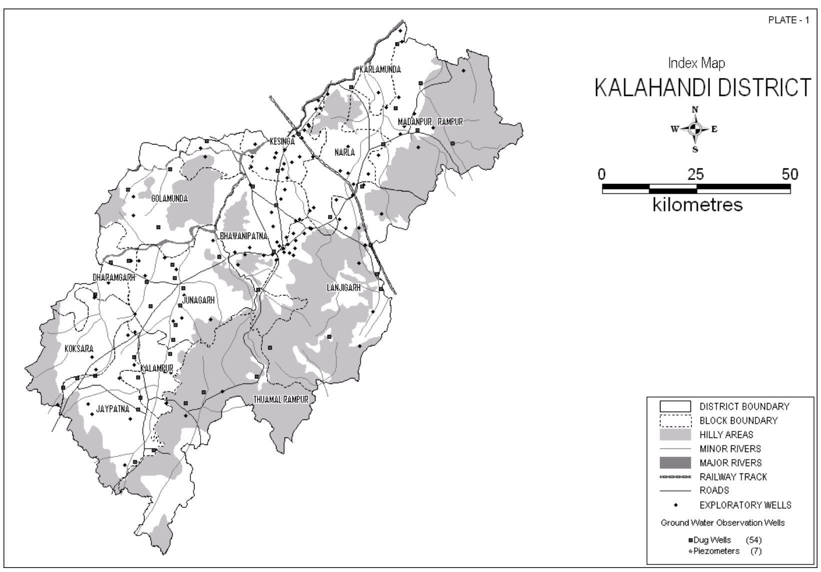
Govt. of India
MINISTRY OF WATER RESOURCES
CENTRAL GROUND WATER BOARD

GROUND WATER INFORMATION BOOKLET

OF

KALAHANDI DISTRICT



SOUTH EASTERN REGION
BHUBANESWAR
MAY, 2013

KALAHANDI DISTRICT AT A GLANCE

Sl No	ITEMS		Statistics
1.	**GENERAL INFORMATION**		
	i.	**Geographical Area (Sq. Km.)**	7920
	ii.	**Administrative Divisions as on 31.03.2011**	
		Number of Tehsil / Block	7 Tehsils, 13 Blocks
		Number of Panchayat / Villages	273 Panchayats 2099- Inhabited Villages, 137-Inhabited Villages,
	iii	**Population (As on 2011 Census)**	13,35,494
	iv	**Average Annual Rainfall (mm)**	1378.2
2.	**GEOMORPHOLOGY**		
		Major physiographic units	Gently undulating terrain, Isolated Mounds & Hills
		Major Drainages	Indra, Udanti, Hatti, Sagada, Jonk
3.	**LAND USE (Sq. Km.)**		
	a)	**Forest Area**	64271
	b)	**Net Sown Area**	290901
	c)	**Cultivable Area**	
4.	**MAJOR SOIL TYPES**		Inceptisols, Alfisols, Vertisols, Histosols, Entisols
5.	**AREA UNDER PRINCIPAL CROPS**		Paddy 265642Ha, Pulses etc. 16892 Ha, Oilseeds 4976 Ha
6.	**IRRIGATION BY DIFFERENT SOURCES (Areas and Number of Structures)**		
	Dugwells, Tube wells / Borewells		28968Ha,
	Major/Medium Irrigation Projects		62,814 Ha (Kharif)27,993 Ha (Rabi)
	Minor Irrigation Projects		21579 Ha (Kharif)3880 Ha (Rabi)
	Minor Irrigation Projects(Lift)		8660 Ha (Kharif)5196 Ha (Rabi)
	Other sources		829Ha
	Net irrigated area		159919 Ha
	Gross irrigated area		188058 Ha
7.	**NUMBERS OF GROUND WATER MONITORING WELLS OF CGWB (As on 31-3-2011)**		
	No of Dugwells		54
	No of Piezometers		4
10.	**PREDOMINANT GEOLOGICAL FORMATIONS**		Granites, Granite Gneiss & its variants, Khondalite,
11.	**HYDROGEOLOGY**		
	Major Water bearing formation **Pre-monsoon Depth to water level during 2011**		1.3 – 9.4 mbgl
	Post-monsoon Depth to water level during 2011		0.84 – 4.47 mbgl
	Long term water level trend in 10 yrs (2001-2011) in m/yr		Pre-monsoon 63.04 % show rising and 36.96% show declining trend. Post-monsoon 63.3% show rising and 36.7 % show declining trend

Sl No	ITEMS	Statistics
12.	**GROUND WATER EXPLORATION BY CGWB (As on 31-03-2011)**	
	No of wells drilled (EW, OW, PZ, SH, Total)	108 EW, 24 OW,
	Depth Range(m)	60.7-200.3
	Discharge(litres per second)	Negligible-18.6
	Storativity(S)	1.3×10^{-4} to 4.3×10^{-4}
	Transmissivity(m^2/day)	4-20
13.	**GROUND WATER QUALITY**	
	Presence of Chemical constituents more than permissible limit(e.g. EC, F, As, Fe)	High iron above the permissible limit is common and sporadic occurrence of fluoride above the permissible limit of 1.5 mg/l is reported.
14.	**DYNAMIC GROUND WATER RESOURCES(2009)**	
	Annual Replenishable Ground Water Resources	74911 Ham
	Net Annual Ground Water Draft	13852 Ham
	Projected Demand for Domestic and Industrial Uses upto 2025	10644 Ham
	Stage of Ground Water Development	18.49%
15.	**AWARENESS AND TRAINING ACTIVITY**	
	Mass Awareness Programmes organized	Nil
	Date	24-08-225
	Place	Bhawanipatna
	No of Participants	350
	Water Management Training Programmes organized	Nil
	Date	25-08-2005
	Place	Bhawanipatna
	No of Participants	100
16.	**EFFORTS OF ARTIFICIAL RECHARGE & RAIN WATER HARVESTING**	
	Projects completed by CGWB(No & Amount spent)	Nil
	Projects under technical guidance of CGWB(Numbers)	Nil
17.	**GROUND WATER CONTROL AND REGULATION**	
	Number of OE Blocks	Nil
	No of Critical Blocks	Nil
	No of Blocks notified	Nil
18.	**MAJOR GROUND WATER PROBLEMS AND ISSUES**	Sporadic fluorosis problem is reported.

1.0 INTRODUCTION

Kalahandi is one of the economically backward district of western Orissa with a geographical area of 7920 Sq. Km and is an integral part of Western Orissa Development Council constituted by Govt. of Orissa very often reels under severe drought condition. About 92.5% percent of the population of the district live in rural areas and agriculture is the main stay of the people. The agriculture is mostly rainfed and due to lack of adequate irrigation facilities and recurring severe drought conditions in the district, the agricultural production is very often curtailed. In the year 1974,1998,1999 the district witnessed an unprecedented drought situation. Kalahandi district lies between North latitudes 19°03’ and 20°45’ and East longitudes 82°18’ and 83°48’, falling in Survey of India toposheet nos. 64 L, 64P, 65 I and 65 M. It is bounded on the north by Balangir and Nuapada districts, on the east by Phulbani district, on the south by Koraput district and on the west by Nawarangpur district of Orissa and Raipur district of Chhattisgarh. The district is well connected by rail and roads. Two National Highways are passing through the district. All the block headquarters are connected by mettalled roads. The district comprises two subdivisions namely Kalahandi and Dharamgarh and 13 community Development blocks with the district headquarters at Bhawanipatna (Plate-I). According to 2001 census data, the total population of the district is 1335494 constituting 3.6% of the total population and 5.09% of land area of Orissa. The rural and urban populations are 1235275 and 100219 respectively. The rural population constitutes 92.5 % of the total population. The density of population is 168against the state figure of 236 persons per sq. km.

