केंद्रीय भूमि जल बोर्ड

जल संसाधन, नदी विकास और गंगा संरक्षण

विभाग, जल शक्ति मंत्रालय

भारत सरकार

Central Ground Water Board

Department of Water Resources, River Development and Ganga Rejuvenation,

Ministry of Jal Shakti

Government of India

AQUIFER MAPPING AND MANAGEMENT OF GROUND WATER RESOURCES

KORAPUT DISTRICT, ODISHA

दक्षिण पूर्वी क्षेत्र, भुवनेश्वर

South Eastern Region, Bhubaneswar

AQUIFER MAPPING AND MANAGEMENT PLAN KORAPUT DISTRICT

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Central Ground Water Board
Ministry of Water Resources, River Development and Ganga RejuvenationGovernment of India
2022

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भारत सरकार
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Central Ground Water Board
South Eastern Region, Bhubaneswar
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FOREWORD

Koraput district is located in the southern part of the Odisha state which is occupied by dense forest, highly rugged mountains, interspersed with narrow intermontane valley. The geographical area of the district is 8807 sq. km. and population is 13, 79,647 as per 2011 census. The Kolab, Indrāvati and their tributaries constitute the main drainage system of the district. Around 26.36 % of the area of the district is under forest cover and the net sown area is 27.35%. As the population increases over the past years, the ground water extraction in the district has also increased. Groundwater forms the major source of drinking and domestic needs in the district. The district is underlain by hard rocks of different geological ages. The major litho-units of the district are, granite, granite gneiss, khondalite, charnokite and quartzite of Eastern Ghats Group while gneiss, limestone, and shale of Chhattisgarh Group. Granite and granite gneiss are major water bearing formation of the district. These rocks are devoid of any primary porosity and ground water occurs in the top weathered and deeper fracture zones in these rocks. Due to wide variation in hydrogeological set up in the district, the occurrence and distribution of aquifers are non-uniform and so also their yielding properties. The common modes of ground water exploitation in the district are dug well, dug-cum bore well, shallow tube well etc.
The present report **"Aquifer Mapping and Management Plan of Koraput District"** is the output of the study taken up under the National Aquifer Mapping Programme of Central Ground Water Board in order to compile all the relevant information related to hydrogeological studies and to suggest a ground water management plan for the district. An attempt has been made to formulate ground water management plan in this report with the help of all relevant information collected through field investigation and earlier hydro geological studies taken up in the district. In addition to the information on the vertical and horizontal disposition of aquifers, their yielding capacity, quality of water in them, the gap between availability and demand of water in future has been assessed and suitable measures to bridge the gap has been suggested in the report.

Sh. Tarun Mishra Scientist-C (HG) and Sh. Satyam Shukla, Assistant Hydrogeologist jointly have compiled and prepared the present report under the supervision of **Dr. B K Sahoo, Scientist-E**. Their sincere efforts in the compilation of this report will no doubt be very useful and beneficial for different groundwater user agencies, administrators, and planners in preparation for groundwater development plans and will be a handy tool in the functional management of groundwater resources.

Bhubaneswar

30th March 2023

P K Mohapatra

	CONTENTS	Page No.

LIST OF FIGURES

LIST OF TABLES

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1. INTRODUCTION:

Central Ground water Board, South Eastern Region has taken up National Aquifer Mapping (NAQUIM) programme during the Annual Action Plan of 2021-2022 to carry out integration of hydrogeological, geophysical, hydrochemical data and on the basis of existing information on geology, geomorphology, soil, hydrometeorology, hydrology, landuse, cropping pattern etc., block - wise Ground Water Management Plan have been prepared on a GIS platform for the whole Koraput district. The formulation of sustainable ground water management plan would help in achieving the demand for drinking, irrigation and industrial need for water with minimal stress on the aquifer.

i. **Objectives**: To establish the disposition of aquifers up to 200-meter depth. To know the ground water quality of the shallow and deep aquifers. To calculate the ground water resources up to 100-meter depth and if feasible beyond 100-meter depth also. To prepare a comprehensive ground water management plan (Supply side and Demand side) for the whole district.

ii. **Scope of the Study**: Koraput District comprises mostly of dense forest with highly rugged mountains, interspersed with intermontane valley and very few number of exploratory tube wells constructed before the NAQUIM study. So to fill up the gap of scarcity of hydrogeological data, there is a good scope for work regarding details of aquifer mapping in this district and as per AAP 2021-22, this district has been chosen for aquifer mapping.

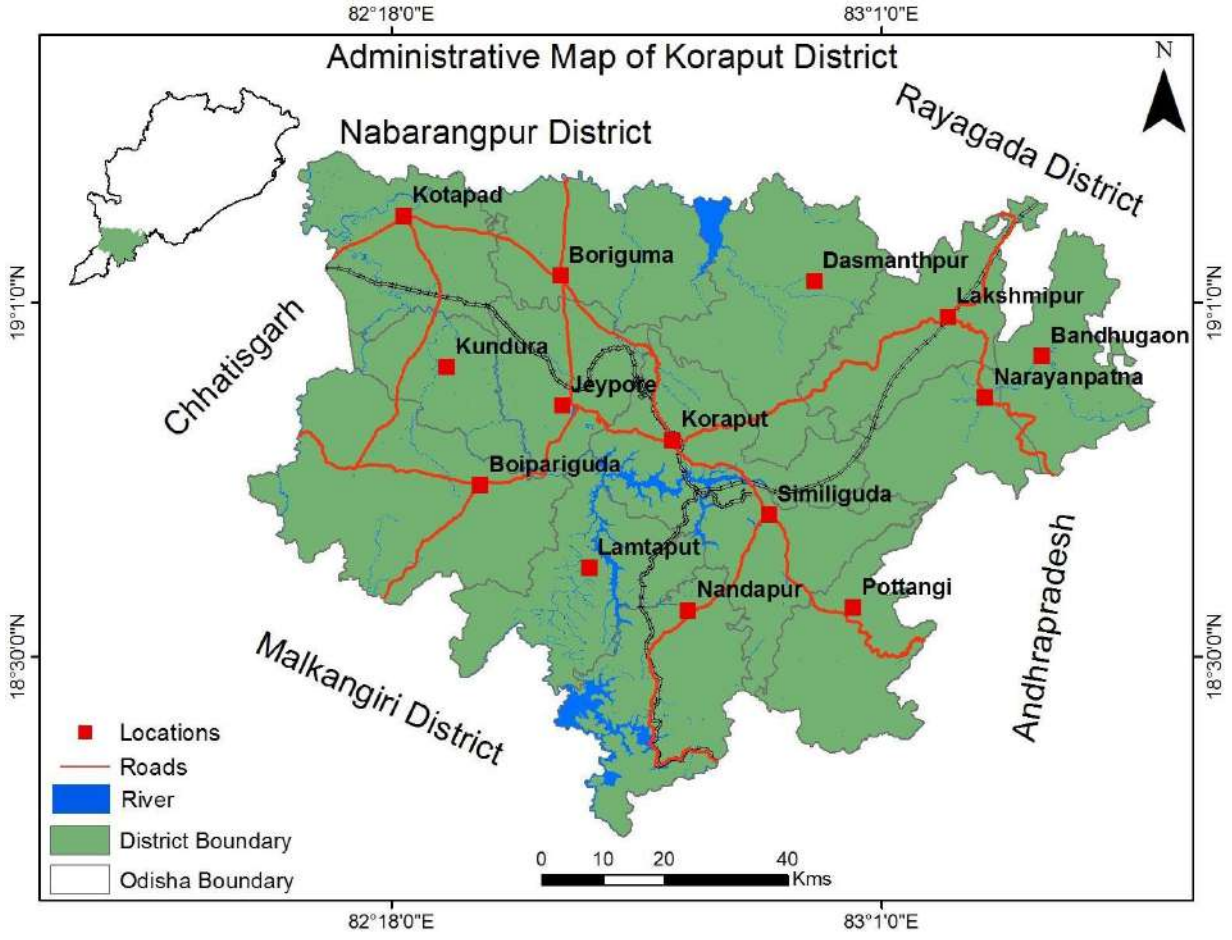
iii. **Approach and Methodology**: The Koraput district is falling in parts of grid/sub grid area of the Toposheet number 65 I/4, 65 I/8, 65 I/12, 65 I/16, 65 J/1, 65 J /2, 65 J/5, 65 J/6, 65 J/9, 65 J/10, 65 J/11, 65 J/13, 65 J/14, 65 J/15, 65 M/4, 65 M/8, 65 N/1, 65 N/2, 65 N/5, 65 N/3. The data of all existing CGWB exploratory wells and NHS monitoring wells in the district are plotted on the Toposheets of 1:50000 scale with 5'X5'grid (9km x 9km). The exploration data shows that majority of tube wells falls in the Shallow aquifer (50 m depth) and Deep aquifer (from50 - 200 m depth). The grids/ formations devoid of SH/PZ/EW are identified as data gaps and these are to be filled by data generation. Similarly, data gap established for ground water key monitoring wells (for collection of water level, quality etc.) in grids/sub grids and data generated for new established key wells. Similar methodology has been adopted for VES surveys.

On the basis of aquifer disposition, decadal water level declining trend areas, availability of excess future ground water resources up to the year 2025 and surplus rainfall – runoff amount, a suitable supply side and demand side management plan for the whole Koraput district have been prepared.

iv. **Area details**: Koraput District located in the backdrop of green valleys contemplating immaculate freshness, was established on 1st April, 1936. Decorated by forests, waterfalls, terraced valleys and darting springs, the District draws the nature loving people. The Koraput District lies at 17.4 degree to 20.7 degree North latitude and 81.24 degree to 84.2 degree east longitude. The District is bounded by Rayagada in the east, Bastar District of Chhatisgarh in the west and Malkangiri District in the south. As far as the history of the District is concerned, the region of Koraput existed far back in the 3rd century BC when it belonged to the valiant and dreaded Atavika people. The region was ruled by several dynasties, like Satavahans, Ikshvakus, Nalas, Ganga kings and kings of Suryavanshi, who nominated the Koraput region before the arrival of British. Finally the Koraput became a District in the year 1936. Koraput district was ruled by several dynasties such as Satavahans, Ikshvakus, Nalas,Ganga kings and kings of Suryavansha. It was a part of the erstwhile Madras presidency and becamea district of Odisha state on 1stApril 1936.In October,1992, Koraput district was divided, resulting in the creation of Malkangiri, Rayagada and Nabarangpur districts.The Koraput District covers an area of 8807 sq km consisting total 13,79,647 population as per 2011 census. The District has got 2 sub divisons namely Koraput and Jeypore. There are total 14 Tahsils, 14 Blocks, three Municipalities, one NAC, 23 Police stations, 2028 Villages and 240 Gram Panchayats functioning in the District of Koraput. Koraput District experiences minimum 12.0 celsius and maximum 38.0 celsius temperature. The District experiences mainly three seasons i.e summer, winter and rainy. Summer occurs from April to June, Rainy season is from June to October and Winter is from November to March. Winter season in Koraput District is longer than other parts of Odisha. The average rainfall in the District is measured to be 1505.8mm(Average) rainfall.The total geographical area is 8807 sq. km and total mappable area is 6928 sq. km. The district accounts for 5.66 percent ofthe state's territory and shares 3.29 percent of the state's population.

The density of population of the district is 157 per sq. kms. This district has 3541 farmers comprising of 7996 small farmers , 597 marginal farmers , 1386 semimedium, 457 medium and 305 big farmers (Minor Irrigation Census of India, 2015) .

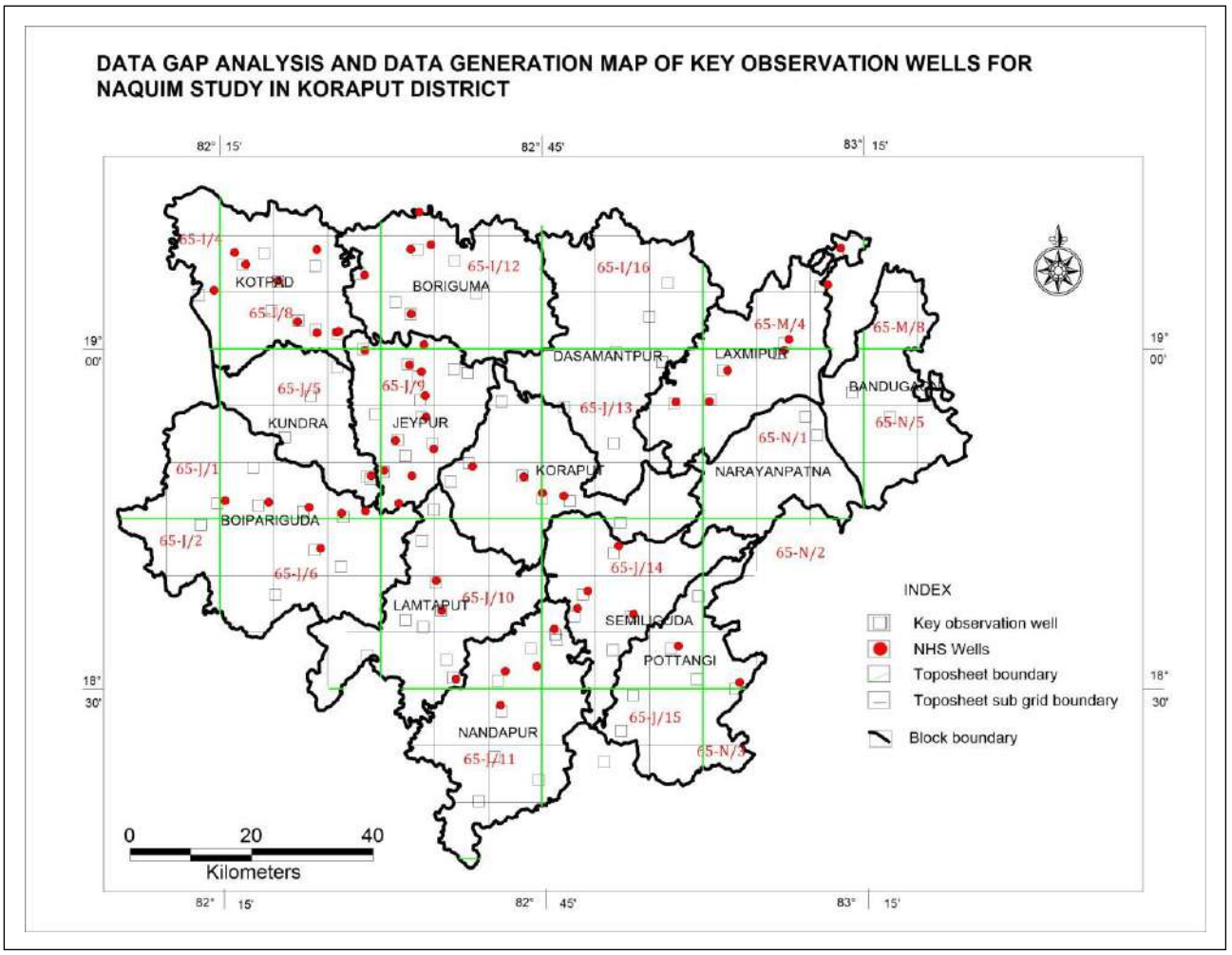
Fig.1. Location Map of Koraput District, Odisha



v. Brief Description (Data Availability, data adequacy, data gap and data generation):

a. Data Availability: Status of exploratory wells (only 21) and NHS monitoring wells (only 49) are plotted in the Fig.2 and Fig.3.

Fig.2. Data gap analysis and data generation map of key observation wells in Koraput District.

