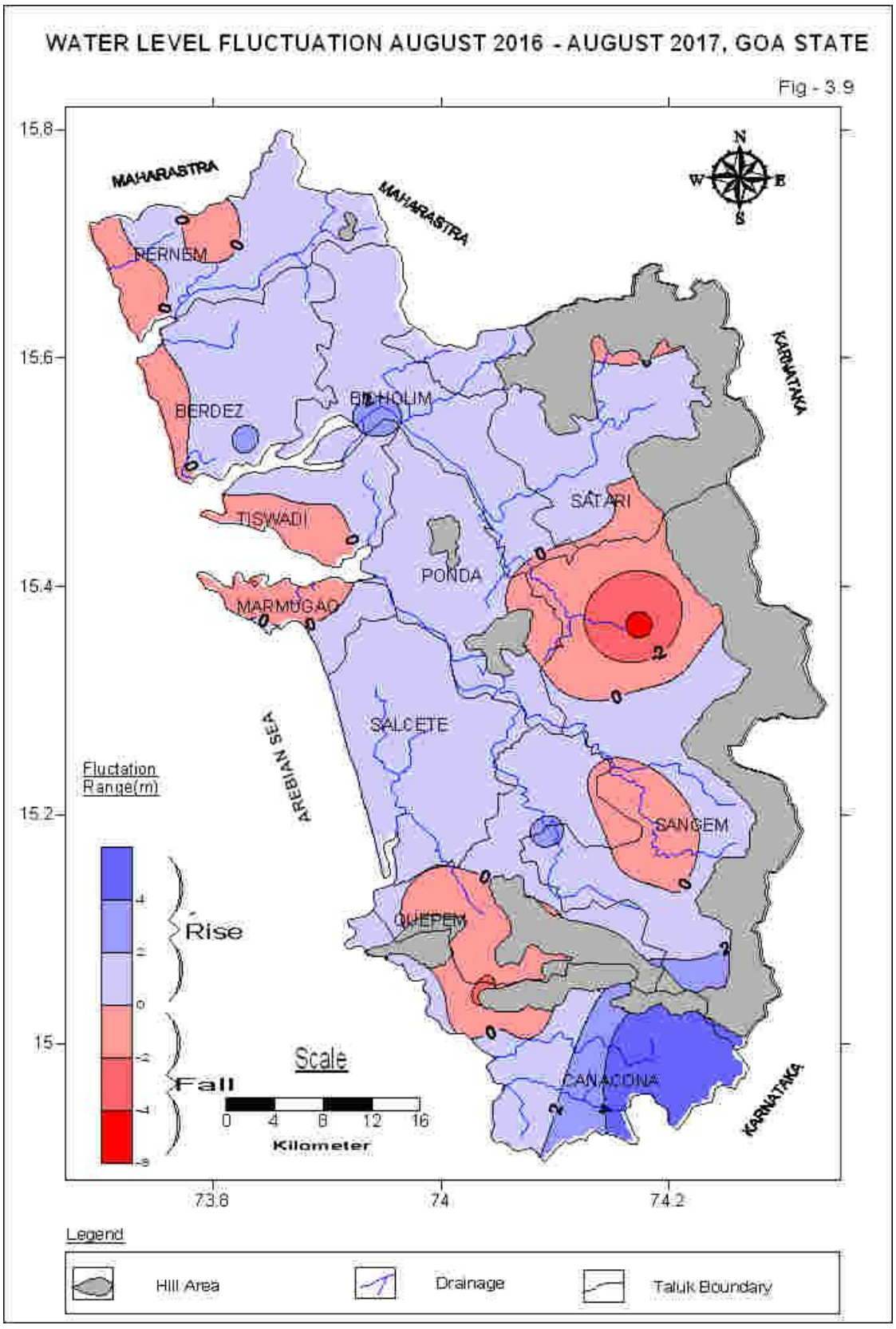
Taluk	Number of Station Analysed	Fall in m						Rise in m					
		0 -2	%	2-4	%	>4	%	0-2	%	2-4	%	>4	%
Bardez	11	1	9.1	0	0.0	0	0.0	9	81.8	1	9.1	0	0.0
Bicholim	6	0	0.0	0	0.0	0	0.0	5	83.3	1	16.7	0	0.0
Canacona	7	1	14.3	1	14.3	0	0.0	4	57.1	0	0.0	1	14.3
Marmugoa	1	0	0.0	0	0.0	0	0.0	1	100.0	0	0.0	0	0.0
Pernem	8	2	25.0	0	0.0	0	0.0	6	75.0	0	0.0	0	0.0
Ponda	5	0	0.0	0	0.0	0	0.0	5	100.0	0	0.0	0	0.0
Quepem	3	0	0.0	0	0.0	0	0.0	3	100.0	0	0.0	0	0.0
Salcete	9	1	11.1	1	11.1	0	0.0	7	77.8	0	0.0	0	0.0
Sangeum	13	4	30.8	0	0.0	1	7.7	6	46.2	2	15.4	0	0.0
Sattari	10	2	20.0	0	0.0	0	0.0	7	70.0	1	10.0	0	0.0
Tiswadi	4	0	0.0	0	0.0	0	0.0	4	100.0	0	0.0	0	0.0
Total	77	11	14.3	2	2.6	1	1.3	57	74.0	5	6.5	1	1.3

Table 3.10

Talukwise Categorisation of Water Level Fluctuation

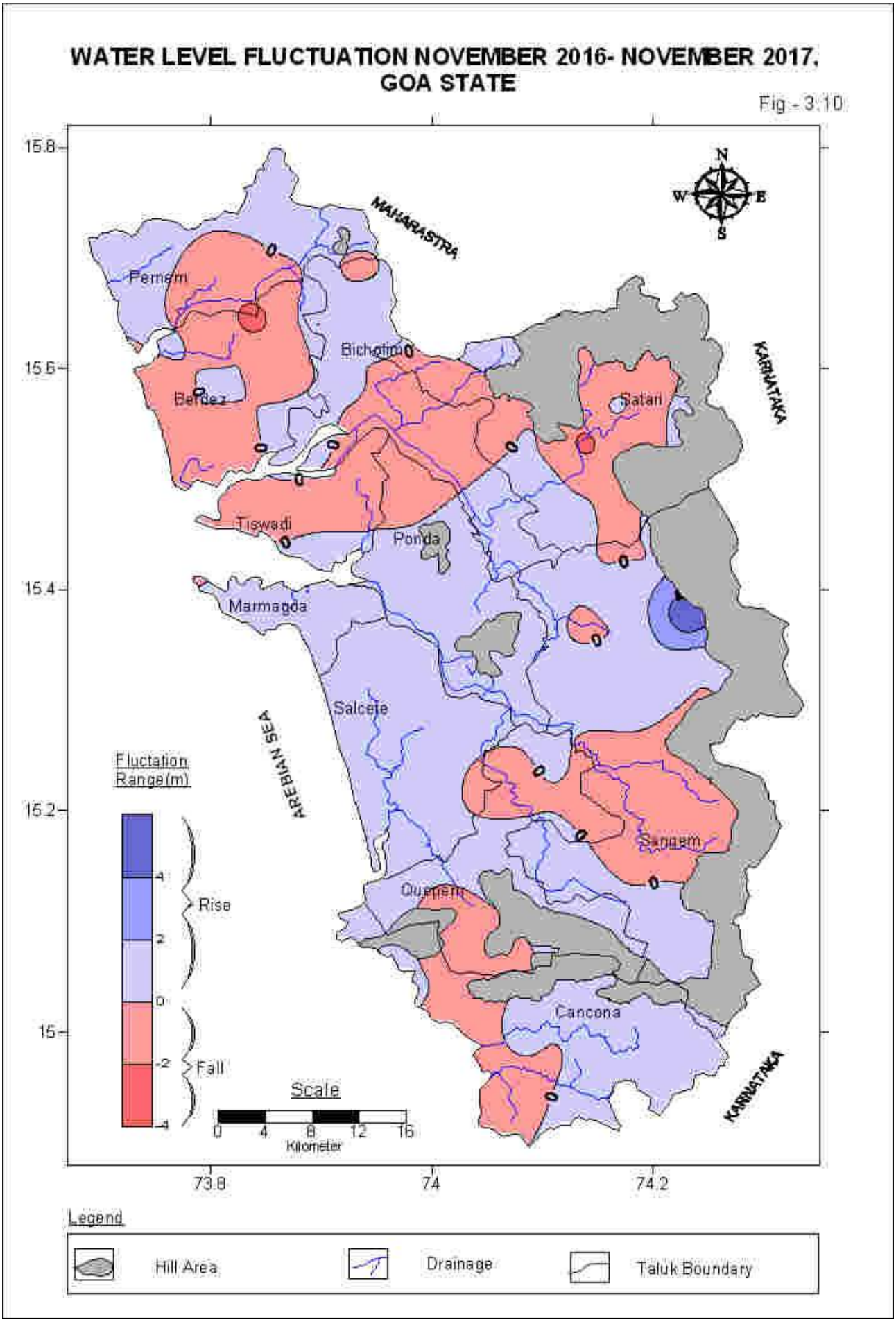
(November 2016 to November 2017)

Taluk	Number of Station Analysed	Fall in m						Rise in m					
		0 -2	%	2-4	%	>4	%	0 - 2	%	2 - 4	%	> 4	%
Bardez	12	6	50.0	1	8.3	0	0.0	5	41.7	0	0.0	0	0.0
Bicholim	6	2	33.3	0	0.0	0	0.0	3	50.0	1	16.7	0	0.0
Canacona	8	4	50.0	0	0.0	0	0.0	4	50.0	0	0.0	0	0.0
Marmugoa	1	0	0.0	0	0.0	0	0.0	1	100.0	0	0.0	0	0.0
Pernem	9	1	11.1	0	0.0	0	0.0	8	88.9	0	0.0	0	0.0
Ponda	5	0	0.0	0	0.0	0	0.0	5	100.0	0	0.0	0	0.0
Quepem	3	1	33.3	0	0.0	0	0.0	2	66.7	0	0.0	0	0.0
Salcete	8	1	12.5	0	0.0	0	0.0	7	87.5	0	0.0	0	0.0
Sangeum	12	3	25.0	0	0.0	0	0.0	8	66.7	0	0.0	1	8.3
Sattari	10	5	50.0	1	10.0	0	0.0	4	40.0	0	0.0	0	0.0
Tiswadi	4	3	75.0	0	0.0	0	0.0	1	25.0	0	0.0	0	0.0
Total	78	26	33.3	2	2.6	0	0.0	48	61.5	1	1.3	1	


WATER LEVEL FLUCTUATION AUGUST 2016 - AUGUST 2017, GOA STATE
Fig - 3.9
MAHARASTRA
MAHARASTRA
KARNATAKA
KARNATAKA
PERNEM
BERDEZ
BICHOLIM
TISWADI
SATARI
PONDA
MARMUGAO
SALCETE
ARABIAN SEA
SANGEM
QUEPEM
CANACONA
Fluctation Range(m)
Rise
Fall
Scale
0 4 8 12 16
Kilometer
15.8
15.6
15.4
15.2
15
73.8
74
74.2
N
W
E
S
Legend
Hill Area
Drainage
Taluk Boundary

WATER LEVEL FLUCTUATION NOVEMBER 2016- NOVEMBER 2017, GOA STATE

Fig - 3.10



water level in the range of 0 to 2 m is observed in major parts of all taluks in Goa State. Rise in water level in the range 2 to 4 and >4m are recorded in Sanguem taluk. Fall in water level in the range of 0 to 2m is observed as isolated patches in almost all the taluks of in Goa State. While fall in water level of >2m is observed in parts of Satari, Berdez and Pernem taluks.

Change in Groundwater Level - January 2017 to January 2018

Water levels from 79 stations were compared to know the change in groundwater level in January 2017 as compared with January 2018 in the State of Goa. It is seen from the table that 45 stations (57%) of the monitored wells have recorded a rise in water level during January 2018 as compared to January 2017 and 34 stations (43%) have shown fall in water level.

Rise in water level in the range of 0 to 2 m is observed in 43 wells accounting for 54.4%, 2 to 4 m is observed in 1 well accounting for 1.3% and more than 4 m is observed in 1 well accounting for 1.3% of the analysed wells. Fall in water level in the range of 0 to 2 m is recorded in 30 wells accounting for 38%, 2 to 4 m is recorded in 3 wells accounting for 3.8%, > 4 m is recorded in 1 well accounting for 1.3% of the analysed wells **(Table 3.11)**.

A map depicting the change in groundwater level in January 2018 as compared to January 2017, showing rise/fall in the ranges of <2 m, 2 to 4 m and >4 m is enclosed as **Fig.3.11**. Rise in water level in the range of 0 to 2 m is observed in major parts of all taluks in Goa State. Rise in water level in the range 2 to 4 and >4m are recorded in Canacona taluk. Fall in water level in the range of 0 to 2m is observed in all taluks of in Goa State. While fall in water level of >2m is observed in parts of Berdez and Tiswadi taluks. Fall in water level of > 4m is observed in Bicholim taluk.

Change in Groundwater Level - Mean (May 2007 to May 2016) – May 2017

Mean groundwater level for the period May 2007 to May 2016 (decadal mean water level) was compared with the groundwater level in May 2017 in the State of Goa. It is seen that out of the 36 stations compared, 23 wells accounting for 64% of analysed wells have shown a rise in the range of 0 to 2 m and 2-4m water level rise is observed in 3 stations (8%) and > 4 m in one well accounting of 3% rise respectively. 9 wells accounting for 25% showed a fall in water level in the range of 0 to 2 m has recorded during May 2017 as compared to preceding decadal mean. **(Table 3.12)**.

A map showing the change in water levels, with rise/fall in the ranges of 0-2 m and 2-4 m and >4m is enclosed as **Fig.3.12**. Rise in water level in the range of 0-2 m is observed almost in all taluks of Goa State. Rise in the range of 2-4 m is observed in Ponda, Satari, Salcete, Bicholim Sanguem and Canacona taluk of Goa State. And >4 m rise is observed in Canacona and Saquem taluks. Fall in water level of 0-2 m is observed in Quepem, Salcete, Berdez, Marmugoa, Sanguem, Ponda and Canacona taluks of Goa State.

