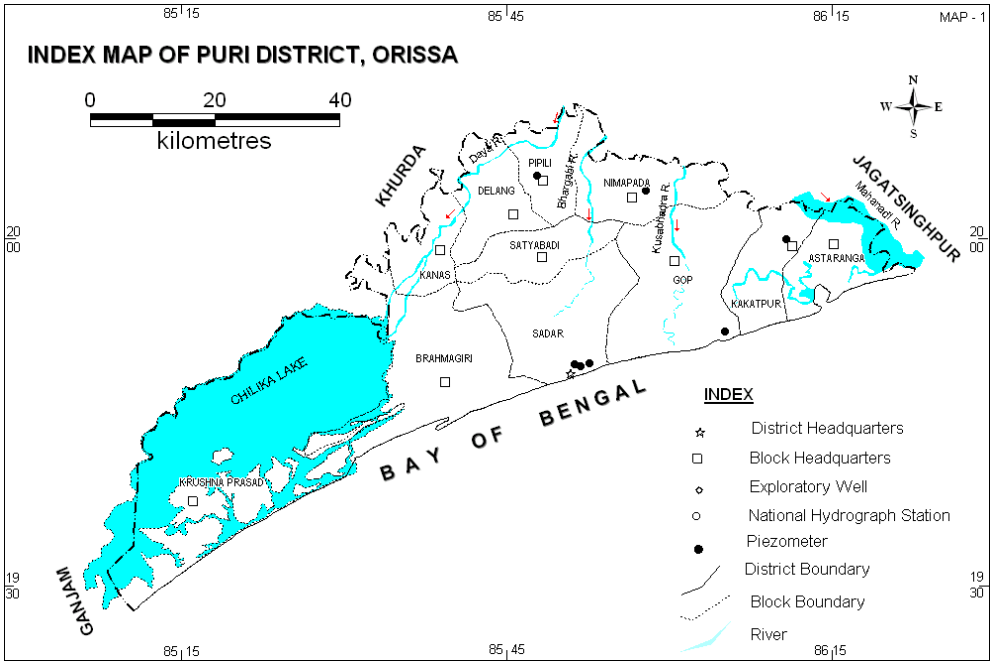
Govt. of India
MINISTRY OF WATER RESOURCES
CENTRAL GROUND WATER BOARD

GROUND WATER INFORMATION BOOKLET

PURI DISTRICT, ORISSA



South Eastern Region
Bhubaneswar
March, 2013

PURI DISTRICT AT A GLANCE

Sl No	ITEMS	Statistics
1.	**GENERAL INFORMATION**	
	i. Geographical Area (Sq. Km.)	3479
	ii. Administrative Divisions as on 31.03.2011	
	Number of Tehsil / Block	7 Tehsils, 11 Blocks
	Number of Panchayat / Villages	230 Panchayats 1715 Villages
	iii Population (As on 2011 Census)	16,97,983
	iv Average Annual Rainfall (mm)	1449.1
2.	**GEOMORPHOLOGY**	
	Major physiographic units	Very gently sloping plain and saline marshy tract along the coast, the undulating hard rock areas with lateritic capping and isolated hillocks in the west
	Major Drainages	Daya, Devi, Kushabhadra, Bhargavi, and Prachi
3.	**LAND USE (Sq. Km.)**	
	a) Forest Area	90.57
	b) Net Sown Area	1310.93
	c) Cultivable Area	1887.45
4.	**MAJOR SOIL TYPES**	Alfisols, Aridsols, Entisols and Ultisols
5.	**AREA UNDER PRINCIPAL CROPS (As on 31.03.2011)**	Paddy 171172 Ha,
6.	**IRRIGATION BY DIFFERENT SOURCES (Areas and Number of Structures)**	
	Dugwells, Tube wells / Borewells	DW 560Ha(Kharif), 508Ha(Rabi),
	Major/Medium Irrigation Projects	66460Ha (Kharif), 48265Ha(Rabi),
	Minor Irrigation Projects	127 Ha (Kharif),
	Minor Irrigation Projects(Lift)	9621Ha (Kharif), 9080Ha (Rabi),
	Other sources	9892Ha(Kharif), 13736Ha (Rabi),
	Net irrigated area	105106Ha (Total irrigated area.)
	Gross irrigated area	158249 Ha
7.	**NUMBERS OF GROUND WATER MONITORING WELLS OF CGWB (As on 31-3-2011)**	
	No of Dugwells	57
	No of Piezometers	12
10.	**PREDOMINANT GEOLOGICAL FORMATIONS**	Alluvium, laterite in patches
11.	**HYDROGEOLOGY**	
	Major Water bearing formation **Pre-monsoon Depth to water level during 2011**	0.16 mbgl to 5.96 mbgl

Sl No	ITEMS	Statistics
	Post-monsoon Depth to water level during 2011 **Long term water level trend in 10 yrs (2001-2011) in m/yr**	0.08 mbgl to 5.13 mbgl Pre-monsoon: 0.001 to 0.303m/yr (Rise) 0.0 to 0.554 m/yr (Fall). Post- monsoon: 0.004 to 0.302 m/yr (Rise). 0.0 to 0.183 m/yr (Fall).
12.	**GROUND WATER EXPLORATION BY CGWB (As on 31-03-2011)**	
	No of wells drilled(EW, OW, PZ, SH, Total)	13EW, 5PZ, 7SH, Deposit wells-9
	Depth Range(m)	105-602
	Discharge(litres per second)	36.32 to 221.4 m^3/hr
	Storativity(S)	6.7 X 10^{-2} to 2.8 X 10^{-5}
	Transmissivity(m^2/day)	34.1 to 8189
13.	**GROUND WATER QUALITY**	
	Presence of Chemical constituents more than permissible limit (e.g. EC, F, As, Fe)	As it is a coastal area high EC is reported, high Fe is also reported and high F above the permissible limit of 1.5 mg/l is reported.
	Type of Water	(Na + K) +Ca, (Cl + NO_3) + HCO_3 High EC and Fe is reported. High fluoride above the permissible limit of 1.5 mg/l is also sporadically reported.
14.	**DYNAMIC GROUND WATER RESOURCES (2009) – in**	
	Annual Replenishable Ground Water Resources	58806 HaM
	Net Annual Ground Water Draft	10448 HaM
	Projected Demand for Domestic and Industrial Uses upto 2025	4102 HaM
	Stage of Ground Water Development	17.77 %
15.	**AWARENESS AND TRAINING ACTIVITY**	
	Mass Awareness Programmes organized	
	Date	16-03-2001 and 19-11-2004
	Place	Puri Town
	No of Participants	250
	Water Management Training Programmes organized	
	Date	18 & 19- 11-2006
	Place	Puri Town
	No of Participants	100
16.	**EFFORTS OF ARTIFICIAL RECHARGE & RAIN WATER HARVESTING**	
	Projects completed by CGWB (No & Amount spent)	Talsuan creek, Kakatpur block. Total cost of the project – 20 lakhs.
	Projects under technical guidance of CGWB (Numbers)	Nil
17.	**GROUND WATER CONTROL AND REGULATION**	
	Number of OE Blocks	Nil
	No of Critical Blocks	Nil

Sl No	ITEMS	Statistics
	No of Blocks notified	Nil
18.	**MAJOR GROUND WATER PROBLEMS AND ISSUES**	In the Jagannath Temple area there is depletion of water table and the ground water is contaminated with high PO_4^{3-} and NO_3^- .

1.0 INTRODUCTION

Puri is one of the nine coastal alluvial district of eastern Orissa with a geographical area of 3479 sq. km. About 84.3 percent of the population of the district live in rural areas and agriculture is the main stay of the people. Puri district lies between North latitudes 19°28' and 20° 10' and East longitude 85° 09' and 86°25', falling in Survey of India toposheet nos74 E, 73 H, 74I, 73L. It is bounded on the north by Jagatsinghpur and Cuttack district; on the east by Bay of Bengal, on the south by Ganjam district, and on the west by Khurda district. The district has only one subdivision. There are 11 community development blocks in the district. The district is well connected by rail and roads and is about 60 kms from Bhubaneshwar. All the block headquarters are connected by metalled roads. The district comprises only one subdivision and 11 Community Development Blocks with the district headquarters at Puri (Plate-1). According to 2001 census data, the total population of the district is 15,02,682 constituting 4.08 % of the total population and 2.23% of total land area of Orissa. The rural and urban populations are 12,98,654 and 2,04,028 respectively. The density of population is 138 against the state figure of 236 persons per sq. km.