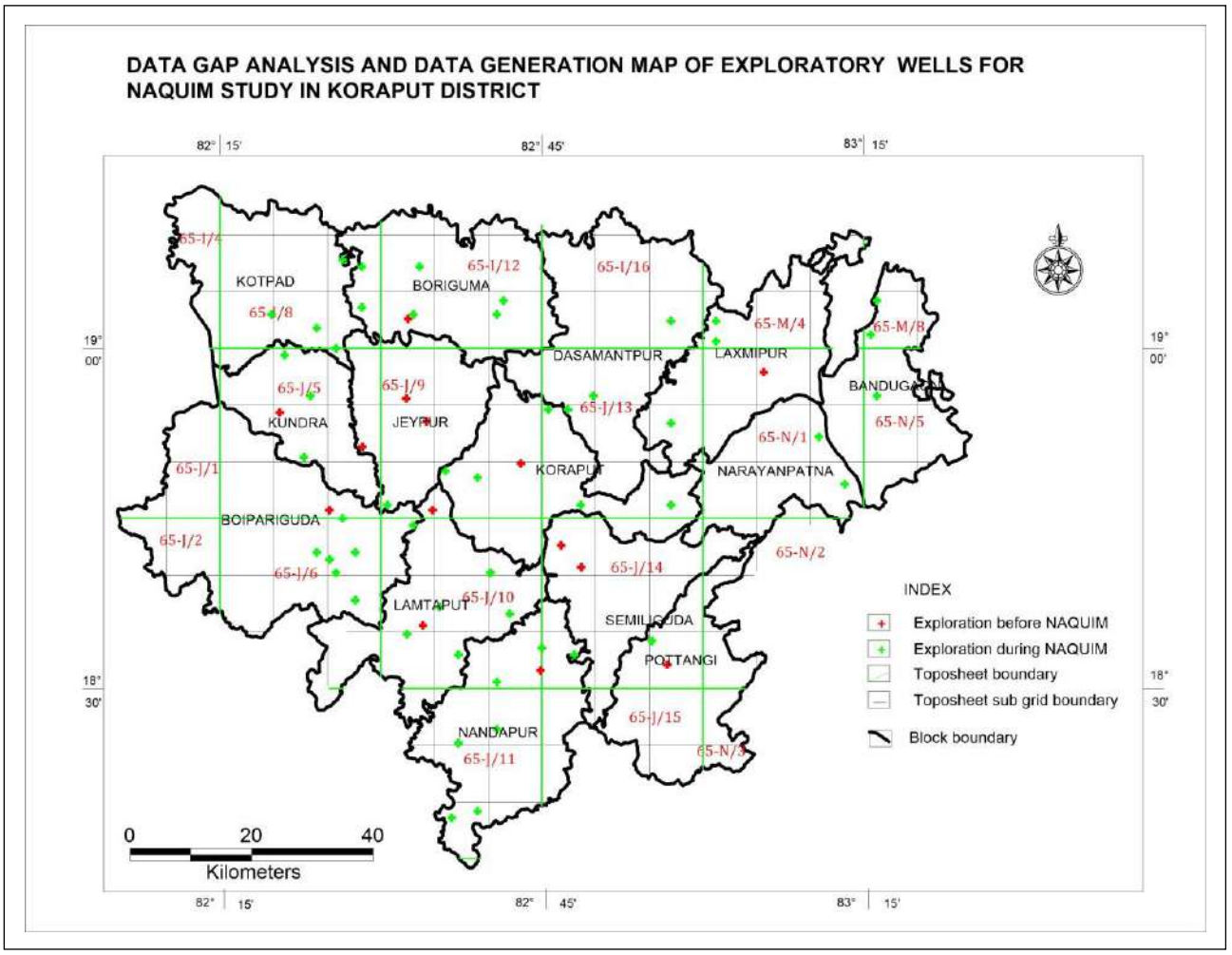


b. Data Adequacy and data gap analysis:

1. Monitoring Wells: On the basis of data adequacy of only 49 NHS monitoring wells data additional 45 key well have been selected to find the gap of water level monitoring and water quality analysis (Fig.2).

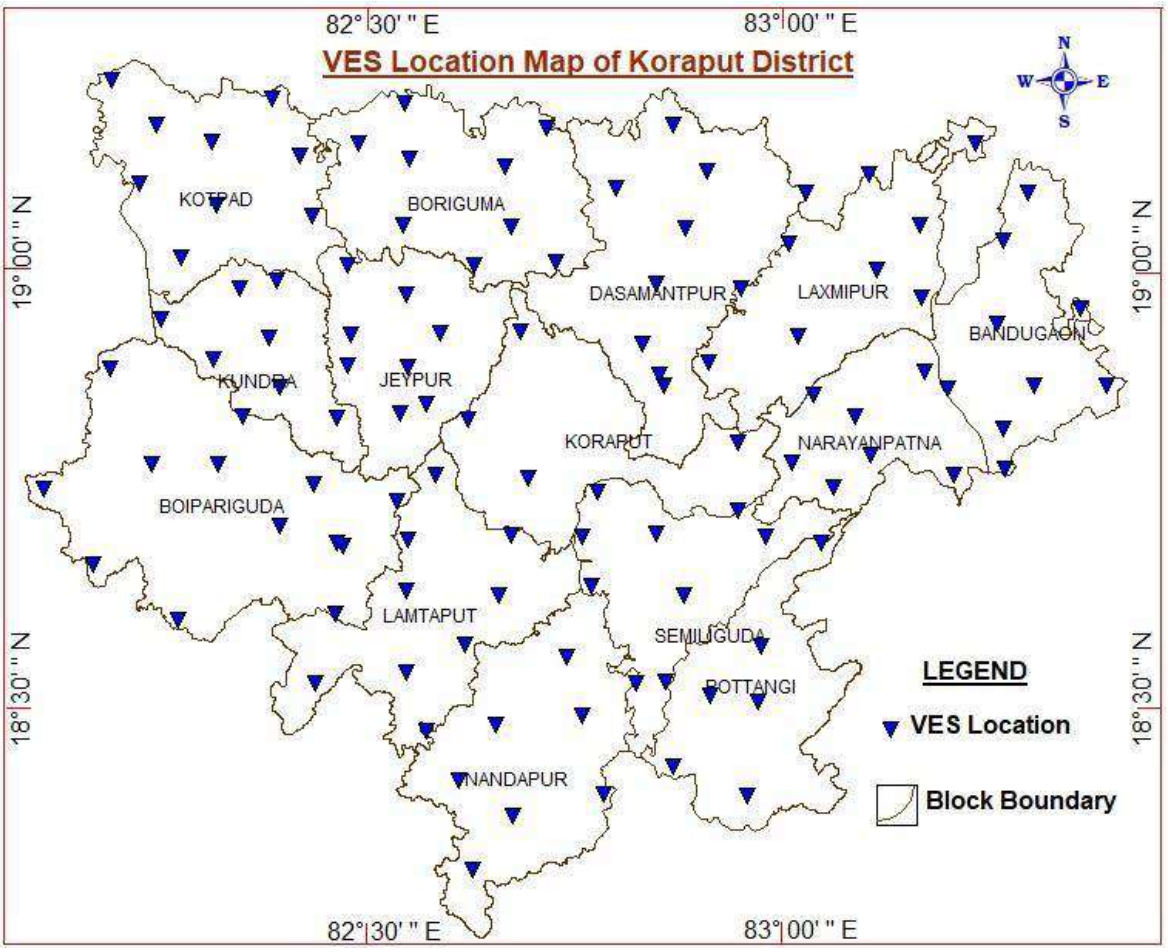
2. Exploratory Wells: On the basis of data adequacy of only 21 exploratory wells data additional 54 exploratory wells (EW) have been selected to find the gap of different aquifer disposition(Fig.3).

Fig 3. Data gap analysis and data generation map of exploratory wells in Koraput District.



3. VES Locations: A total of 115 VES were carried out in Koraput district. The VES locations are shown in Fig 4.

Fig 4. Data gap analysis and data generation map of VES survey in Koraput District.



c. **Data Generation**: On the basis of construction of 75 exploratory wells a three-dimensional panel diagram to show the disposition of weathered zone and fractured zone have been prepared. Similarly on the basis of data obtained from key wells, NHS wells different types of water level map, decadal trend map, hydrograph, chemical quality parameters etc., are generated. Data generation points of Key wells , exploratory wells are shown in Fig.2 and 3. Total 115 number of VES survey has been done in Koraput during NAQUIM study (Fig4). The details results are given in Annexure II.

vi. Rainfall-spatial, temporal and secular distribution:

The district enjoys tropical climate characterized by hot summer, cold winters and rainy seasons. The winter season generally commences from late November and continues up to the end of February. The temperature in winter

drops below 1°C at places like Pottangi otherwise it is in the range of 10°C to 13.5°C in the valley plains. The summer season commences from March and continues till middle of June. The summer is quiet pleasant here with the mean daily maximum temperature around 40°C while the mean daily minimum temperature is around 14°C.It is observed that about 80% of the total annual rainfall takes place due to south-west monsoon between the middle of June and mid-October.The north east monsoon gives erratic and insufficient rainfall. The average annual rainfall varies between 1320-1520mm. The district is drought prone because of the erratic and uneven pattern of rainfall. Block wise details of rainfall and year wise rainfall of the whole district are given Table 1 and 2 respectively. Rainfall distribution map is shown in Fig. 5.

Table 1- Year wise monthly rainfall (in mm) details of Koraput District (Source-Odisha Meteorological website)

Five years average rainfall data of Koraput District							
Sl. No.	Block Name	Total rainfall in 2017	Total rainfall in 2018	Total rainfall in 2019	Total rainfall in 2020	Total rainfall in 2021	Average rainfall (mm)
1	Koraput	1422.6	2094.7	2152.9	1476.8	1557.2	1740.84
2	Lamataput	1328	2264.5	2105.4	1957.4	2139.1	1958.88
3	Pottangi	1435.7	1433.4	1452.6	1578.2	1484.3	1476.84
4	Bandhugaon	1375.6	1209.7	2343.5	1528.9	1324.7	1556.48
5	Nandapur	1126.6	1996.5	2126.4	1458.9	1098.5	1561.38
6	Dasmantpur	1496.6	1749.3	2222.6	1525.8	1059	1610.66
7	Narayanpatna	1117.6	1110	1397.6	1338.6	1431.2	1279
8	Laxmipur	1430.6	1370	1471	1453.9	1536	1452.3
9	Similiguda	1938.9	2533.7	1974.1	2070.8	1636.6	2030.82
10	Jeypore	1558	2028.5	2491.8	1701.6	1539.7	1863.92
11	Kotpad	1968.4	2098.5	2916.4	2558	1938.9	2296.04
12	Kundra	1687.4	1525.4	2021.4	1584.3	1277.3	1619.16
13	Borigumma	1473.6	1375.2	2038.2	1037.7	946.8	1374.3
14	Boipariguda	1928	2326.3	2757.2	2283	1734	2205.7
15	**Total**	21287.6	25115.7	29471.1	23553.9	20703.3	
16	**Average**	1520.5	1793.98	2105	1682.42	1478.77	1716.134

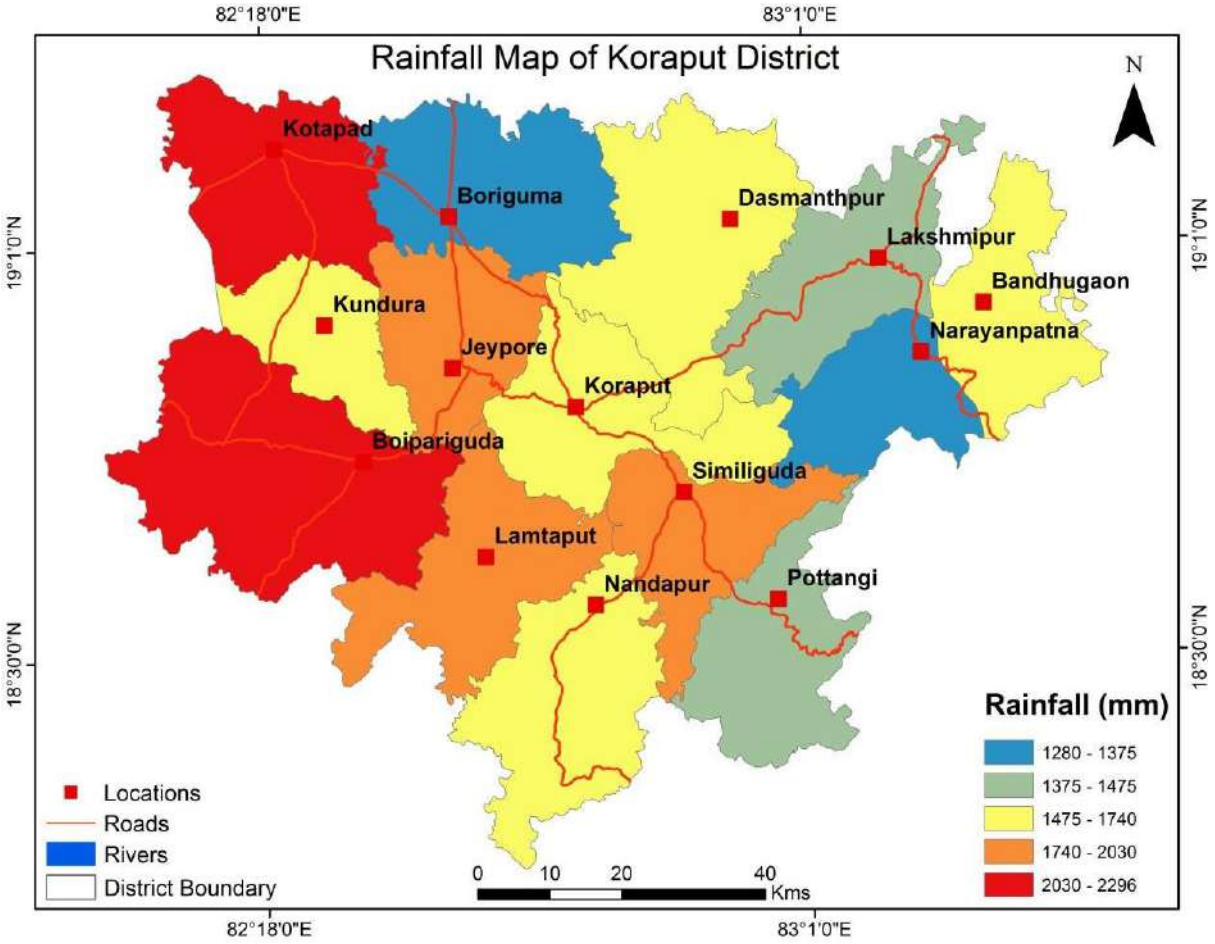
Table 2: Blockwise monthly rainfall in Koraput District, Odisha

Statement showing up to date Block/ Month wise actual (Average) rainfall for the year, 2021 for Koraput District

Sl. No.	Block Name	January	February	March	April	May	June	July	August	September	October	November	December	Total
1	Koraput	8.4	14.8	5.2	68.8	131.4	266.8	266.6	319.4	338.5	83.7	42	11.6	1557.2
2	Lamataput	1.0	25.2	10.9	147.1	149	446.6	386.4	326.5	508	66.6	62.3	9.5	2139.1
3	Pottangi	0.0	0	7.3	35.8	123.8	151	192.2	415.9	401.9	59.2	91.2	6	1484.3
4	Bandhugaon	4.0	3	0	32.5	48.4	206.6	181	257.4	360.8	112.6	110	8.4	1324.7
5	Nandapur	0.0	3.4	8.8	91	73.4	328.6	91	87.4	282.5	81.4	47	4	1098.5
6	Dasmantpur	0.0	15	1	15	71	270	161	224	222	58	14	8	1059.0
7	Narayanpatna	0.0	2	0	36.1	116.7	156.6	277.6	297.4	364.8	93.6	77.8	8.6	1431.2
8	Laxmipur	0.0	4	0	59	124	266	244.6	279	348.6	98.2	101.6	11	1536.0
9	Similiguda	0.0	2.6	18	88.8	99	325.2	236	372	394	63	22	16	1636.6
10	Jeypore	0.0	6.4	5.6	50.2	37.2	318.2	344.6	310.5	320.6	61.6	78	6.8	1539.7
11	Kotpad	0.0	5	4	46.2	67	407.9	339.5	499	405.3	49	116	0	1938.9
12	Kundra	0.0	16.4	0	35.8	63.6	209	223.7	281	320.8	57.4	69.6	0	1277.3
13	Borigumma	0.0	4.2	8.8	10.2	28.6	114.6	147	374	191.6	40.6	25.4	1.8	946.8
14	Boipariguda	0.0	17	0	58	131	228	247	409	477	67	96	4	1734.0
	Total	**13.4**	119	69.6	774.5	1264.1	3695.1	3338.2	4452.5	4936.4	991.9	952.9	95.7	20703.3
	Average	**1.0**	8.5	4.971429	55.32143	90.29286	263.9357	238.4429	318.0357	352.6	70.85	68.06429	6.8	1478.8

Source: Meteorological Department, Odisha, 2021.

Fig.5. Rainfall Distribution map, Koraput District



vii. **Physiography and Geomorphology:** Physiographically, except the north western and west-west central part, almost the entire district is occupied by dense forest, highly rugged mountain, interspersed with narrow intermontane valleys. The average altitude of the hilly terrain ranges from 900 to 1400 m above mean sea level. North Western and West-west central parts are characterized by gently undulating plains dotted with isolated hillocks. The Kolab and Indravati river and their tributaries constitute the main drainage system of the district. Details of elevation map and geomorphology map is presented in Figure 6 and 7.