Table 3.11

Talukwise Categorisation of Water Level Fluctuation

(January 2017 to January 2018)

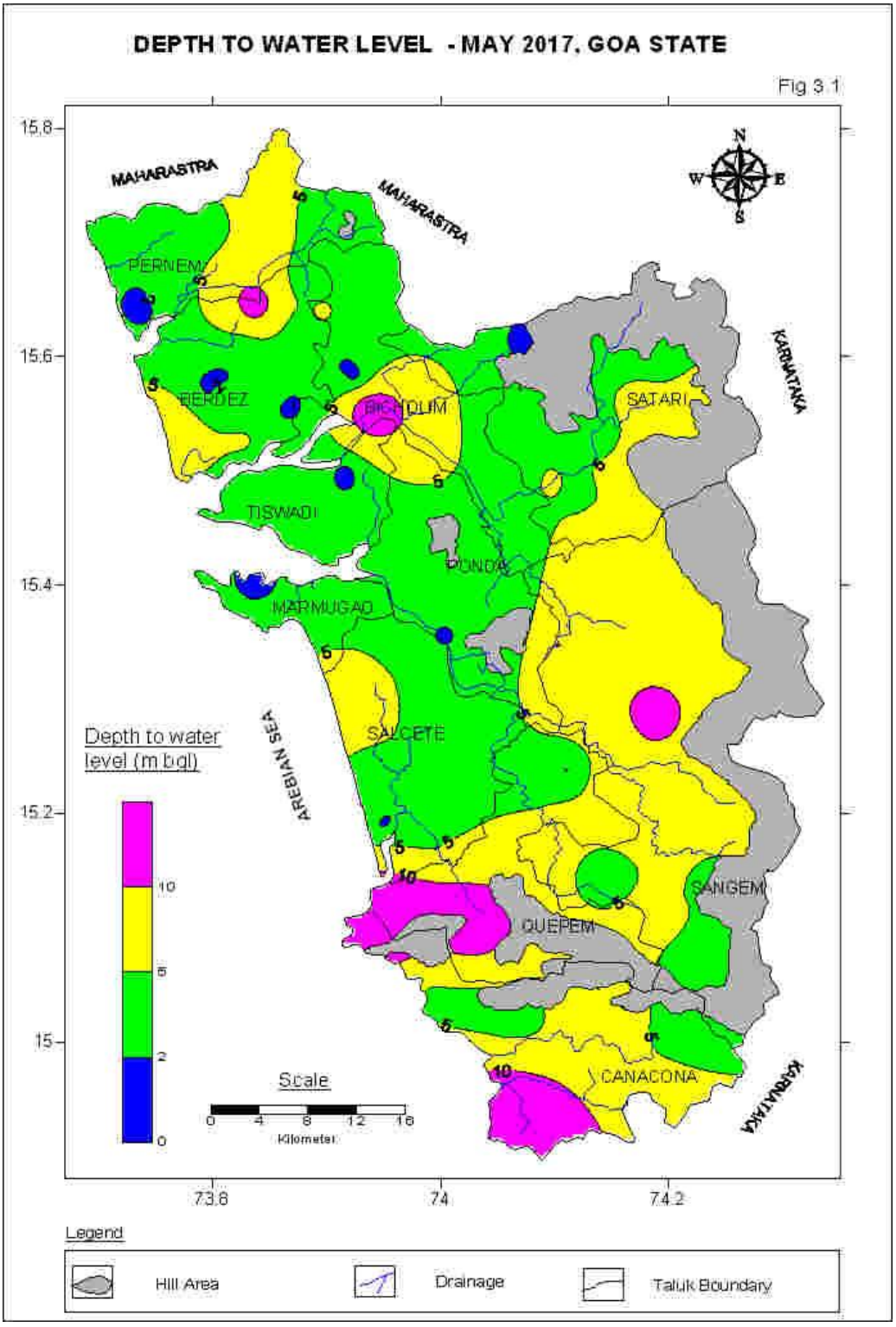
Taluk	Number of Station Analysed	Fall in m						Rise in m					
		0 -2	%	2-4	%	> 4	%	0- 2	%	2 -4	%	> 4	%
Bardez	12	3	25.0	1	8.3	0	0.0	8	66.7	0	0.0	0	0.0
Bicholim	7	4	57.1	0	0.0	1	14.3	2	28.6	0	0.0	0	0.0
Canacona	7	4	57.1	0	0.0	0	0.0	1	14.3	1	14.3	1	14.3
Marmugoa	1	1	100.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Pernem	9	3	33.3	0	0.0	0	0.0	6	66.7	0	0.0	0	0.0
Ponda	5	2	40.0	0	0.0	0	0.0	3	60.0	0	0.0	0	0.0
Quepem	3	1	33.3	0	0.0	0	0.0	2	66.7	0	0.0	0	0.0
Salcete	8	3	37.5	0	0.0	0	0.0	5	62.5	0	0.0	0	0.0
Sangeum	13	4	30.8	1	7.7	0	0.0	8	61.5	0	0.0	0	0.0
Sattari	10	4	40.0	0	0.0	0	0.0	6	60.0	0	0.0	0	0.0
Tiswadi	4	1	25.0	1	25.0	0	0.0	2	50.0	0	0.0	0	0.0
Total	79	30	38.0	3	3.8	1	1.3	43	54.4	1	1.3	1	1.3

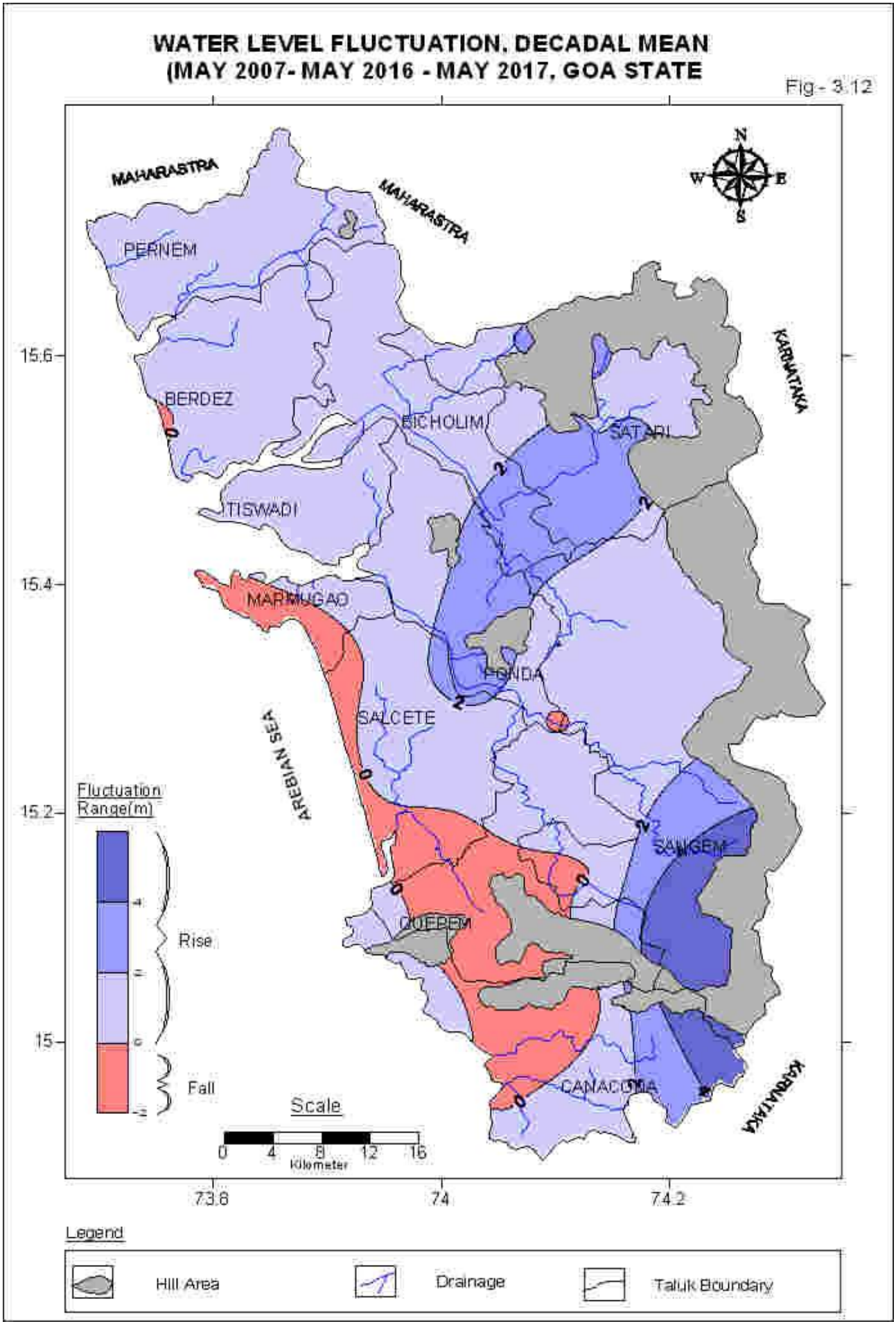
Table 3.12

Talukwise Categorisation of Change in Water Level

10 Yrs Mean (May 2007 to May 2016) - May 201717

Taluk	Number of Station Analysed	Range in m				Rise in m						Fall in m					
		Rise		Fall		0- 2		2 -4		> 4		0 -2		2 -4		>4	
		Min	Max	Min	Max	No	%	No	%	No	%	No	%	No	%	No	%
Bardez	4	0.60	1.16	0.08	0.08	3	75.0	0	0.0	0	0.0	1	25.0	0	0.0	0	0.0
Bicholim	2	0.41	0.65			2	100.	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Canacona	6	0.21	0.21	0.08	1.56	1	16.7	0	0.0	0	0.0	5	83.3	0	0.0	0	0.0
Pernem	5	0.44	1.36			5	100.	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Ponda	2	2.87	2.87	0.19	0.19	0	0.0	1	50.0	0	0.0	1	50.0	0	0.0	0	0.0
Quepem	3	0.21	1.10			3	100.	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Salcete	3	1.24	1.24	0.57	0.97	1	33.3	0	0.0	0	0.0	2	66.7	0	0.0	0	0.0
Sangeum	3	0.00	8.38			2	66.7	0	0.0	1	33.3	0	0.0	0	0.0	0	0.0
Sattari	5	0.20	3.22			3	60.0	2	40.0	0	0.0	0	0.0	0	0.0	0	0.0
Tiswadi	3	0.30	1.54			3	100.	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Total	36					23	63.9	3	8.3	1	2.8	9	25.0	0	0.0	0	0.0


DEPTH TO WATER LEVEL - MAY 2017, GOA STATE
Fig 3.1
15.8
15.6
15.4
15.2
15
73.8
74
74.2
MAHARASTRA
MAHARASTRA
KARNATAKA
KARNATAKA
PERNEM
BARDEZ
BICHOLIM
SATARI
TISWADI
PONDA
MARMUGAO
SALCETE
SANGEM
QUEPEM
CANACONA
ARABIAN SEA
N
W
E
S
Depth to water level (m bgl)
10
5
2
0
Scale
0 4 8 12 16
Kilometer
Legend
Hill Area
Drainage
Taluk Boundary


WATER LEVEL FLUCTUATION, DECADAL MEAN
(MAY 2007- MAY 2016 - MAY 2017, GOA STATE
Fig - 3.12
MAHARASTRA
MAHARASTRA
PERNEM
BERDEZ
BICHOLIM
SATARI
TISWADI
KARNATAKA
MARMUGAO
PONDA
SALCETE
ARABIAN SEA
SANGEM
QUEPEM
CANACONA
KARNATAKA
15.6
15.4
15.2
15
73.8
74
74.2
N
W
E
S
Fluctuation Range(m)
Rise
Fall
Scale
0 4 8 12 16
Kilometer
Legend
Hill Area
Drainage
Taluk Boundary

Change in Water Level, Mean (August 2007 to August 2016) – August 2017

Mean groundwater level for the period August 2007 to August 2016 was compared with the groundwater level in August 2017 in the State of Goa. It is seen that out of the 34 stations compared while 26 stations have shown a rise in water level accounting for 77 % of analyzed wells and 8 stations accounting for 24% of analyzed wells have shown a fall in water level.

In the rise category, 26 wells accounting for 77% of the analyzed wells are in the range of 0 to 2 m. In the fall category, 7 wells accounting for 21% of the wells have recorded a range of 0 to 2m water level and 1 well accounting for 3% of the analysed wells have fallen in the range of 2 to 4m water level fluctuation during August 2017 as compared to proceeding decadal mean **(Table 3.13)**. A map showing the change in water levels, with rise/fall in the ranges of 0 to 2 m, 2 to 4 m and >4m is enclosed as **Fig. 3.13**. Rise in water levels of 0-2 m is observed in parts of almost all taluks of Goa State. Fall in water level of 0-2 m is observed predominating in parts of Pernem, Berdez, Quepem, Canacona and Sangem taluks of Goa State.

Change in Water Level, Mean (November 2007 to November 2016) – November 2017

Mean groundwater level for the period November 2007 to November 2016 was compared with the groundwater level in November 2017 in the State of Goa. It is seen that out of the 35 stations compared while 28 stations have shown a fall in water level accounting for 80 % of analyzed wells and 7 stations accounting for 20% of analyzed wells have shown a rise in water level.

In the fall category, 28 wells accounting for 80% of the analyzed wells are in the range of 0 to 2 m. In the rise category, 6 wells accounting for 17% of the wells have recorded a range of 0 to 2m rise and 1 well accounting for 3% of the analysed wells have of 2 to 4m rise fluctuation during November 2017 as compared to preceding decadal mean **(Table 3.14)**. A map showing the change in water levels, with rise/fall in the ranges of 0 to 2 m, 2 to 4 m and >4m is enclosed as **Fig. 3.14**. Fall in water levels of 0-2 m is observed in parts of almost all taluks of Goa State. Rise in water level of 0-2 m is observed as isolated patches in Satari, Salcete, Quepem, Canacona and Sangem taluks of Goa State. Rise in water level more than 2m is observed as small patches in Sanquem taluk of Goa State.

Change in Groundwater Level- Mean (Jan 2008 to Jan 2017) – Jan 2018

Mean groundwater level for the period January 2008 to January 2017 was compared with the groundwater level in January 2018 in the State of Goa. It is seen that out of the 35 stations compared while 17 stations have shown a fall in water level accounting for 49 % of analyzed wells and 18 stations accounting for 51% of analyzed wells have shown a rise in water level.