The river Tel and its tributaries constitute the main drainage system in the district. Some important rivers like Indravati, Nagavalli and Vansadhara owe their origin to the hill ranges in the southeastern parts of the district. The hilly streams are perennial in nature and many of the tributaries are ephemeral in nature. The drainage pattern of the district is of dendritic, radial and centripetal types. The drainage is effluent in nature. The river Tel, a major tributary of river Mahanadi, originates in the Nawarangpur highlands and enters the district near Dharamgarh. Udanti, Indra, Sagada, Ret, Hatti and Uttei are important tributaries of river Tel. These streams are ephemeral in nature.

The Upper Indravati and Uttei are the main irrigation projects providing irrigation facilities in the district. There are 109 operational Minor Irrigation Projects (Flow), 364 government Lift Irrigation Projects and 174 private Lift Irrigation Projects in the district. Ground water contributes about 24 % during *kharif* and 44% during *rabi* of the total irrigation potential created so far for the two crop seasons respectively in the district. However there is a vast scope of creating additional irrigation potential through ground water in the district, as most part of the ground water resource remains unutilized. As per available data total irrigation potential created from all sources aggregates to 122021 Ha during *Kharif* and 66037 Ha during *rabi* season in the district. Agriculture in the rest part of the cultivable area in the district remains rain fed and unstable.

The entire Kalahandi district has been geologically mapped by the Geological Survey of India and C.G.W.B on 1: 50,000 scale. Hydrogeological surveys have been conducted in different parts of the district by S / Shri. B.B.Basak (1975-76, 1977-78, 1978-79, 1979-80, 1980-81) , S. C. Behera (1987-89), G.C. Pati (1992-93) , A.D. Rao (1986-87) and R.K Nayak, S. Brahma (2005-06) of CGWB, SER on 1:50,000 scale. Under Rajiv Gandhi Technology Mission Programme on drinking water supply in problematic villages of the district, the officers of C.G.W.B were engaged in selection of suitable sites with consultation of state authorities, Orissa Govt., for provision of safe drinking water to the people by sinking borewells and installation of I.M-II Pump.

Ground water exploration by deep drilling upto 200m has been taken up in the district and 100 nos. exploratory wells so far has been drilled to delineate the deeper potential water saturated fracture zones. The location of the wells are depicted in Plate –I Ground water monitoring is being done through 54 National 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 1378.2mm. About 80 to 85% of the total rainfall is received during the period from June-September. Droughts are quite common in the district. Block-wise average annual rainfall varies from 1111.8 mm to 2712.9 mm.

The climate of the district is sub-tropical 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. Humidity is high during middle of June and it's less in post-monsoon period. The average relative humidity in the district varies from 27% to 80% through out the year. The mean monthly potential evapo-transpiration value ranges from 45mm in December to 470 mm in May. Wind is generally light to moderate. During summer and Southwest monsoon months wind velocity increases. The mean annual wind speed is 3.0 km/hr.

3.0 GEOMORPHOLOGY & SOIL TYPES

Physiographically the district comprises diverse landforms consisting of rugged hill ranges, plateaus, undulating plains dotted with residual hills and mounds and fertile erosional plains and valleys. A gently undulating terrain with a vast stretch of cultivable land characterizes the major parts west of Bhawanipatna in the district. The elevation of the hills located in the southeastern and southern parts ranges from 953 to 1229 m above mean sea level. In Arupani – Koksara – Junagarh tract the elevation of land surface varies from 220 m to 325 m above MSL. In Bhawanipatna – Utkela – Kesinga tract the elevation of land surface ranges from 186 m to 350 m above MSL. In the undulating plains the general topographic slope is towards northeast.

The distribution of different soil types in the district depends much on its physiographic and lithologic variations. Based on the physical and chemical characteristics, mode of origin and occurrence, soils of the district may be classified into three groups namely Inceptisols, Alfisols, Vertisols, Histosols and Entisols. The detail description is given below:

1 Inceptisols:

Red soils are the most predominant soil type in Kalahandi district covering about 45 % of the total area. These soils occur in foothills terrain and as capping over the hillocks. These soils are poor in nitrogen, phosphate, potassium and organic matters. These soils are light textured and the pH ranges from 4.5 to 6.0.

2. Alfisols:

The Alfisols include red sandy soils, red loamy soils mixed red and black soils. These soils cover about 27 % of the total area of the district and occur at lower elevations with undulating topography. These soils are neutral to slightly alkaline in nature (pH varies from 5.5 to 8.5). The characteristic features of red soils are (i) light texture, porous and friable structure, (ii) absence of lime kankar and free carbonates and (iii) soluble salts in small quantity usually not exceeding 0.05%. These are usually deficient in nitrogen, phosphate, organic matter and lime. These soils are suitable for cultivation of paddy and other crops.

3. Histosols:

Black soil is an important soil type in the district occupying parts of Bhawanipatna, Narla, Kesinga, Dharamgarh, Golamunda and Koksara blocks. These soils are rich in potassium and nitrogen but poor in phosphorus. These soils are most favourable for cotton cultivation which is a generally draught resistant, labour intensive but a highly remunerative crop.

4. Vertisols :

These are medium black soils found around the course of Tel river and its tributaries. These soils are highly argillaceous and contain high amount of iron, calcium and magnesium. These are usually poor in nitrogen, phosphate and organic matter but rich in potash and lime. The pH varies from neutral to alkaline and texture varies from loam to clay loam. These are quite fertile soils and suitable for paddy cultivation.

5. Entisols:

These consist of alluvial soil occupying the flood plains of major rivers and streams in the district. These are deficient in nitrogen, phosphoric acid and lumbers but not in potash and lime. These soils are alkaline in nature and fertile.

4.0 GROUNDWATER SCENARIO

4.1 Hydrogeology

The hydrogeological framework of the district is mainly controlled by the geological set up, rainfall distribution and the degree of secondary and primary porosities in the geological formations for storage and movement of ground water. Since major parts of the district are underlain by hard rocks of diverse lithological composition and structure, the water bearing properties of the formations also vary to a great extent. The area has undergone several phases of intense tectonic deformations which has been responsible for the development of deep seated intersecting fracture system. Hydrogeological surveys in the district reveals the lithological characteristics and the role of tectonic deformation on the occurrence and distribution of ground water reservoirs and their water bearing and water yielding properties. Lineaments formed due to tensile deformation were picked up from remote sensing studies. The structural elements mainly control the occurrence and movement of groundwater in the typical fractured crystalline basement terrain. The major hydrogeologic units in the district can be subdivided into two broad groups.

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

(ii) Areas underlain by recent unconsolidated alluvial formations.

Water bearing properties of the Consolidated formations :

The crystalline rocks like granite gneisses, khondalites, charnockites, quartzites, which are devoid of primary porosity, occupy about 95% of the area of the district. The weathered residuum and jointed & fractured portion of these consolidated rocks constitute principal water bearing horizons. The thickness of the weathered zone is generally more in the topographic lows and undulating plains than in the high land areas. Ground water occurs under phreatic condition in the weathered zone and in semi-confined to confined condition in deeper fractured zones. The water yielding capacity of fractured rocks largely depends on the extent of fracturing openness and size of fracture and nature of their interconnections. Usually two to four water bearing fractures occur down to a depth of 100m below ground level. Potential fracture zone is encountered even at depth of 194 m at Dadpur (Block-Narla).