Fig.6. Elevation contour map, Koraput District

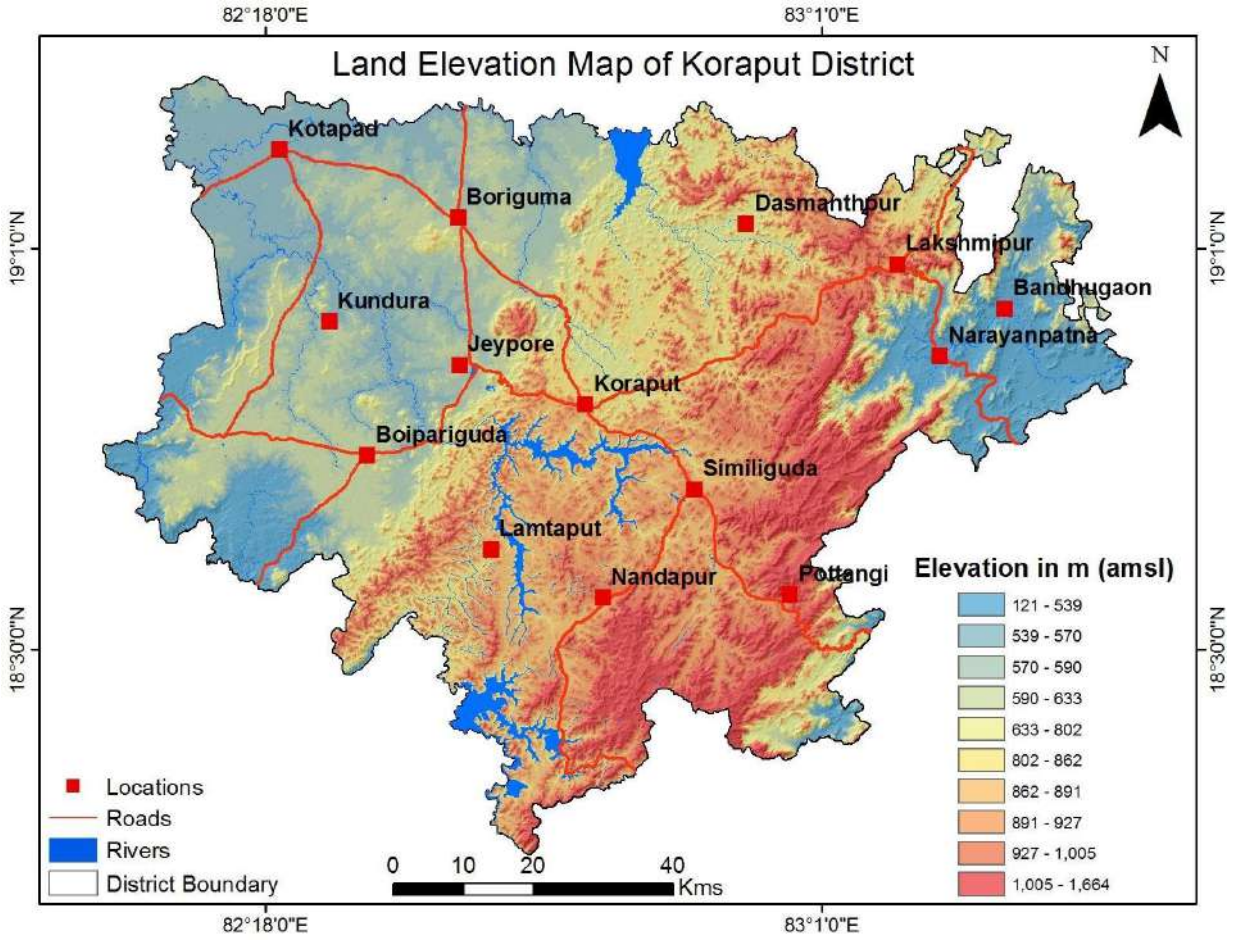
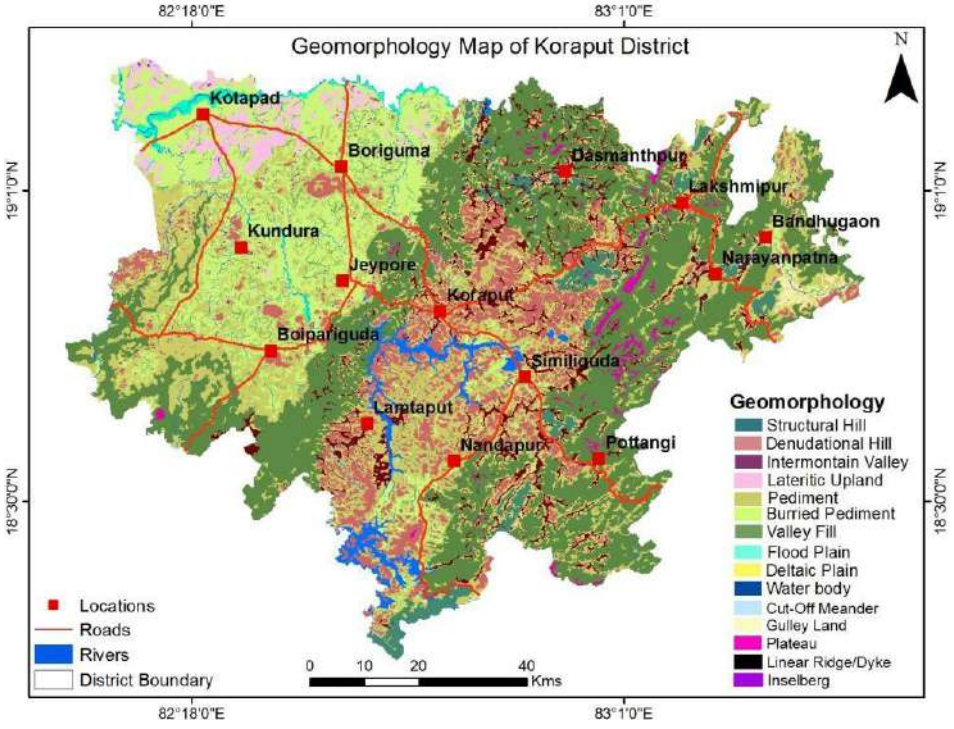


Fig.7. Geomorphology map, Koraput District, Odisha



viii. **Land use:** The total geographical area of the district is 8807 sq.km out of which net sown area is 1268 sq.km, area under forest is 2581.61 sq.km and 5629 sq.km comes under non agriculture land and 1482 sq. km is area under culturable waste land. Gross cropped area of the district is 3566.10 sq.km, out of which 1531.70 sq.km is irrigated and 2034.40 sq. km area is rainfed (Source, PMKSY,Koraput,2016). Block wise details of land use pattern are mentioned in Table-3 and Fig 8.

Fig. 8: Landuse map of Koraput District

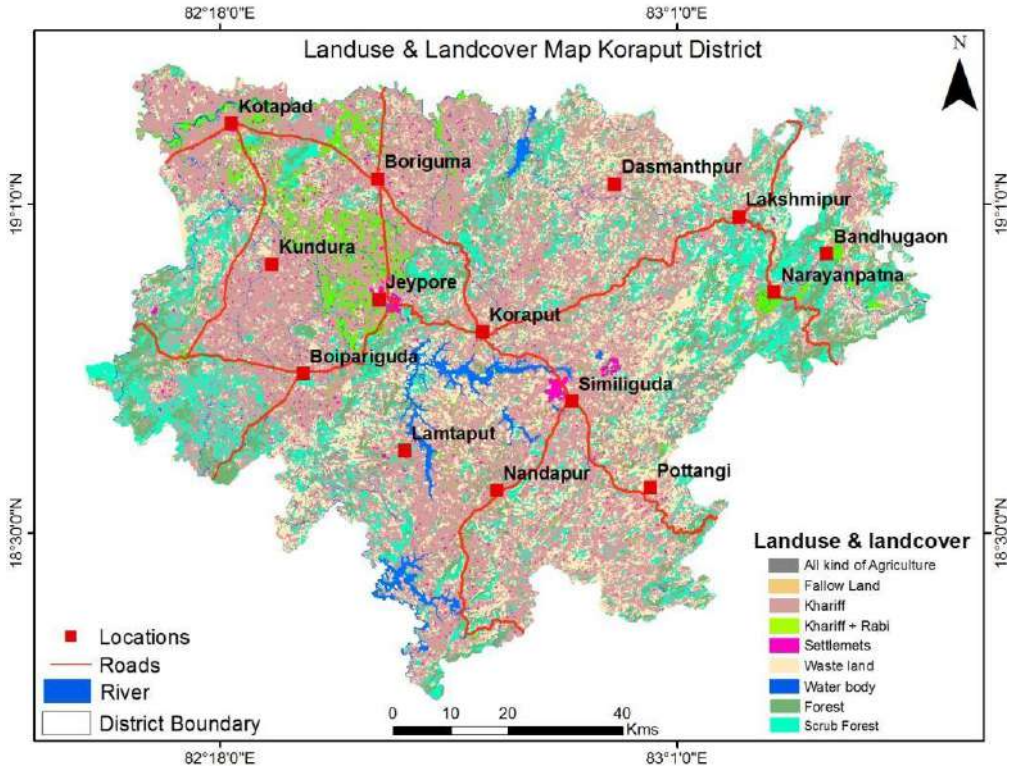


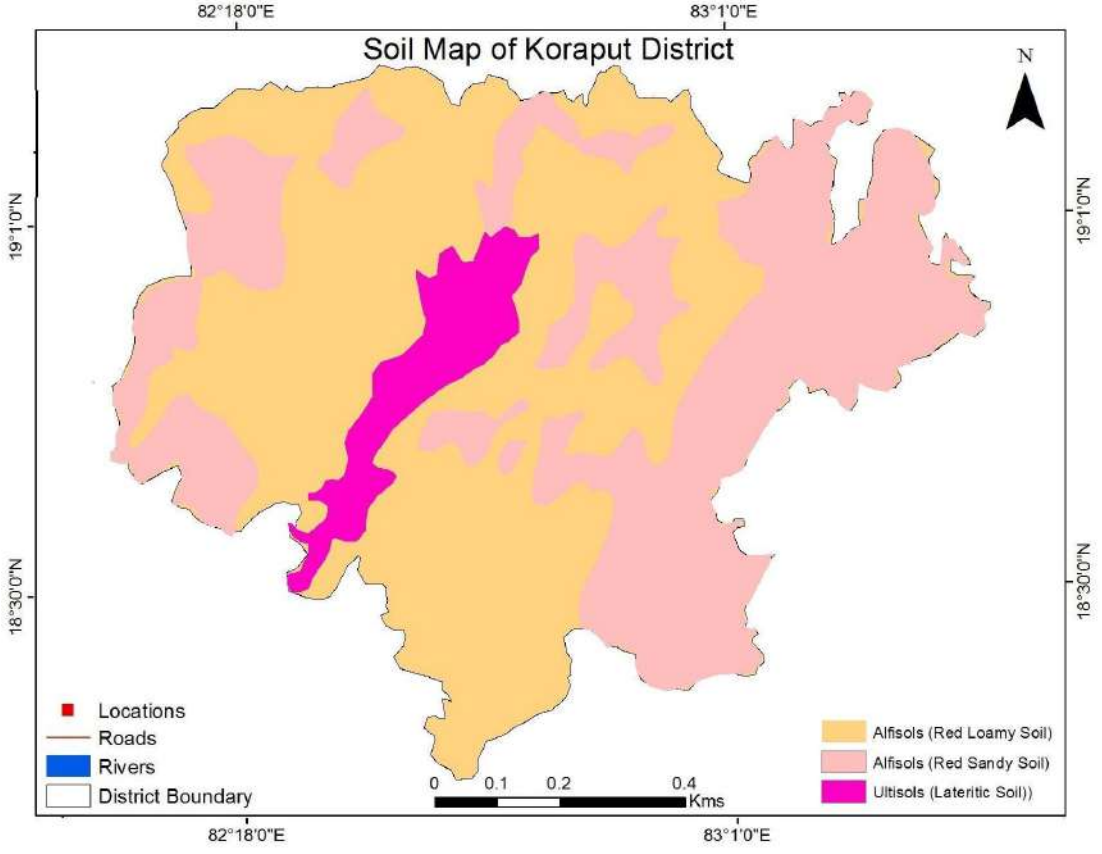
Table 3: Block wise Land use Pattern, Koraput District, Odisha
Source: ***Census Report, 2011.***

Name of the Block	Forests	Area under Non-agricultural Uses	Barren and Un-cultivable land	Permanent Pastures and Other Grazing Lands	Land Under Miscellaneous Tree Crops etc.	Culturable Waste Land	Fallow lands other than current fallows	Current Fallows	Net Area Sown	Total Irrigated L and Area	Total Un-irrigated Land Area
Bandhugaon	**3320.2**	**3883.1**	**5355.6**	**752.7**	**361.6**	**302.3**	**1274.5**	**1335.7**	**5730.1**	**756.5**	**4973.5**
Boipariguda	**17146.7**	**7759.6**	**4430.5**	**3999.9**	**1342.3**	**2275.2**	**2687.4**	**2284.1**	**34557**	**1039.3**	**33517.7**
Boriguma	**5172.9**	**6268.1**	**6994.8**	**2082.3**	**2828**	**1194.9**	**1544**	**3683.3**	**29859.9**	**3956.5**	**25903.1**

Dasamantapur	3284.8	4542.1	20266.1	1521.6	392.5	3576.1	549.4	5126.1	27139.3	513.8	26625.5
Jeypore	8543.7	3309.3	454.2	1958.4	988.6	216.6	111.2	1360.7	24133.6	11417.2	12716.8
Koraput-Sadar	2595.6	4454.8	11931.9	1092	2761.3	948.2	1041.4	1773.5	14065.9	79.4	13986.4
Kotapad	4923.9	1355.8	4156.7	1675.8	135.1	443.9	96.3	3278.1	26146.9	6240	19906.6
Kundra	5771.9	2435.5	1838.5	2230	916.1	2029.9	170.6	464.3	20224.3	1682.5	18541.4
Lamataput	2280.9	4655	30154.4	1122.4	4789.2	558	102	2991.3	11062.3	307.7	10754.1
Laxmipur	1593.6	2213	11623.3	827.8	3.4	746	1985.9	1404.3	10721.8	556	10165.5
Nandapur	1809.3	2274.4	18229.6	933.8	1525	989.7	1415.5	1184.8	21608	1967.3	19640.5
Narayanpatna	2465.7	307.7	7141.7	474.2	96.5	382.8	123.2	893	3681.3	356	3325.4
Patangi	1304.6	10713.7	1469.4	812.1	66.9	301	269.6	472.8	10360.1	200.5	10159.5
Similiguda	1632.6	2118.1	12411.1	1066.3	91.6	859.9	654.2	597.6	18870.9	649.4	18221.4

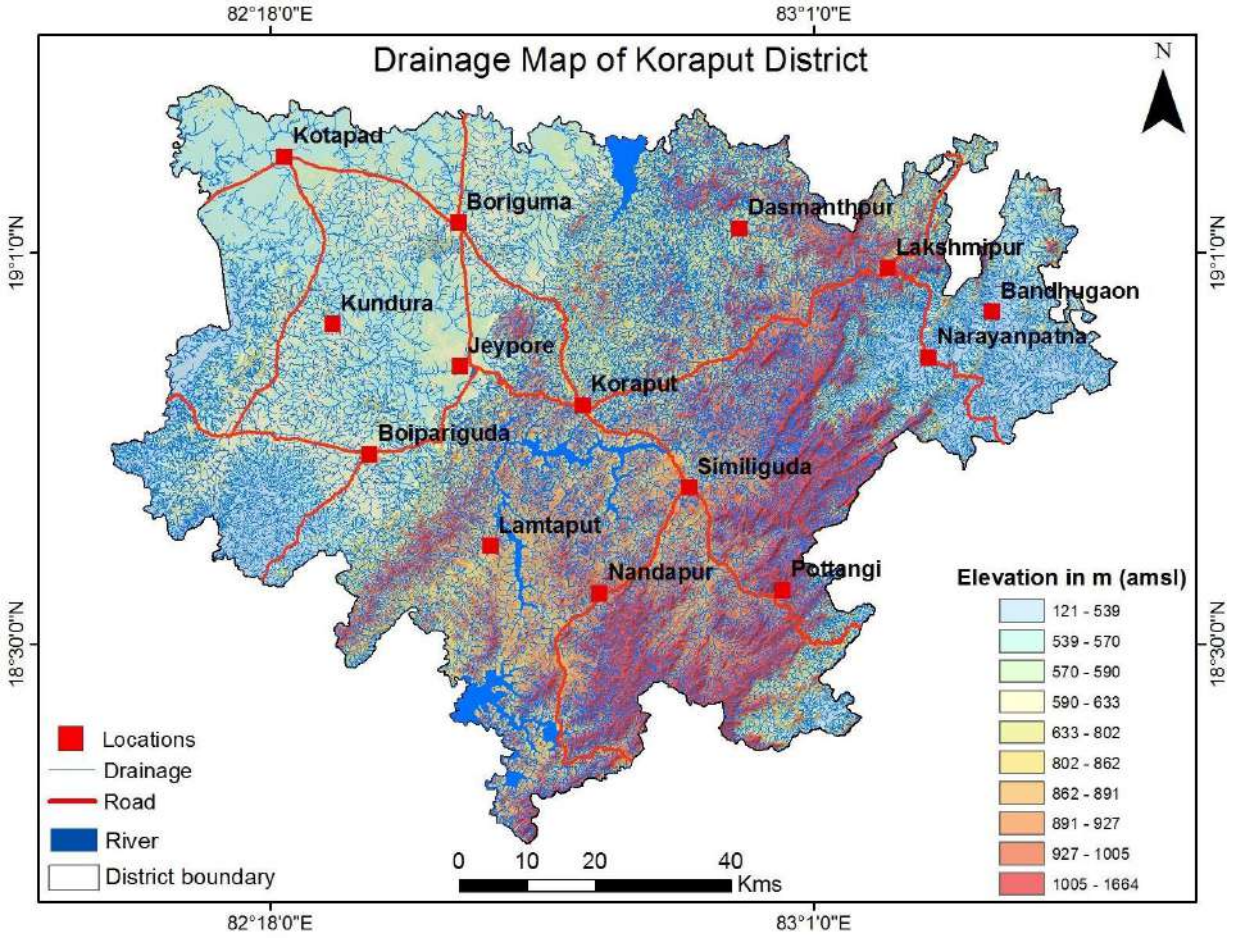
ix. **Soil:** Major soil classes of the district are (i) Alfisols (red sandy and red loamy soil) and (ii) Ultisol (black soil). The alfisols includes Red loamy soil and red Sandy Soil and are generally light textured with a P.H. ranging from 6.5 to 7.3. The soils are in general having average to good fertility. The Ultisols occurs as narrow and elongated patch in the Central part of the district. These soils are slightly acidic in nature with a P.H. ranging from 4.5 to 6.0. (District Brochure of Koraput*, 2019).* Details of soil types are presented in Fig.9.