Table 3.13

Taluk wise Categorization of Change in Water Level

10 Yrs Mean (August 2007 to August 2016) - August 2017

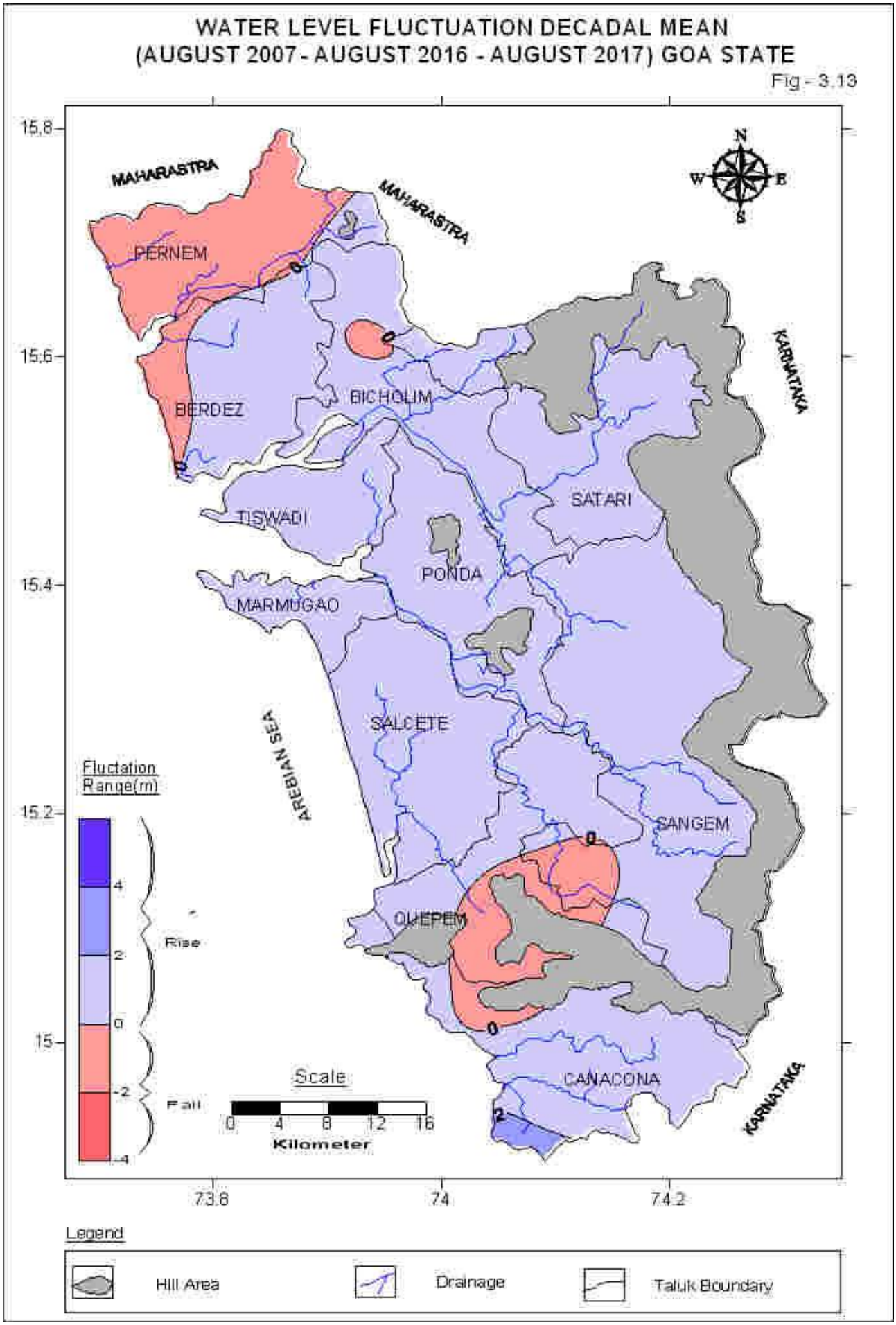
Taluk	Number of Station Analysed	Range in m				Rise in m						Fall in m					
		Rise		Fall		0- 2		2 -4		> 4		0-2		2 -4		> 4	
		Min	Max	Min	Max	No	%	No	%	No	%	No	%	No	%	No	%
Bardez	4	0.20	1.61	0.77	0.77	3	75.0	0	0.0	0	0.0	1	25.0	0	0.0	0	0.0
Bicholim	2	0.29	0.29	0.09	0.09	1	50.0	0	0.0	0	0.0	1	50.0	0	0.0	0	0.0
Canacona	5	0.45	1.92	2.01	2.01	4	80.0	0	0.0	0	0.0	0	0.0	1	20.0	0	0.0
Pernem	5	0.56	0.56	0.28	1.14	1	20.0	0	0.0	0	0.0	4	80.0	0	0.0	0	0.0
Ponda	2	0.12	0.61			2	100.	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Quepem	2	0.35	0.59			2	100.	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Salcete	2	0.54	0.90			2	100.	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Sangeum	4	0.00	1.22	0.33	0.33	3	75.0	0	0.0	0	0.0	1	25.0	0	0.0	0	0.0
Sattari	5	0.07	1.30			5	100.	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Tiswadi	3	0.32	0.82			3	100.	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Total	34					26	76.5	0	0.0	0	0.0	7	20.6	1	2.9	0	0.0

Table 3.14

Talukwise Categorisation of Change in Water Level

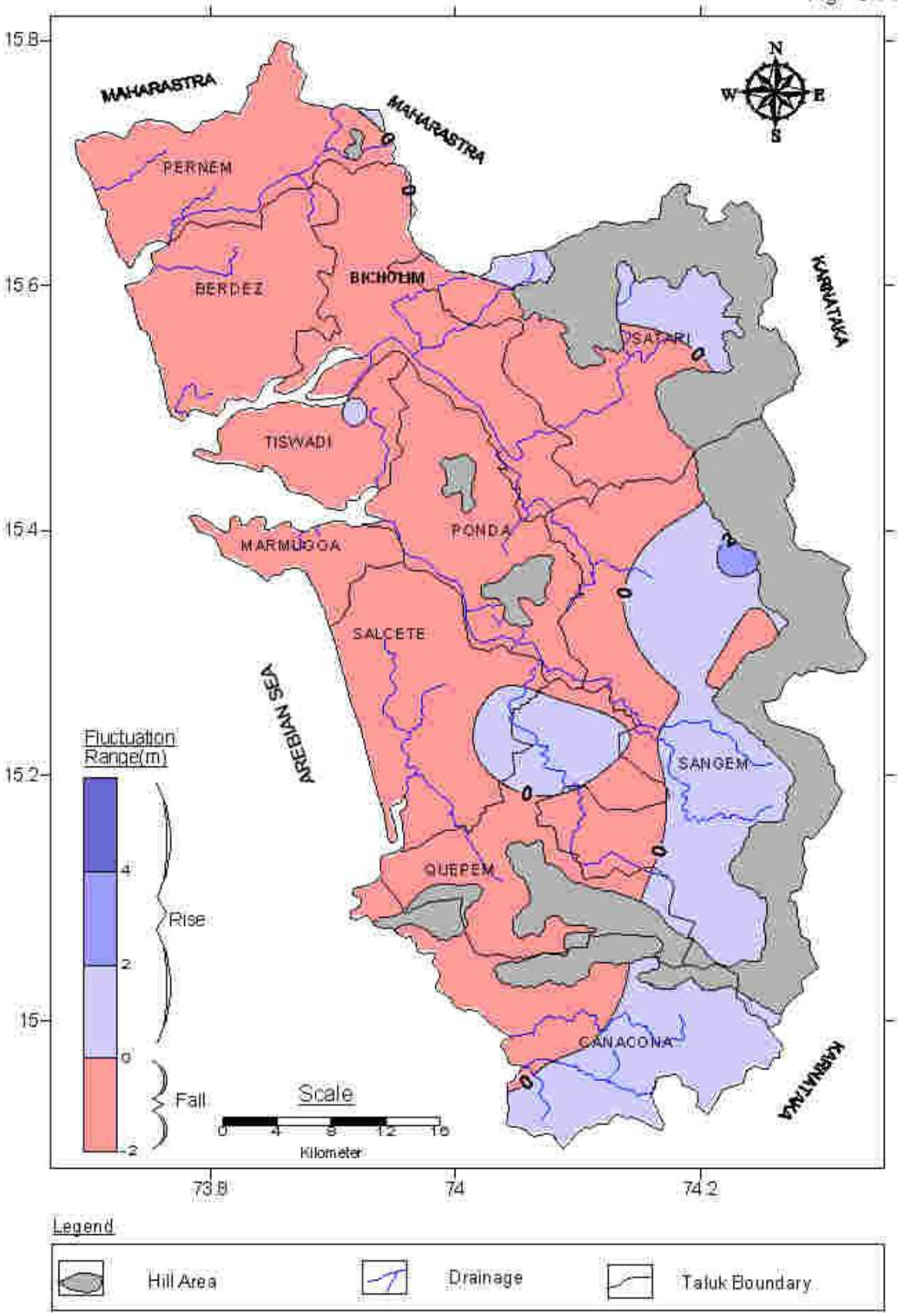
10 Yrs Mean (November 2007 to November 2016) - November 2017

Taluk	Number of Station Analysed	Range in m				Rise in m						Fall in m					
		Rise		Fall		0- 2		2 -4		> 4		0 -2		2 -4		> 4	
	Min	Max	Min	Max	No	%	No	%	No	%	No	%	No	%	No	%	
Bardez	4			0.75	1.37	0	0.0	0	0.0	0	0.0	4	100.	0	0.0	0	0.0
Bicholim	2			0.10	0.33	0	0.0	0	0.0	0	0.0	2	100.	0	0.0	0	0.0
Canacona	6			0.01	1.72	0	0.0	0	0.0	0	0.0	6	100.	0	0.0	0	0.0
Pernem	5	0.13	0.13	0.06	0.77	1	20.0	0	0.0	0	0.0	4	80.0	0	0.0	0	0.0
Ponda	2			0.05	0.26	0	0.0	0	0.0	0	0.0	2	100.	0	0.0	0	0.0
Quepem	2	0.08	0.53			2	100.	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Salcete	2			0.17	0.41	0	0.0	0	0.0	0	0.0	2	100.	0	0.0	0	0.0
Sangeum	4	1.45	3.03	0.54	0.66	1	25.0	1	25.0	0	0.0	2	50.0	0	0.0	0	0.0
Sattari	5	1.14	1.14	0.21	1.05	1	20.0	0	0.0	0	0.0	4	80.0	0	0.0	0	0.0
Tiswadi	3	0.09	0.09	0.24	0.33	1	33.3	0	0.0	0	0.0	2	66.7	0	0.0	0	0.0
Total	35					6	17.1	1	2.9	0	0.0	28	80.0	0	0.0	0	0.0


WATER LEVEL FLUCTUATION DECADAL MEAN
(AUGUST 2007 - AUGUST 2016 - AUGUST 2017) GOA STATE
Fig - 3.13
MAHARASTRA
MAHARASTRA
PERNEM
BERDEZ
BICHOLIM
TISWADI
PONDA
SATARI
KARNATAKA
MARMUGAO
SALCETE
ARABIAN SEA
SANGEM
QUEPEM
CANACONA
KARNATAKA
N
W
E
S
Fluctation Range(m)
4
2
0
-2
-4
Rise
Fall
Scale
0 4 8 12 16
Kilometer
15.8
15.6
15.4
15.2
15
73.8
74
74.2
Legend
Hill Area
Drainage
Taluk Boundary

WATER LEVEL FLUCTUATION, DECADAL MEAN (NOV 2007- NOV 2016) - NOV 2017, GOA STATE

Fig - 3.14



In the fall category, 16 wells accounting for 45.7% of the analyzed wells are in the range of 0 to 2 m and 1 well accounting for 2.9% is in the range of 2 to 4 m. In the rise category, 18 wells accounting for 51.4% have recorded a range of 0 to 2m rise during January 2018 as compared to preceding decadal mean **(Table 3.15)**. A map showing the change in water levels, with rise/fall in the ranges of 0 to 2 m, 2 to 4 m and >4m is enclosed as **Fig.3.15**. Fall in water levels of 0 to 2 m is observed in parts of almost all taluks of Goa State except Bicholim taluk and fall of 2 to 4m is observed in Bardez taluk. Rise in water level of 0 to 2 m is observed in all taluks except Salcete taluk of Goa State.

3.3 Depth to Water Level – Piezometers

CGWB has a network of 49 piezometers drilled in Goa State under Hydrology Project II. These piezometers are also monitored for manual water level along with the dug well four times in a year. The water level data of these piezometers during the water year 2017-18 is given in **Annexure - V**. However the piezometers water levels are not incorporated in the preparation of water level and fluctuation maps discussed below.

Table 3.15

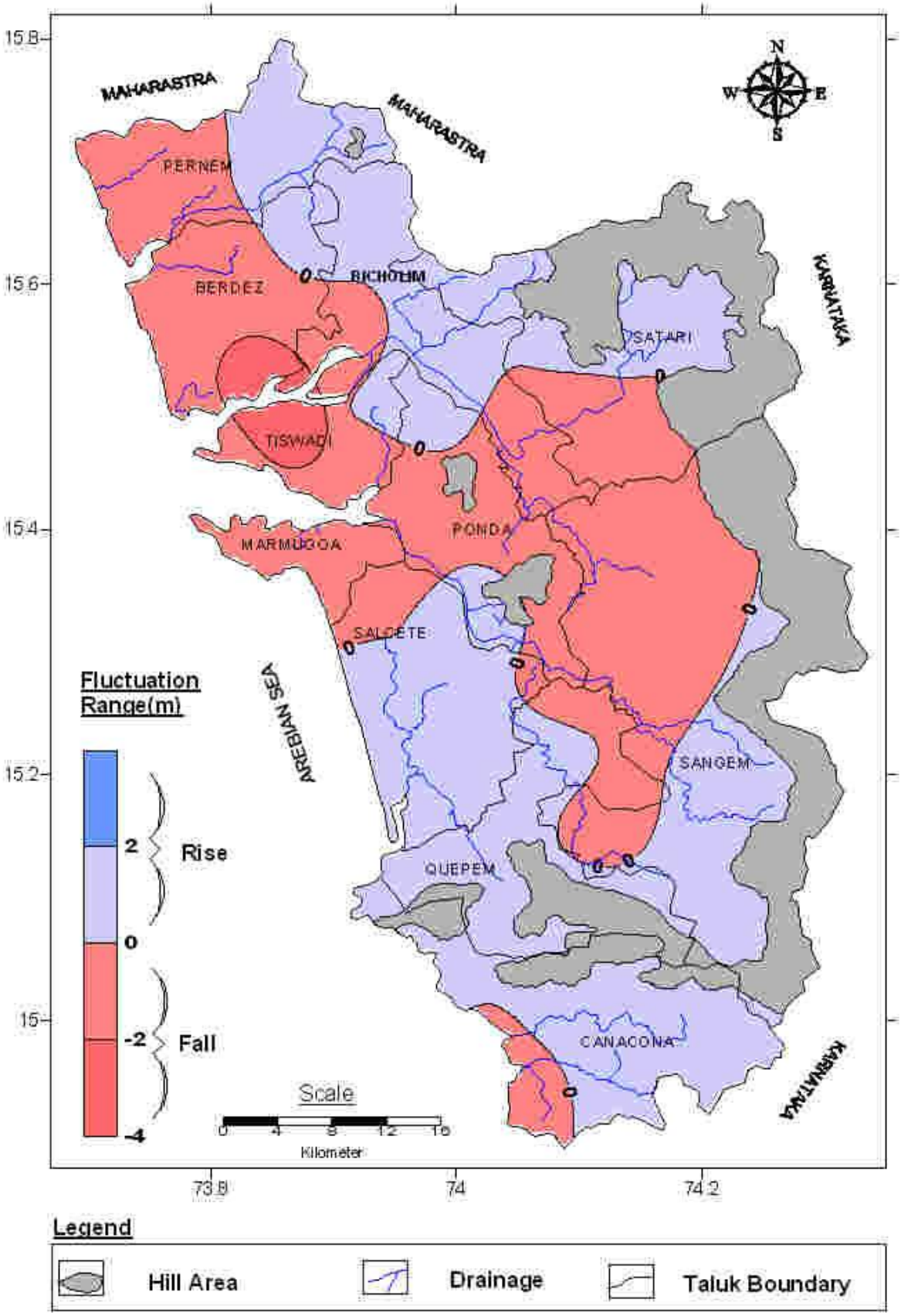
Taluk wise Categorisation of Change in Water Level