Puri district falls in the Mahanadi river basin and the main drainage is formed by the rivers Daya, Devi, Kushabhadra, Bhargavi, and Prachi, which have southerly, southeasterly and south westerly courses. The river Bhargavi changes its course from north south to southwest near Sakhigopal and further downstream it bifurcates into numerous channels. All the rivers have reached their old stage and are meandering in nature, branching into a number of distributaries draining into the sea or the Chilika lake. Other important rivers flowing in the area are Kadua, Ratnachira, Dhanua and Kandal. The tidal effects are observed upstream even upto 10kms from the confluence point. All the rivers maintain sluggish flow during the summer months, but swell menacingly during the rainy season. The other important surface water bodies in the district are Sar and Samang lakes. Another important water body is Chilika, which is a lagoon separated long back from Bay of Bengal.

Puri district is covered by well developed irrigation network covered by Mahanadi Delta Stage-II canal systems. The net sown area in the district is 1,31,093 ha. Only 9% of the cultivable area is irrigated. The total cultivable land in the district is 188745 Ha and irrigated area is 105106 Ha. There are three crop seasons in command area and two crop seasons in non-command area. The Kharif crops are Paddy, Jute, Oilseeds, and Pulses etc. The Rabi crops are Paddy, Gram, Pulses, Groundnut, Oilseeds, Mustard, Vegetables and Potato etc. and summer crops include summer Paddy, Cowpea, Vegetables, Groundnut, Ragi. Paddy is the principal crop of the district and is cultivated in 171172 Ha in 2004-05.

Systematic geological mapping of the district has been completed by the officers of Ground Water Division of Geological Survey of India during the seasons 1968-69 and 1969-70. The entire district has been covered by systematic hydrogeological survey by S/Shri B.B. Basak, G.K. Roy, Scientist 'B'during the field seasons1984-85, 85-86, 91-92 and 1995-96. The district has further been covered through reappraisal surveys by S/Shri N.C.Nayak, P.K.Naik Scientist'B' of Central Ground Water Board during the period 2000-2001 and 2005-06 on 1:50,000 scale. The district report on hydrogeological framework and groundwater development prospects in Puri District, Orissa was prepared by Shri G.K. Roy, Scientist-D on November-2004.

Ground water exploration by deep drilling upto 602m has been taken up in the district and 13nos. exploratory wells so far has been drilled to delineate the deeper potential aquifer. The location of the wells are depicted in Plate –I Ground water monitoring is being done through 69 hydrograph network stations four times in a year.

2.0 RAINFALL & CLIMATE

The south-west monsoon is the principal source of rainfall in the district. Average annual rainfall of the district is 1449.1 mm. About 75% of the total rainfall is received during the period from June-September. Floods are quite common in the district. As the district mainly receives rainfall from south-west monsoon which is very erratic. Analysis of 24 years of rainfall data from 1982 to 2006 reveals that the rainfall is uneven with maximum rainfall (2146mm) in 1991 and minimum (522mm) in1974.

The climate of the district is subtropical with hot and dry summer and pleasant winter. The summer season extends from March to middle of June followed by the rainy season from June to September. The winter season extends from November till the end of February. Relative humidity is generally high throughout the year and at Puri it varies from 62-85%. The mean monthly potential evapo-transpiration values varies from 57mm. in January to 254mm in May. The mean annual wind velocity at Puri (IMD) station, is recorded as 14.8 km/hr. During summer and southwest monsoon months wind velocity increases.

3.0 GEOMORPHOLOGY & SOIL TYPES

Physiographically the district can be broadly divided into three natural divisions, viz,

(i) The Saline marshy tract along the coast.
(ii) The very gently sloping plain.
(iii) Undulating hard rock areas with lateritic capping and isolated hillocks.

The coastal sand dunes occur as a linear strip, running parallel to the shore line, which maintain higher altitude than the immediate interior part. The width of this tract varies from few hundred meters to 7km. Swamps and tidal flats are also common in this tract.

The deltaic plains may be divided into three parts: lower, middle and upper. The lower deltaic plains occur adjacent to the coastal sand dunes, having a width of 5 to 10km. Extensive flood plains, meandering stream curves, swamps, minor ridges etc. characterize this geomorphic unit. The Sar and Samang lake near Puri were important features in this terrain which have been silted up at present. The middle deltaic plains have characteristic parallel to sub-parallel drainage pattern and splitting distributaries. The upper deltaic plains occur along the course of the Daya river with an width of 2 to 3 km. This alluvial plain is characteristically flat. The altitude of the deltaic plain varies from 1 to 10m above mean sea level.

The undulating hard rock terrain occurring over a limited area in the western parts covering Delang and Kanas blocks, maintain a general slope towards south. The country rocks are often covered by laterites and the general elevation varies from 8 to 15m above mean sea level.

There are mainly three types of soils in the area, which are Alfisols, Aridsols and Entisols. However, Ultisols occur over a small patch in the northwestern sector of the district.

Alfisols: The deltaic alluvial soils belong to this group and occupy major parts of the area. These deltaic soils are generally deficient in P_2O_5 and N_2. The K_2O are fairly adequate, and pH varies between 6.5 and 7.3. Generally these soils support paddy crops.

Ardisols: These are saline and saline alkali soils found near the coast and are restricted to Krushnaprasad and Astarang blocks. In Astarang block it occurs along the course of the Devi river. These soils are rich in calcium, magnesium and contain half decomposed organic matter.

Entisols: these include youngest alluvial soils occurring in the western parts of the district, coastal sandy soils around Chilika lake and in the coastal tract. These soils are deficient in nitrogen, phosphoric acid and humus material, but generally not in potash and lime. The pH values are on the alkaline side. The texture varies from sandy to loamy sand. These are fertile soils and can produce a wide variety of crops, including paddy, wheat, sugarcane, cotton, banana and tobacco.

Ultisols: The Ultisols soil include the laterite and lateritic soils found in a small area in the northern part of the district in and around Delang, characterized by compact vesicular mass. It is developed on the hard rock terrain as well as in the alluvial areas. The soil is gravelly to loamy and rich in iron, aluminium but low in nitrogen, phosphorous, potash and silica. Fertility of the soil is low and it is well drained.

4.0 GROUNDWATER SCENARIO

4.1`Hydrogeology

The geological formations in the district spans in age from Archean to Recent (Quaternary). The Tertiary and Quaternary formations occurring over major parts of the district while the Archeans occupy the hilly areas under higher altitudes in the west.

The Quaternary deposits consist of laterites and alluvium. While the laterite occurs only in the western and northwestern parts, major parts of the district are covered by alluvium of varying thickness. The average thickness of laterite is around 8 to 10m.The older alluvium is generally exposed in the northwestern parts including a sequence of sand, clay and kankars of grey to brown in colour. The younger alluvium, which covers nearly 90% of the area, occurs as flood plain deposits along the course of major rivers and streams. These sediments consist of an admixture of silt, sand, gravel and pebble in varying proportions. These layers increase in thickness towards the sea, showing a gentle dip. Discontinuous ridges of sand dunes occur along the coast and are formed due to wind action.

(i) Areas underlain by alluvium.

(ii) Areas underlain by fractured, fissured and consolidated basement rock formations.

Water bearing properties of the Consolidated formations:

The aquifer system in the district may be broadly divided into
(i) Shallow aquifers (ii) Deeper aquifers.

6.1.1 Shallow Aquifer

The thickness of shallow aquifers (near surface aquifer) varies widely due to salinity problem. The geological setup as discussed earlier controls the occurrence and movement of ground water. The crystalline Archeans are devoid of primary porosity. Although they possesses secondary porosity on being weathered and fractured. However, the unconsolidated sand and gravel layers of Tertiary and Quaternary age form the main repository of ground water. Groundwater occurs under water table conditions in shallow aquifers. All the hydrogeological formations can be broadly divided into three sub groups viz. (a) Crystalline formations (b) Sedimentary formations and (c) Laterites.