Fig.9. Soil distribution map, Koraput District, Odisha.



x. **Drainage:** The main slope of the district is towards west and north-west**Error! Reference source not found.** The drainage pattern in the district is controlled by Indravati, Sabari (Kolab), Sileru, Vegavati, Kubarnamukhi, Jaryhavati and their tributaries. Most of the tributaries of Kolab river and Indravati river are perennial in nature. (District Brochure of Koraput*, 2019)*. The details of major drainages are shown in the Fig.10.

Fig.10. Drainage map, Koraput District, Odisha



xi. **Agriculture:** The total cropped area (TCA) is about 3.56 lakh ha out of which 1.53 lakh ha (43.0% of TCA) is irrigated and 2.03 lakh ha (57.0% of TCA) is under rainfed area. The blocks like Bandhugaon, Boriguma, Jeypore, Kotapad, and Narayanpatna having higher percent of irrigated as compared to other blocks.

Among the different crop groups, cereals accounts for 54.5% of the irrigated area followed other crops (34.6%), coarse cereals (4.7%), horticulture & plantation (2.9%), pulses (2.5%) and oil seed crops (0.7%). This indicates that major source of water in agriculture is being used for cultivation of cereals like paddy and maize.In the district as a whole, total cereals account for 24.0% of the TCA is under irrigated and 29.5% of the total TCA is under rainfed. Among the blocks, Jeypore (79.3%) and Kotapad (42.8%) having higher percent of the TCA is under irrigated and followed by Bandhugaon (37.0%). Other hand, Lamataput (56.9%), Boipariguda (51.9%), Nandapur(39.2%), Dasamantapur (37.4%) and Kundra (35.9%) are the blocks, where higher percent of TCA is under rainfed cereals. Total pulses accounts nearly 1% of the TCA are under irrigated and 7.4 % is under rainfedin the district. The blocks like Semiliguda (3.3%), Koraput (2.3%), Dasamantapur (2.2%)and Pottangi (2.0%) are the blocks having higher percent of the total pulses under irrigated. It's very interesting to know that, only 25.2% the TCA is under irrigated food crops and nearly 38.3% of the TCA is under rainfed food crops. The blocks like Jeypore(79.7%), Kotapad (43.2%) and Bandhugaon (37.5%) are having higher per cent of TCAunder irrigated food crops. This suggests that other blocks having greater potential to convert rainfed area into irrigated.Oil seeds accounts for hardly 0.3% of the TCA is irrigated and 7.1% of the TCA is underrainfed, which shows majority of the oilseeds is under rainfed areas. In the district only Semiliguda block is having maximum nearly 1% of TCA is under irrigated oil seeds.Other crops including fibre accounts about 14.9% of the TCA is irrigated but percent areaunder rainfed is less than 10% (8.7%) due to major crops are being the vegetable crops isunderirrigated.In the district only 1.2% of the TCA is irrigated horticulture and plantation crops whereas3.9% of the TCA is under rainfed horticulture & plantation. Particularly blockslike Boriguma and Jeypore are having lesser horticulture and plantation cropped area in the district.

xii. **Irrigation:** Cultivable land is grouped in to irrigated and rainfed area. Under irrigated area again it classified into gross irrigated area and net irrigated area. Partially irrigated /Protective Irrigation area under rainfed area has been assumed to be 5% of the total rainfed area, and this protective irrigation mainly

through various kinds of rainwater harvesting structures particularly developed through watershed and other programmes like MGNREAGA etc. Kotapad block (21744ha) has highest net irrigated area followed by Jeypore block (17992ha) (Table 4).Bandhugaon and Narayanpatna blocks have least net irrigated area(Table 4).Partially irrigated or protective irrigated area prevails in all blocks, highest in Boipariguda block(5708ha), followed by Borigumablock (3095 ha).Percentage of Net Irrigated Area (NIA) to Net Sown Area (NSA) is highest for Jeypore block (87.3%), followed by Kotapad (80.6%) and Laxmipur (48.8%), whereas same is least for Nandapur(12.1%). Similarly percent of Gross Irrigated Area (GIA) to TCA is highest for Jeypore (89.0%), followed by Kotapad (77.5%) and Laxmipur(42.0%), whereas same is least for Boipariguda (12.6%) (Table-4, Table-5).

Table 4: Irrigation Based Classification- Block wise TIA, NIA and Rainfed area in Koraput District

Table 4: Irrigation Based Classification- Block wise TIA, NIA and Rainfed area in Koraput District					
Sl. No.	**Block**	**Irrigated Area(ha)**		**Rainfed (ha)**	
		Total Irrigated Area	**Net Irrigated Area**	**Partially/Protective Irrigation (@5% of Rainfed area)**	**Totally Rainfed**
1	Bandhugaon	5164	2640	269	5390
2	Boipariguda	4621	4322	1397	27940
3	Boriguma	22831	12049	1305	26102
4	Dasmantpur	6489	4879	981	19630
5	Jeypore	33178	17992	163	3268
6	Koraput	5503	4000	712	14246
7	Kotpad	30148	21744	461	9219
8	Kundra	12407	6779	910	18191
9	Lamptaput	3380	3258	975	19491
10	Laxmipur	5250	5094	420	8390
11	Nandapur	6050	3440	1179	23586
12	Narayanapatna	3507	2601	244	4889
13	Pottangi	5541	3489	503	10063
14	Semiliguda	9101	5864	652	13034
	Total	**153170**	**98151**	**10172**	**203440**

- Block wise irrigation infrastructure through Tanks, open wells, Tube/Bore wells, Lift irrigation, Minor and Major irrigation systems, Creeks are given in Table 5.
- A total of only 106 tanks are available for irrigation in six blocks of the districts covering an area of 2127 ha. Maximum tanks are in Boipariguda block (52 Nos.) followed by Bandhugaon block (21 Nos.).
- There are 2449 open wells in 12 blocks of the district covering an irrigated area of 1938ha.Maximum open wells are available in Boriguma block whereas no openwells in Nandapur and Narayanpatna blocks.
- Quite few number of tube/bore wells are available in some blocks of the district used for irrigation covering an area of only 419.2 ha.
- Lift irrigation (559 Nos.) is one of the major source of irrigation in the district and foundin every blocks, covers an area of 10180 ha. Maximum lift irrigation points are found inBoriguma block (112) followed by Kundra (109) block.
- There 46 Nos. of minor irrigation and only one major irrigation (covers five blocks) in the district. Area under minor irrigation is only 5135 ha where as through major irrigation, there is 43423 ha irrigated with maximum in Kotpad block with 17216 ha followed by Jeypore (15720 ha) block.
- Three blocks namely Kotpad, Jeypore and Borigumma cover 77 % of the total irrigated area whereas remaining11 blocks covers only 23% of the irrigated area.

Source: District irrigation plan of Koraput, Odisha, PMKSY, 2016.

Table 5: Blockwise existing type of irrigation in the Koraput district(ha)

Block	Tanks		Openwells		Tube/Borewells		Lift irrigation		Minor Irrigation(MIP)		Major		Creek	Total (ha)	
	Nos	Area	Nos.	Area	Nos.	Area	Nos.	Area	Nos.	Area	Nos	Area	Area	Nos.	Area
Jeypore	15	34	230	92	17	72	67	1340	2	143	1	15720	369	**332**	**17401**
Borigumma	0	0	880	292	22	84.2	112	2405	8	470		7682	1217.8	**1022**	**10933**
Boipariguda	52	60	350	122	47	97	25	500	4	864		0	97	**478**	**1643**
Kotpad	0	1826	240	92	5	72	35	700	1	49		17216	0	**281**	**19955**
Kundra	0	0	250	80	0	0	109	2095	1	200		2805	1845	**360**	**5180**
Koraput	7	82	40	15	6	12	15	300	2	170	0	0	1810	**70**	**579**
Semiliguda	0		120	47			25	464	5	745	0	0	0	**150**	**1256**
Dasmantpur	9	5	106	46	1	2	6	330	2	295	0	0	2285	**124**	**678**
Lamtaput	0	0	150	36	0	0	28	210	0	0	0	0	1680	**178**	**246**
Nandapur	2	10	0	518	0	0	29	71	5	304	0	0		**36**	**903**
Pottangi	0	0	50	18	0	0	11	165	5	264	0	0	0	**66**	**447**
Narayanpatna	0	0	0	539	0		37	740	3	723	0	0	1278	**40**	**2002**
Laxmipur	0	0	21	17	7	20	37	740	4	398	0	0	1422	**69**	**1175**
Bandhugaon	21	110	12	24	120	60	23	120	4	510	0	0	Nil	**180**	**824**
Total(district)	**106**	**2127**	**2449**	**1938**	**225**	**419.2**	**559**	**10180**	**46**	**5135**	**1**	**43423**	**12003.8**	**3386**	**63222**

xiii. **Cropping pattern:** The crop wise production and productivity in Koraput district is presented in Table 6. Productivity of rainfed *kharif* paddy is highest for Boipariguda block(3500kg/ha),whereas lowest for Dasamantapurblock (1481 kg/ha). Only five blocks namely Biopariguda, Jeypore, Kotapad, Kundra, and Semiliguda, where the productivity of rainfed *kharif* paddy is higher than the district average (2295 kg/ha) and other 9 blocks productivity less than district average.Irrigated *kharif* maize is cultivated in 9 blocks, where as rainfed *kharif* maize is cultivated in10 blocks .The productivity of irrigated *kharif* maize is highest for Boriguma block (9636 kg/ha),and the productivity of rainfed *kharif* maize is lowest for Koraput and Narayanpatna blocks. In five blocks productivity of rainfed *kharif* maize is more than the district average (5643kg/ha).In four blocks *rabi* maize productivity is more than that of district average (7650 kg/ha).Seven blocks (Bandhugaon, Biopariguda, Dasamantapur, Lamataput, Nandapur, Pottangi,Semiliguda), do not cultivate maize and one block (Boipariguda) does not grow paddyduring *rabi* season, the cause may attributed to non-availability of irrigation facility. (Source-District irrigation Plan, Koraput District, PMKSY, 2016).

Table 6:Production and productivity of major crops under irrigated & rainfed condition in Koraput district																
Season	Crop sown				Irrigated				Rainfed				Total			
	Cereals	Coarsecereals	Pulses	Oilseeds	Area(ha)	Production(t/yr)	Productivity(kg/ha)	Cost Cultivation (Rs./ha)	Area(ha)	Production(t/yr)	Productivity(kg/ha)	Cost Cultivation (Rs./ha)	Area(ha)	Production(t/yr)	Productivity(kg/ha)	Cost Cultivation (Rs./ha)
Kharif	Paddy				50,016	1,57,808	3,155	47,800	49,801	1,17,891	2,367	40,000	99,817	2,75,698	2,762	43,900
	Maize				3,889	25,033	6,437	40,200	13,805	95,135	6,891	36,100	17,694	1,20,168	6,791	38,150
	Ragi				977	1,341	1,373	-	26,038	30,058	1,154	3,086	27,015	31,399	1,162	3,086
	Sugarcane				4,890	46,435	9,496	1,15,800	-	-	-	-	4,890	46,435	9,496	1,15,800
Rabi	Paddy				25,905	1,14,951	4,437	47,800	-	-	-	-	25,905	1,14,951	4,437	47,800
	Maize				1,460	12,021	8,233	40,200	-	-	-	-	1,460	12,021	8,233	40,200
	Potato				365	3,517	9,636	-	-	-	-	-	365	3,517	9,636	-
				G. Nut	300	403	1,344	-	-	-	-	-	300	403	1,344	-
	Sugarcane				7,733	93,511	12,092	1,15,800	-	-	-	-	7,733	93,511	12,092	1,15,800
Horticultural&Plantation																
Mango					-	-	-	-	10,422	91,788	1,26,014	84,600	10,422	91,788	1,26,014	11,84,400
Cashew					-	-	-	-	11,990	84,741	76,185	84,300	11,990	84,741	76,185	11,80,200
Banana					275	15,150	5,54,718	-	-	-	-	-	275	15,150	5,54,718	-
Others					-	-	-	-	545	1,536	-	96,100	545	1,536	25,359	8,64,900

xiv. **Prevailing water conservation, recharge practices etc.:** About 567 Tanks/ponds and 2641 water conservation structures are exists in Koraput District. These watersheds are being taken up for Run-off management, soil water conservation and improving soil-moisture regime (Dynamic Ground Water Resources Assessment of Odisha, 2021). The details of water conservation structures and recharge structures are shown in the Table-7.

Table-7. Block wise details of existing Tanks/Ponds and Water Conservation Structures, Koraput District, Odisha.

NAME OF BLOCK	Number of Tanks/Ponds		Number of Water Conservation Structures	
	Command Area	Non Command Area	Command Area	Non Command Area
Jeypore	5	7	242	303
Borigumma	6	45	71	488
Boipariguda	0	47	0	294
Kundra	3	36	25	274
Koraput	0	68	0	84
Semiliguda	4	13	28	52
Dasmantpur	0	78	0	41
Lamtaput	0	100	0	45
Nandapur	6	17	31	58
Pottangi	0	21	0	66
Narayanpatna	0	27	0	24
Laxmipur	0	46	0	38
Bandhugaon	0	36	0	117
Kotpad	2	3	98	262

2. DATA COLLECTION AND GENERATION

i. HYDROGEOLOGY: *Previous study*

Consolidated formations

These include all the hard rocks of Eastern Ghat Group, such as granite gneiss, khondalite, charnokite and quartzite, gneiss, limestone, and shale of Chhatisgarh Group.These rocks are devoid of primary porosity. The secondary porosity in these rocks developed as a result of weathering and fracturing due to major & minor tonic movements along with climatological actions. The secondary porosity forms the conditions for the movement of ground water and acts as a reservoir of ground

water. Groundwater occurs under water table conditions in weathered residuum while it occurs under semi-confined to confined conditions in the fractured & jointed rocks. The hydrogeological characteristics of different rocks formations falling under the consolidated unit are described below.

Granite Gneisses -These are the most prominent rock types among all other rocks falling under the consolidated unit. The thickness of the weathered residuum ranges from negligible to 34 m. The Depth at the openwells ranges from 2.25 to 12.45 m bgl. The Depth to the water level in the dug wells during the pre-monsoon period varies from 1.53 to 12.29 m bgl while during the post-monsoon period from 0.33 to 7.6 m bgl. The yield of the wells depends on the thickness of the water-saturated, zone as also the number of intersecting fractures tapped. The average yield of existing dug wells is around 1 lps, and the wells can be pumped for 3-4 hrs during post monsoon and 2-3 hrs during pre-monsoon in a day. Out of the total wells drilled, around 45% of the well has recorded yield 3 to 6.9 lps, and only 20% wells yielded less than 1 lps, and the rest of the 35% of the wells recorded yield between 1 to 3 lps. The yield of the wells located in granitic terrain in Jeypore and Boriguma block is considerably more than those in khondalitic terrain. Maximum potential fractures in this formation occur in the depth range of 45-125 mbgl. The transmissivity value of the aquifer ranges from 0.5 to 10.68 m^2/ day.

Khondalites - Khondalite suites of rocks are generally highly metamorphosed intensely folded with fractures that are 25-30 m deep. The joints extend beyond 65 m depth bgl. Groundwater occurs under unconfined to semi-confined conditions. The thickness of this residuum ranges from 27 to 47 m bgl. TheDepthtothe waterlevelinphreaticaquiferduringpreandpost-monsoonperiodsvariesfrom0.65to15.35 mbgl and 0.42 to 13.75 mbgl respectively. The discharge of the bore well varies from 1 to 3 lps. Maximum potential fractures in this formation occur in the depth range of 35-96 m bgl. Transmissivity value of the aquifer ranges from 0.5 to 2-3 m^2/ day.

Charnokite -Due to the hard, compact, and massive nature of this formation, the thickness of weathered residuum is limited. The weathering is not very pronounced, being upto only 7-10 m in Depth. The spacing of the joints is wide apart. The Depth to the water level in phreatic aquifer is of limited areal extent during pre and post-

monsoon period varies from 2.05 to 14.9 m bgl and from 2.31 to 11.30 m bgl, respectively. Discharge of bore wells tapping fractured zone ranges from 1 to 5 lps. Maximum potential fractures in this formation occur in the depth range of 30-136mbgl. The transmissivity value of the aquifer ranges from 1.8-3.0 m^2/ day.

Quartzite/gneiss - The phreatic aquifer in this formation is of limited areal extent. The thickness of weathered residuum varies from 10 to 12 m bgl. The Depth to the water level in the phreatic aquifer during pre and post-monsoon periods varies from 3.52 to 10.7 mbgl & from 1.24 to 7.08 mbgl, respectively. The yield of the dug well is less than 1 lps.