10 Yrs Mean (January 2008 to January 2017) - January 2018

Taluk	Number of Station Analysed	Range in m				Rise in m						Fall in m					
		Rise		Fall		0- 2		2 -4		> 4		0 -2		2 -4		>4	
		Min	Max	Min	Max	No	%	No	%	No	%	No	%	No	%	No	%
Bardez	4	0.71	0.71	0.26	3.12	1	25.0	0	0.0	0	0.0	2	50.0	1	25.0	0	0.0
Bicholim	2	0.07	0.28			2	100.	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Canacona	6	0.04	1.44	0.41	0.41	5	83.3	0	0.0	0	0.0	1	16.7	0	0.0	0	0.0
Pernem	5	0.53	0.53	0.05	0.57	1	20.0	0	0.0	0	0.0	4	80.0	0	0.0	0	0.0
Ponda	2	0.30	0.30	0.75	0.75	1	50.0	0	0.0	0	0.0	1	50.0	0	0.0	0	0.0
Quepem	2	0.36	0.36	0.05	0.05	1	50.0	0	0.0	0	0.0	1	50.0	0	0.0	0	0.0
Salcete	2			0.01	0.05	0	0.0	0	0.0	0	0.0	2	100.	0	0.0	0	0.0
Sangeum	4	1.78	1.78	0.07	0.53	1	25.0	0	0.0	0	0.0	3	75.0	0	0.0	0	0.0
Sattari	5	0.04	1.12	0.78	0.78	4	80.0	0	0.0	0	0.0	1	20.0	0	0.0	0	0.0
Tiswadi	3	0.02	0.32	0.22	0.22	2	66.7	0	0.0	0	0.0	1	33.3	0	0.0	0	0.0
Total	35					18	51.4	0	0.0	0	0.0	16	45.7	1	2.9	0	0.0

WATER LEVEL FLUCTUATION, DECADAL MEAN JAN 2008 - JAN 2017) - JAN 2018, GOA STATE

Fig - 3.15



4.0 STATUS OF GROUNDWATER QUALITY

The quality of shallow groundwater in Goa state has been evaluated by sampling and analysis of water sample collected from Groundwater Monitoring wells. About 80 Groundwater Monitoring wells were monitored for water quality during May 2017 representing pre-monsoon water quality. The district-wise chemical analysis data of the samples are given in the Annexure - VI. The summarized results of groundwater quality ranges are given in **Table - 4.1.**

Table 4.1. Summarized results of groundwater quality ranges, (May 2017)

S. No.	Parameters		Range	No. of sample	Percentage
1	Electrical Coductivity µs/cm at 25^{o}c	Fresh	< 750	78	97.50
		Moderate	751- 2250	01	1.25
		Slightly mineralized	2251- 3000	NIL	0.00
		Highly mineralized	> 3000	01	1.25
2	Chloride mg/L	Desirable limit	< 250	79	98.75
		Permissible limit	251-1000	01	1.25
		Beyond permissible limit	> 1000	NIL	0.00
3	Fluoride mg/L	Desirable limit	< 1.0	80	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	78	97.50
		Beyond permissible limit	> 45	02	2.50

4.1 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).

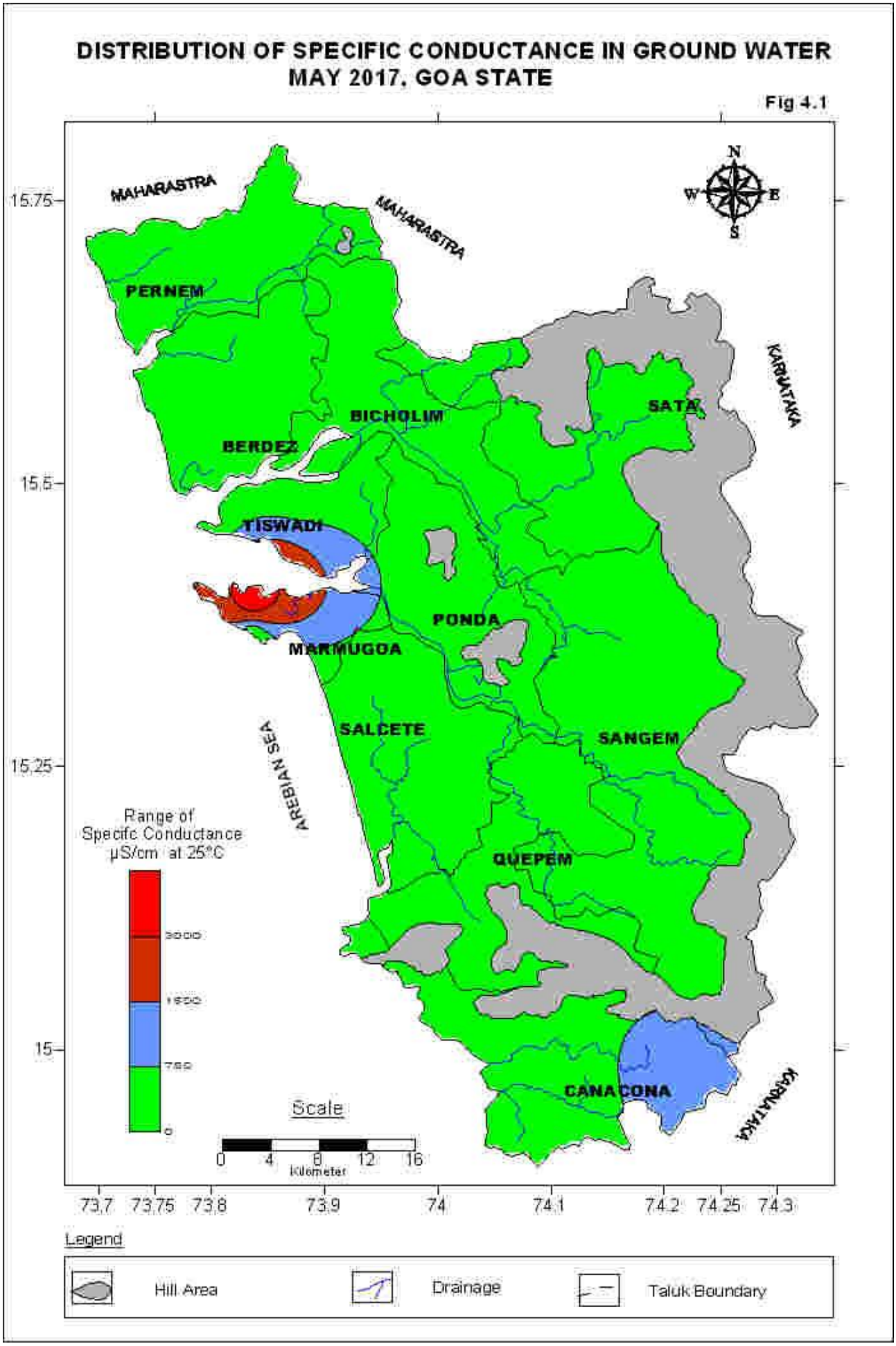
Due to the solubility of atmospheric carbon dioxide, the rainwater pH would be around 5.6. In industrial areas, where there are more oxides of sulphur and nitrogen emission, the rainwater pH would be even less because the dissolution of these gases forms strong acids such as nitric (HNO_3) and sulphuric acids (H_2SO_4), resulting acid rain. As rainwater percolates, the pH may further be lowered, due to the dissolution of soil carbon dioxide liberated by plants and other microbial reactions. In groundwater, pH increases the solubility of minerals and other anthropogenic pollutants. Therefore, pH plays a major role in the mineralization of groundwater and it is expected to increase along groundwater flow path. The pH of groundwater is normally controlled by the equilibrium between the dissolved carbon dioxide – bicarbonate – carbonate species.

In the shallow groundwater of the state, the pH ranged between 6.93 and 8.67. Analysis of the data shows that a major part of state has pH 7 to 8.3. Based on the NHS 2017 data, in about 18% of the area the groundwater pH is between 8.3 and 8.67. 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.

4.2 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 **Fig. 4.1**.

In general the groundwater quality in the state is fresh in about 97 % of the Groundwater Monitoring wells as indicated by the EC value less than 750 μs/cm at 25^{o}C. In about 3 % of the Groundwater Monitoring wells, the EC is more than 3000 μs/cm at 25^{o}C indicating that the groundwater is highly mineralized. The highest value 4700 μs/cm at 25^o C was observed in Chikalem, North Goa district.


DISTRIBUTION OF SPECIFIC CONDUCTANCE IN GROUND WATER
MAY 2017, GOA STATE
Fig 4.1
MAHARASTRA
MAHARASTRA
PERNEM
BICHOLIM
BERDEZ
SATA
KARNATAKA
TISWADI
PONDA
MARMUGOA
SALCETE
SANGEM
QUEPEM
CANACONA
KARNATAKA
ARABIAN SEA
N
W
E
S
15.75
15.5
15.25
15
73.7
73.75
73.8
73.9
74
74.1
74.2
74.25
74.3
Range of
Specifc Conductance
µS/cm at 25°C
3000
1500
750
0
Scale
0
4
8
12
16
Kilometer
Legend
Hill Area
Drainage
Taluk Boundary

4.3 Chloride

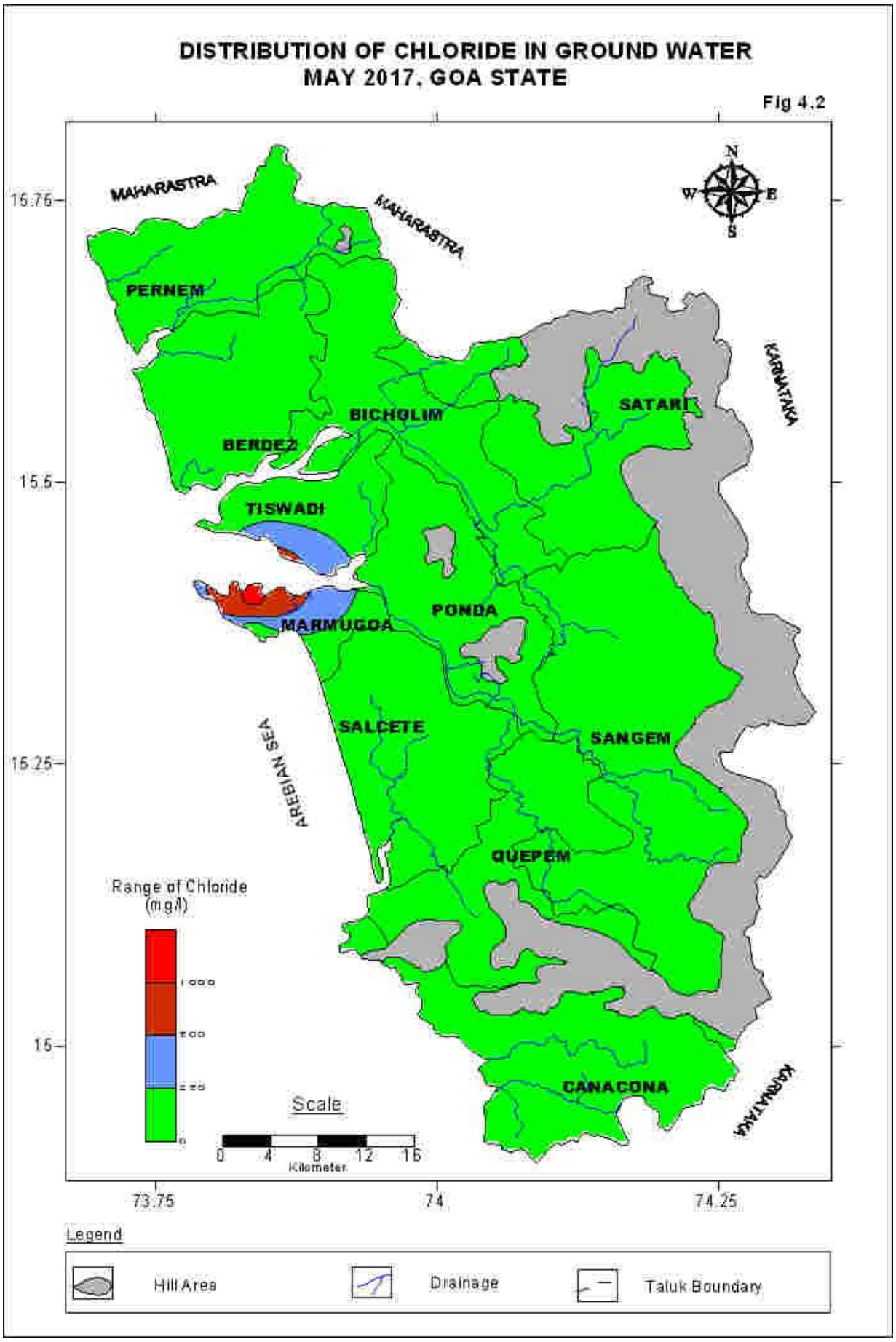
Chloride is one of the major anion in groundwater. The high mobility of the ion and the high solubility of chloride salts make the chloride ions present in waters. Moreover, chloride ions do not take part in any of the geochemical (or) biochemical reactions, hence it can be used as a good indicator of 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. The chloride content is less than 250 mg/L in about 98 % of the sample analyzed and 2 % of the samples are between 251 to 1000 mg/L. The spatial distribution of chloride concentration in groundwater of Goa state is shown in **Fig. 4.2**.

4.4 Nitrate (NO_3)

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.

NO_3 is an oxidizing agent and is readily oxidizes haemoglobin (Hb) in to methaemoglobin (MeHb) a blue coloured pigment and gets reduced to NO_2. 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 $\propto_2\gamma_2$ type has greater affinity for oxygen (O_2) than adult Hb which is $\propto_2\beta_2$ 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 (NO_2) 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 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.