The unconsolidated or porous formations comprising of Tertiary and Quaternary sediments, encountered in the major parts of the district. The sand and gravel layers form the main repository of ground water in this area. The groundwater in near surface shallow aquifers occurs under phreatic conditions, even down to a depth of even 135 m below ground level. The laterites occurring as capping over the country rocks are vesicular, ferruginous and highly porous, which support large number of domestic wells.

6.1.2 Deeper aquifers

The occurrence of fresh water bearing deeper aquifers are identified from available bore hole data down to a maximum depth of 602m in Puri town. The available information indicate that in general the deeper fresh water bearing zones are sandwitched between saline water bearing zones. The fresh water bearing zones are composed of sand, silt, clay, gravel and among these materials sand and gravel horizon and mixture of sand and gravel zones form the prolific fresh water bearing aquifers. The deeper aquifers occur under semi confined and confined conditions. The aquifers are extensive, interconnected and have prolific yield potentials (upto 65 lps). The thickness of individual aquifers varies from 6 to 7m, while the cumulative thickness of aquifer materials down to a depth of 250m varies from 10 to 79m. The common groundwater abstraction structures are dug wells, shallow tube wells, deep tube wells and filter points.

Groundwater Exploration

In Puri district Central Ground Water Board has drilled 13 exploratory wells, 9 deposit wells, 5 deep piezometers, and 7 slim holes. The depth of the borehole varies from 54.57m at Santrapur to 602m at Agricultural farm, Puri. The hard crystalline basement complex was encountered at several places at different depths, shallowest in Delang (119.8m) and deepest at Jagannathballabh in Puri Sadar block (556m). In the central part of the district basement was encountered at 208m depth at Rupadeipur, 282m at Sakhigopal. Athgarh sandstone was encountered in the borehole of Pipli at 56m. depth.

The yield of the exploratory borewells varied from 36.32 m^3/hr to 221.4 m^3/hr. The transmissivity values ranges from 34.10 m^2/day at Sakhigopal to 8189 m^2/day at Tompalo.The storativity values varies from 6.7 x 10^{-2} to 2.8 x 10^{-5}. The static water level in deeper aquifer varies from 0.05 to 9.97 mbgl. Some of the deeper aquifer are autoflow in nature.

Auto flow zones

In the southern sector of the area, adjoining Chilika lake a numbers of auto flow wells are found which have been constructed by PHED and DANIDA. Autoflow wells are located in Krishnaprasad, Brahmagiri blocks and partly in Kanas, Delang, Puri Sadar and Satyabadi block. The zones tapped varies from 150m to 250 mbgl. At Sadanandapur and Birgobindapur (74 E/13) two auto flow wells have been constructed by Danida. The piezometric head at Birgobindapur has been found to be 2.64 magl and at Sadanandapur it is about 0.45 magl. The temperature of water from auto flow wells varies from 29 ^{0}C at Sadanandapur to 35^{0}C at Bengama. The temperature of the auto flow wells around Chilika varies from 32 ^{0}C to35^{0}C. The quality of water varies from fresh at Sanabandha to saline at Sadanandapur. The well at Birgobindapur was fresh at the beginning but with time at present it has turned into saline well.

Depth to Water Level (Pre-monsoon and Post-monsoon, 2011)

The depth to water level is measured from the National Hydrograph Staions situated in different blocks of the Puri district. The Pre monsoon, 2011 water level data varies from 0.16 mbgl (Pratapramchandrapur) to 5.96 mbgl (Satpada). The depth to water level map of pre -monsoon, 2011 is displayed in Plate II.

The depth to water level data of Post-monsoon, 2011 represents 0.08 mbgl (Sadanandapur) to 5.13 mbgl (Ramchandi). Plate III represents depth to water level map of post –monsoon,2011.

Seasonal Fluctuation

The fluctuation of depth to water level in 2011 between pre-monsoon and post-monsoon varies from 0.1 m (Juinti) to 3.51 m (Chandanpur).

Long Term Water Level Trend in last 10 years in Ground Water Monitoring wells

The long term trend of (10 years) in water level for the **pre-monsoon** shows rise from 0.001 to 0.303m/yr. Fall in water level is restricted within 0.0 to 0.554 m/yr. 63.6% of the wells show rising trend and 36.4 % of the wells show falling trend.

The long term trend of (10 years) in water level for **post monsoon** season shows rise in water level from 0.004 to 0.302m/yr. The fall in water level is in the range of 0.0 to 0.183 m/yr. 63.4% of the wells show rising trend and 36.6 % of the wells show falling trend.

4.2 Ground Water Resources

The Ground Water Resources of the district has been assessed adopting the methodology recommended by the Groundwater Estimation Committee (1997), constituted by Govt. of India. The task was jointly carried out by the Central Ground Water Board and Ground water Survey & Investigation, Department of Water Resources, Govt. of Orissa. The block wise computation of ground water resources in the district has been presented in Table 4.1. The Annual Replenishable ground water resources in the district are computed as 58806 HaM, out of which the existing Ground Water Draft for irrigation is 7246 HaM. The ground water draft for irrigation is through dug wells shallow tube wells and tube wells. So far ground water development in the district has been meagre, and all the blocks fall under the safe category. The stage of ground water development varies from 4.83% (Krushnaprasas) to 29.45% (Puri) in different blocks. The overall Stage of Groundwater development of the district is 17.77%. There is ample scope for stepping up ground water development in the district. The ground water budget of the district is presented in Plate No. IV.

Table-4.1 Ground Water Resources of Puri District

(in ha m)

Sl No	Assesment Unit/ District	Net Annual Ground Water Availability	Existing Gross Ground Water Draft for irrigation	Existing Gross Ground Water draft for domentic and industrial Water Supply	Existing Gross Ground water draft for all uses (4+5)	Allocation for domestic and industrial requirement supply upto next 25 years	Net Ground Water availability for future irrigation Development (3-4-7)	Stage of Ground Water Development {(6/3)*100}%
1	2	3	4	5	6	7	8	9
	Puri							
1	Astaranga	2496.00	382.00	138.82	521.00	177.00	1937.00	20.87
2	Brahmagiri	7515.00	1070.00	232.25	1302.00	312.00	6133.00	17.33
3	Delanga	4024.00	782.00	245.13	1026.00	330.00	2913.00	25.50
4	Gop	6346.00	622.00	293.86	916.00	399.00	5325.00	14.43
5	Kakatpur	3379.00	675.00	186.07	860.00	241.00	2463.00	25.45
6	Kanas	4498.00	263.00	262.99	526.00	336.00	3898.00	11.69
7	Krushnaprasad	11418.00	381.00	170.00	551.00	251.00	10786.00	4.83
8	Nimapada	5882.00	1122.00	398.44	1520.00	535.00	4225.00	25.84
9	Pipli	5337.00	840.00	340.51	1181.00	435.00	4062.00	22.13
10	Puri	4742.00	721.00	680.65	1401.00	768.00	3254.00	29.54
11	Satyabadi	3169.00	388.00	256.51	644.00	318.00	2463.00	20.32
	District Total	58806.00	7246.00	3205.00	10448.00	4102.00	47459.00	17.77

4.3 Ground Water Quality

The chemical quality of ground water in the district has been assessed on the basis of ground water samples collected during ground water monitoring, hydrogeological surveys and ground water exploration. The range of different chemical constituents in shallow and deeper aquifers is given in Table-4.2.