Limestone -This formation is generally found in the western fringe of the district and is of limited areal extent. Groundwater occurs in weathered zone under unconfined to confined conditions. The Depth to the water level in phreatic aquifers ranges from 8.03 to 10.15 mbgl during the pre-monsoon period and from5.59 to 7.66 mbgl during the post-monsoon period.

Laterite -These are highly porous and are formed as capping over the older formations. At quite a few places, hydrological testing has revealed that the lateritic aquifer has the potentiality of yielding groundwater from 1-12 lps. The lateritic profile extends down to a depth of 10-20m. The Depth of dug well varies from 3.14 to 13.4 mbgl. The Depth to the water level in phreatic aquifer varies from 1.93 to 13.22 mbgl during the pre-monsoon period while the water level ranges from 1.9 to 11.44 mbgl during the post-monsoonperiod.

Unconsolidated formations

Alluvium of Recent to Sub-Recent age constitutes the unconsolidated formation comprising of gravel, sand, and clay. The alluvial deposits of recent origin occur as their discontinuous patches along the prominent drainage channels and 'particularly in the flood plains of Indravati and Kolab river. Due to the high degree of porosity and permeability, the alluvial strips constitute the moderately potential aquifers. Ground water occurs under semi-confined to confined conditions. The potential aquifers present in this zone can be tapped through filter point shallow tubewells and dugwells. The maximum thickness of the alluvium is in the order of 20-23 m. The Depth to water level varies from 1.3 to 7.64 mbgl during pre-monsoon period

and from 0.40 to 5.89 mbgl during post monsoon period. Yield of a dug well varies from 8-15 lps.

Present Study: During the present NAQUIM study details of key 95 wells, its depth, depth to water level (pre and post,2021), annual fluctuation etc., are summarized block wise in Table-8.

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ii. **Hydrochemical:** For water sample collection from shallow aquifers (mainly weathered zone) 85 number of water samples (includes NHS water samples) collected for basic analysis (only for major elements in mg/l) only during post monsoon time. Another set of 43 water samples collected during construction of Exploratory wells are also summarized. All samples are being analysed in CGWB Lab as well as NABL accredited lab.The details are summarized in Table 9a and 9b.

Table 8. Details of Key wells, its water level (pre and post monsoon, 2020), annual fluctuation in Koraput District.

Sl. No.	Name of the location	Location	Block	Longitude	Latitude	Well depth (m)	M.P(m)	W.L.(Pre) mbgl	W.L.(Post)	Fluctuation in meter
1	Deoghati	Govt. Girls high school compound	Koraput	82.64	18.83	9.3	0.75	7.42	4.25	3.17
2	Jeypore	NH I.B. compound	Jeypore	82.58	18.86	10.73	0.7	8.16	5.9	2.26
3	Umeri	Opposite to Swasthya Upakendra (Health subcentre) beside road side of H/O Dambaru Nahak 6km from Jeypur	Jeypore	82.56	18.90	9.4	0.6	8.52	5.5	3.02
4	Kaliagaon	In the house of Sh Radhakrishna Padhi	Jeypore	82.49	18.90	8.5	0.9	9.33	3.1	6.23
5	Anta	Southern side of the road to Puranapani, at the end of the village.	Jeypore	82.53	18.87	6.81	0.7	8.71	3.1	5.61
6	Randapalli	Beside road , near bus stand, 7km from jeypore	Jeypore	82.56	18.93	8.4	0.7	8.58	4.5	4.08
7	Ambaguda	Side of PHC Compound, Infront of house of Mina Sarathi	Jeypore	82.56	18.96	8.5	0.75	8.69	4.6	4.09
8	Kebidi	Near the house of Lalu Majhi	Jeypore	82.61	18.97	7.5	0.6	8.36	4.2	4.16
9	Boriguma	In BDO colony	Boriguma	82.55	19.05	12.45	0.8	8.85	2.95	5.90
10	Nuagaon	Near RWSS overhead tank	Boriguma	82.65	19.08	6.1	0	8.19	2.6	5.59

11	Pandasguda	Near the house of Sh Gupta charan Disani,in agricultural field	Boriguma	82.61	19.13	10.14	0.66	8.39	4.04	4.35
12	Kenduguda	In the house of Sh. Amiyajyoti Nayek	Jeypore	82.54	18.98	9.8	0.8	8.81	6.2	2.61
13	Konga	Near Revenue rest shed	Jeypore	82.47	19.00	7.7	0.77	9.38	1.53	7.85
14	C.Kusumi	Inside U.K. project colony	Kotpad	82.43	19.02	11.15	0.8	9.65	3.4	6.25
15	Girliguda	Govt. Well, Near Shop (Jason Bagh)	Kundra	82.43	18.97	6.35	0.75	10.45	3.75	6.70
16	Ghatarla	Adj to UP school		82.40	19.03	11.17	0.86	9.90	4.44	5.46
17	Bajiguda	Infront of Shri Narasimha Panigrahi house	Kotpad	82.37	19.04	10.5	0.9	9.83	2.55	7.28
18	S B Nuagaon	Govt. well, Inside viaalge Thakurani Mandir.	Kotpad	82.33	19.06	11.73	0.77	9.66	2.23	7.43
19	Gumur	Inside village.Owner-Sh Sanjay Kumar Adhikari	Kotpad	82.34	19.10	14	0.8	9.31	2.6	6.71
20	Kotpad	Infront of NAC Office	Kotpad	82.32	19.14	8.15	0.8	9.08	2.1	6.98
21	Damnahandi	Infront of Shri Ram Prasad's house	Kotpad	82.29	19.12	9.75	1	9.14	1.3	7.84
22	Chandili	Opp to Post Office	Kotpad	82.22	19.08	10.56	0.85	9.12	3.95	5.17
23	Miriguda	North of Shri Padmanabha's house	Kotpad	82.40	19.12	12.0	0.8	9.08	1.6	7.48
24	Sasahandi	Behind SDO quarters (Upper Kolab project)	Boriguma	82.47	19.11	12.0	0.75	8.89	3.35	5.54

25	Bijapur	North of Sh. Ramesh Pujari's house. Left side of Kotpad road.	Boriguma	82.52	19.07	8.0	0.8	8.83	1.4	7.43
26	Challanguda	On road 11 km from Boriguma. Owner-K Santosh Kumar	Boriguma	82.56	19.15	9.73	0.6	8.60	5.3	3.30
27	Balipujariput	Inside village.In the residence of Sh Nilkanta Patra.	Jeypore	82.63	18.97	11	1	8.19	8	0.19
28	Bagra	Irrigation dug well, near bridge.	Koraput	82.69	18.92	2.72	0.78	7.75	1.42	6.33
29	Kunturkhal	Behind the house of Maheswar Nilagudia. Opposite to UGME school, 3 km from Jeypore towards Balia.	Jeypore	82.54	18.84	7.5	0.7	8.49	3.57	4.92
30	Balia	Opp. To UP Sevashram School hostel beside Reliance Mobile tower. 9 km from Jeypore towards Baipariguda via Balia.	Jeypore	82.50	18.82	7.5	0.8	8.61	4.5	4.11
31	New Ghasarda	Beside approach road to village from main road 12km from jeypore via Balia	Kundra	82.48	18.81	8.1	1.1	8.61	3.5	5.11
32	Boipariguda	At the entrance of village 200 m from Boriguma-Nawrangpur road towards left side. 17 km from Boriguma.	Boipariguda	82.44	18.75	184.63	0.5	8.35	5	3.35
33	Tanginiguda	Infront of H/O Sri Madhab Bairagi of Tanginiguda Village. West of the Jeypore-Malkangiri Road. Near new	Boipariguda	82.40	18.70	6.0	0.93	8.53	2.67	5.86

		U.P School. in Tanginiguda,In between Baipariguda and Govindpalli.								
34	Mantriam	Near BSF camp	Boipariguda	82.34	18.64	8.22	0.6	7.88	2.9	4.98
35	Pandipada	Near signboard, on raod	Boipariguda	82.44	18.68	8.8	0.8	8.35	4.8	3.55
36	Mundaguda	Inside Mushroom Farm of Nidhiram Jena right side of Baipariguda-Ramgiri road. 5 km from Baipariguda.	Boipariguda	82.38	18.76	8.8	0.65	8.91	2.75	6.16
37	Dhaulapur	Near Forest IB.	Boipariguda	82.31	18.77	10.37	0.6	9.49	6.4	3.09
38	Ramgiri	Entrance of Ramgiri Village, beside road in between Forest office and Village Mandap, After Bangala sahi chowk	Boipariguda	82.25	18.77	5.5	0.75	7.44	0.55	6.89
39	Ratakundi	Near the house of Sh Paramananda Nayek	Boipariguda	82.22	18.74	8.5	0.86	7.80	2.34	5.46
40	Juriaguda	On road, east side of village, near mango garden	Boipariguda	82.30	1 8 18.83	5.1	GL	8.55	1.6	6.95
41	Ghauriaguda	Near Sh Jana Besei house	Kundra	82.35	18.87	8.78	0.8	10.21	4.8	5.41
42	Kundra	Inside Sarpanch house	Kundra	82.39	18.93	5.9	GL	12.01	2.9	9.11
43	Patraput	Infront of ME school.	Semiliguda	82.37	18.79		0.85	7.77	5.35	2.42
44	Ranitota	Ranitota ploce station compound	Lamptaput	82.56	18.72	9.4	0.9	7.95	7.4	0.55
45	Terraguda	5km from Lamptaput, near road junction to K.Maliput	Lamptaput	82.59	18.66	10.3	0.85	7.93	7.75	0.18

46	Lamtaput	On the way to PWD I.B(near post office)	Lamptaput	82.59	18.62	10.0	0.9	7.65	6.7	0.95
47	Duripada	Near the house of Trinath Pujari	Lamptaput	82.57	18.59	8.6	0.84	7.73	4.11	3.62
48	Baringiput	Outskirts of village,on road.	Lamptaput	82.60	18.54	8.9	0.55	7.94	4.35	3.59
49	Soguru	In the Forest residence compound	Lamptaput	82.61	18.52	8.9	0.78	7.99	7.8	0.19
50	Bheja	Beside approach road to bheja railway station. in front of house of Jagadish chandra sisha, 300 m from Bheja-lamtapiet main road	Nandapur	82.69	18.47	7.5	0.8	8.17	11.7	-3.53
51	Padua	Inside PHC	Nandapur	82.68	18.40	12.5	0.45	8.18	10.55	-2.37
52	Bailguda	Near temple on road	Nandapur	82.65	18.34	12.2	0.9	8.12	5.9	2.2
53	Musafar	Near overhead tank	Nandapur	82.75	18.37	13.4	GL	8.19	7.15	1.04
54	Satasemili	8km from Nandapur Towards Handiput. In front of H/o Pirulla Khan, Right Side of the road, Opposite to Water supply Pump house.	Nandapur	82.68	18.51	11.0	0.83	7.96	2.47	5.49
55	Nandapur	Soil conservation office compound	Nandapur	82.73	18.56	10.73	0.57	7.47	4.33	3.14
56	Chingudichuan	Village- Chingudichuan, 6Km fromSubai Towards Nandapur, Beside Road & Middle Of Village.	Nandapur	82.77	18.58	6.7	0.5	7.09	2.4	4.69

57	Karajhula	In agricultural field	Nandapur	82.77	18.57	7.5	0.9	7.17	3.3	3.87
58	Subei	13 Km From Semliguda Towards Nandapur. Left side of the Road, End of the Village & Beside Road.	Semiliguda	82.80	18.61	14.8	0.8	6.82	11	-4.18
59	Pitaguda	In front of Nrusingha Pujari's house right side of road near Check Gate. 9 km from Similiguda towards Nandapur.	Semiliguda	82.81	18.64	20	0.6	6.79	6.6	0.19
60	Kolab	Near Shivmandir	Koraput	82.61	18.80	5.2	0.68	7.60	3.82	3.78
61	Ganjaipadar	Owner-Arokhilo	Lamptaput	82.58	18.76	8.2	0.85	7.85	5.25	2.60
62	Alankpada	Owner-Damru Dumari	Lamptapu	82.54	18.60	10.9	1	7.60	7.4	0.20
63	Machkund	Near market place,Owner-Hussain	Lamptaput	82.48	18.55	12.3	0.75	7.65	8.85	-1.20
64	Koraput-I	Poultry Farm premises (Right side at the entrance from Rayagada)	Koraput	82.72	18.81	12.37	0.74	10.16	8.66	1.50
65	Koraput-II	Opp ro DEO Office (opp to Poultry farm Koraput -I)	Koraput	82.48	18.81	8.7	0.75	6.10	5.25	0.85
66	Ekdali	Inside village.Owner-Laxminarayan Jamgachia	Koraput	82.87	18.74	10.9	0.8	7.77	6.2	1.57
67	Malkangiri	Inside village.Owner-Subarna Nayek	Dasmantapur	82.79	18.91	6.3	0.9	7.52	3.2	4.32
68	Lula	Near busstand. Owner-janaki Kanti Bisoi.	Dasmantapur	82.87	19.00	12.3	0.8	6.51	10.1	-3.59
69	Dasmantapur	Owner-Raghunath Jena	Dasmantapur	82.92	19.05	5.8	0.75	5.45	3.65	1.80

70	Chikamba	Owner-Minakataur Sugudhi	Dasmantapur	82.95	19.10	10.3	0.9	6.08	4.9	1.18
71	Chanabad	Irrigation large dai well.On road side to NH.	Dasmantapur	82.94	18.98	6.7	0.8	6.23	3.9	2.33
72	Odiapento	Girls' Hostel. Bore Well.	Narayanpatna	83.16	18.90	60	0.3	8.47	9.86	-1.39
73	Podagada	In the compound of Sh. Sudar Baghji house, opposite Podagada market complex. 50 m left side of main road towards Koraput.	Dasmantapur	82.86	18.86	7.5	0.95	7.58	6.97	0.61
74	Panchada	8km fromKakriguma towards Koraput, opposite to Panchayat office, beside the approch road to High School (SC & ST)	Laxmipur	82.95	18.92	9.8	0.92	6.94	8.18	-1.24
75	Katriguma	PWD I.B. compound	Laxmipur	83.01	18.93	13.34	0.8	7.37	11.3	-3.93
76	Dasni	Large dia dug well just before village appraoching towards Bandhugaon.	Bandhugaon	83.23	18.94	5	0.5	8.82	0.1	8.72
77	Katulpeta	Bore well. In agricultural field on roadsise to Alamunda.	Bandhugaon	83.29	18.90	29.1	0.5	10.74	7.6	3.14
78	Narayanpatna	Bore well.Near Ma Bastrayee Dhaba.	Narayanpatna	83.18	18.87	65	0.55	9.02	3.05	5.97
79	Laxmipur	Infront of H/O Sanjivani Bagha in Kanimusa Colony . Opposite & east of Sanganna high school, Left side of main road Leading towards Koraput	Laxmipur	83.12	18.99	12.0	0.9	7.77	8.75	-0.98
80	Kusumguda	Behind Kusumguda ME School left side of road. 12 km from Laxmipur towards Koraput.	Laxmipur	83.03	18.97	9.1	1.1	7.38	7.5	-0.12

81	Disarikaraguda	Backside of house of Kumar Kirsani, new colony, near mobile tower. 7km from Koraput towards Sunabeda	Koraput	82.75	18.78	10.6	0.87	8.08	8.03	0.05
82	Dumriput	Dumuriput (Hatapada): In the compound of Nighamaniguda Govt. High School 200m from NH. 11 kms from Koraput towards Sunabeda on NH-26.	Koraput	82.79	18.78	13.5	0.75	7.84	6.25	1.59
83	Semiliguda	Opposite to block office, west of Siva temple, Beside National Highway	Semiliguda	82.86	18.70	8.4	0.63	7.69	4.22	3.47
84	Kunduli	12 km from Semiliguda towards pottangi. In front of PHC, Kunduli, Hanuman Chowk. Behind H/O M.Srinivas rao, At/po- Kunduli	Semiliguda	82.89	18.61	10.0	0.9	10.47	6.9	3.57
85	Taupadar	On road,large dia irrigation well.	Potangi	82.99	18.64	5.4	0.7	9.25	1.5	7.75
86	Pandriguda	Near Sundar Pamia's house	Semiliguda	82.86	18.56	9.7	0.6	8.40	7.4	1.00
87	Pukali maliguda	Just at the entrance of village, behind Hasina General Store	Potangi	82.89	18.49	7	0.7	9.18	1	8.18
88	Sambai	Hand Pump near school	Potangi	82.87	18.44	32	0.4	8.79	2.2	6.59
89	Rallegada	Near bus stand	Potangi	82.99	18.51	4.6	0.63	1.90	1.3	0.60
90	Potangi	Opp to BDO office	Potangi	82.95	18.56	10.93	0.92	10.83	3.99	6.84
91	Sunki	Backside of Sunki post office and Telephone exchange 20kms from Pottangi	Potangi	83.05	18.50	11.7	0.81	10.05	3.2	6.85

92	Bhurja	Beside approach road to bheja railway station. in front of house of Jagadish chandra sisha, 300 m from Bheja-lamtapiet main road	Laxmipur	83.13	19.01	10.9	0.9	7.75	5.7	2.05
93	Damanganda	On downland, opposite to village area. About 70mts away from state highyway, 5kms from Rupkana towards laxmipur	Laxmipur	83.18	19.09	5.5	0.72	7.36	0.18	7.18
94	Mandalguda Colony	2.5 Kms From Rapkana Chowk Towards Gorkhpur. Left side Or Road. Near Passanger Waiting Room	Laxmipur	83.21	19.14	10.7	0.77	7.32	7.93	-0.61

Table-9a. Chemical quality analytical results of major elements and Uranium from all key wells (Shallow aquifer), Koraput District.