DISTRIBUTION OF CHLORIDE IN GROUND WATER
MAY 2017, GOA STATE
Fig 4.2
MAHARASTRA
MAHARASTRA
PERNEM
BICHOLIM
BERDEZ
TISWADI
SATARI
KARNATAKA
PONDA
MARMUGOA
SALCETE
SANGEM
QUEPEM
CANACONA
KARNATAKA
AREBIAN SEA
N
W
E
S
15.75
15.5
15.25
15
73.75
74
74.25
Range of Chloride (mg/l)
1000
500
250
0
Scale
0 4 8 12 16
Kilometer
Legend
Hill Area
Drainage
Taluk Boundary

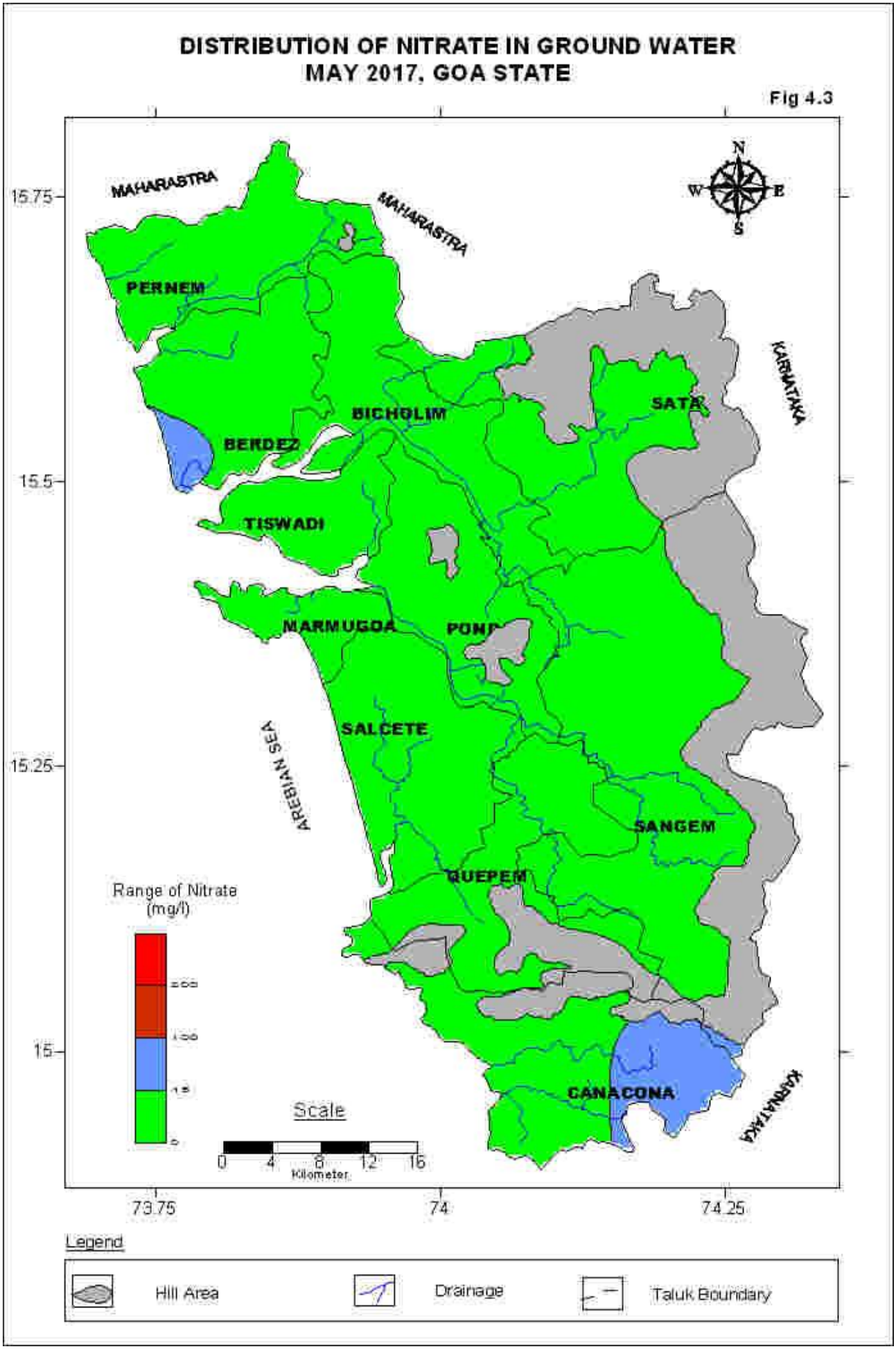
The Nitrate content is less than 45mg/L in about 97 % of the sample analyzed and and 3 % of sample shows more than 45 mg/L which are from North Goa district. The distribution of nitrate in shallow groundwater is shown as contour map in **Fig. 4.3**.

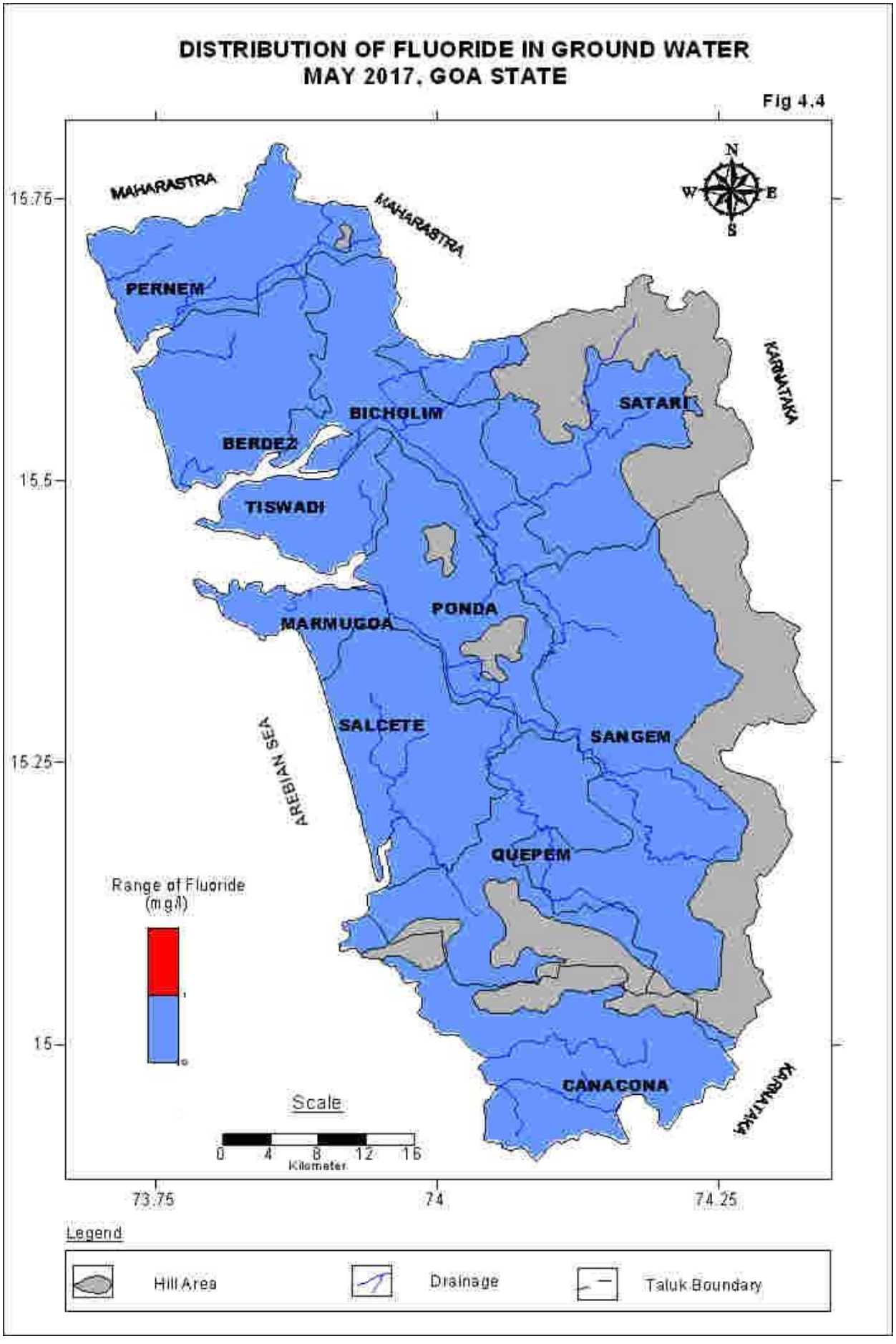
4.5 Fluoride

Fluorine 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 ($Ca_{10}F_2(PO_4)_6$), 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. The Fluoride content is less than 1.5 mg/L in all the 80 samples collected from National Hydrograph stations. Distribution of fluoride is shown in **Fig. 4.4**.


DISTRIBUTION OF NITRATE IN GROUND WATER
MAY 2017, GOA STATE
Fig 4.3
MAHARASTRA
MAHARASTRA
PERNEM
BICHOLIM
BERDEZ
TISWADI
SATA
KARNATAKA
MARMUGOA
PONDA
SALCETE
ARABIAN SEA
SANGEM
QUEPEM
CANACONA
KARNATAKA
15.75
15.5
15.25
15
73.75
74
74.25
N
W
E
S
Range of Nitrate (mg/l)
Scale
0 4 8 12 16
Kilometer
Legend
Hill Area
Drainage
Taluk Boundary


DISTRIBUTION OF FLUORIDE IN GROUND WATER
MAY 2017, GOA STATE
Fig 4.4
MAHARASTRA
MAHARASTRA
PERNEM
BICHOLIM
BERDEZ
TISWADI
SATARI
KARNATAKA
PONDA
MARMUGOA
SALCETE
SANGEM
AREBIAN SEA
QUEPEM
CANACONA
KARNATAKA
N
W
E
S
15.75
15.5
15.25
15
73.75
74
74.25
Range of Fluoride (mg/l)
Scale
0 4 8 12 16
Kilometer
Legend
Hill Area
Drainage
Taluk Boundary

5. CONCLUSION

The present report includes results of a study on the behavior of the Ground Water Regime in the State of Goa through a network 103 National Groundwater monitoring Stations tapping the phreatic aquifer.

Out of the 103 stations, 35% of the stations fall in the Mandovi basin, 24% fall in the Zuari basin, 16% fall in the Sal basin, and the remaining 25% fall in the West flowing minor river basins. Quartz Chlorite Biotite occupies the largest area in the state and 52% of stations fall in these areas. This is followed by Metabasalt rocks and Granite gneiss, in which 12% and 11% respectively of the monitoring stations are located. The remaining 25% of the stations are in Greywack, Carbonate quartz chlorite and recent alluvium.

The data of depth to water levels shows that during the pre-monsoon period of 2017 about 91% of the analysed wells have water levels within 10 mbgl. Moderately deep water levels of 10 to 20 mbgl are seen in about 9% wells. No well shows deep water levels >20 mbgl. The depth to water level during August 2017 ranged from 0.13 mbgl to 12.3 mbgl, about 51% of analysed wells have less than 2 mbgl water levels, 36% wells have 2 to 5 mbgl water level, 10% wells have 5 to 10 mbgl water level and the remaining 3% wells have 10 to 20mbgl water level. During post-monsoon period of 2017, about 93% of the analysed wells have water level within 10 mbgl. Moderately deep water levels of 10 to 20 mbgl are seen in 7% wells. The depth to water level during January 2018 ranged from 0.94 mbgl to 15.44 mbgl, about 9 % analysed wells have less than 2 mbgl water levels, 50 % wells have 2 to 5 mbgl water levels, 33 % wells have 5 to 10 mbgl water level and the remaining 8 % wells have 10 to 20mbgl water level.

The chemical quality of groundwater collected from 80 water level monitoring stations representing the shallow aquifers during May 2017 indicate, the quality 97% of samples are suitable for drinking purpose.

ANNEXURE - I

GENERAL DETAILS OF HYDROGRAPH NETWORK STATIONS

SOUTH WESTERN REGION

GOA STATE

Sl No.	Well No.	District	Talulk	Village	Latitude	Longitude	Total Depth (mbgl)
1	GAJY1307	North Goa	Bicholim	Adavapal	15°38'23"	73°53'45"	9.48
2	48E2D12	North Goa	Bardoz	Alto Betim Porvorim	15°31'25"	73°49'49"	17.6
3		North Goa	Pernem	Ambernem	15°44'26"	73°49'28"	8
4	GAJY1302	North Goa	Bardez	Anjuna Beach	15°35'03"	74°44'17"	13.12
5	48E2D10	North Goa	Bardoz	Baga	15°33'37"	73°45'03"	3.37
6	48I2A2	North Goa	Sattari	Bayalwadikeri(querim)	15°36'36"	74°04'00"	8.45
7	GAJY1303	North Goa	Sattari	Bhamber(Nanoda Cross)	15°35'16"	74°11'28"	7.26
8	GAJY1311	North Goa	Sattari	Bhujpal	15°32'21"	74°05'17"	8.35
9	48E2D8	North Goa	Bicholim	Bicholim	15°35'05"	73°57'27"	6.81
10	48E2D9	North Goa	Bicholim	Bicholim(pz)	15°35'00"	73°57'40"	46.7
11	GAJY1310	North Goa	Ponda	Bori	15°21'10"	74°00'12"	7.92
12	GAMY1301	North Goa	Bardez	Britona	15°30'45"	73°50'34"	4.1
13	48I3A6	North Goa	Tiswadi	Collem(kolamba)	15°20'03"	74°14'39"	10.5
14	48E2D11	North Goa	Bardoz	Calangute	15°32'43"	73°45'29"	9.7
15	GAJY1312	North Goa	Sattari	Charayode	15°37'40"	74°07'50"	7.32
16	GAMY1303	North Goa	Bardez	Colval	15°38'38"	73°50'14"	30
17		North Goa	Bicholim	Devulawada Narve	15°33'16"	73°56'14"	5.4
18		North Goa	Bicholim	Dhatwado Vante	15°29'46"	74°05'51"	15.2
19	GAMY1305	North Goa	Tiswadi	Gauli Mola	15°27'41"	73°53'53"	5.4
20	GAJY1305	North Goa	Tiswadi	Gavalebhat, Chimbel(kirl)	15°29'22"	73°52'27"	8.3
21	48E3D3	North Goa	Tiswadi	Goa Velha	15°26'29"	73°52'47"	2.4
22		North Goa	Pernem	Hasapur	15°44'15.5"	73°54'13"	7.1
23		North Goa	Pernem	Hasaravanni Vaipal	15°43'17"	73°53'39'	4.6
24	48I2A1	North Goa	Sattari	Hivre Budruk	15°37'55"	74°08'47"	9.8
25	48I2A4	North Goa	Sattari	Honda	15°32'48"	74°03'02"	6.16
26		North Goa	Bicholim	Jambhul Batt	15°34'49.7"	73°55'34"	4.1
27	48E3D2	North Goa	Tiswadi	Karanjhalen	15°27'29"	73°48'15"	6.38

28	48I3A1	North Goa	Sattari	Khadki(harijanwada)	15°29'04"	74°08'26"	14.47
29	GAJY1313	North Goa	Sattari	Khotodem	15°28'58"	74°08'13"	8.5
30	48E2D3	North Goa	Pernem	Korgaon	15°42'29"	73°45'05"	6.9
31		North Goa	Ponda	Kundel Dassalwada	15°27'10"	73°57'10'	6.95
32	GAJY1309	North Goa	Ponda	Mankem	15°18'19"	74°02'54"	7.22
33	48E2D7	North Goa	Bardoz	Mapuca	15°36'34"	73°49'35"	8.55
34	48E2C1	North Goa	Pernem	Morji	15°38'15"	73°44'12"	3.71
35	48I2A3	North Goa	Sattari	Morlem	15°35'35"	74°02'47"	6.51
36	48E2D6	North Goa	Bicholim	Mulgaon Shivalkherwad	15°36'49"	73°55'35"	5.04
37	GAJY1304	North Goa	Sattari	Nagargoan	15°33'41"	74°09'47"	8
38	48E2D2	North Goa	Pernem	Nagjhar	15°42'31"	73°51'18"	7.95
39	GAMY1302	North Goa	Bicholim	Olaulim	15°34'10"	73°51'48"	9.6
40	48I3A8	North Goa	Ponda	Panchawadi(pz)	15°16'57"	74°05'45"	-
41	GAJY1301	North Goa	Bardez	Parra	15°34'22"	73°47'33"	7.85
42	48E2D1	North Goa	Pernem	Pernem	15°43'03"	73°47'56"	4.25
43	GAMY1304	North Goa	Bardez	Pirna	15°40'06"	73°52'53"	6.8
44		North Goa	Bardez	Pomburpa Palmar	15°33'33.2"	73°52'03"	4.8
45	48I3A4	North Goa	Ponda	Ponda(pz)	15°23'27"	74°00'01"	30
46	48E2D4	North Goa	Bicholim	Sal	15°41'11"	73°55'38"	5.82
47		North Goa	Bardez	Salwardhar Dumun	15°32'15"	73°52'07'	4.35
48	GAJY1306	North Goa	Pernem	Sawanthwada(mandrem)	15°40'53"	73°45'08"	6.27
49	48I3A7	North Goa	Ponda	Shiroda	15°19'12"	74°02'08"	10.91
50	GAJY1308	North Goa	Bardez	Shivoli (brahmanwada)	15°37'24"	73°46'03"	5.2
51	48E2D5	North Goa	Bardoz	Sirsaim	15°37'36"	73°52'35"	5.21
52	48I2A6	North Goa	Bicholim	Surla(pz)	15°30'26"	74°02'47"	41.76
53	48E1D1	North Goa	Pernem	Uguem(ugawe)	15°45'08"	74°50'20"	6.2
54	48I2A5	North Goa	Sattari	Valpoi	15°31'55"	74°08'18"	9.13
55	48E3D1	North Goa	Tiswadi	Velha Goa	15°29'59"	73°55'00"	14.4
56	48I4D3	South Goa	Canacona	Agonda Desaiwada	15°02'25"	73°59'32"	7.9
57	48I4A5	South Goa	Quepem	Akamol Ambavalli	15°11'25"	74°02'17"	8.21
58		South	Mormugoa	Bagmola	15°22'17"	73°50'15"	4.17
59	48E3D6	South Goa	Salcete	Ballynuvhen	15°18'56"	73°56'55"	10.77