Granites and Granite Gneisses: These are the most predominant rock types in the district occupying undulating terrain and topographic lows. On weathering these rocks yield sandy residuum and the intensity of weathering is controlled by the presence of open joints and foliations. Joints and fractures are well-connected creating free circulation of ground water. In general these rocks can sustain yield between 3 and 18.6 lps depending on topographic setting, thickness of weathered residuum, number of saturated fracture zones encountered and their interconnection as inferred from the ground water exploration carried out by CGWB in the district. The weathered zones in the granite gneisses can be developed through open wells and bore wells..

Khondalites : The Khondalites, in general occupy the hills and have limited ground water development potentials except when they occupy low laying areas. Due to well-foliated nature of these rocks, weathering is quite deep in low laying areas. These rocks are also well jointed. The thickness of the weathered zone ranges from 12 to 20 m. Ground water development potential of these rocks is meager except in low laying areas. The yield of the bore wells ranges from 1 to 4 lps as revealed by the ground water exploration carried out by CGWB in the district.

Charnockite: In these rocks weathering is not pronounced and foliations and joints are not well developed. These rocks are mostly hard, compact and massive. The thickness of weathered zone ranges from 6 to 10 m. Due to hard and compact nature of the rocks ground water development prospects in the charnockite is not good and the yield from the bore wells is very poor.

Pegmatite and Quartz veins: These are coarse grained and hard. These form good aquifers when fractured and friable.

Khondalites : These rocks generally form steep linear ridges hence don't form potential aquifers. Well foliated nature of these rocks allows deep weathering. In the pediment areas, the thickness of weathering is varying from 5 to 32m. Ground water occurs under water table condition in the weathered zone and circulates through deeper fractures. The yield of bore wells range from 1 to 5 LPS. The specific capacity of the dug wells ranges from 2.3 to 13.3 LPM/m draw down.

Charnockite : These formations are of very much restricted occurrences in the district. Due to paucity of joints and fractures the thickness of weathering in these formations is limited up to 10m. Due to the compact nature and less weathering, ground water prospects in charnockites are not good.

Gabbro – Anorthosites : The rheologic property of these rocks resembles with charnockite, Barring few locations dismal weathering and lack of fracturing renders these formation as a bad water yielder. The Sp. Capacity of dug wells in anorthosite vary from 16 to 102 LPM/M drawdown.

Quartzites : This unit also less fractured and weathered hence do not form good aquifers. However fractured quartzites along lineaments yield good amount of water.

Pegmatite and quartz vein : These are course grained intrusives and form good aquifers when fractured.

Water bearing properties of the unconsolidated Formation:

Laterites belonging to the Pleistocene age and alluvium of Sub-recent to Recent age constitute the unconsolidated formations in the district.

Laterites and lateritic gravels: Laterites of both high and low level environments occur extensively in the district forming capping over the older formations. Laterites occurring as capping over older formations are vesicular, ferruginous and highly porous in nature and at places form good near surface aquifers to be tapped through dug wells. Ground water generally occurs under phreatic condition in the shallow zone.

Alluvial deposits: The alluvial sediments of recent origin occur as thin discontinuous patches along the prominent drainage channels and form prolific aquifers under favourable conditions. Of particular interest are the alluvial deposits occurring as discontinuous patches in the flood plains of major rivers such as Tel, Udanti, Ret and the alluvial fan deposits in Indravati, Nagavalli and Vansadhara sub basins. The thickness of alluvial deposits varies from 10 to 30 m in the Indravati and Tel sub basins. These mainly consist of silt, sand with gravel and clay and form potential shallow aquifers. Ground water occurs under phreatic condition and the water table flies at shallow depths. These deposits are very suitable for ground water development through dug wells and shallow tube wells. Yield of tube wells in the alluvium varies from 5 to 10 lps for drawdown ranging from 5 to 8 m.

Aquifer Characteristics of Crystalline: In the hard crystalline rock recharge of ground water from precipitation or seepage from surface water bodies percolate into the weathered (saprolite) zone. In case the underlying basement rocks (both weathered and fresh) are incised by open fractures, the downward movement of the water from the upper regolith zone (comprising the top soil and saprolite horizon) is facilitated. In the saprolite/ regolith horizon ground water generally occurs under unconfined condition where as is the fractured bedrock aquifers it occurs under semi-confined to confined conditions. The ground water potentials of various zones i.e. saprolite (tapped by dug wells), weathered basement rock and shallow fractured basement rock horizon (tapped by the hand pumps) and deeper fractured basement rock (tapped by the deep boreholes by CGWB) vary considerably depending upon their lithological and structural characteristics.

Groundwater Exploration

Exploratory drilling has been taken up by the Central Ground Water Board in Bolangir district with the objective to delineate deeper water bearing fractures in the consolidated formation and their yield potentiality within a maximum depth of 200.3m. Till March 2011, 108 exploratory and 24 observation wells were drilled in hard crystalline and semi-consolidated formations in the district under Normal Ground Water Exploration Programme and Accelerated Exploration Drilling Programme. The depth range of these wells varies from 69.1m to 200.3m below ground level. The thickness of the overburden ranges from 4.15 to 39 m. The yield of exploratory wells vary from negligible to 18.6 LPS. A number of bore wells constructed in Kalahandi district within a depth of 200m mainly sustain yield of the order of 3 to 18.6 liters per second for drawdowns of the order of 8 to 35m. Nearly 35% of the bore wells yield less than 3 lps with high drawdowns. There are about five potential fractured zones, which have been tapped in the bore wells within a depth of about 170m below ground level. Transmissivity values range from 4 to $20m^2$/day and storativity ranges from 1.3 $x10^{-4}$ to 4.3x 10^{-4}.

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

The depth to water level is measured from the National Hydrograph Stations situated in different blocks of the Kalahandi District. The Pre monsoon, 2011 water level data varies from 1.3 mbgl (Ranmalchak) to 9.4 mbgl(Dalguma). 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 0.84 mbgl (Ranmalchak) to 4.47 mbgl (Kesinga). Plate III represents depth to water level map of post –monsoon, 2011.

Seasonal Fluctuation

A study of the map reveals that in the major parts of the district fluctuation of the water table is in the range of 2m to 4m.The fluctuation ranges from 0.22- 6m. The seasonal fluctuation of ground water level is more than 4 meters in the northeastern hilly areas of the district (parts of Rampur Madanpur and Narla blocks). But valley and canal command areas show water level fluctuation within 2 meters.

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

The long term trend (10 years) in water level for the pre-monsoon shows rise in 63% of wells the maximum being 0.633 m/Yr. The average rise in the stations showing water level rise during the decade is 0.219 m/yr. The present rising trend is mainly due to the introduction of canal irrigation in Kalampur, Junagarh and Dharamgarh blocks.

The long term trend of (10 years) in water level for post-monsoon season shows rise in water 63% of wells and falling trend in rest 37% wells in the district. The maximum rise recorded is 0.495 m/yr with the majority of the values being less than 0.10 m/yr. The maximum fall is around 0.429m/yr with the majority of the values being less than 0.1m/yr.