Site Name	pH	EC	TDS	TH	Alkalinity	Ca^{++}	Mg^{++}	Na^{+}	K^{+}	CO^{3-}	HCO^{3-}	Cl^{-}	SO^{4-}	NO^{3-}	F^{-}	U
		(µS/cm)	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	ppb
Deoghati	6.53	97	66	36	47	6	5	12	1.6	0	58	10	2	0.5	0.07	0.1
Jeypur	7.37	683	436	276	154	67	27	67	0.9	0	188	144	32	6.9	0.07	0.2
Umeri	6.8	1166	648	412	66	117	29	80	14	0	80	279	76	14	0.04	0.1
Kaliagaon	7.38	251	184	94	110	27	6	10	32.7	0	134	29	13	0.1	0.07	0.1
Anta	7.61	575	314	141	148	27	18	37	47	0	181	55	34	7.5	0.15	0.1
Randapalli	7.26	466	266	151	126	31	18	42	5.5	0	154	75	18	1.1	0.08	0.2
Ambaguda	6.52	259	155	63	28	19	4	31	7.4	0	34	58	12	8	0.06	0.2
Kebidi	6.66	516	296	52	71	10	6	74	35	0	87	91	22	14	0.07	0.2
Boriguma	7.62	370	208	148	115	31	17	23	2.5	0	140	48	16	1.7	0.09	0.2
Nuagaon	7	205	133	78	44	17	9	15	12.3	0	54	48	5	0.3	0.06	0.2
Pandasguda	7.8	911	480	276	220	29	49	75	13.8	0	268	120	55	6.6	0.51	0.3
Kenduguda	6.96	434	261	141	88	27	18	33	25.8	0	107	82	14	9.4	0.07	0.3
C. Kusumi	6.92	209	142	78	71	23	5	20	3.4	0	87	41	6	0.3	0.06	0
Girliguda	6.89	337	202	78	50	19	8	31	28.6	0	60	72	9	5.1	0.04	0.3
Ghatarla	7.36	71	54	25	32	4	3	6	9.2	0	39	10	2	0.1	0.05	0.3
S B Nuagaon	6.69	315	183	68	55	19	5	20	36.6	0	67	58	5	7	0.05	0.3
Gumur	7.12	320	203	104	93	21	13	20	30.1	0	114	48	14	2	0.04	0.2
Kotpad	7.88	335	160	162	148	29	21	4	0.9	0	181	10	5	0.7	0.1	0.2
Damanahandi	6.58	102	63	30	25	6	4	8	7	0	31	18	0	5.95	0.06	BDL
Miriguda	6.65	235	140	50	30	12	5	22	17	0	37	53	0	12.9	0.05	BDL
Sasahandi	6.71	56	39	20	20	4	2	6	1.6	0	24	11	0	2.31	0.17	BDL
Challanguda	6.44	195	121	35	25	10	2	18	13	0	31	35	0	27	0.19	BDL
Balipujariput	7.76	672	426	260	245	74	18	40	45	0	299	85	6	11	0.16	BDL
Bagra	7.4	290	179	140	100	30	16	13	2.2	0	122	32	2	24	0.07	BDL

Balia	7.8	1235	690	435	200	62	68	61	38	0	244	291	20	30	0.46	BDL
Boipariguda	7.57	197	114	65	65	18	5	16	3.5	0	79	32	0	1.09	0.06	0.0093
Mantrian	7.62	456	295	165	150	44	13	46	6.4	0	183	67	0	28	0.05	BDL
Pandipada	7.3	131	76	25	40	6	2	18	2.6	0	49	18	0	5.14	0.05	BDL
Mundaguda	7.27	307	209	70	50	18	6	46	8.6	0	61	99	1	0.61	0.04	BDL
Ramgiri	7.45	128	78	55	40	12	6	10	0.7	0	49	25	0	0.48	0.08	BDL
Ratakundi	6.89	54	40	15	20	4	1	8	1.3	0	24	11	0	2.3	0.08	BDL
Juriaguda	6.89	147	96	50	25	8	7	10	7.5	0	31	35	0	13.07	0.32	BDL
Ghauriaguda	7.35	151	98	50	50	14	4	16	1.8	0	61	25	0	7.98	0.42	BDL
Kundra	7.45	680.3	396	197	183	51	17	28	61.9	0	223	93	34	2.9	0.28	2.2
Patraput	6.91	115	90	58	63	14	6	7	7.9	0	77	9	6	1.8	0.12	0.6
Ranitota	7.29	64	46	35	37	6	5	4	0.6	0	45	7	0	1	0.07	0
Terraguda	6.98	76	49	29	26	6	3	5	3	0	32	8	1	6.7	0.05	0.2
Duripada	7.13	42	29	21	15	4	3	2	2.4	0	18	7	3	0.3	0.06	0.2
Baringiput	7.17	37	26	13	18	2	2	5	1.6	0	22	5	0	0.2	0.03	0.2
Bheja	7.39	140	79	64	57	18	5	4	0.6	0	70	12	1	4.3	0.04	0
Padua	6.85	98	60	48	50	10	6	6	0.8	0	61	8	0	0.5	0.08	0.2
Bailguda	7.41	136	82	68	62	18	6	4	1.8	0	76	6	7	1.7	0.07	0.2
Musafar	7.82	692	318	125	162	22	17	27	64.2	0	198	39	27	25.4	0.14	4.1
Satasemili	6.44	32	24	18	16	6	1	2	0.4	0	19	4	1	1.1	0.03	0.2
Nandapur	6.86	35	25	14	15	4	1	4	0.6	0	18	6	0	0.6	0.02	0.2
Karajhula	6.82	35	21	15	10	6	0	2	0.8	0	13	5	1	1	0.03	0.2
Subei	7.04	50	31	19	19	4	2	2	3.2	0	23	5	0	3.4	0.03	0.2
Kolab	7.96	292	153	130	144	24	17	11	3.8	0	175	9	2	0	0.1	0.1
Ganjaipadar	7.7	1635	657	256	120	43	36	47	134.1	0	147	198	81	45.2	0.17	0.1
Alankpada	6.89	43	31	23	22	4	3	3	0.4	0	27	4	0	3.1	0.02	0.2
Machkund	6.74	465	207	94	21	26	7	33	8.6	0	26	73	3	44.4	0.03	0.2
Koraput 1	7.54	650	278	162	109	32	20	37	1.8	0	133	51	36	35	0.1	0.2
Ekdali	7.77	415	209	128	120	26	16	15	25	0	146	36	19	1.8	0.28	0.1

Malkangiri	7.78	678	336	132	167	22	19	17	83.5	0	204	41	31	23.4	0.14	0.1
Lula	7.27	885	402	143	84	38	12	28	90.9	0	102	81	56	47.1	0.07	0.2
Dasmantapur	7.56	144	81	72	74	10	11	6	0.5	0	90	7	1	1.2	0.28	0.2
Chikamba	6.67	34	24	18	17	2	3	2	1.5	0	20	4	1	0.7	0.02	0.1
Chanalad	6.75	80	51	43	39	6	7	3	2.4	0	47	7	1	2.8	0.04	0.2
Odiapentho	7.57	638	253	88	185	8	17	70	1.1	0	225	17	29	0.1	1.1	0.1
Podagada	6.96	230	124	59	31	14	6	12	6.9	0	38	27	2	36.8	0.04	0.1
Panchada	6.89	108	59	46	35	10	5	4	0.6	0	43	10	1	6.9	0.06	0.1
Katriguma	7.17	126	66	55	55	20	1	3	1.2	0	67	4	1	2	0.04	0.1
Pattamunda	7.42	214	108	88	88	22	8	8	1.9	0	107	9	6	1.4	0.3	0.2
Mandiaguda	7.67	560	216	157	132	16	29	20	1.5	0	161	14	24	33.7	0.36	0.1
Katragada	7.57	595	216	175	155	10	36	16	1.9	0	189	11	18	28.7	0.43	0.1
Dasni	7.38	208	107	84	94	16	11	8	2.6	0	115	7	6	0.7	0.15	0.1
Bandlugaon	7.2	230	122	103	94	22	12	8	1.2	0	115	11	9	3.1	0.2	0.2
Katulpeta	7.83	332	150	117	106	24	14	13	1.2	0	129	16	10	9.4	0.15	0.2
Near laxmipur (spring)	7.65	82	41	32	29	6	4	3	1.5	0	35	7	2	0	0.08	0.2
Laxmipur	6.9	71	41	23	13	6	2	4	1.1	0	16	8	2	9.6	0.04	0.2
Kusumguda	7.7	381	126	96	82	26	8	6	6.5	0	100	9	16	6.4	0.12	0.2
Disarikaraguda	7.58	206	105	39	21	10	4	16	2.5	0	26	17	2	42.3	0.03	0.3
Sunabeda	7.59	144	76	56	59	14	5	8	1.6	0	72	6	5	0.9	0.31	0.3
Semliguda	7.34	210	117	57	20	12	7	15	3.1	0	24	28	6	35.1	0.04	0
Kunduli	7.16	226	115	70	53	20	5	13	2.4	0	64	20	10	13.3	0.05	0.3
Khasuguda	6.7	66	35	16	10	4	1	4	3.3	0	12	7	2	7.9	0.02	0.3
Taupadar	6.3	28	12	8	7	2	1	2	0.6	0	9	2	1	0	0.02	0.3
Pandriguda	6.48	67	44	22	14	6	2	7	0.9	0	17	13	1	5.8	0.02	0.2
Pukali Maliguda	7.08	176	91	64	16	16	6	6	1.3	0	19	29	3	19.5	0.03	0.2
Sambai	7.16	413	220	131	98	30	14	12	21.8	0	119	39	0	44.8	0.03	0.2
Rallegada	7.96	250	143	106	100	24	11	13	1.6	0	121	11	15	8	0.12	0.2

Potangi	7.5	233	113	89	83	30	4	8	2.3	0	101	14	5	1	0.07	0.3
Bhurja	7.62	720	350	137	150	32	14	37	60.7	0	183	68	39	9.8	0.08	0.3
Damanganda	7.29	402	208	141	103	41	9	16	3.8	0	126	25	13	36.9	0.21	0.3
Mandalguda	7.35	200	94	65	61	12	9	8	3.6	0	74	13	1	10.5	0.1	0.3

Table-9b. Chemical quality analytical results of major elements from all key wells (Deeper aquifer), Koraput District.

Site Name	pH	EC	TDS	TH	F-	Cl-	SiO2	NO3-	Ca2+	Mg2+	Na+	K+	SO4	HCO3	Fe	CO3
		(µS/cm)	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l
Kuntes	6.87	294	186	110	0.22	10	2	3.4	24	12	14.7	1.1	15.8	110	0.08	0
Paikapuki	8.07	368	236	100	0.38	10	2.6	4.4	24	9.6	35.6	1.8	30.6	130	0.12	0
Machhput	7.28	458	290	150	0.42	30	2.9	5.3	32	16.8	33.1	2	35.7	140	0.14	0
Mainamal	7.68	468	296	150	0.49	20	2.4	5.3	32	16.8	35.4	1.9	25.3	160	0.12	0
Chikamba	7.26	238	154	80	0.2	10	2	3.8	20	7.2	15.2	1.5	80	17.2	0.1	0
Machhra	7.64	346	220	120	0.4	10	2	4.4	28	12	21.4	1.7	20.1	130	0.14	0
Lachmani	7.78	316	204	80	0.34	10	2	4.4	20	7.2	33.1	1.5	24.9	110	0.1	0
Dhaudapadar	7.92	552	348	120	0.5	15	4.8	7.2	28	12	67.8	2.5	40.7	200	0.16	0
Badsarapalli	8.53	938	596	50	0.6	20	5.6	8.1	12	4.8	189	2.5	25.7	380	0.14	20
Narayanpatna	7.81	614	390	210	0.48	25	3.4	6.3	44	24	40.9	2.3	20	240	0.14	0
Upper Bilangul	8.1	366	235	50	0.3	15	2.8	5	12	4.8	57.9	1.9	22	130	0.09	0
Panchada	7.83	526	334	200	0.52	15	5	7.2	44	21.6	25.1	2.5	37.8	190	0.16	0
Kollar	7.67	404	256	800	0.4	15	2.6	5.6	20	7.2	52.6	2.1	39.1	130	0.12	0
Mahantput	7.28	458	290	150	0.42	30	2.9	5.3	32	16.8	33.1	2	35.7	140	0.14	0
Majhiguda	6.9	174	112	40	0.2	10	1.8	3.1	8	4.8	19.5	1	35.4	60	0.08	0
Gunji	7.84	572	366	230	0.5	15	4.2	7.5	48	26.4	22	2.3	69	180	0.15	0
Doraput	7.84	398	256	130	0.43	15	2.4	5.3	28	14.4	28.5	2	36.8	130	0.12	0
Girliput	8.15	464	298	160	0.4	15	2.8	5.6	36	16.8	29.6	2.1	39.2	160	0.14	0
Boipariguda	7.07	285	160	180	0.28	20	2	3.7	20	7.2	16.1	1.5	15.2	70	0.1	0
Badatema	7.75	462	294	160	0.46	10	2.6	5	36	16.8	10	29.2	26.8	180	0.13	0
Pombi	8.05	802	510	300	0.68	20	7	9.4	92	16.8	42.3	2.7	122	230	0.18	0
Kumargandha	7.58	336	214	120	0.36	10	2.2	4.7	28	12	18.8	1.8	24.4	120	0.08	0
Banamaliput	7.12	386	246	150	0.26	15	2.1	4	32	16.8	16.3	2.1	13.8	150	0.08	0
Kundra	7.39	554	360	140	0.47	65	4	6.3	32	14.4	59.5	2.1	90.6	80	0.13	0
Bagderi	7.68	316	208	100	0.24	10	2	4.7	24	9.6	23.4	1.9	34	100	0.11	0

Gundal	7.08	814	518	230	0.64	80	4.9	8.8	48	26.4	77	2.9	172.1	100	0.16	0
Satsimili	7.92	476	304	160	0.49	10	3.4	6	36	16.8	32.2	2.3	41.7	170	0.14	0
Nandapur	7.88	252	160	50	0.26	10	1.8	3.4	12	4.8	10	32.4	24.4	80	0.1	0
Khubudo	7.82	524	336	200	0.47	10		6.6	48	19.2	24.8	2.3	35	200	0.14	0
Panhlung	7.82	548	344	210	0.54	15	4	6.6	52	19.2	25.7	2.3	30.1	210	0.14	0
Attanda	7.57	576	364	220	0.52	25	4.8	7.6	48	24	27.6	2.3	57.4	180	0.15	0
Sipaiput	7.06	328	210	100	0.38	10	2.1	4	24	9.6	26.4	1.7	21.5	120	0.1	0
Lalmunda	7.54	448	290	170	0.49	15	3.8	6.3	36	19.2	21.4	2.1	21	170	0.14	0
S B Nuagaon	7.7	428	274	160	0.48	10	2.9	5	36	16.8	21.4	2.1	20.1	170	0.14	0
Mundipadar	7.61	416	271	100	0.42	15	2.7	5.3	24	9.6	46.2	2.1	35.9	140	0.13	0
B Ghatarla	7.28	228	146	60	0.24	10	1.6	3.8	16	4.8	22.7	0.9	12.4	80	0.08	0
Kamara	7.47	546	350	220	0.54	10	4	7	56	19.2	20.4	2.5	25.8	220	0.14	0
Boriguma	7.98	274	178	60	0.3	15	2.2	4	16	4.8	32.6	1.6	27.2	80	0.12	0
Kuntiapala	7.42	218	140	70	0.3	10	2	3.8	16	7.2	15.1	1.5	17.2	70	0.1	0
Katragada	7.71	446	284	170	0.42	15	3	5.6	36	19.2	21	2.1	30.6	160	0.14	0
Jodaput	7.78	452	288	80	0.44	15	2.5	4.4	20	7.2	63.7	2.1	35.4	160	0.13	0
Lamtaput	7.68	374	240	120	0.3	10	2	4.4	28	12	27.6	1.9	23.2	140	0.1	0
Poibeda	8.01	334	218	120	0.34	15	1.9	4.4	28	12	18.4	1.9	17.2	120	0.08	0

iii. **Geophysical Study:** Recommendations on the basis of 115 number of VES survey are enclosed as Annexure-II.

iv. **Exploratory Drilling (Previous study):** Total 24 exploratory and observation wells drilled before the NAQUIM study in Koraput district. Details observations are given in Table – 10 .