60	Jy13117	South Goa	Salcete	Barodi Velni (betul)	15°08'59"	73°57'39"	5.4
61	Jy13116	South Goa	Salcete	Betalbatti	15°18'02"	73°55'12"	7.5
62	Jy13114	South Goa	Sanguem	Bhati	15°10'54"	74°13'35"	7.7
63	48I3A2	South Goa	Sanguem	Bolkharnem	15°25'42"	74°11'36"	8.24
64	48I4A12	South Goa	Canacona	Canacona	15°00'23"	74°03'02"	8.8
65	48E4D1	South Goa	Salcete	Carmona	15°12'10"	73°57'09"	9.42
66	Jy1306	South Goa	Salcete	Chikalim	15°23'53"	73°50'12"	3.5
67	Jy13118	South Goa	Salcete	Cuncalim	15°10'48"	74°00'00"	4.3
68	48I4A6	South Goa	Salcete	Cuncalim(pz)	15°10'28"	74°00'22"	20
69	48J1A2	South Goa	Canacona	Daptamol Lolien	14°56'56"	74°03'22"	16.27
70	48I3A3	South Goa	Sanguem	Darbandahra(pz)	15°23'25"	74°07'28"	14.07
71	48I4A7	South Goa	Sanguem	Deulwada Kolamba	15°08'56"	74°07'55"	4.52
72	48I3D7	South Goa	Salcete	Fathorda Margao(pz)	15°17'17"	73°58'10"	-
73	48I4A1	South Goa	Quepem	Ghadiawada	15°14'17"	74°06'50"	7.78
74	Jy1312	South Goa	Sanguem	Guddemal	15°17'08"	74°46'08"	13.5
75	48I4A11	South Goa	Canacona	Gulem Velipwada	15°02'12"	74°01'52"	5.6
76	48J1A1	South Goa	Canacona	Hattipal Poinguinem	14°59'00"	74°06'33"	9.41
77	Jy13120	South Goa	Sanguem	Jambavli	15°11'11"	74°05'43"	13.31
78	Jy1311	South Goa	Sanguem	Kalay	15°17'18"	74°10'48"	13.45
79	48E4D2	South Goa	Quepem	Kanagini(pz)	15°07'24	73°56'48"	42.12
80		South Goa	Quepem	Kapsa	15°16'24"	74°06'02"	7.6
81	Jy1305	South Goa	Salecete	Kaveslium	15°11'08"	73°56'50"	6.14
82	48E3D5	South Goa	Salcete	Majorda Bpada Curilo	15°19'28"	73°55'04"	6.17
83	Jy1301	South Goa	Sangeum	Malkarnem	15°10'41"	74°09'06"	11.28
84	48E3D4	South Goa	Marmugoa	Marmagoa	15°24'22"	73°47'54"	7.1
85	Jy1309	South Goa	Salcete	Mashe	14°01'30"	74°08'49"	5.6
86	48I3A5	South Goa	Sanguem	Molem	15°22'33"	74°13'49"	15.49
87	Jy13115	South Goa	Salcete	Navelim	15°15'16"	73°58'02"	7.41
88	48I4A9	South Goa	Sanguem	Netrolim	15°05'22"	74°13'00"	11.42
89	Jy13119	South Goa	Salcete	Padi	15°05'34"	74°01'50"	14.2
90	48J1A3	South Goa	Canacona	Polem(polen)	14°54'39"	74°05'11"	6.57
91	Jy1308	South Goa	Canacona	Ponquini	14°58'31"	74°05'43"	18.1

92	48I4A4	South Goa	Quepem	Quepem	15°13'01"	74°04'53"	9.13
93	Jy13121	South Goa	Sanguem	Revona	15°09'51"	74°06'24"	10.62
94	48I4A10	South Goa	Canacona	Shrishtal Gaondongar	15°02'07"	74°07'08"	25
95	Jy1307	South Goa	Canacona	Sristal	15°01'12"	74°04'31"	7.9
96	Jy1310	South Goa	Sanguem	Suktali (molem)	15°21'49"	74°10'31"	7.45
97	Jy13113	South Goa	Sanguem	Themchewada	15°13'10"	74°09'27"	15.58
98	48I4A2	South Goa	Sanguem	Ugem(pz)	15°13'47"	74°10'55"	6.2
99	Jy1303	South Goa	Sangeum	Vadam	15°07'50"	74°12'27"	9.15
100	48I4A3	South Goa	Sanguem	Valkinim	15°13'12"	74°12'53"	26.3
101	Jy1302	South Goa	Sangeum	Vichundrem	15°06'12"	74°12'11"	8.26
102	48I4A8	South Goa	Sanguem	Waddem(pz)	15°07'27"	74°12'37"	24.45
103	Jy1304	South Goa	Canacona	Yedda	14°59'52"	74°11'28"	16.12

Annexure-II

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

ANNEXURE-III

WATER LEVEL DATA FOR GROUNDWATER MONITORING STATIONS FOR WATER YEAR 2017-2018

SOUTH WESTERN REGION, GOA

S.No	Well No	District	Location	Depth to water level (mbgl)				Decadal mean water level (mbgl)			
				May-17	Aug-17	Nov-17	Jan-18	May-17	Aug-17	Nov-17	Jan-18
1	GAJY1307	North Goa	Adavapal	5.99	4.29	3.39	5.55	5.84	4.52	4.75	5.52
2	48I4D3	South Goa	Agonda Desaiwada	4.82	0.43	3.08	3.62	4.14	1.76	2.83	3.89
3	48I4A5	South Goa	Akamol Ambavalli	-	2.28	-	-	4.22	3.12	4.90	3.08
4	48E2D12	North Goa	Alto Betim Porvorim	5.61	6.32	6.33	9.58	5.68	3.68	5.39	6.09
5		North Goa	Amberem	7.4	6.22	6.8	7.1	7.28	6.53	6.66	6.47
6	GAJY1302	North Goa	Anjuna Beach	9.45	2.26	9.33	9.95	11.29	6.81	7.78	10.34
7	48E2D10	North Goa	Baga	-	4.38	-	-	2.79	2.13	2.24	2.67
8		South Goa	Bagmola	3.05	-	1.85	3	3.06	2.41	2.50	2.93
9	48E3D6	South Goa	Ballynuvhen	5.56	-	5.78	6.08	6.46	5.23	5.37	6.50
10	Jy13117	South Goa	Barodi Velni (betul)	-	-	-	2.22	-	-	-	2.66
11	48I2A2	North Goa	Bayalwadikeri(querim)	1.58	1.16	2.66	1.85	3.29	1.90	3.45	2.58
12	Jy13116	South Goa	Betalbatti	6.39	1.9	3.12	4.65	5.96	2.11	3.08	4.87
13	GAJY1303	North Goa	Bhamber(Nanoda Cross)	4.58	2.75	4.46	4.6	5.67	3.03	4.20	4.57
14	Jy13114	South Goa	Bhati	5.47	2.12	3.52	4.58	5.12	2.66	2.87	3.69
15	GAJY1311	North Goa	Bhujpal	2.54	0.85	1.26	3.13	4.97	1.16	2.46	3.38
16		North Goa	Bicholim	-	-	-	-	-	9.91	11.91	-
17	48I3A2	South Goa	Bolkharnem	6.28	4.16	5.28	5.94	6.94	4.17	4.77	5.85
18	GAJY1310	North Goa	Bori	1.68	0.8	1.3	1.37	3.51	1.87	1.32	2.68
19		North Goa	Britona	1.75	1.35	1.75	1.89	2.72	1.49	1.81	2.18
20	48E2D11	North Goa	Calangute	8.18	4.54	5.26	6.66	7.64	3.91	4.60	6.43
21	48I4A12	South Goa	Canacona	4.8	1.19	2.76	3.61	4.69	1.57	2.65	3.68
22	48E4D1	South Goa	Carmona	-	-	-	-	-	3.44	3.23	6.40

23	GAJY1312	North Goa	Charayode	3.28	0.98	2.08	3.2	5.19	1.16	2.06	3.77
24	Jy1306	South Goa	Chikalim	1.38	2.78	0.78	1.84	2.20	1.25	0.97	1.76
25		North Goa	Collem(kolamba)	8.45	2.95	7.75	8.33	8.95	3.69	7.60	8.33
26		North Goa	Colval	13.07	-	12.85	14.05	14.44	-	10.87	14.07
27	Jy13118	South Goa	Cuncalim	2.65	0.86	1.82	2.1	2.24	2.29	5.67	3.92
28	48I4A6	South Goa	Cuncalim(pz)	5.5	-	-	-	4.90	-	-	-
29	48J1A2	South Goa	Daptamol Lolien	15	12.3	14.75	14.85	14.92	14.01	14.63	14.44
30	48I3A3	South Goa	Darbandahra(pz)	-	-	-	9.23	2.63	-	-	9.27
31	48I4A7	South Goa	Deulwada Kolamba	2.41	1.63	2.64	2.61	12.00	1.41	2.14	2.26
32		North Goa	Devulawada Narve	15.5	10.1	14.7	14.79	8.39	8.52	11.43	15.18
33		North Goa	Dhatwad Vante	5.32	2.16	4.25	7.25	-	3.86	4.70	5.90
34	GAJY1305	North Goa	Gavalebhat Chimbel(kirl)	5.02	0.6	1.42	5.3	4.88	2.18	1.43	3.52
35	48I4A1	South Goa	Ghadiawada	1.67	0.67	1.51	2.14	1.96	0.98	1.57	2.02
36	48E3D3	North Goa	Goa Velha	-	-	-	-	2.56	1.06	1.11	1.51
37	Jy1312	South Goa	Guddemal	12.31	4.07	7.45	9.4	11.81	5.90	7.81	9.60
38	48I4A11	South Goa	Gulem Velipwada	3.74	2.49	2.49	2.54	3.61	0.69	0.96	2.53
39		North Goa	Hasapur	3.85	1.6	3.48	5.2	4.46	3.08	3.72	4.00
40		North Goa	Hasaravanni Vaipal	2.4	0.9	2.98	2.66	2.88	1.35	2.80	3.40
41	48J1A1	South Goa	Hattipal Poinguinem	8.41	4.24	6.36	6.53	8.32	5.34	6.34	6.95
42	48I2A4	North Goa	Honda	2.4	-	3.47	8.88	3.79	1.77	2.53	3.02
43	Jy13120	South Goa	Jambavli	9.15	4.45	8.5	2.7	9.10	6.23	8.60	9.01
44		North Goa	Jambhul Bhatt	1.63	0.73	1.21	10.78	2.90	1.01	1.35	2.59
45	Jy1311	South Goa	Kalay	11	7.98	10.15	-	11.84	8.05	10.45	10.77
46	48E4D2	South Goa	Kanagini(pz)	16.08	-	-	-	15.90	-	-	-
47		South Goa	Kapsa	5.6	1.64	3.9	4.72	5.60	2.71	3.84	4.51
48	48E3D2	North Goa	Karanjhalen	2.8	1.22	2.1	2.8	3.04	1.52	1.81	2.62
49	Jy1305	South Goa	Kaveslium	1.81	1.02	1.9	2.67	3.94	1.60	1.88	2.96
50	48I3A1	North Goa	Khadki(harijanwada)	6.89	2.98	7.25	7.79	9.76	3.96	6.64	7.33
51	GAJY1313	North Goa	Khotodem	4.29	2.19	5.87	5.99	6.09	3.67	5.54	6.30
52	48E2D3	North Goa	Korgaon	3.9	3.29	3.7	4.13	4.74	2.88	3.53	3.71
53		North Goa	Kundel Dassolwada	-	0.98	1.55	1.59	-	1.24	1.54	2.07

54	48E3D5	South Goa	Majorda Bpada Curilo	6.08	1.38	2.43	3.73	5.12	1.91	2.35	3.75
55	Jy1301	South Goa	Malkarnem	-	-	-	5.78	-	-	-	6.36
56	GAJY1309	North Goa	Mankem	3.85	1.34	3.45	3.57	4.20	2.35	3.51	3.72
57	48E2D7	North Goa	Mapuca	2.55	1.65	3.5	3.82	3.15	2.60	2.76	3.13
58	Jy1309	South Goa	Mashe	4.22	1.92	3.62	3.78	4.52	2.85	3.50	3.89
59	48I3A5	South Goa	Molem	-	1.75	4	10.35	13.78	1.76	6.72	10.33
60	48E2C1	North Goa	Morji	1.53	0.63	0.73	0.94	1.92	0.25	0.42	0.76
61	48I2A3	North Goa	Morlem	3.29	2.63	3.88	3.2	3.52	2.69	3.69	3.41
62	48E2D6	North Goa	Mulgaon Shivalkherwad	2.62	2.1	2.93	3.36	2.71	1.73	2.83	3.28
63	GAJY1304	North Goa	Nagargoan	5.8	0.6	3.73	5.81	7.34	0.95	3.54	5.05
64	48E2D2	North Goa	Nagjhar	7.53	6.82	7.63	7.43	8.44	6.59	7.67	7.87
65	Jy13115	South Goa	Navelim	4.72	1.08	1.74	4.24	5.06	2.03	2.36	4.43
66	48I4A9	South Goa	Netrolim	8.2	8.01	8.94	8.13	10.39	9.10	10.23	9.61
67		North Goa	Olaulim	3.1	-	-	6.6	5.56	6.26	5.76	3.98
68	Jy13119	South Goa	Padi	13.32	7.62	5.92	8.82	13.04	4.03	6.36	9.06
69	48I3A8	North Goa	Panchawadi(pz)	7	3.97	6.5	6.84	6.79	0.83	1.04	6.27
70	GAJY1301	North Goa	Parra	1.6	0.47	1.17	1.3	2.33	2.79	2.91	1.50
71	48E2D1	North Goa	Pernem	2.42	3.62	3.63	3.67	3.84	1.81	1.81	3.54
72		North Goa	Pirna	1.96	1.38	1.91	2.62	3.97	1.50	1.49	2.95
73	48J1A3	South Goa	Polem(polen)	-	-	-	-	4.33	2.70	3.31	-
74		North Goa	Pomburpa Palmar	1.1	2.3	3.2	3.21	2.79	-	3.31	2.80
75	Jy1308	South Goa	Ponquini	-	-	15.34	15.44	-	-	15.32	15.46
76	48I4A4	South Goa	Quepem	2.7	1.1	2.2	2.78	3.81	1.69	2.69	3.15
77	Jy13121	South Goa	Revona	8.25	4.64	7.24	7.49	8.03	5.43	7.51	6.42
78	48E2D4	North Goa	Sal	2.63	1.41	2.91	2.68	3.05	1.66	2.61	3.36
79		North Goa	Salwardhar Dumun	-	1.15	2.25	2.78	-	2.29	2.59	2.91
80	GAJY1306	North Goa	Sawanthwada(mandrem)	2.38	0.68	2.13	3.26	4.01	1.32	2.78	3.77
81	48I3A7	North Goa	Shiroda	3.85	4.45	6.05	6.45	6.45	4.96	5.56	5.98
82	GAJY1308	North Goa	Shivoli (brahmanwada)	3.1	0.13	1.22	2.18	3.43	0.60	1.82	2.32
83		South Goa	Shrishtal Gaondongar	8.2	-	4.1	4.32	6.79	3.79	3.56	5.77
84	48E2D5	North Goa	Sirsaim	3.05	1.65	4.05	3.01	4.08	1.80	3.61	3.61