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 4.3. The Annual replenishable ground water resources in the district are computed as 74911Ham, out of which the existing Ground Water Draft for irrigation is 9618 Ham. The ground water draft for irrigation is through dug wells and tube wells. A large number of hand pumps fitted in PHED bore wells and tube wells also cater to the rural and urban water supply needs. On the basis of the estimated ground water potentials a detailed scheme for ground water development may be launched in the district. So far ground water development in the district has been meager, and all the blocks fall under the safe category. The stage of ground water development varies from 9.53 % (Th. Rampur) to 29.64% (Narla). The overall Stage of Groundwater development of the district is 18.49 %. 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 : STAGE OF GROUND WATER DEVELOPMENT OF ORISSA, BLOCKWISE AS ON 31ST MARCH, 2009

(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 (11+12)	Allocation for domestic and industrial requirement supply upto next 25 years	Net Ground Water availability for future irrigation Development (10-11-14)	Stage of Ground Water Develeopment {(13/10)*100}%
1	2	10	11	12	13	14	15	16
1	Bhawanipatna	6412	1358	529.00	1887	1204	3850	29.43
2	Dharmagarh	5355	647	356.34	1003	809	3899	18.73
3	Golmunda	6208	1020	306.00	1326	702	4486	21.36
4	Jaipatna	4761	324	339.00	663	762	3675	13.93
5	Junagarh	9686	882	479.25	1360	1076	7729	14.04
6	Kalampur	3044	444	167.91	611	346	2254	20.07
7	Karlamunda	4965	359	152.97	512	321	4285	10.31
8	Kesinga	5365	1231	343.00	1574	752	3382	29.34
9	Koksara	8691	838	342.67	1181	727	7126	13.59
10	Lanjigarh	5481	588	215.00	803	488	4405	14.65
11	M.Rampur	3910	618	297.63	916	1834	1457	23.43
12	Narla	4797	998	424.00	1422	964	2835	29.64
13	Th.Rampur	6236	311	283.00	594	659	5266	9.53
	District Total	74911	9618	4236.00	13852	10644	54649	18.49

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 as follows:

Table 4.2 Range of Chemical Constituents in shallow Aquifers

SL. No.	Parameters	Range	
		Shallow aquifer	Deeper aquifer
1	pH	7.32 – 9.07	6.8-8.28
2	Electrical conductivity (In µs/cm at 25^0C)	110 – 4805	255-1856
3	Carbonate (CO_3) (in mg/l)	Nil - 42	0-42
4	Bicarbonate (HCO_3)(in mg/l)	37 – 787	93-628
5	Chloride (CL) (in mg/l)	7.1 – 1304	7.1-283
6	Sulphate (SO_4)(in mg/l)	Nil – 625	0.5-153
7	Nitrate (NO_3)(in mg/l)	Nil – 492	0.3-300
8	Fluoride (F) (in mg/l)	0.26 – 4.0	0.2-5.3
9	Total Hardness as $CaCO_3$ (TH) (in mg/l)	40 – 2130	70-720
10	Calcium (Ca)(in mg/l)	8 – 216	12-194
11	Magnesium (Mg)(in mg/l)	2.4 – 399	1.2-88
12	Sodium (Na)(in mg/l)	4.1 – 432	12-186
13	Potassium (K)(in mg/l)	0.59 – 39	<1-37

SL. No.	Parameters	Range	
		Shallow aquifer	Deeper aquifer
14	Total dissolved solids (TDS) (in mg/l)	66 - 976	204-1095
15	Fe(mg/l)		<0.01-5.8
16	SiO_2(mg/l)		17-79

The specific conductance and chloride values generated from the chemical analysis of the region are found to be comparatively higher in the Badabasul – Daspur – Narla – Pastikudi. In localized patches of shallow aquifer at Moter, Ranmal, Ladugaon, Baldiamal, Badabasul, Chilpa, Golamunda, Tundia, Santpur, and in deeper aquifer at Nunpur,Madanpur, Ranmal concentration of fluoride is above 1.5 mg/l otherwise everywhere it is below the permissible limit. The chemical analysis data suggests that the quality of ground water both from shallow and deeper aquifers are well within the permissible limit of utilisation for drinking purposes expect in the pockets of high fluoride**.** The suitability of ground water for irrigation in shallow aquifer 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	
		Shallow aquifer	Shallow aquifer (%)
C_1S_1	Good	5	27.8%
C_1S_2	Moderately Good		
C_1S_3	Unsuitable		
C_1S_4	Highly Unsuitable		
C_2S_1	Good	11	61.1
C_2S_2	Moderately Good		
C_2S_3	Unsuitable		
C_3S_1	Moderately Good	2	11.1

It may be noted that about 100% of the groundwater samples collected from the phreatic and deeper aquifers are good for irrigation purposes.

4.4 Status of Ground Water Development

Ground water development in the district is mainly through dug wells, Dug-cum-bore wells and bore 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 14.25% of its resources has been exploited. Hence a strategy for detailed ground water development is required. 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).

Dugwells : The wells may be sited in the topographic lows and should tap the maximum saturated thickness of the weathered zone. The depth of the dugwells may vary from 9 to 15m with 4.5m to 6m diameter. The wells may be fitted with 1.5 to 2 H.P. centrifugal pumps. The wells may sustain yield maximum up to 2 to 3 lps.

Dug-cum-borewells: The dug cum bore well can be constructed in the areas where the thickness of weathered residuum is less than 15 meters deep. The vertical hole drilled in the dug well increases the yield of the well. Depth of the dug well should be up to 12 metres with diameter of 4.5 to 6 metres. The depth of the vertical borehole should be about 25 to 30 metres. The diameter of the borehole may be 102 or 152 mm.

This dug cum bore well should be facilitated by centrifugal pump or submersible pump, where necessary, for the optimal utilization of their potential. The tentative number of additional dug wells feasible includes the dug cum bore wells, which can be constructed at suitable locations.

Borewells The results of the recent surveys and ground water exploration are quite encouraging for the exploitation of ground water through bore wells in different parts of the district, constructed at suitable locales. Deeper water bearing fracture zones may be tapped through bore wells. Usually two to five water saturated fractured zones are encountered in a depth range of about 150 m and the fractured zones are more common within a depth of about 100m. The bore wells are suitable ground water abstraction structures even in the areas where water level is deeper and hard rocks are encountered at shallow depths. The bore wells may be 100 to 150 m deep having casing in the top weathered zone with diameter of about 152 to 203 mm. Based on the availability of productive fractured zones, the depth of the bore well is decided. Depending upon the discharge and draw down of the bore wells, suitable pumps may be fitted for the optimum utilization of ground water resources. The recommended capacity is 2 to 3 H.P. submersible pumps and the yield of the wells may go up to 10 lps.

Since the surface water resources are inadequate and the district often comes under the grip of drought, development of ground water resources may help in expanding irrigated agriculture in the district. An optimal utilisation of ground water in the district requires adoption of a suitable cropping pattern and energisation of the wells.

5.0 Ground Water Management Strategy

5.1 Ground Water Development

The Ground Water Development of the entire Kalahandi 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

Kalahandi district is mostly traversed by Precambrian consolidated formations. The deeper water level of the order of 5-10 mbgl is observed in the northern part of Kalahandi district such as Badbasul, Dharamgarh, Jurakhaman, Kesinga, Thuamalrampur etc. At Dalguma, Gopalpur, Kesinga, Mukhiguda, Thuamalrampur the water level is deeper than 5mbgl. The data of water level of 10 years shows fall in the Golamunda, Junagarh, Koksara, Lanjigarh, Narla blocks during Post monsoon period. This is mainly due to prevailing topographic conditions and water table gradient, which facilitates flow of ground water through nalas and rivers and streams as base flows. To arrest the rapid decline of water table in these areas special studies may be taken up to pin point the areas where water scarcity problems are more pronounced during post monsoon and premonsoon period. In these pockets suitable sites are required to be pin pointed to adopt artificial recharge techniques and rain water harvesting methods based on site specific conditions. This artificial recharge will also help in increase in storage and also in improving the quality of water etc. The most feasible artificial recharge and rain water harvesting structures are percolation tanks, nala/contour bunding, small check dams/weirs, renovation of old tanks to percolation tanks, subsurface dykes, water spreading, gully plugging, gabion structures etc.