Range of different chemical constituents in shallow aquifers

Table 4.2 Range of Chemical Constituents in Different Aquifers

	Shallow aquifer		Deeper aquifer	
Chemical constituents	Range	Average	Range	Average
E.C. (µs/cm at 25^0c)	155-4882	353-2829	159-8920	524-4086
p^H	-	-	7.1-8.2	7.13-8.1
Bicarbonate (mg/l)	-	-	20-439	116-390
Chloride(mg/l)	14-1389	57-695	3-3332	46-1536
Nitrate(mg/l)	0-164	2.54-8.61	0-13	0.5-10
Fluoride(mg/l)	0.34-12	0.48-2.65	0.07-1.9	0.2-1.3
Total Hardness (mg/l)	40-940	90-580	25-1640	70-351
Calcium(mg/l)	-	-	8-409	14-84
Magnesium(mg/l)	-	-	4.9-151	8.5-40
Sodium(mg/l)	-	-	7.2-1449	53-463
Potassium(mg/l)	-	-	4-36	7.7-33
Carbonate(mg/l)	-	-	-	-
Sulphate(mg/l)	-	-	0-448	11-240
Iron(mg/l)	0.07-8.63	0.51-2.47	0.01-9.93	0.25-0.89
Silica(mg/l)	-	-	18-66	18-29

As it is a coastal district so salinity hazard is very common in both shallow and deeper aquifer and electrical conductivity reaches as high as 8920 mg/l. High value of chloride, sodium and sulphate is reported in deeper aquifer. High fluoride is reported sporadically in shallow aquifer but so far no health hazard is reported. The suitability of ground water for irrigation in the district has been assessed by use of US salinity diagram prepared on the basis of sodium absorption ratio (SAR) and specific conductance. The classification of water in the district is given in Table 4.3 below.

Table 4.3 US Salinity Classification

Classification based on Salinity diagram	Grade	No. of Samples	
		Deeper aquifer (Total-19)	Deeper aquifer (%)
C_1S_1	Good	2	10.52
C_1S_2	Moderately Good	-	- -
C_1S_3	Unsuitable	-	-
C_1S_4	Highly Unsuitable	-	-
C_2S_1	Good	5	26.31
C_2S_2	Moderately Good	1	5.26
C_2S_3	Unsuitable	--	-

C_3S_1	Moderately Good	1	5.26
C_3S_2	Unsuitable	1	5.26
C_4S_1	Unsuitable	4	21.05
C_4S_3	Unsuitable	3	15.79
C_4S_4	Unsuitable	2	10.52

It may be noted that about 50% of the groundwater samples collected from deeper aquifers are not suitable for irrigation purposes as it is a coastal area and suffers from salinity hazard. From Piper diagram it is interpreted that in deeper aquifer the water type is $(Na+K) + Ca - (Cl + NO_3) + HCO_3$.

4.4 Status of Ground Water Development

Ground water development in the district is mainly through dug wells, shallow tube wells and deep tube wells. Ground water is mainly used for domestic and irrigation purpose and in limited scale for industrial purposes. The stage of development of ground water in the district is low. So far only 10.51% of its resources has been exploited. Hence a strategy for detailed ground water development is required. Depth range, probable thickness of aquifers and yield of different groundwater structures in Puri district is given in Table-4.4. The hydrogeological, remote sensing studies and ground water exploration so far carried out in the district depict the tentative possibilities of ground water development through suitable ground water abstraction structures in various hydrogeological settings (Plate –VI).

Table-4.4

Depth range, probable thickness of aquifers and yield of different groundwater structures in Puri district

Sl. No.	Type of structure	Depth range	Probable thickness or aquifer	Probable yield (LPS)	Approx command area (Ha)	Hydrogeological setting
1	Dugwell	9-12	4.5-6	<3	1	Crystalline and alluvial area
2.	Borewell	60-150	-	<5	3	Crystalline area
3.	Filter point and shallow tubewells	25-60	10-15	<10		Alluvial area
4.	Medium deep tubewell	60-100	20-30	15-40	25	Tertiary and alluvial area
5.	Deep tubewell	135-290	30-40	>40	40	Alluvial area

The areas suitable for different structures are described below:

Medium deep Tube wells: The medium deep tube wells are feasible in alluvial areas in Gop, Kakatpur, Nimapara, Pipli. The depth of wells may range from 60-100 m tapping 20-30 m of aquifer thickness. The diameter of the wells can be 150 mm and the yield may range from 15-40 lps. Submersible pumps 7.5 to 20 HP can be installed depending on yield.

Shallow Tubewells: The shallow tube wells are feasible in Gop, Kakatpur, Astarang , Nimapara, Pipli blocks covering alluvial formations. The depth of these wells will be less than 50 m. and the diameter of these wells can be 100 mm and the yield is expected to be less than 10 lps.

Filter point Tubewells:- The filter point tube wells are feasible in alluvial areas covering parts of Gop, Kakatpur, Nimapara, Pipli blocks. The depth of these wells are generally within 45 m tapping a aquifer thickness of 10-15 m. The yield of filter point tube wells is expected to be up to 10 lps. The diameter of the filter point tube well may be 100 mm and borewell may be 150 mm and submersible pump of 2 to 3 HP can be installed.

Dug wells: The dug wells are feasible in all the blocks. In the blocks like Brahmagiri, Krushnaprasad, which are beset with salinity problems, where the ground water is saline from top to bottom, the dug wells are feasible only in pockets where fresh water is available in a limited area. Depth of the dug wells in the alluvial areas vary from 9 to 12 meters with a dia of 4.5 to 6 meter. The yield of the wells is expected to be less than 3 lps and centrifugal pumps of 2 HP can be installed

5.0 Ground Water Management Strategy

5.1 Ground Water Development

The Ground Water Development of the entire Puri District is depicted in Plate -VI. Depending on the hydrogeological condition of the area the development possibilities has been predicted.

5.2 Water Conservation & Artificial Recharge

As it is a coastal area in Pre-monsoon also water level recorded is less than 5mbgl except in Puri Municipality where deeper water level of more than 10 m is reported. Roof Top Rain Water Harvesting has to be followed in Puri Municipality. In islands like Mahasa-Barahampura etc in Krushnaprasad block due to salinity hazard there is acute shortage of fresh water. In these areas rainwater is the only source of fresh water.

A creek project has been taken up in coastal saline hazard areas of Kakatpur block for utilizing the minor creeks and nalas for storing the fresh water for irrigation and side by side injecting the fresh water into saline water bearing shallow aquifers so that the salinity of water can be reduced and make it useful for irrigation and other purpose. The length of the Talasuan creek is 3.5km and sub creeks are 7.0 km. The total drainage area is 500 ha. The creeks and sub creeks are silted up. It was proposed to construct sluice gate to regulate the flow of sweet/fresh water and renovation of creek and sub creeks at estimated cost of Rs20 lakhs. With this, drainage congestion will be relieved and ingress of saline water can be checked through sluice gate.

6.0 Ground Water related issues & Problems

6.1 Ground Water Problems

Salinity Hazard: The area lies in eastern coastal tract where salinity prevails in phreatic as well as in deeper aquifer. In Krushnaprasad, Brahmagiri, Delang, Kanas, Gop, Astaranga, Puri Sadar block etc. salinity hazard is widespread. In Pipli, Nimapara, Kakatpur salinity hazard is less prevalent.

In Puri district 19480ha (7.3%) is affected with salinity and 15192ha (5.72%) is waterlogged. In 2006, crop of 1606 villages of 232 grampanchayat was submerged (submergence more than 50%) due to flood . Total area affected was 58465 ha which is 22 %of the total area.