85	Jy1307	South Goa	Sristal	2.74	4.2	10.38	10.83	5.87	3.88	9.09	8.48
86	Jy1310	South Goa	Suktali (molem)	-	8.36	3.86	4.34	-	5.90	6.10	5.11
87	Jy13113	South Goa	Themchewada	9.39	6.48	7.73	7.18	8.72	6.48	7.73	7.82
88	48E1D1	North Goa	Uguem(ugawe)	3.02	2.2	3.32	3.18	3.51	2.85	3.54	3.16
89	Jy1303	South Goa	Vadam	-	3.58	3.71	3.76	-	3.32	3.46	3.63
90	48I2A5	North Goa	Valpoi	3.6	1.62	4.6	5.25	5.23	2.70	4.41	5.44
91	48E3D1	North Goa	Velha Goa	1.1	0.53	1.09	1.21	3.23	0.77	1.36	1.49
92	Jy1302	South Goa	Vichundrem	7.72	0.44	6.53	7.05	6.43	1.00	6.12	6.18
93		South Goa	Waddem(pz)	5.16	-	-	-	6.88	-	-	-
94	Jy1304	South Goa	Yedda	4.6	0.3	0.1	3.01	5.99	2.23	0.53	2.672

ANNEXURE-IV

FLUCTUATION DATA OF GROUND WATER MONITORING STATIONS FOR WATER YEAR 2017-2018

SOUTH WESTERN REGION, GOA STATE

S. No	Well No	Location	District	Seasonal Water Level Fluctuation (m)			Annual Water Level Fluctuation (m)				Water Level Fluctuation with respect to decadal mean water level (m)			
				May 17-Aug 17	May 17-Nov 17	May 17-Jan 18	May 16-May 17	Aug 16-Aug 17	Nov 16-Nov 17	Jan 17-Jan 18	Mean May(2007-2016) to May 2017	Mean Aug(2007-2016) to Aug 2017	Mean Nov(2007-2016) to Nov 2017	Mean Jan (2008-2017) to Jan 2018
1	GAJY1307	Adavapal	North Goa	1.7	2.6	0.44	-0.42	0.22	2.07	-0.16	-	-	-	-
2	48I4D3	Agonda Desaiwada	South Goa	4.39	1.74	1.2	-0.84	1.02	0.26	-0.14	-0.829	1.493	-0.265	0.268
3	48E2D12	Alto Betim Porvorim	North Goa	3.33	-0.72	-3.97	1.12	2.85	-0.48	-3.35	0.723	1.611	-0.848	-3.118
4		Ambernem	North Goa	1.08	0.6	0.3	-0.3	0.1	0.25	0.3	-	-	-	-
5	GAJY1302	Anjuna Beach	North Goa	3.23	0.12	-0.5	-	0.91	-1.39	1.88	-	-	-	-
6		Bagmola	South Goa	0.79	1.2	0.05	-	0.21	0.93	-0.15	-	-	-	-
7	48E3D6	Ballynuvhen	South Goa	1.18	-0.22	-0.52	0.92	0.66	0.07	0.08	1.241	0.899	-0.408	-0.01
8	48I2A2	Bayalwadikeri(querim)	North Goa	0.42	-1.08	-0.27	0.98	0.54	0.53	-0.09	2.22	0.764	1.136	1.117
9	Jy13116	Betalbatti	South Goa	4.49	3.27	1.74	0.48	0.5	0.42	0.12	-	-	-	-
10	GAJY1303	Bhamber(Nanoda cross)	North Goa	1.83	0.12	-0.02	1.24	0.08	-0.21	0.19	-	-	-	-
11	Jy13114	Bhati	South Goa	3.35	1.95	0.89	-0.18	-0.01	-1.2	-2.11	-	-	-	-
12	GAJY1311	Bhujpal	North Goa	1.69	1.28	-0.59	2.84	0.25	0.18	0.23	-	-	-	-
13		Bicholim	North Goa	-	1	-	-	0.44	-0.03	-	-	-	-	-
14	48I3A2	Bolkharnem	South Goa	2.12	-	0.34	0.6	-1.22	-	0.11	0.718	0.061	-0.535	-0.104
15	GAJY1310	Bori	North Goa	0.88	0.38	0.31	-	0.36	0.07	-0.15	-	-	-	-
16	GAMY1301	Britona	North Goa	0.4	-	-0.14	0.35	-0.97	0.02	0.05	-	-	-	-
17	48E2D11	Calangute	North Goa	3.64	2.92	1.52	-0.03	0.6	-1.49	-0.31	-0.075	-0.765	-0.746	-0.265

18	48I4A12	Canacona	South Goa	3.61	2.04	1.19	0.05	-	-0.23	-0.05	-0.101	0.453	-0.14	0.043
19	GAJY1312	Charayode	North Goa	2.3	1.2	0.08	2.96	-0.4	-0.2	-0.12	-	-	-	-
20	Jy1306	Chikalim	South Goa	-1.4	0.6	-0.46	1.75	-2.15	0.42	-0.44	-	-	-	-
21		Collem(kolamba)	North Goa	5.5	0.7	0.12	0.55	1.4	0.18	0.23	0.551	0.817	-0.245	0.024
22	GAMY1303	Colval	North Goa	-	0.22	-0.98	0.03	-	-2.78	0.1	-	-	-	-
23	Jy13118	Cuncalim	South Goa	1.79	0.83	0.55	-0.17	0.29	-	-0.1	-	-	-	-
24	48I4A6	Cuncalim(pz)	South Goa	-	-	-	-0.7	-	-	-	-0.567		-	-
25	48J1A2	Daptamol Lolien	South Goa	2.7	0.25	0.15	-0.3	0.19	-0.14	-1.75	-0.085	1.925	-0.009	-0.412
26	48I4A7	Deulwada Kolamba	South Goa	0.78	-0.23	-0.2	0.59	0.3	-	-0.01	0.004	-0.332	-0.659	-0.532
27		Devulawada Narve	North Goa	5.4	0.8	0.71	-	3.04	-0.25	1.01	-	-	-	-
28		Dhatwado Vante	North Goa	3.16	1.07	-1.93	3.83	0.68	0.96	-0.69	-	-	-	-
29	GAJY1305	Gavalebhat	North Goa	4.42	3.6	-0.28	0.92	0.41	-0.1	-3.9	-	-	-	-
30	48I4A1	Ghadiawada	South Goa	1	0.16	-0.47	0.03	0.35	0.25	-	0.381	0.353	0.084	-0.051
31	48E3D3	Goa Velha	North Goa	-	-	-	-	-	-	0.03	-	-	-	-
32	Jy1312	Guddemal	South Goa	8.24	4.86	2.91	-0.31	3.15	0.58	0.05	-	-	-	-
33	48I4A11	Gulem Velipwada	South Goa	1.25	1.25	1.2	0.2	-2.38	-1.82	-	-0.107	-2.008	-1.716	0.058
34		Hasapur	North Goa	2.25	0.37	-1.35	1	0.64	0.43	-1.55	-	-	-	-
35		Hasaravanni Vaipal	North Goa	1.5	-0.58	-0.26	-	1.93	0.32	1.74	-	-	-	-
36	48J1A1	Hattipal Poinguinem	South Goa	4.17	2.05	1.88	0.23	1.78	-0.05	3.98	-0.122	1.263	-0.018	0.423
37	48I2A4	Honda	North Goa	0.8	-1.07	-0.67	2.02	0.55	-0.94	0.29	1.56	0.233	-1.05	0.037
38	Jy13120	Jambavli	South Goa	4.7	0.65	0.27	-0.05	3.15	0.2	0.37	-	-	-	-
39		Jambhul Batt	North Goa	0.9	0.42	-1.07	2.12	0.29	0.15	-0.09	-	-	-	-
40	Jy1311	Kalay	South Goa	3.02	0.85	0.22	0.79	1.59	0.5	0.17	-	-	-	-
41	48E4D2	Kanagini(pz)	South Goa	-	-	-	-0.27	-	-	-	0.208	-	-	-
42		Kapsa	South Goa	3.96	1.7	0.88	0.48	1.38	0.05	-0.52	-	-	-	-
43	48E3D2	Karanjhalen	North Goa	1.58	0.7	-	0.55	0.46	-0.71	-0.2	0.302	0.34	-0.331	-0.22
44	Jy1305	Kaveslium	South Goa	0.79	-0.09	-0.86	2.74	0.44	0.14	-	-	-	-	-
45	48I3A1	Khadki(harijanwada)	North Goa	3.91	-0.36	-0.9	1.87	-0.07	-0.01	-0.12	3.222	0.857	-1.022	-0.78
46	GAJY1313	Khotodem	North Goa	2.1	-1.58	-1.7	2.44	2.4	0.04	0.34	-	-	-	-

47	48E2D3	Korgaon	North Goa	0.61	0.2	-0.23	1.04	0.23	0.28	-1.88	0.92	-0.657	-0.366	-0.565
48		Kundel Dassalwada	North Goa	-	-	-	-0.55	0.44	0.01	1.36	-	-	-	-
49	48E3D5	Majorda Bpada Curilo	South Goa	4.7	3.65	2.35	-	0.64	0.23	0.11	-0.97	0.543	-0.169	-0.05
50	GAJY1309	Mankem	North Goa	2.51	0.4	0.28	0.2	1.64	0.22	0.08	-	-	-	-
51	48E2D7	Mapuca	North Goa	0.9	-0.95	-1.27	1.33	0.5	-0.05	-0.22	0.603	0.841	-0.991	-0.938
52	Jy1309	Mashe	South Goa	2.3	0.6	0.44	0.3	1.19	-0.15	0.01	0.437	-	-	-
53	48I3A5	Molem	South Goa	-	-	-	-	-	6.05	0.15	0.197	0.001	3.028	-0.066
54	48E2C1	Morji	North Goa	0.9	0.8	0.59	0.8	-0.46	0.1	0.1	0.646	-0.427	-0.344	-0.193
55	48I2A3	Morlem	North Goa	0.66	-0.59	0.09	0.3	0.54	-0.08	-0.3	-	0.066	-0.209	0.239
56	48E2D6	Mulgaon Shivalkherwad	North Goa	0.52	-0.31	-0.74	0.27	0.26	0.02	-0.05	-	-0.094	-0.096	0.071
57	GAJY1304	Nagargoan	North Goa	5.2	2.07	-0.01	1.49	0.22	0.12	0.05	-	-	-	-
58	48E2D2	Nagjhar	North Goa	0.71	-0.1	0.1	0.1	0.39	0.1	1	1.083	-0.275	-0.058	0.531
59	Jy13115	Navelim	South Goa	3.64	2.98	0.48	0.42	0.49	0.26	-0.12	-	-	-	-
60	48I4A9	Netrolim	South Goa	0.19	-0.74	0.07	1.54	0.91	1.2	0.66	2.421	1.218	1.453	1.776
61	GAMY1302	Olaulim	North Goa	-	-	-3.5	4.26	-	-	-5.08	-	-	-	-
62	Jy13119	Padi	South Goa	5.7	7.4	4.5	-0.32	-1.85	-	0.69	-	-	-	-
63	48I3A8	Panchawadi(pz)	North Goa	3.03	0.5	0.16	0.1	0.44	0.07	0.09	-0.186	0.125	-0.262	-0.749
64	GAJY1301	Parra	North Goa	1.13	0.43	0.3	0.83	0.35	0.09	0.2	-	-	-	-
65	48E2D1	Pernem	North Goa	-1.2	-1.21	-1.25	-	-0.3	-0.09	0.07	1.356	-1.141	-0.772	-0.185
66	GAMY1304	Pirna	North Goa	0.58	0.05	-0.66	1.23	0.07	-0.01	0.23	-	-	-	-
67	48J1A3	Polem(polen)	South Goa	-1.2	-	-	-	0.77	-	-	-	-	-	-
68		Pomburpa Palmar	North Goa	-	-2.1	-2.11	2.26	-	0.11	-0.2	-	-	-	-
69	48I4A4	Quepem	South Goa	1.6	0.5	-0.08	1.09	0.45	-0.38	0.62	1.101	0.594	0.527	0.358
70	Jy13121	Revona	South Goa	3.61	1.01	0.76	-0.76	1	1	-0.72	-	-	-	-
71	48E2D4	Sal	North Goa	1.22	-0.28	-0.05	0.23	0.67	-0.2	0.23	0.41	0.29	-0.33	0.282
72		Salwardhar Dumun	North Goa	-	-	-	-	1.18	0.5	0.47	-	-	-	-
73	GAJY1306	Sawanthwada(mandrem)	North Goa	1.7	0.25	-0.88	0.63	-	0.15	0.01	-	-	-	-
74	48I3A7	Shiroda	North Goa	-0.6	-2.2	-2.6	5.05	1.02	0.31	-0.33	2.872	0.61	-0.046	0.298
75	GAJY1308	Shivoli	North Goa	2.97	1.88	0.92	0.32	0.38	0.14	-	-	-	-	-

		(brahmanwada)												
76	48I4A10	Shrishtal Gaondongar	South Goa	-	4.1	3.88	-0.1	-	0.09	6.88	-1.563	-	-0.312	1.443
77	48E2D5	Sirsaim	North Goa	1.4	-1	0.04	1.22	0.28	-0.93	0.64	1.156	0.2	-1.373	0.706
78	Jy1307	Sristal	South Goa	-1.46	-7.64	-8.09	3.04	-1.06	0.4	0.65	-	-	-	-
79	Jy1310	Suktali (molem)	South Goa	-	-	-	-	-4.9	0.1	-0.4	-	-	-	-
80	Jy13113	Themchewada	South Goa	2.91	1.66	2.21	-1.66	-1.4	-1.43	0.1	-	-	-	-
81	48E1D1	Uguem(ugawe)	North Goa	0.82	-0.3	-0.16	0.28	0.6	0.28	-0.13	0.592	0.557	0.133	-0.05
82	Jy1303	Vadam	South Goa	-	-	-	-	-0.03	0.14	0.17	-	-	-	-
83	48I2A5	Valpoi	North Goa	1.98	-1	-1.65	1.87	1.43	-2.64	0.05	1.974	1.298	-0.503	0.165
84	48E3D1	Velha Goa	North Goa	0.57	0.01	-0.11	0.98	0.09	-0.15	0.27	1.537	0.324	0.086	0.322
85	Jy1302	Vichundrem	South Goa	7.28	1.19	0.67	0.08	1.11	0.17	-0.05	-	-	-	-
86	Jy1304	Yedda	South Goa	4.3	4.5	1.59	0.79	7.34	0.51	-1.31	-	-	-	-