6.0 Ground Water related issues & Problems

Ground Water Problems: The ground water problems include Ground Water Pollution and Ground Water Depletion.

Ground Water Pollution: Based on the chemical analyses of water samples collected from different aquifers, it is observed that almost all chemical constituents are well with in the permissible limit for drinking as well as irrigational purposes, excepting at some localized patches where high fluoride and nitrate values have been observed. As such there is no ground water pollution in the district.

Ground Water Depletion: The stage of ground water development in different blocks varies from 5.83 % (Thuamal Rampur) to 29.17 % (Kesinga) with the overall stage of development 14.25% in the district. From the perusal of 10 years of data it has been realized that there is a falling trend in 46.4% of water level measuring wells within the range of 0-2 m during pre monsoon and 13.5% of wells shows fall during post monsoon within range of 0-2 m. Khaprakhol, Muribahal, Patnagarh, Puintala, Saintala blocks show major fall during premonsoon period . Agalpur and Puintala blocks shows major fall during postmonsoon. The long term trend (10 years) in water level for the pre-monsoon shows rise in 63% of wells the maximum being 0.633 m/Yr. The average rise in the stations showing water level rise during the decade is 0.219 m/yr. The present rising trend is mainly due to the introduction of canal irrigation in Kalampur, Junagarh and Dharamgarh blocks.

The long term trend of (10 years) in water level for both post- monsoon and pre-monsoon season shows fall in water level 37% of wells . The maximum fall in pre-monsoon is 0.633 m/yr. The maximum fall in post-monsoon is around 0.429m/yr with the majority of the values being less than 0.1m/yr.

7.0 Awareness & Training Activity

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

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

The program was organized on 24-08-2005 at Bhawanipatna town, Kalahandi district. More than 350 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.

(ii)Water Management Training Programme (WMTP), Kalahandi District:

The program was organised on 25-08-05 at Bhawanipatna town, Kalahandi District. More than 100 Block Development Officers, District Level Officers, NGO's have participated in the program. 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. Bore wells/dug wells should be located in the vicinity of NE-SW and NW-SE trending lineaments which have been proved to be high yielding & productive and in thickly buried pediment areas.

3. Existing dug wells should be deepened to tap the maximum saturated thickness of the weathered mantle or vertical bores maybe drilled to enhance the yield of the well where normally the dug wells get dried up.

4. Energisation of wells should be stepped up to ensure optimal utilisation of the ground water resources to create additional irrigation potential.

5. The State Ground Water Organization should render expert guidance for citing ground water structures in favourable hydrogeological settings.

6. The farmers should be educated through agricultural extension services, Mass Awareness and water management training programme to adopt suitable cropping pattern, conservation of ground water and irrigation practices especially for drought tolerant crops for optimal utilisation of available ground water resources.

7. Programme for artificial recharge may also be taken up in areas where deeper water table condition coupled with high fluctuation is observed for augmentation of ground water resources through construction of percolation tanks, subsurface dykes, check dams, nala bunding and contour bunding and other site specific favourable artificial recharge structures.

8. In areas of shallow water table lying with in 0 to 5 m bgl during post monsoon period, surface water bodies like local ponds, farm ponds and small earthen dam along small streams may be constructed to hold water for long duration and for replenishment of soil moisture.

9. For augmentation of drinking water supply to the major towns and villages near the major rivers, infiltration galleries or collector wells may be constructed in suitable locales to fruitfully harness the base flow /subsurface flow which otherwise goes as waste.

10. Growing of sugarcane and cash crops may be encouraged along the thin linear alluvial patches lying adjacent to major rivers where prolific ground water is available throughout the year.

11. In the canal command areas of Indravati and Uttai irrigation projects in the district, there are conditions of steady rising trend of water level, which may lead to water logging in near future at some places. Simultaneously there is scarcity of supplied irrigation water in the tail end areas. These situations can be rectified through conjunctive use of surface water and ground water, which shall also augment irrigation potentials and ensure agriculture in periods of delayed rainfall.