Water logging and Crop submergence: In Puri district 19480 ha (7.3%) is affected with salinity and 15192ha (5.72%) is waterlogged. In 2006, crop of 1606 villages of 232 grampanchayat was submerged (submergence more than 50%) due to flood. Total area affected was 58465 ha which is 22 %of the total area. Waterlogged area, saline area and crop submergence (in 2006) in Puri district is given in Table-6.1

Table-6.1

Waterlogged Areas/ Saline area/ Crop Submergence (in 2006) in Puri District (Area in ha)

Sl.No	Block	Total area	Saline area	% of area affected by salinity	Waterlo-gged area	% of area waterlo-gged	Submergence in 2006			
							No. of GP affected	No. of village affected	Total area affected	% of area affected
1	Astaranga	16223	2500	15.41	185	1.14	14	97	2663	16.41
2	Brahmagiri	30289	3000	9.90	6621	21.86	18	164	2948	9.73
3	Delang	20189	80	0.39	128	0.63	18	135	7765	38.46
4	Gop	33340	1500	4.50	628	1.88	30	209	7904	23.70
5	Kakatpur	16706	2000	11.97	3378	20.22	14	115	3251	19.46
6	Kanas	22668	700	3.09	146	0.64	22	138	6344	27.98
7	Krushnaprasad	32873	8000	24.34	705	2.14	20	110	5535	16.83
8	Nimapara	28403	0	0	890	3.13	29	211	4092	14.40
9	Pipli	20324	0	0	425	2.09	20	178	5755	28.31
10	Puri Sadar	26082	1700	6.52	1703	6.53	25	153	6412	24.58
11	Satyabadi	18309	0	0	383	2.09	22	96	5796	31.65
	Total	265406	19480	7.3	15192	5.72	232	1606	58465	22.03

Ground Water Pollution : As no major industries are located in the district ground water pollution is not reported in Puri district except in Puri urban area. As the phreatic aquifer extends upto 39 meter below ground level and there is no confining layer there is chances of contamination from municipal wastes. Hence suitable sewarage system is urgently required to be planned and implemented to curb further ground water contamination. The area surrounding the famous temple of Sri Jagannath have most of the houses and the dharamasalas the traditional soak pit system of faecal waste disposal. Storm water drains exist only for disposal of other domestic wastes. There is considerable contamination of both shallow and deeper aquifers. High PO_4^{3-} and NO_3^- have been detected mostly in the thickly populated area. The concentration of the NO_3^- varies between 91-336 mg/l.

Ground Water Depletion: The stage of ground water development in different blocks varies from 3.72% (Krushnaprasad) to 16.88% (Delang) with the overall stage of development 10.51% in the district. So all the blocks fall in safe category. As it is a coastal area there is no significant decline in water level in Puri district. But in Puri urban area the stage of ground water development is almost 100%. Both in Pre- and Post-monsoon deeper water level of more than 8 mbgl is reported particularly in the Temple area as there is very little scope for recharge of rainfall. Hence, the sweet water recharge in Chakratirtha and Baliapanda areas needs to be protected.

7.0 Awareness & Training Activity

7.1 Mass Awareness Programme (MAP) & Water Management Training Programme (WMTP) by CGWB

(i) Mass Awareness Programme (MAP) Puri, Puri District:

The program was organized twice on 16-03-2001 and 19-11-2004 at Puri town, Puri district. More than 250 persons including farmers, Block Development Officers, District level officers/ officials have participated in program. Deliberations on ground water development protection and conservation were held among the participants and CGWB scientists.

The exhibition was arranged in which the achievements of CGWB were displayed through different models, plates, photographs and instruments. Different posters were displayed for conservation of ground water, ground water pollution and its effects and slogans protecting this valuable resource. The programme have received high appreciation and were widely covered by press as well as electronic media.

(i) Water Management Training Programme (WMTP) Puri, Puri District:

The program was organised on 17-03-2001 and 18- 11-2004 at Puri town. Deliberation on Ground Water Development Protection and Conservation were held among the participants and CGWB scientists.

An exhibition was organized in which the achievements of CGWB were displayed through different models, plates, photographs and instruments. Different posters were displayed for conservation of ground water, ground water pollution and its effects and slogans protecting this valuable resource. The programme have received high appreciation and were widely covered by press as well as electronic media.

8.0 Areas Notified by CGWA

The stage of groundwater development is well within safe category and there is no overexploitation and major threat of groundwater pollution and depletion. Hence no area has been notified by CGWA.

9.0 Recommendations

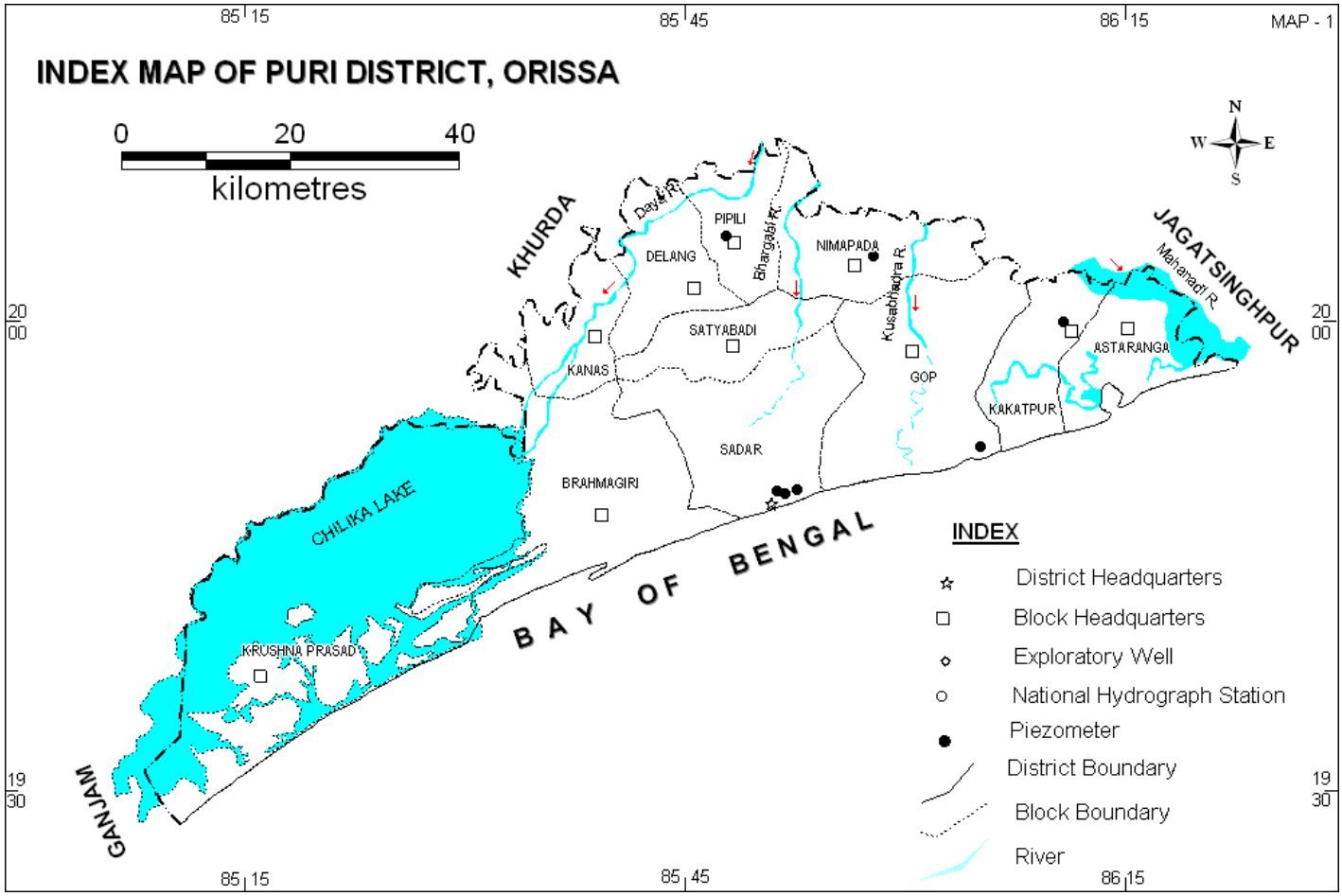
1. Large scale planning for Ground Water Resources development should be preceded by intensive hydrogeological and geophysical survey aided by Remote Sensing studies and ground truth data.
2. As the district is a part of coastal area salinity hazard is prevalent in the area. In Puri district 19480 ha (7.3%) is affected with salinity. In Krushnaprasad block adjacent to Chilika lake and Brahmagiri, Kanas block salinity hazard is acute.
3. Though in most part of the district water level is between 2-4 mbgl but deeper water level of more than 8mbgl is reported in both Pre- and Post-monsoon in Puri urban area. Roof top rain water harvesting can only enhance ground water recharge and check the depleting water table.
4. Renovation of old ancestral structures like ponds/tanks etc. should be renovated which enhances ground water recharge and stores rainwater. Experiments have shown that removal of bottom clay enhances ground water recharge upto 10 times.
5. Though 55 % of the cultivable area of the district is covered with irrigation facilities Krishnaprasad block is having no irrigation facilities yet. Harvesting of rainwater is the only viable alternative by development of minor irrigation facilities.
6. As it is a coastal district the water level is shallow and 15192ha (5.72%) of the area is waterlogged. In 2006, crop of 1606 villages of 232 grampanchayat was submerged. So appropriate drainage clearance measured has to be taken to check waterlogging.
7. Siltation is the main problem Chilika lake is facing and it is calculated to be 1.5 sq. km. per year. Due care must be taken to reduce this load by suitable plantation and watershed development programme in the catchment areas.
8. In Puri district 19480ha (7.3%) is affected with salinity and 15192ha (5.72%) is waterlogged. In 2006, crop of 1606 villages of 232 grampanchayat was submerged (submergence more than 50%) due to flood. Total area affected was 58465 ha which is 22 %of the total area. Total area affected was 58465 ha which is 22 % of the total area.