ANNEXURE - V

Depth to Water Level of Piezometers in Goa State during 2017-18							
Sl No.	District	Taluk	Location	Depth to Water Level			
				May-17	Aug-17	Nov-17	Jan-18
1	North Goa	Bardez	Adavapal	6.2	-	3.6	4.5
2	North Goa	Tiswadi	Ajosi	-	-	-	4.28
3	North Goa	Bardez	Aldona	13.9	9.42	13.43	14.9
4	North Goa	Bardez	Aropora	-	-	0.37	1.49
5	North Goa	Pernem	Asapur	-	-	-	5.15
6	North Goa	Pernem	Colvale	20.6	-	12.5	12.71
7	North Goa	Bicholim	Kasar Pal	8.6	5.9	9.05	8.85
8	North Goa	Bardez	Kirl Pirna	-	-	-	7.95
9	North Goa	Pernem	Korgoan	11.4	10	10.75	10.61
10	North Goa	Ponda	Madakai	-	-	13.1	19.71
11	North Goa	Bicholim	Mayam	5.63	2.74	5.7	6.79
12	North Goa	Tiswadi	Mola	1.2	0.35	0.5	0.52
13	North Goa	Pernem	Morjum	2.3	1.03	1.9	1.89
14	North Goa	Bicholim	Narve	-	9.67	11.74	12.02
15	North Goa	Pernem	Parsekarwada	16.5	-	25.5	17.9
16	North Goa	Bicholim	Sanqulim	5.8	17.36	19.2	27.18
17	North Goa	Pernem	Sawantwada	4.3	1.28	4.25	4.69
18	North Goa	Pernem	Silolieum	4.5	0.05	4.6	4.63
19	North Goa	Bardez	Tivim	20.4	-	19.5	20.05
20	North Goa	Pernem	Varkhand	14	11.15	12.6	14.15
21	South Goa	Sanquem	Kalay	3.82	2.65	3.25	3.15
22	South Goa	Canacona	Dabel	12.43	5.65	9.14	9.9
23	South Goa	Canacona	Yedda	10.02	2.3	7.22	8.05
24	South Goa	Canacona	Aven	9.8	2.8	7.85	8.16
25	South Goa	Canacona	Ponquini	9.6	4.3	8.55	8.8
26	South Goa	Canacona	Patnem	8.2	1	3.15	4.84
27	South Goa	Salcete	Chinchinim	2.3	0.1	0.3	1.12
28	South Goa	Salcete	Chandavar	11.83	1.3	2.65	1.79
29	South Goa	Salcete	Manora Rai	1.6	2.45	4.75	4.98
30	South Goa	Salcete	Cavelosim	6.94	0.58	0.85	1.44
31	South Goa	Salcete	Carmona	6	4.36	5.4	5.57
32	South Goa	Salcete	Canabonulim	1.2	-	3.3	4.3
33	South Goa	Salcete	Verna	1.2	0.01	1.3	1.63
34	South Goa	Mormugao	Bogmola	0.26	0.2	0.3	0.31
35	South Goa	Salcete	Dovorlim	4.4	3.13	7.65	4.79
36	South Goa	Quepem	Paddi Quiescend	-	-	-	14.1
37	South Goa	Sanquem	Collem	5.8	-	4.8	5.67
38	South Goa	Sanquem	Meidawada	11	4.8	10.05	10.8
39	South Goa	Sanquem	Molem	8.3	0.88	2.3	6.32
40	South Goa	Satari	Thane	8.8	4.46	6.95	7.39
41	South Goa	Satari	Nanoda	20.8	18.24	19.1	17.96
42	South Goa	Satari	Severdem	14.52	11.5	13.4	13.65

nnexure VI

HYDROCHEMICAL DATA OF WATER LEVEL MONITORING STATIONS, GOA, MAY 2017

S.No	LOCATION	DISTRICT	Date of Collection	pH	EC in µS/cm at 25°C	TH as CaCO3	Ca	Mg	Na	K	CO_3	HCO_3	Cl	SO_4	NO_3	F
						<……mg/L……>										
1	BAYALWADIKERI(QUERIM)	NORTH GOA	06-01-2017	7.80	68	35	4	6	7	1	0	18	18	2	7	0.12
2	MORLEM	NORTH GOA	06-01-2017	8.36	62	40	4	7	6	1	0	24	18	2	1	0.03
3	HONDA	NORTH GOA	06-01-2017	8.02	108	40	6	6	9	2	0	24	21	2	15	0.06
4	BHUIPAL	NORTH GOA	06-01-2017	8.17	135	45	6	7	12	2	0	31	21	3	18	0.11
5	VALPOLI	NORTH GOA	06-01-2017	7.74	154	50	12	5	12	6	0	37	25	11	12	0.08
6	HASARAVANNI VAIPOL	NORTH GOA	06-02-2017	7.69	222	85	16	11	19	5	0	61	32	24	6	0.15
7	CHARAYOD	NORTH GOA	06-01-2017	7.70	162	65	12	8	12	3	0	67	18	4	5	0.15
8	ALTO BETIM PORVORIM	NORTH GOA	06-03-2017	7.62	274	75	18	7	29	7	0	37	53	12	34	0.00
9	KARANJIHALEN	NORTH GOA	06-03-2017	7.81	130	60	10	8	11	2	0	37	28	3	6	0.13
10	BRITONA	NORTH GOA	06-02-2017	7.55	217	95	26	7	12	4	0	49	32	12	24	0.10
11	VELHA GOA	SOUTH GOA	06-04-2017	7.96	194	85	24	6	11	1	0	67	21	4	16	0.04
12	MORJI	NORTH GOA	06-02-2017	7.94	188	70	14	8	19	2	0	67	36	8	4	0.13
13	UGUEM(UGAWE)	NORTH GOA	06-02-2017	7.92	106	40	8	5	8	2	0	18	21	3	8	0.15
14	SAWANTHWADA	NORTH GOA	06-02-2017	7.11	299	80	14	11	26	15	0	18	60	14	35	0.11
15	ADAVAPAL	NORTH GOA	06-02-2017	7.86	81	35	6	5	7	2	0	12	25	1	13	0.00
16	MULGAON SHIVALKHERWAD	NORTH GOA	06-01-2017	8.38	71	35	4	6	7	1	0	18	25	2	4	0.19
17	PERNEM	NORTH GOA	06-02-2017	7.14	224	95	20	11	15	8	0	49	53	12	20	0.16
18	BAMBER	NORTH GOA	06-01-2017	7.87	75	45	8	6	5	1	0	31	18	1	4	0.06
19	BORI	NORTH GOA	06-05-2017	7.92	304	110	28	10	25	9	0	61	50	23	20	0.08
20	KOTADEN	NORTH GOA	06-01-2017	8.22	98	45	10	5	6	1	0	31	21	3	9	0.00
21	POMBURPA-PALMAR	NORTH GOA	06-02-2017	7.99	216	70	18	6	18	6	0	31	46	7	16	0.01
22	SHIVOLI(SILOLIUM)	NORTH GOA	06-02-2017	8.33	362	150	40	12	19	11	30	104	39	7	9	0.01
23	SAL	NORTH GOA	06-02-2017	7.91	184	65	14	7	10	16	0	43	32	10	13	0.00
24	HASAPUR	NORTH GOA	06-02-2017	7.97	312	110	20	15	21	18	0	61	46	22	31	0.08
25	OLAUIM	NORTH GOA	06-02-2017	8.08	92	45	12	4	5	2	0	37	21	1	4	0.00
26	MAPUCA	NORTH GOA	06-02-2017	8.17	267	60	12	7	34	5	0	24	46	7	43	0.00
27	DEVULAWADANARVE	NORTH GOA	06-01-2017	8.55	80	35	6	5	8	1	0	12	28	1	9	0.05

28	DHAT-WADO-VANTE	NORTH GOA	06-01-2017	8.23	111	60	12	7	8	1	0	24	28	2	11	0.00
29	NAGARGAON	NORTH GOA	06-01-2017	8.17	70	40	6	6	5	1	0	24	18	2	8	0.00
30	JAMBHULBATT	NORTH GOA	06-01-2017	7.39	94	45	8	6	8	2	0	31	21	2	10	0.00
31	KHADKI(HARIJANWADA)	NORTH GOA	06-01-2017	8.64	51	30	4	5	4	1	0	12	21	1	3	0.00
32	CALANGUTE	NORTH GOA	06-02-2017	7.99	616	180	46	16	59	13	0	85	82	33	101	0.00
33	PARRA	NORTH GOA	06-01-2017	8.182	387	125	28	13	34	10	0	128	46	35	11	0.13
34	PIRNA	NORTH GOA	06-02-2017	8.37	72	30	8	2	5	1	0	12	18	2	7	0.00
35	KORGAON	NORTH GOA	06-02-2017	8.22	132	50	10	6	10	3	0	18	25	2	20	0.00
36	SIRSAIM	NORTH GOA	06-01-2017	8.56	77	35	4	6	7	1	0	12	21	2	6	0.00
37	AMBEREM	NORTH GOA	06-02-2017	8.50	188	50	10	6	11	14	0	18	39	9	7	0.00
38	ANJUNA BEACH	NORTH GOA	06-02-2017	7.88	191	55	8	8	20	2	0	49	36	5	20	0.01
39	NAGJHAR	NORTH GOA	06-02-2017	8.12	160	35	6	5	8	3	0	12	21	3	11	0.00
40	AROPORA	NORTH GOA	GATE CLOSED	8.15	162	50	10	6	17	5	0	31	32	8	8	0.21
41	GAVALEBHAT	NORTH GOA	06-03-2017	7.42	123	45	8	6	12	2	0	24	25	2	12	0.00
42	MANORA RAI	SOUTH GOA	06-03-2017	7.77	469	110	30	8	49	6	0	67	71	20	35	0.00
43	BALLYNUVHEN	SOUTH GOA	06-03-2017	7.99	130	60	8	10	12	1	0	49	21	2	13	0.00
44	GULEM VELIPWADA	SOUTH GOA	06-03-2017	7.51	128	70	10	11	8	1	0	55	18	9	4	0.00
45	KAVASELIUM	SOUTH GOA	06-04-2017	8.04	221	110	32	7	9	2	0	104	21	3	2	0.00
46	PADI	SOUTH GOA	06-04-2017	7.96	91	55	10	7	6	0	0	49	14	1	2	0.00
47	SRISTAL	SOUTH GOA	06-04-2017	8.26	136	55	10	7	12	2	0	37	21	7	9	0.00
48	VINCHURDEM	SOUTH GOA	06-04-2017	7.52	73	45	10	5	4	1	0	31	18	1	3	0.00
49	MASHE	SOUTH GOA	06-04-2017	8.14	77	30	2	6	8	1	0	18	18	1	3	0.01
50	CUNCULIUM	SOUTH GOA	06-04-2017	7.72	126	45	8	6	12	2	0	43	18	4	4	0.00
51	BETALBATTI	SOUTH GOA	06-03-2017	7.40	173	75	18	7	14	3	0	67	25	8	2	0.00
52	NAVELIM	SOUTH GOA	06-04-2017	8.19	163	45	4	8	19	2	0	18	39	4	8	0.00
53	CHIKALEM	NORTH GOA	06-03-2017	8.35	4700	695	98	109	649	23	18	85	1303	124	4	0.28
54	SHIRODA	NORTH GOA	06-05-2017	7.96	138	65	12	8	11	4	0	37	46	2	8	0.00
55	JAMBAVALI	SOUTH GOA	06-04-2017	8.13	64	40	4	7	6	1	0	18	28	0	3	0.00
56	BAGMOLA	SOUTH GOA	06-03-2017	8.00	162	70	12	10	14	2	0	49	28	2	13	0.00
57	CANACONA	SOUTH GOA	06-04-2017	7.99	188	80	12	12	15	3	0	67	32	2	5	0.00
58	KANAGINI(PZ)	SOUTH GOA	06-04-2017	8.51	61	30	4	5	6	1	0	12	18	1	5	0.00
59	QUEPEM	SOUTH GOA	06-04-2017	7.92	110	60	8	10	6	2	0	43	18	5	3	0.00
60	MANKEN	NORTH GOA	06-05-2017	8.05	129	55	8	8	12	4	0	43	21	8	4	0.00

61	MOLEM	SOUTH GOA	06-02-2017	8.07	188	105	20	13	5	1	0	116	14	1	2	0.00
62	YEDDA	SOUTH GOA	06-04-2017	8.07	1245	300	46	45	102	81	0	250	188	40	87	0.06
63	DAPTAMOL LOLIEN	SOUTH GOA	06-04-2017	8.08	97	55	8	8	5	3	0	37	18	1	10	0.00
64	NETROLIM	SOUTH GOA	06-04-2017	7.82	210	75	16	8	17	8	0	49	36	11	10	0.00
65	AGONDA DESAIWADA	SOUTH GOA	06-04-2017	8.27	71	15	2	2	7	1	0	12	14	0	3	0.00
66	PATNEM	SOUTH GOA	06-04-2017	7.74	176	70	12	10	13	1	0	49	25	4	15	0.00
67	HATTIPAL POINGUINEM	SOUTH GOA	06-04-2017	6.93	92	30	8	2	5	3	0	18	14	2	10	0.00
68	MAJORDA BPADA CURILO	SOUTH GOA	06-03-2017	7.93	292	85	16	11	31	15	0	85	36	28	8	0.01
69	BHATI	SOUTH GOA	06-04-2017	8.10	49	30	4	5	2	0	0	12	14	1	2	0.00
70	KAPSA	SOUTH GOA	06-05-2017	7.56	301	70	10	11	30	6	0	43	75	3	4	0.00
71	GHADIAWADA	SOUTH GOA	06-05-2017	8.25	149	50	8	7	12	6	0	31	25	8	9	0.00
72	REVONA	SOUTH GOA	06-04-2017	8.14	146	55	8	8	11	5	0	31	25	4	15	0.00
73	KALAY	SOUTH GOA	06-05-2017	8.38	65	35	6	5	4	1	0	18	14	1	5	0.00
74	GUDEMAL	SOUTH GOA	06-05-2017	8.30	116	55	8	8	9	4	0	49	18	3	5	0.00
75	DEULWADA KOLAMBA	SOUTH GOA	06-04-2017	7.98	111	60	12	7	5	3	0	49	14	3	5	0.00
76	PANCHAWADI(PZ)	NORTH GOA	06-05-2017	8.51	59	20	2	4	6	2	0	18	14	0	3	0.00
77	COLLEM(KOLAMBA)	SOUTH GOA	06-05-2017	8.63	53	30	4	5	5	1	0	18	14	0	2	0.00
78	VADDEM	SOUTH GOA	06-04-2017	8.08	43	25	2	5	4	1	0	12	14	0	4	0.00
79	SHRISHTAL GAONDONGAR	SOUTH GOA	06-04-2017	8.18	100	55	8	8	8	2	0	43	18	2	11	0.00
80	BOLKHARNEM	SOUTH GOA	06-05-2017	8.04	90	45	12	4	5	2	0	37	14	1	3	0.07