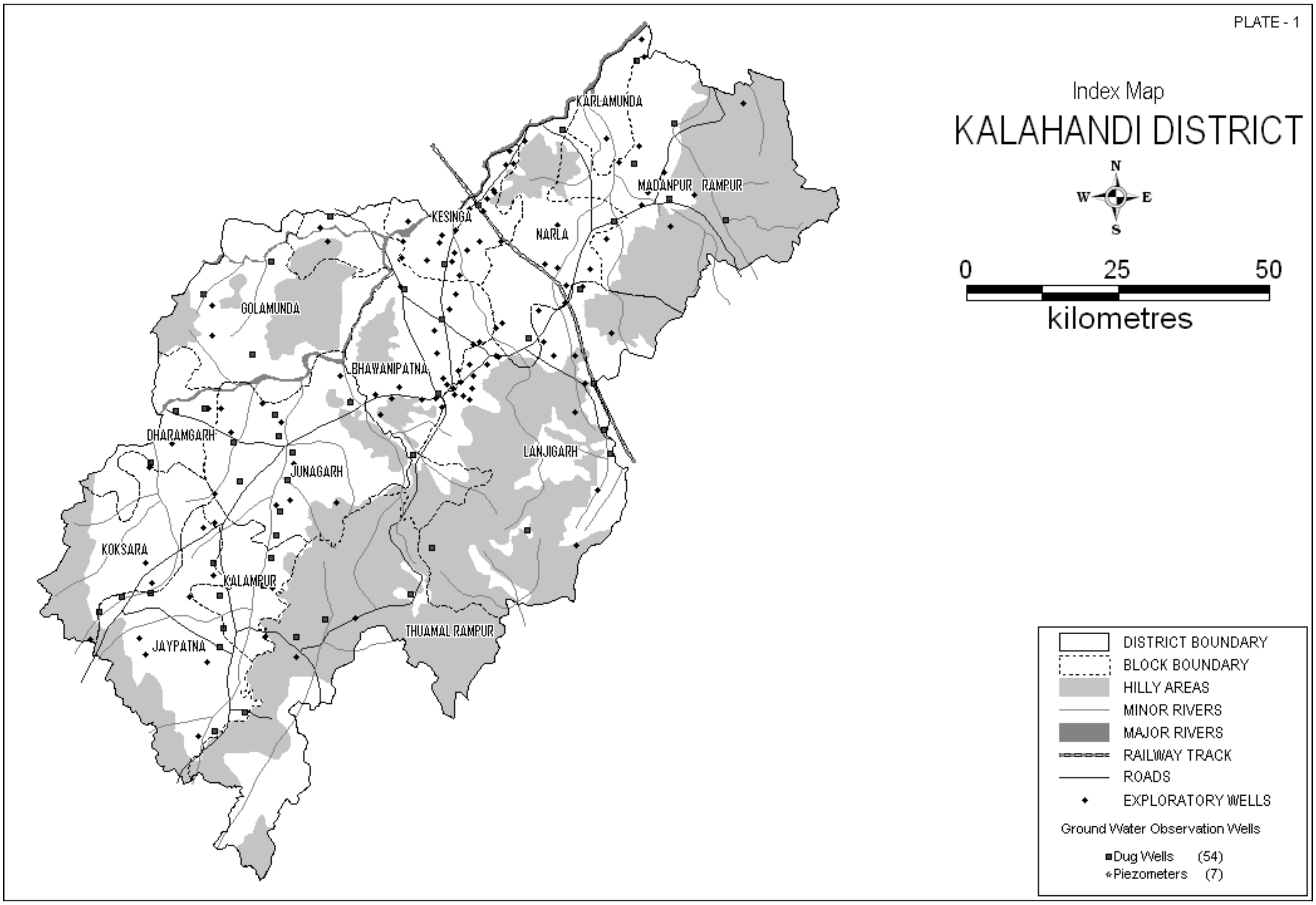
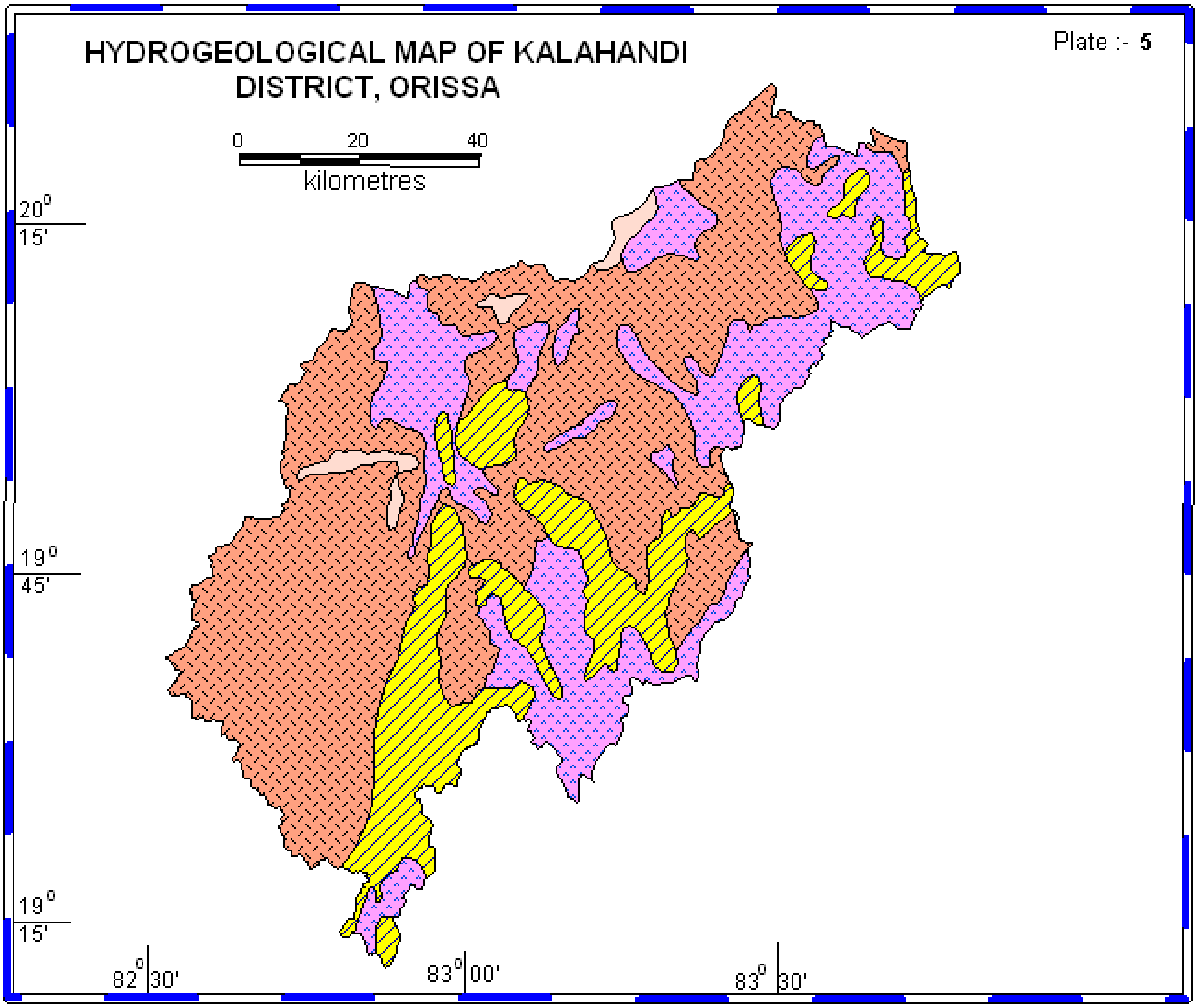


PLATE - 1
Index Map
KALAHANDI DISTRICT
N
W
E
S
0
25
50
kilometres
KARLAMUNDA
MADANPUR RAMPUR
KESINGA
NARLA
GOLAMUNDA
BHAWANIPATNA
DHARAMGARH
JUNAGARH
LANJIGARH
KOKSARA
KALAMPUR
JAYPATNA
THUAMAL RAMPUR
DISTRICT BOUNDARY
BLOCK BOUNDARY
HILLY AREAS
MINOR RIVERS
MAJOR RIVERS
RAILWAY TRACK
ROADS
EXPLORATORY WELLS
Ground Water Observation Wells
Dug Wells (54)
Piezometers (7)