9. In the islands of the Chilika lake area there is acute salinity problem and shortage of fresh water so rainwater harvesting is the only scope for fresh water.

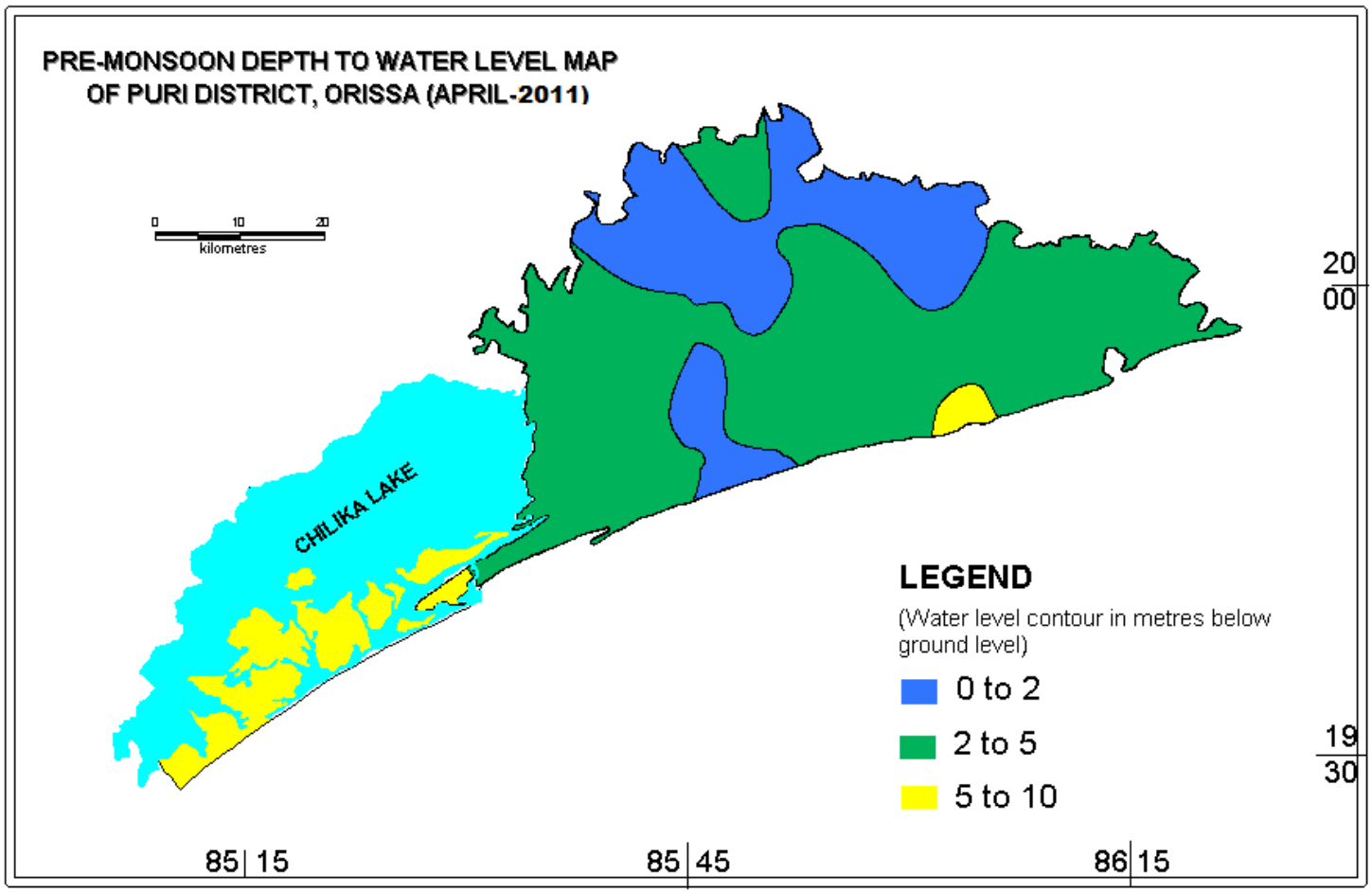
10. In Jagannath Temple area there is decline in ground water table because of overexploitation and decreasing recharge to ground water. So Roof Top Rainwater harvesting is the only alternative. Due to overexploitation of ground water along the Puri coast there are chances of sea water intrusion. Overexploitation of ground water has to be stopped.

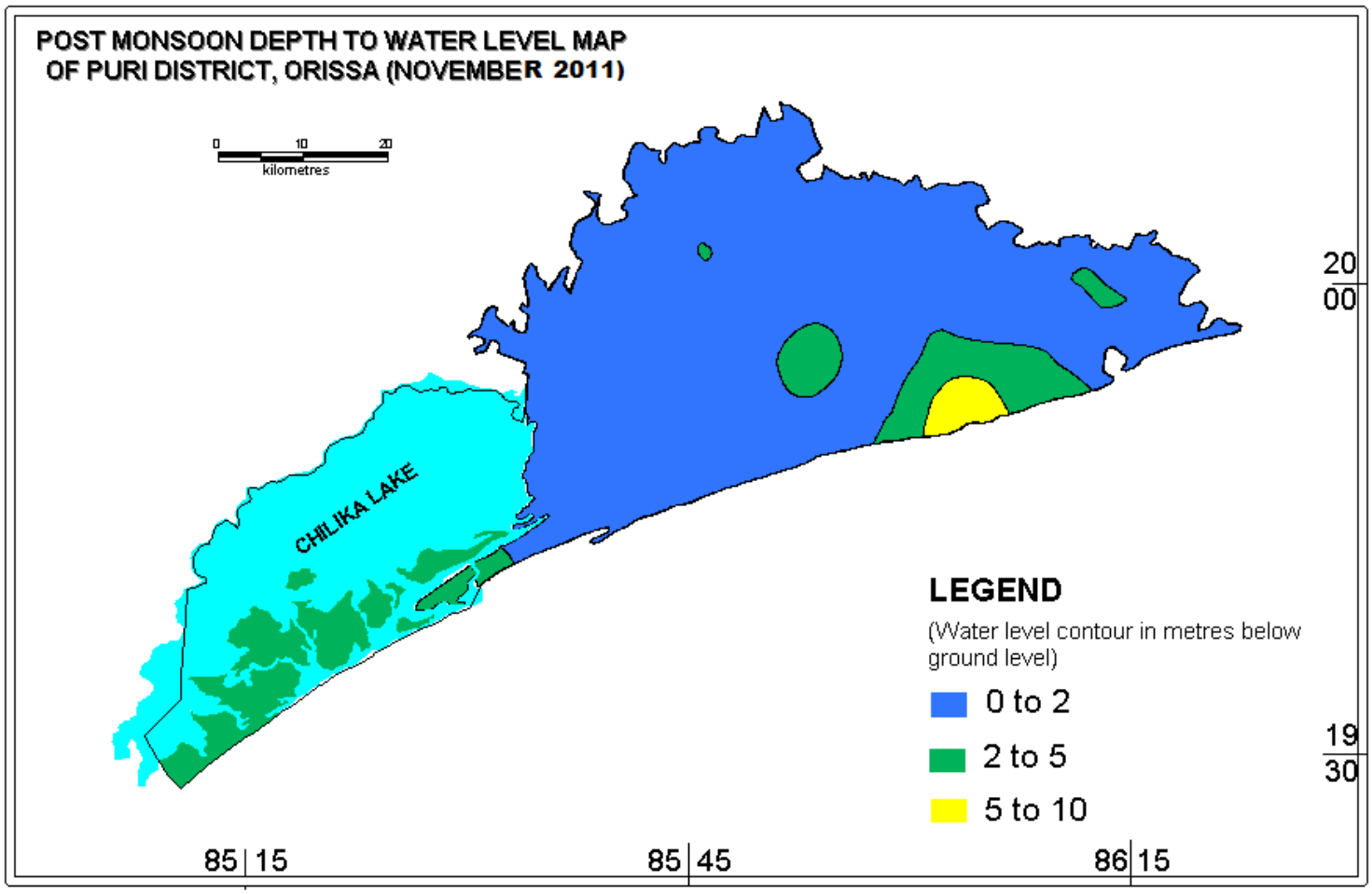
11. The ground water of the area surrounding the famous temple of Sri Jagannath is contaminated with high PO_4^{3-} and NO_3^- . Proper measures has to be taken up to protect the ground water.