Table 10 . Details of exploration before NAQUIM study in Koraput District

Sr.No	District	Block	Location	Depth drilled (mbgl)	Lithology	Depth to Bed rock (mbgl) Casing Pipe Lowered	Fracture zones (mbgl)	SWL (mbgl) / Date	Discharge (lps)
1	**Koraput**	Laxmipur	Laxmipur	200.8	Khondalite Gr. Gneiss	29.29	66,68	32.69	3.05
2	**Koraput**	Laxmipur	Laxmipur	64.00	Khondalite Gr. Gneiss	25.60	60,62	20.82	3.30
3	**Koraput**	Koraput	Koraput I	86.60	Khondalite Gr. Gneiss	39.20	75,81	5.43	1.80
4	**Koraput**	Koraput	Koraput II	119.80	Khondalite Gr. Gneiss	46.40	35,46	1.76	0.40
5	**Koraput**	Simliguda	Simliguda	200.40	Khondalite Gr. Gneiss	29.30	51,96	9.06	3.60
6	**Koraput**	Simliguda	Sunabeda	197.70	Migmatite	49.20	67,92,123,150	1.55	2.16
7	**Koraput**	Pottangi	PottangI	25.0	Norite	19.60	20,24	2.83	0.25
8	**Koraput**	Pottangi	-do-	57.0	Norite	18.40	18,19	3.95	0.38
9	**Koraput**	Jeypore	Ekamba	199.60	Biotel gr. Gneiss	19.30	80,120,140, 150	9.38	1.00
10	**Koraput**	Jeypore	Ambaguda I	45.60	Pyroxene granite	24.80	24,36		2.40
11	**Koraput**	Jeypore	Ambaguda II	92.00	Pyroxene granite	35.55	24,36	6.43	2.5
12	**Koraput**	Jeypore	Ambaguda III	138.10	Px Granite	30.90	31,93,107,136	7.19	5.50
13	**Koraput**	Jeypore	Jeypore I	62.0	Granodioite	31.80			2.3
14	**Koraput**	Jeypore	Jeypore II	140.40	Granodioite	31.0	124,125	10.45	6.10
15	**Koraput**	Jeypore	Jeypore III	182.0	Granodioite	36.50	138,140,181 ,182	10.33	1.15
16	**Koraput**	Jeypore	Pampuni	169.0	Bio. gneiss and basic intrusive	28.50	27,32,44,69, 139	3.1	6.90
17	**Koraput**	Jeypore	Pampuni	178.60	Bio. gneiss and basic intrusive	26.55	27,32,51,151		1.20
18	**Koraput**	Boiparigud a	Boiparigu da	178.30	Bio. Gr. gneiss	35.08	51,84,98,118	3.16	1.52
19	**Koraput**	Kundra	Kundra	200.35	Gr. Greniss				1.5
20	**Koraput**	Nandapur	Nandapur	125.6	Khondalite, granite	67.55	68,77	1.79	0.96

21	**Koraput**	Boriguma	Boriguma	132.3	Chanokite, Amphifolite	26.8		2.69	5
22	**Koraput**	Lamtaput	Lamtaput	109.47	Gr. Gneiss	34.6	46,57,71	3.92	1.58
23	**Koraput**	Boriguma	Boriguna	168.4	Charnockite, amphibohte	31.1	54,63,72,90, 96,103,145, 151,153, 160,163	3.33	1.26
24	**Koraput**	Dasmanthpur	Tonda	154.1	Gr. Gneiss, charnockite		54,69,79,88, 99		6.8

Present Study: During AAP 2021-22 a total number of 53 exploratory wells have been constructed within a depth ranges from 88 – 200 mbgl depth and discharge varying from 0.4 lps to 12.3 lps. Lithologs data, discharge data, chemical quality data etc. are also collected from the Basic data reports of 75 Exploratory wells constructed in Koraput District. Block wise details of exploratory wells are given in Table-11. Therefore, on the basis of 75 Exploratory well data composite cross section, panel diagram has been prepared.

Table-11: Block wise details of exploratory wells in Koraput District, Odisha

Sr. No	Block	Location	Latitude in decimal	Longitude in decimal	Depth drilled (mbgl)	Depth constructed (mbgl)	Lithology	Depth to Bed rock (mbgl) Casing Pipe Lowered	Fracture zones/ deciphered (mbgl)	Discharge (lps)	Drawdown (m)	T (m^2 / day)	S
1	Dasmantpur	Kuntes	19.04	83.02	200	200	Khondalite	34	51,62,104	2.5	15.76	5.76-6.69	
2	Dasmantpur	Paikapuki	18.93	82.83	200	174	Khondalite	11.5	38,69,85,107	2.2	20.77	2.99-3.39	
3	Dasmantpur	Machhput	19.04	82.95	201	200	Khondalite	36	67, 81	0.8		0.47	
4	Dasmantpur	A Malkangiri	18.91	82.79	201	200	Khondalite	8.5	54	Negligible			
5	Dasmantpur	Mainamal	18.91	82.76	200	162	Khondalite	61.08	74,104	1.73	20.03	2.25-2.33	
6	Dasmantpur	Chikamba	18.32	82.65	132	132	Khondalite	45.5	64,83,94	12.19	31.66	22.11-32.77	$11.28x10^{-4}$
7	Koraput	Machhra	18.81	82.65	201	200	Granite	30.9	--	Negligible			
8	koraput	Mohanpada	18.77	82.81	200	200	Khondalite	23.5	NIL	Dry			
9	koraput	Lachmani	18.77	82.95	200	200	Khondalite	62.3	64, 186	2.23	31.18	3.53-5.08	
10	koraput	Dhaudapadar	18.82	82.6	200	200	Granite	25.5	39,53,181	Negligible			
12	Bandhugaon	Kumbhariput	19.02	83.26	200	200	Khondalite	8	36	Negligible			
13	Bandhugaon	Garidi	19.07	83.27	200	200	Granite	20.2	NIL	Dry			
14	Bandhugaon	Badsarapalli	18.93	83.27	200	200	Khondalite	5.5	77-78	2.3	6.88	7.29-9.72	
15	Narayanpatna	Lagadwada	18.8	83.22	201	200	Granite	8.5	NIL	Dry			

16	Narayanpatna	Narayanpatna	18.87	83.18	200	200	Khondalite	17.5	21-22	Negligible			
17	Laxmipur	Upper Bilangul	19.01	83.02	201	200	Khondalite	18	23,46,57,65	0.4		0.47	
18	Laxmipur	Panchada	18.89	82.95	201	200	Khondalite	17.5	43	Negligible			
19	Boipariguda	Kollar	18.7	82.4	201	200	Khondalite	36	40,52,120,127, 159,183	Negligible			
20	Boipariguda	Mahantput	18.69	82.42	201	200	Granite	19	23,33	Negligible			
21	Boipariguda	Majhiguda	18.63	82.46	201	200	Khondalite	25.5	33,180	2.13	10.59	4.38-4.44	
22	Boipariguda	Gunji	18.74	82.55	203	200	Granite	24.5	44,51	Negligible			
23	Boipariguda	Doraput	18.7	82.46	201	200	Khondalite	30	85, 187	6.5	34.69	6.51-14.71	$3.38x10^{-4}$
24	Boipariguda	Bichalkota	18.77	82.51	200	175	Khondalite	23	NIL	Dry			
25	Boipariguda	Girliput	18.67	82.43	200	200	Granite	16	61,83,138,187	6.85	33.99	4.83-5.58	$1.18x10^{-4}$
26	Boipariguda	Boipariguda	18.75	82.44	200	200	Granite	30.5	43,160	4.42	14.56	20.81-131.84	$1.38x10^{-2}$
27	Semliguda	Badatema	18.67	82.67	203	200	Khondalite	19	51, 64	Negligible			
28	Semliguda	Pombi	18.55	82.8	201	200	Khondalite	48	52	Negligible			
29	Lamtaput	Kumargandha	18.67	82.67	200	132	Khondalite	36.3	67	10.5	10.82	19.34-22.48	
30	Lamtaput	Banamaliput	18.61	82.7	203	200	Khondalite	40.04	45	1.98	22.04	1.57-2.68	
31	Lamtaput	Badapada	18.55	82.62	203	200	Khondalite	16	170	Negligible			
32	Kundra	Kundra	18.93	82.39	201	200	Granite	29.5	35	3.28	11.37	7.42-12.03	
33	Kundra	Bagderi	18.99	82.35	200	88	Granite	47.5	72,79	2.3		3.46-3.7	
34	Kundra	Gundal	18.84	82.38	203	200	Granite	43		1.98	16.67	2.74-3.14	
35	Nandapur	Balda	18.44	82.68	201	200	Khondalite	55.5	61,71,85	Negligible			
36	Nandapur	Satsimili	18.51	82.68	201	200	Khondalite	61.5	74,77,82	0.8		0.33	
37	Nandapur	Nandapur	18.56	82.75	203	200	Khondalite	52.5	58	Negligible			

38	Nandapur	Khubudo	18.32	82.65	201	200	Khondalite	61	67,71,84,136	8.07	31.66	9.72-18.26	$4.80x10^{-4}$
39	Nandapur	Panhlung	18.31	82.61	200	156	Granite	37.9	51, 143	8.07	7.32	63.92-143.65	
40	Nandapur	Attanda	18.42	82.62	200	200	Granite	5.5	75	2.2	17.13	2.32-3.27	
41	Pottangi	Sipaiput	18.57	82.92	200	200	Khondalite	33.5	36,56,93,116,131,161	Negligible			
42	Kotpad	Lalmunda	19.13	82.44	200	152	Granite	49.5	112	8	7.76	44.31-48.01	
43	Kotpad	S B Nuagaon	19.05	82.33	200	200	Granite	47.6	110	Negligible			
44	Kotpad	Mundipadar	19	82.43	200	200	Khondalite	8.5	10,14,26	Negligible			
45	Kotpad	Kurmakote	19.06	82.47	200	200	Granite	31		Dry			
46	Kotpad	B Ghatarla	19.03	82.4	200	200	Khondalite	21.5	31	7.5	27.17	14.21-116.48	$2.21x10^{-4}$
47	Boriguma	Kamara	19.12	82.56	200	200	Khondalite	21.5	27	Negligible			
48	Boriguma	Boriguma	19.05	82.55	200	200	Khondalite	30.5	33	Negligible			
49	Boriguma	Kuntiapala	19.07	82.69	200	200	Khondalite	37.5	45	0.8			
50	Boriguma	Katragada	19.12	82.47	200	200	Khondalite	36	48,545,59,64	Negligible			
51	Boriguma	Jodaput	19.05	82.68	200	200	Khondalite	27	86,96,138	Negligible			
52	Lamtaput	Lamtaput	18.62	82.59	168	168	Granite	37.5	------	5.5		6.5-14.71	$1.21x10^{-4}$
53	Lamtaput	Poibeda	18.58	82.54	200	174	Khondalite	51.5	85,159	7		14.79-15.58	

3. DATA INTREGATION, INTERPRETATION AND AQUIFER MAPPING

A.GEOLOGY: Significant parts of the Koraput district is underlain by hard rocks of Pre-Cambrian age (Fig.11). The consolidated rocks of upper to middle Proterozoic age occupy a small portion of the northwestern part of the district. Recent to sub-Recent alluvium occurs as thin and discontinuous patches in a limited scale along the prominent drainage channel. The Laterite occurs as their capping over the country rocks in isolated pockets. The generalized stratigraphic sequence in the district is depicted in **Table12**.

Table 12: Geological Succession Koraput District, Odisha

Recent to Sub Recent		Alluvium, Laterite
Upper to middle Proterozoic	Chhattisgarh Group	Purple shale, limestone, Basal quartzite.
Proterozoic to Archaean	Bengal group	Quartzite, Quartz and biotite gneiss
	Eastern Ghat group	Biotite bearing garnetiferous granite. Gneiss with mega-crystal of white Feldspar.
		Acid, intermediate, basic Charnockite.
Archaean		Garnet-sillimanite Schist, green khondalite Quartzite& calc-granulite.

Granite Gneisses -These rock types of Eastern Ghat Group generally occur in the undulating plains and sometimes form hills and hillocks. These rocks are mostly represented by biotite gneiss, porphyritic granitic gneiss, etc. They are porphyritic and non-porphyritic and are usually grey to light grey in color.

Khondalites - This suite of rocks comprises mainly of quartz-garnet sillimanite gneiss and schist, garnetiferous sillimanite gneiss and schist, garnetiferous sillimanite quartzite and calc-granulite, which occurs in an interbedded sequence. Khondalite is found associated with charnockite andporphyroblastic granitoid gneiss. The rocks are greyish brown to reddish-brown in color and are well foliated. The occurrence of quartzite and calc granulites are minimal and sporadic.

Charnockite -This suite of rocks comprises of pyroxene granulite (basic), hypersthene granite and granodiorite (acid and intermediate). These are generally found to occur in the south and central part of the district. The acid and

intermediate variety of charnockite is more prominent and form longer bodies than the basic variety. The charnockite are fine to coarse grained, greenish-grey color having greasy luster.

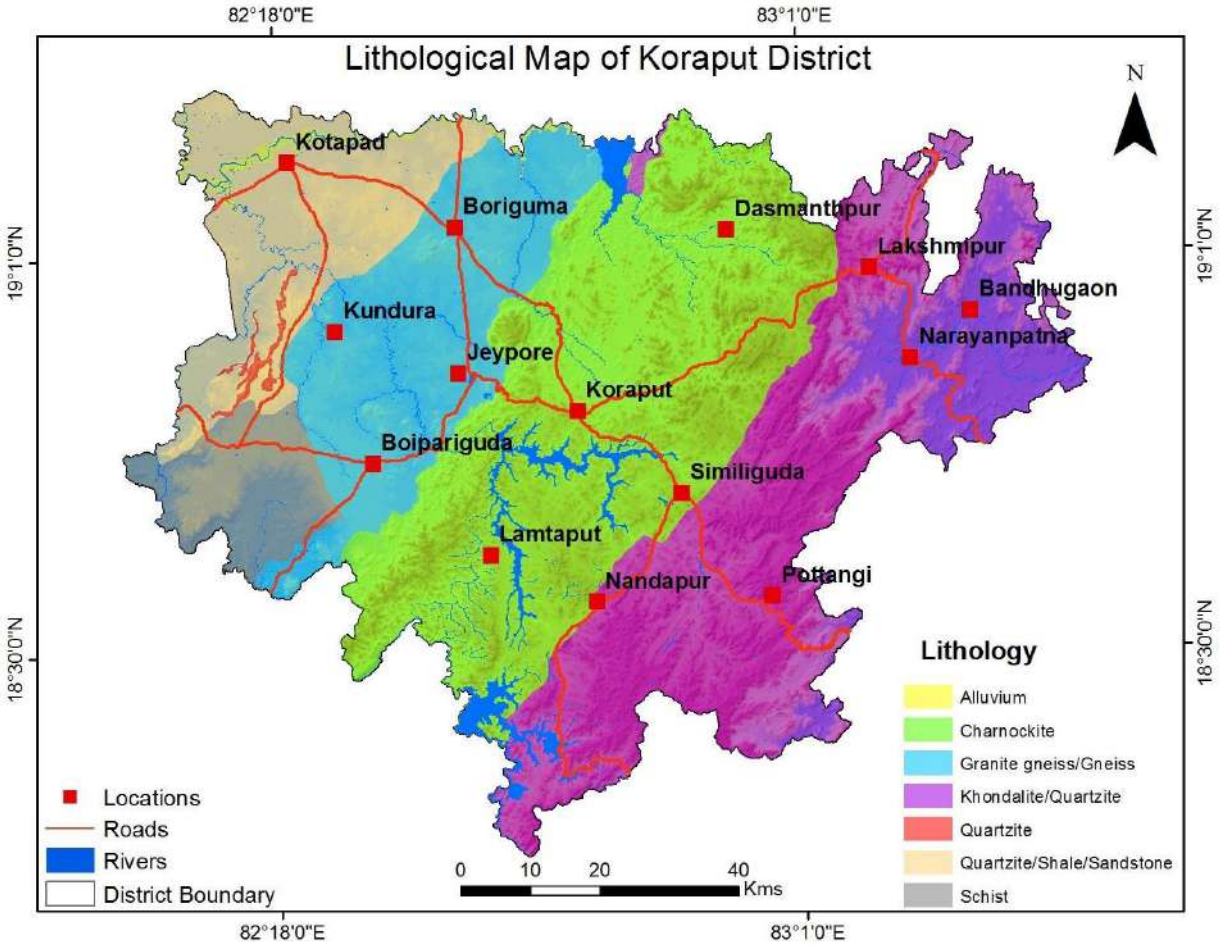
Quartzite -These include quartzite, garnet, andalusite gneiss of Bengal Group. These are metasediments occupying the limited area in the western part of the district.

Shale, limestone, and Quartzite - These belong to Chattisgarh Group of middle to upper Proterozoic age occurring unconformably over granite gneisses. These groups of rocks are slightly metamorphosed and consist of white non-feldspathic quartzites, impure limestone, and purple shales. They are exposed in the north-eastern part of the district. They are best exposed around Gupteswar - Ramgiri area in Boipariguda blocks.

Laterite and Alluvium -These are reddish, porous; concretionary material occurs as capping over the country rocks. The considerable thickness of Laterite mainly of detrital origin have also been formed or shaly formation around Kotpad area. Laterite generally occurs due to intensive weathering under extreme oxidizing conditions in tropical to a sub-tropical climate characterized by strongly contrasting wet and dryseasons.The alluvium of recent origin comprising of sand, silt and clay of limited extension and thickness occurs in pockets along major drainage channels. They are generally fine to coarse grain in nature.