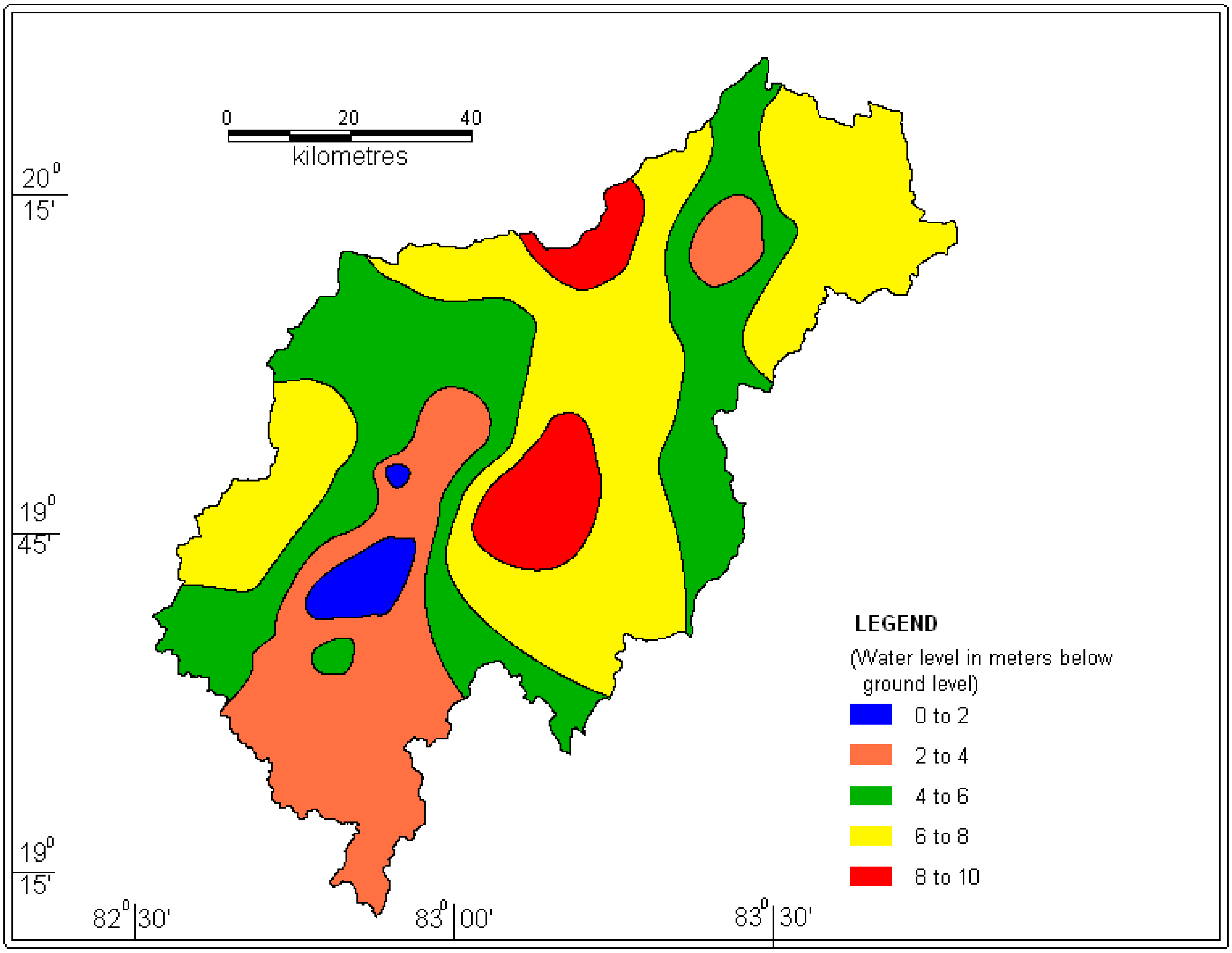


LEGEND

AGE GROUP		LITHOLOGY	HYDROGEOLOGICAL CONDITIONS	GROUND WATER POTENTIAL
			POROUS FORMATIONS	
UNCONSOLIDATED FORMATIONS	QUATERNARY	RECENT ALLUVIUM, LATERITES & LATERITIC GRAVELS	THIN DISCONTINUOUS PATCHES FORMING SHALLOW AQUIFERS	LIMITED TO MODERATE YIELD PROSPECTS BELOW 20m^3/Hr.
			FISSURED FORMATION	
CONSOLIDATED FORMATIONS	ARCHEAN	GRANITE & ITS VARIANTS	GROUND WATER RESTRICTED TO RESIDUUM AND FRACTURE ZONE HAVING SECONDARY POROSITY	LIMITED TO MODERATE YIELD PROSPECTS BELOW 30 m^3/ Hr.
		CHARNOCKITES		
		KHONDALITES		

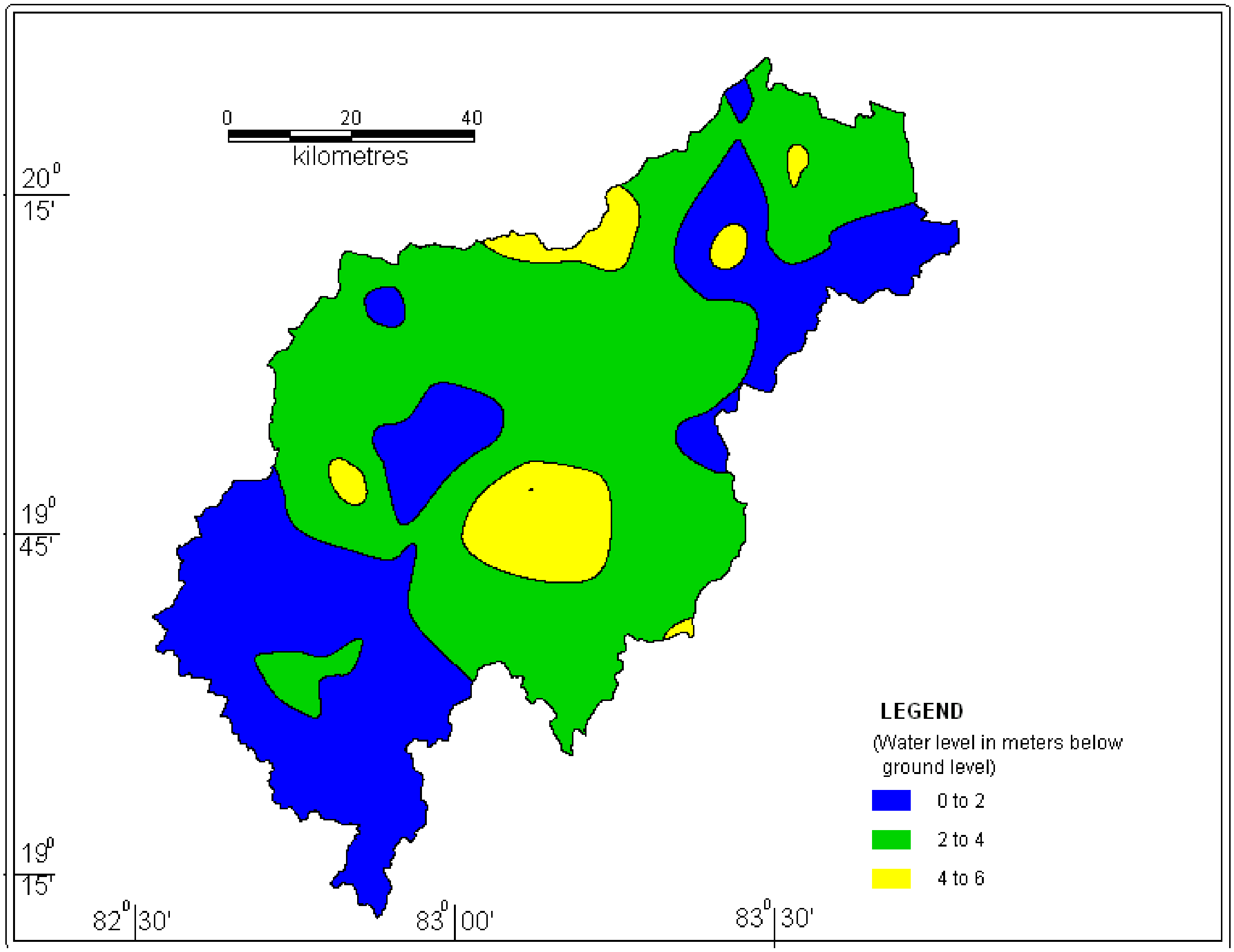
PRE-MONSOON DEPTH TO WATER LEVEL MAP OF KALAHANDI DISTRICT, ORISSA (APRIL-2011)