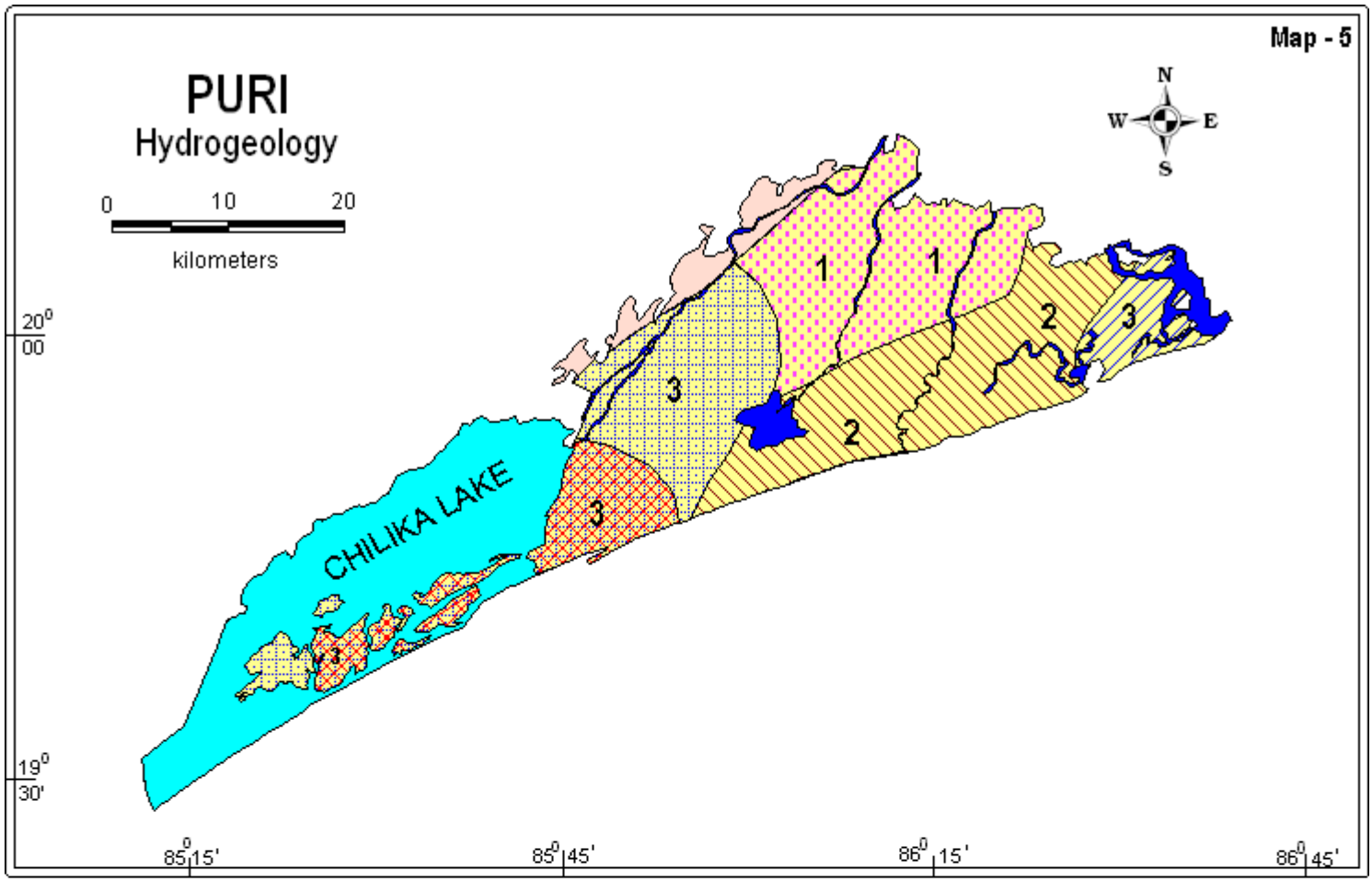
12. The sweet water recharge in Chakratirtha and Baliapanda areas needs to be protected to enhance ground water recharge.


INDEX MAP OF PURI DISTRICT, ORISSA
MAP - 1
85 15
85 45
86 15
20 00
19 30
0 20 40
kilometres
N
W E
S
KHURDA
JAGATSINGHPUR
GANJAM
Daya R.
Bhargabi R.
Kusabhadra R.
Mahanadi R.
PIPILI
DELANG
NIMAPADA
SATYABADI
KANAS
GOP
ASTARANGA
KAKATPUR
SADAR
BRAHMAGIRI
CHILIKA LAKE
KRUSHNA PRASAD
BAY OF BENGAL
INDEX
District Headquarters
Block Headquarters
Exploratory Well
National Hydrograph Station
Piezometer
District Boundary
Block Boundary
River

Map :- 2


PRE-MONSOON DEPTH TO WATER LEVEL MAP
OF PURI DISTRICT, ORISSA (APRIL-2011)
0
10
20
kilometres
CHILIKA LAKE
LEGEND
(Water level contour in metres below ground level)
0 to 2
2 to 5
5 to 10
20 00
19 30
85 15
85 45
86 15

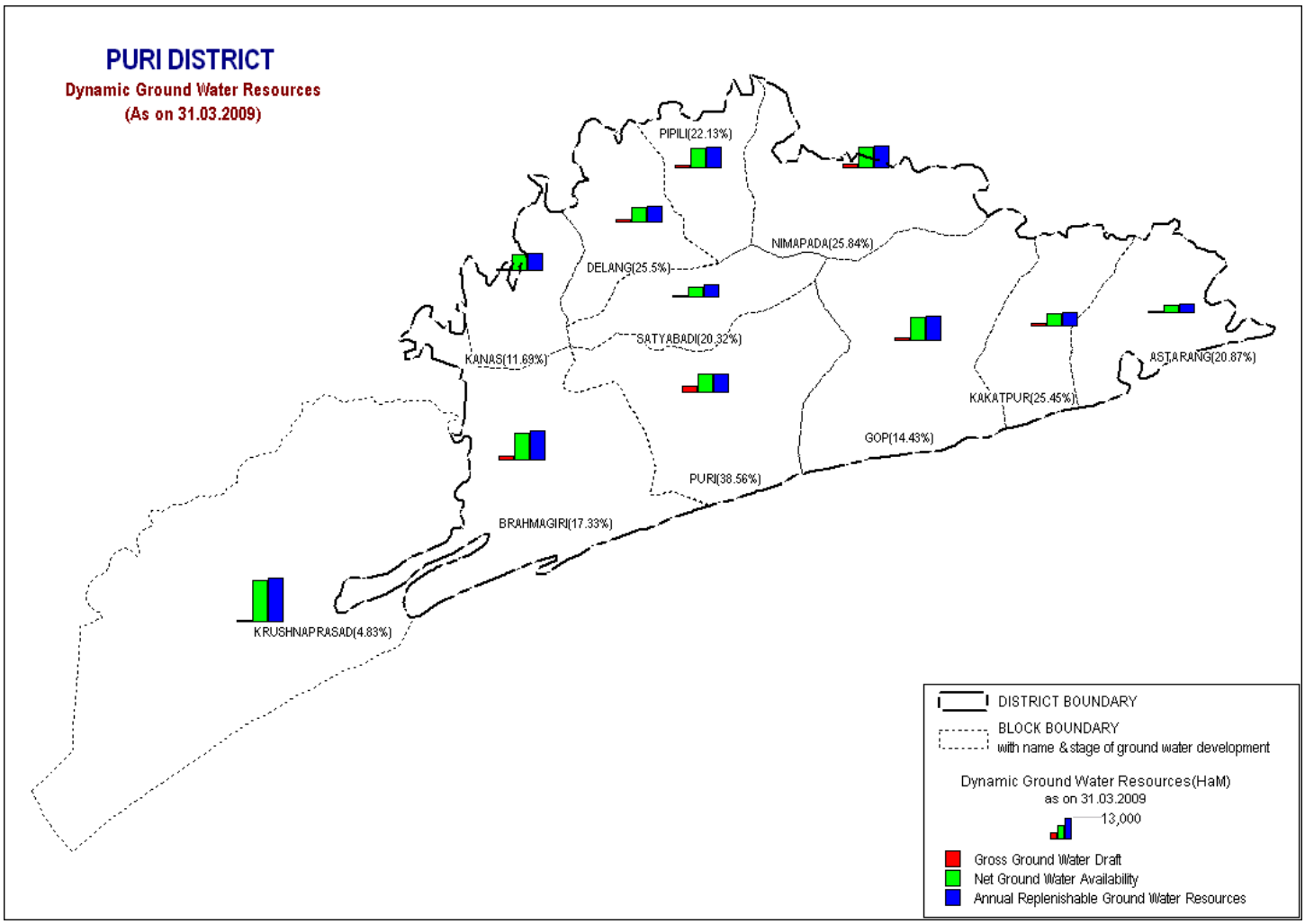

POST MONSOON DEPTH TO WATER LEVEL MAP
OF PURI DISTRICT, ORISSA (NOVEMBER 2011)
0
10
20
kilometres
CHILIKA LAKE
LEGEND
(Water level contour in metres below ground level)
0 to 2
2 to 5
5 to 10
20 00
19 30
85 15
85 45
86 15

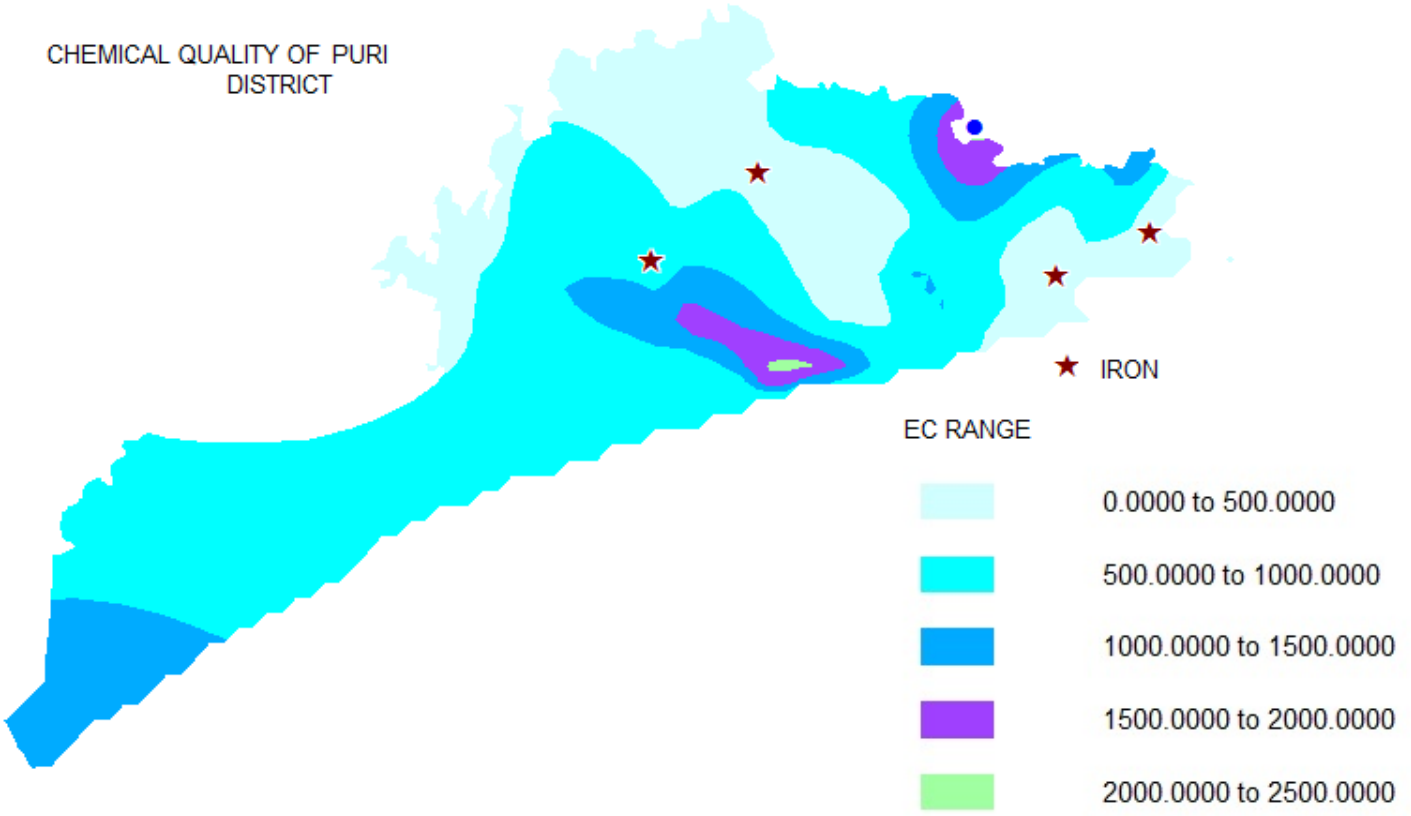


LEGEND

AGE GROUP	LITHOLOGY	HYDROGEOLOGICAL CONDITIONS (POROUS FORMATION)	GROUND WATER POTENTIALS
QUATERNARY UPPER TERTIARY	Recent Alluvium, clay, silt, sand, gravel, pebbles, etc.	Fairly thick, regionally extensive unconfined / confined aquifer down to 300m.	Large yield prospect more than 40 lps — 1
	Older Alluvium and laterite, silt, sand, ferruginous/ calcareous concretion, lithomargic clay.	Moderately thick and regionally extensive confined/unconfined aquifer down to 150m	Moderate yield prospects 15 to 40 lps — 2
			Low yield prospects less than 15 lps — 3

HYDROGEOLOGICAL FEATURES	HYDROCHEMICAL FEATURES
Artesian flow	Area where fresh ground water is overlain by saline ground water
Rivers / Streams/ lakes	Area where saline ground water is overlain by fresh ground water
	Area where ground water is saline at all levels except in local patches.


PURI DISTRICT
Dynamic Ground Water Resources
(As on 31.03.2009)
PIPILI(22.13%)
NIMAPADA(25.84%)
DELANG(25.5%)
SATYABADI(20.32%)
KANAS(11.69%)
ASTARANG(20.87%)
KAKATPUR(25.45%)
GOP(14.43%)
PURI(38.56%)
BRAHMAGIRI(17.33%)
KRUSHNAPRASAD(4.83%)
DISTRICT BOUNDARY
BLOCK BOUNDARY
with name & stage of ground water development
Dynamic Ground Water Resources(HaM)
as on 31.03.2009
13,000
Gross Ground Water Draft
Net Ground Water Availability
Annual Replenishable Ground Water Resources


CHEMICAL QUALITY OF PURI DISTRICT
IRON
EC RANGE
0.0000 to 500.0000
500.0000 to 1000.0000
1000.0000 to 1500.0000
1500.0000 to 2000.0000
2000.0000 to 2500.0000