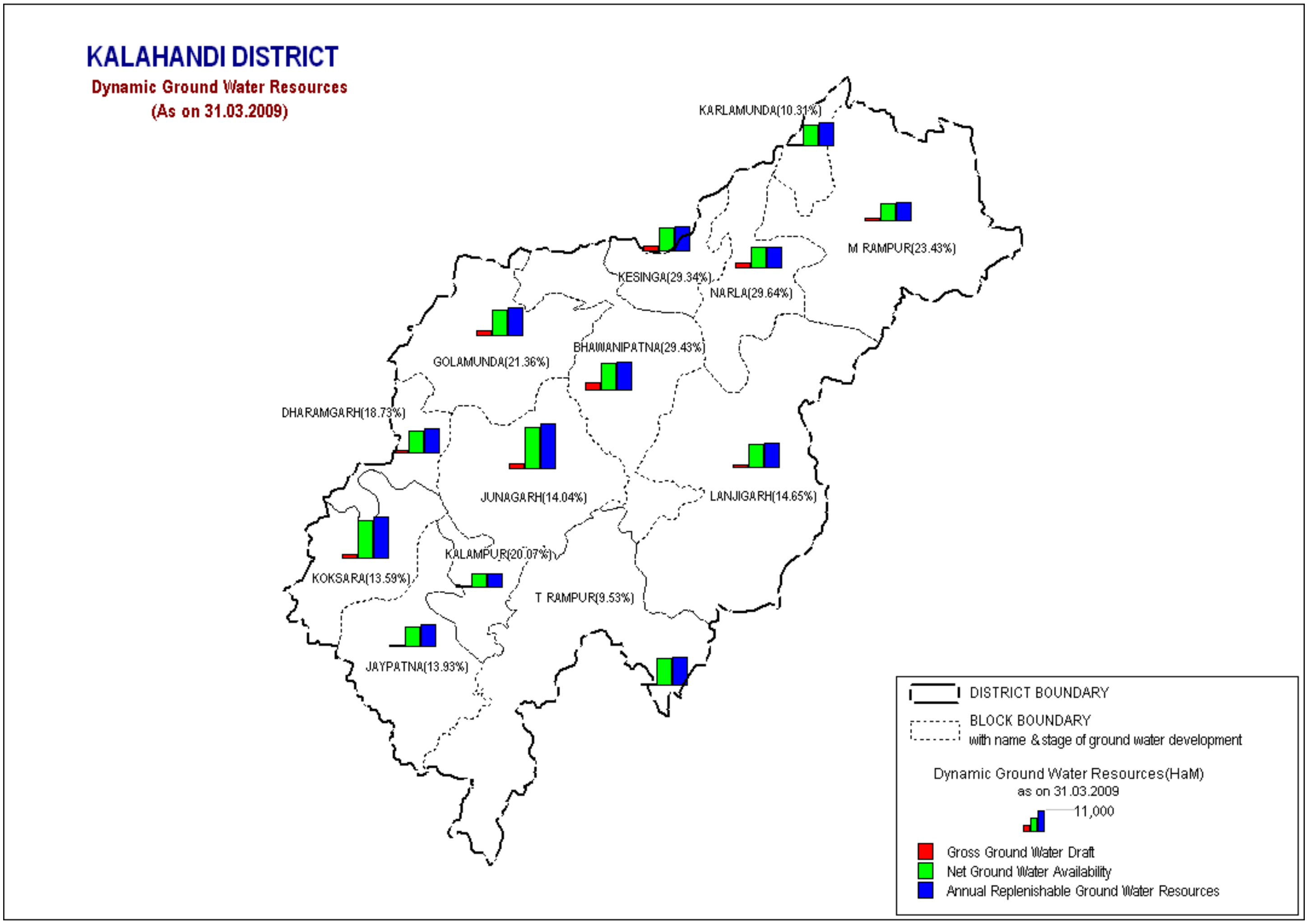
Plate :- 2

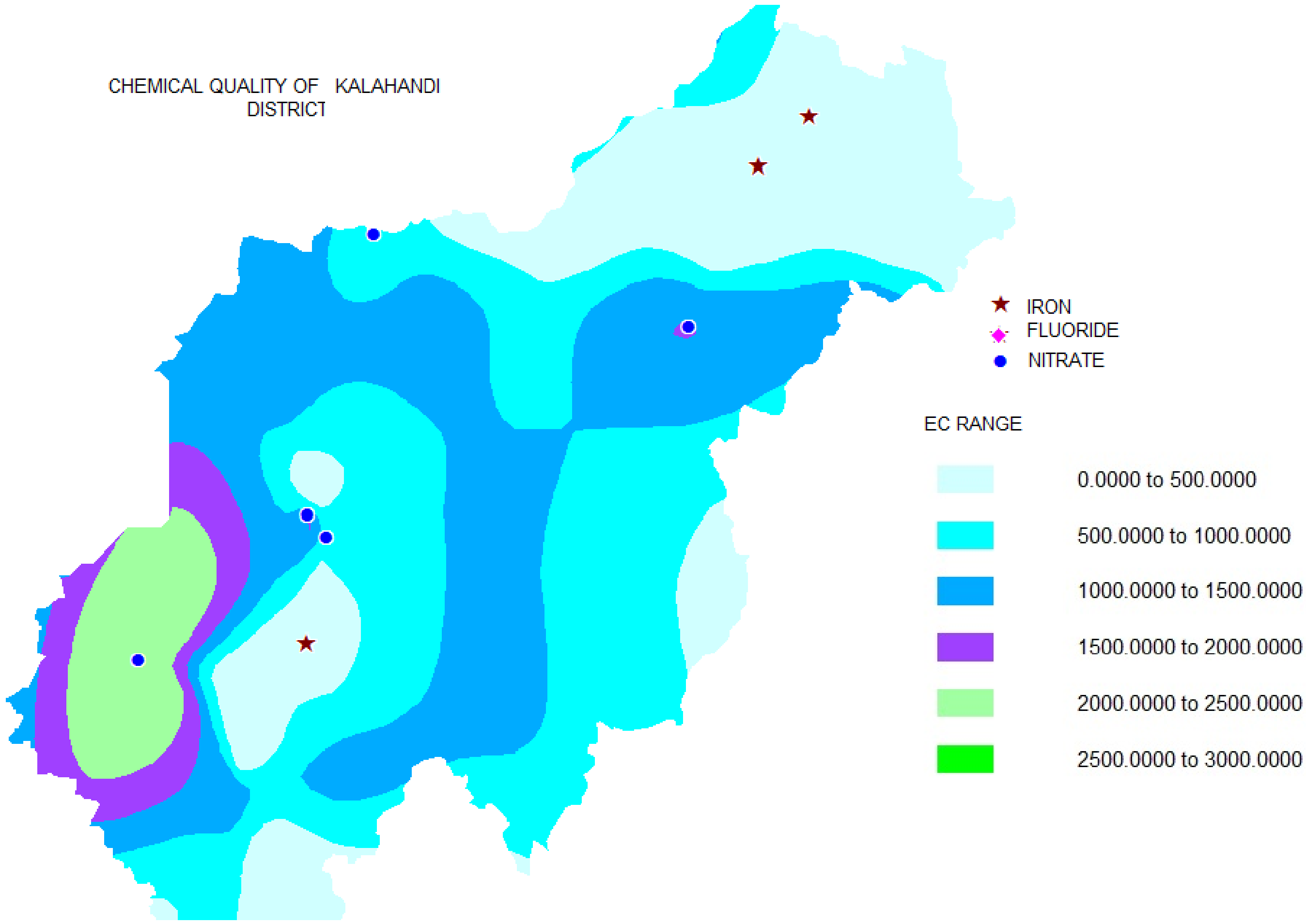


POST MONSOON DEPTH TO WATER LEVEL MAP OF KALAHANDI DISTRICT, ORISSA (NOVEMBER-2011)

Plate:- 3




KALAHANDI DISTRICT
Dynamic Ground Water Resources
(As on 31.03.2009)
KARLAMUNDA(10.31%)
M RAMPUR(23.43%)
KESINGA(29.34%)
NARLA(29.64%)
GOLAMUNDA(21.36%)
BHAWANIPATNA(29.43%)
DHARAMGARH(18.73%)
JUNAGARH(14.04%)
LANJIGARH(14.65%)
KALAMPUR(20.07%)
KOKSARA(13.59%)
T RAMPUR(9.53%)
JAYPATNA(13.93%)
DISTRICT BOUNDARY
BLOCK BOUNDARY
with name & stage of ground water development
Dynamic Ground Water Resources(HaM)
as on 31.03.2009
11,000
Gross Ground Water Draft
Net Ground Water Availability
Annual Replenishable Ground Water Resources


CHEMICAL QUALITY OF KALAHANDI DISTRICT
IRON
FLUORIDE
NITRATE
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
2500.0000 to 3000.0000