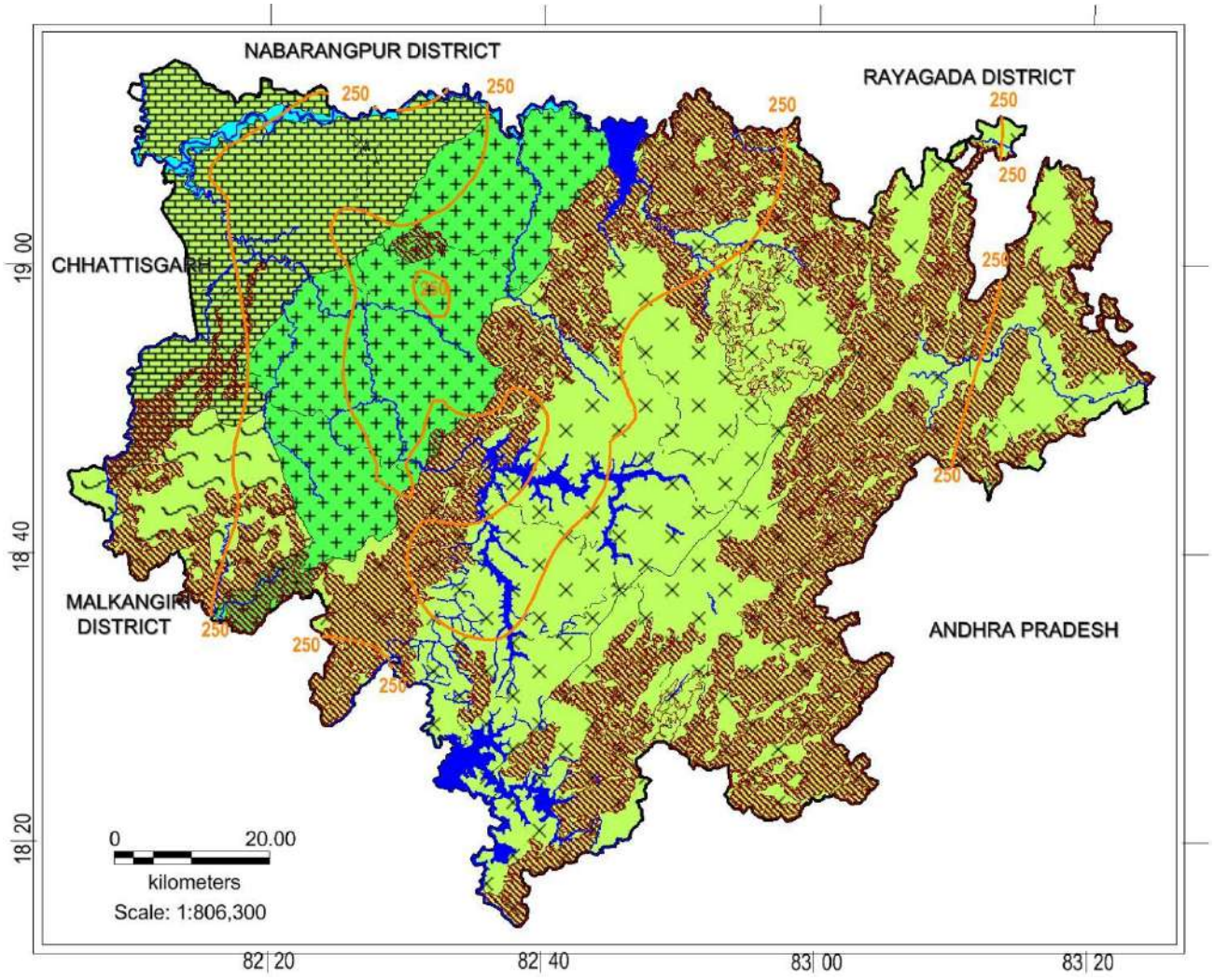
The major part of Koraput district is underlain by the rocks of the eastern ghat group which has undergone multiple deformation as revealed by the presence of structural features like fold, faults, joints, foliation etc: There are at least five major tectonic events represented by NE-SW, ENE-WSW, N-S, NW-SE and NNE-SSW tectonic patterns in chronological order. Granite gneisses exhibit gneissosity in the NNE-SSW direction. Khondalite is highly fractured and sheared. Charnockite is usually massive and compact in nature.The rocks of the Chhattisgarh group are gently folded with low dips of both the limbs (4°-11°). The fold axis trends in N 35° E - S 35 °E.

Fig.11. Geological map of Koraput district, Odisha



B. HYDROGEOLOGY: As discussed earlier the district comprises with consolidated formation and unconsolidated formations (Fig.12a). As the district comprises mostly of hills and plateaus, no clear groundwater movement is observed. Overall slope of the topography and drainage are from SE to NW direction.

Fig.12a. Hydrogeological Map of Koraput District



CONSOLIDATED FORMATION	Pre-Cambrian	Volcanics, Epidiorites etc.	FISSURED FORMATION	Groundwater restricted to weathered residuum fracture zones having secondary porosity	10-15 or more Lps
		Quartzite, Shale, Sandstone, BIF, Limestone & Dolomite			Low to moderate yield 3-10 Lps
		Slate, Phyllite, Schist, Gneiss, Marble, intrusive(acid/basic/ultrabasic/ultramafic)			Low Yield 1-5 Lps
	Archean	Khondalites, Charnockites, and Calc Silicate Rocks		Groundwater restricted to weathered residuum fracture zones	Hilly Areas without productive aquifers except in pockets yield < 1 Lps
		Granite and Granite Gneiss			

C. SUBSURFACE DETAILS:

More than 90% of the total geographic area is occupied by crystalline rocks (Consolidated Formation) comprising of granite gneiss, charnokites and khondalites. Aquifer is unconfined within weathered zone and semiconfined within fracture zone. Majority of fracture zones are confined within 100 meter depth and very few are beyond 100 meter depth upto a drilling depth of 200 mbgl. Fracture zones are generally discontinuous upto a drilling depth of 200 mbgl. Weathered zone depth in granite varies from 5.5 to 49.5 mbgl and depth of fracture varies from 23 mbgl to 187 mbgl. Discharge of tube wells in granite varies from 1.98 to 8.07 lps and drawdown varies from 7.32 to 33.99 m. Transmissivity value obtained after conducting pumping test/PYT/slug test in granite ranges from 2.32 to 143.65 m^2/day, whereas storativity value ranges from $1.38x10^{-2}$ to $1.21 x10^{-4}$. Weathered zone depth in khondalite varies from 5.5 to 62.3 mbgl and depth of fracture varies from 27 mbgl to 183 mbgl. Discharge of tube wells in khondalite varies from 0.4 to 12.19 lps and drawdown varies from 6.88 to 34.69 m. Transmissivity value obtained after conducting pumping test/PYT/slug test in khondalite ranges from 0.33 to 32.77 m^2/day, whereas storativity value ranges from $2.21x10^{-4}$ to $11.28 x10^{-4}$. Weathered zone depth in charnockite varies from 26.8 to 31.1 mbgl and depth of fracture varies from 54 mbgl to 163 mbgl. Discharge of tube wells in charnockite varies from 1.26 to 6.8 lps and drawdown varies from 27.1 to 31.29 m. Weathered zone depth in basic intrusive and migmatites varies from 19.6 to 49.2 mbgl and depth of fracture varies from 20 mbgl to 150 mbgl. Discharge of tube wells in basic intrusive and migmatite varies from 0.25 to 6.9 lps and drawdown varies from 25.8 to 40.00 m. Three dimensional panel diagram is given in Fig.12b .

D. VES SURVEY INTERPRETATION:

In the surveyed area of Koraput district, in general, the weathered / semi weathered zone extends down to the depth of 30 mbgl. Thin fractured zones were identified by ‘current increase’, ‘curve break’ and ‘factor flat’. Mostly the 2nd, 3rd or 4th geoelectric layer, occasionally the 5nd one with resistivities ranging from 9 to 400 Ohm m, occasionally exceeding to more than 600 Ohm m has been inferred as Less compact formation / formation with fractures. Wide range of the resistivities may be due to the variations in the degree of fracturing, nature of the formation, etc. The thickness of the geoelectric layer inferred as less compact / formation with fractures varies between 7 and 170 m. The depth to bottom of this layer is, in general, varying from 9 to 200 m, occasionally more than 200m.

On the basis of geoelectrical layer parameters and the fractured zone analysis a few sites are recommended for borehole drilling (Annexure-II).

Fig.12b.Three-dimensional aquifer disposition model, Koraput District

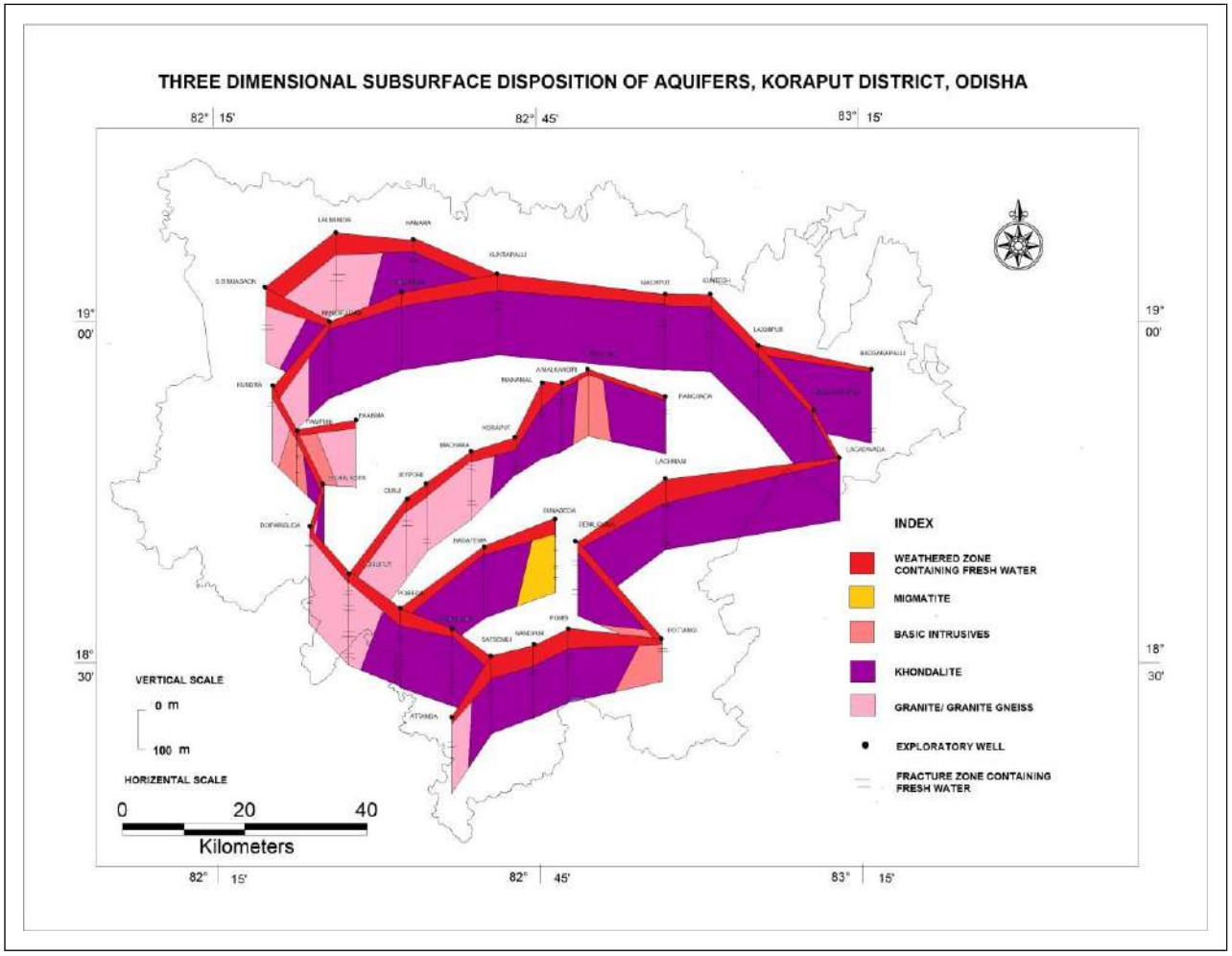


Fig.12C.Cross section lines in different directions , Koraput District

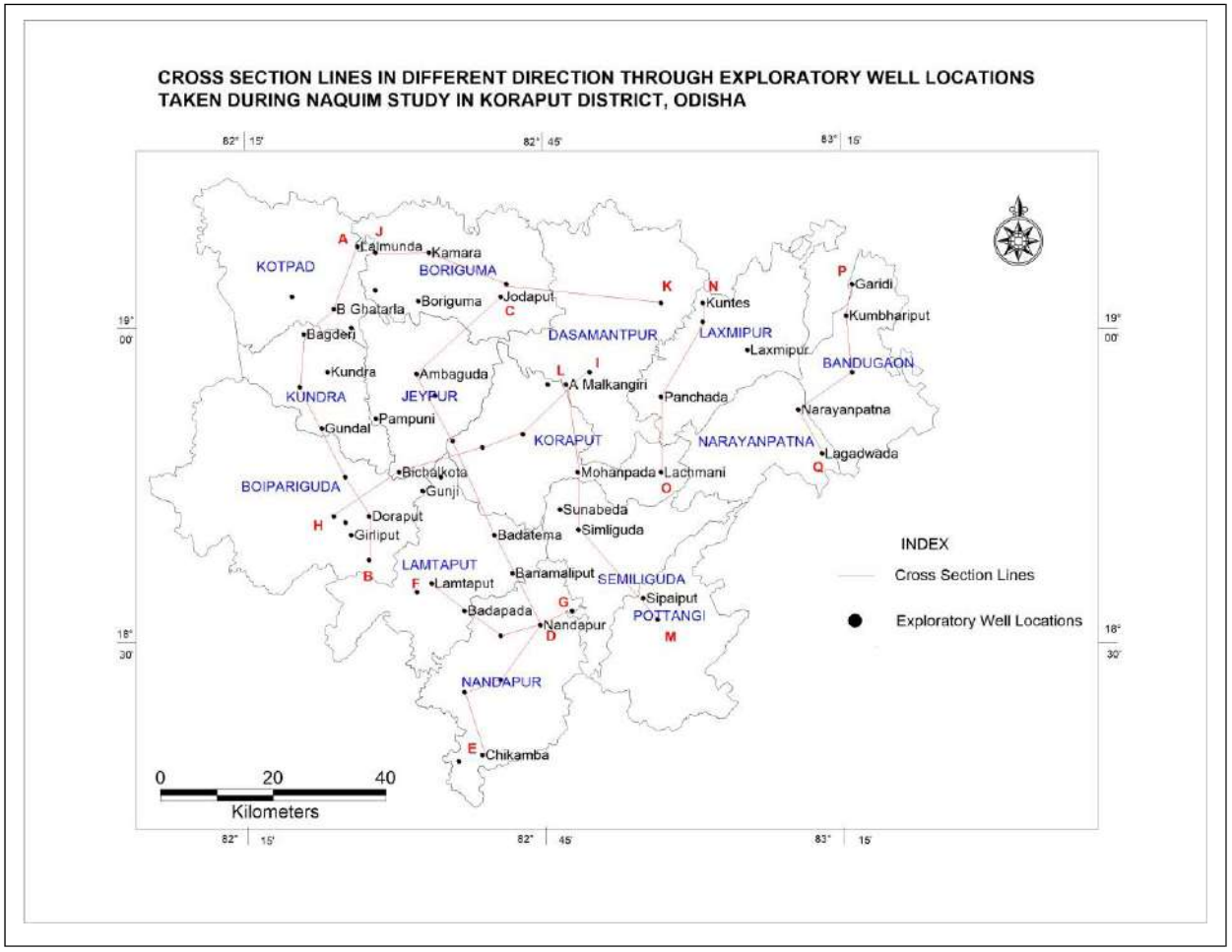


Fig.12d.Cross section along AB directions , Koraput District

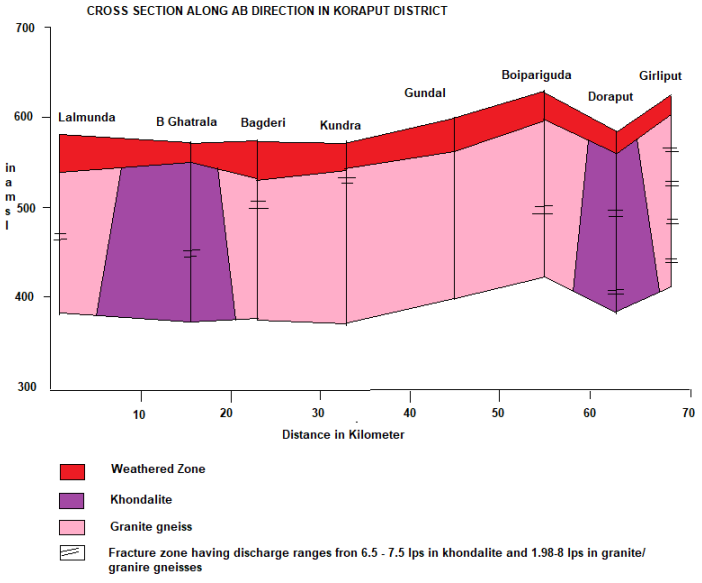


Fig.12e.Cross section along CDE directions , Koraput District

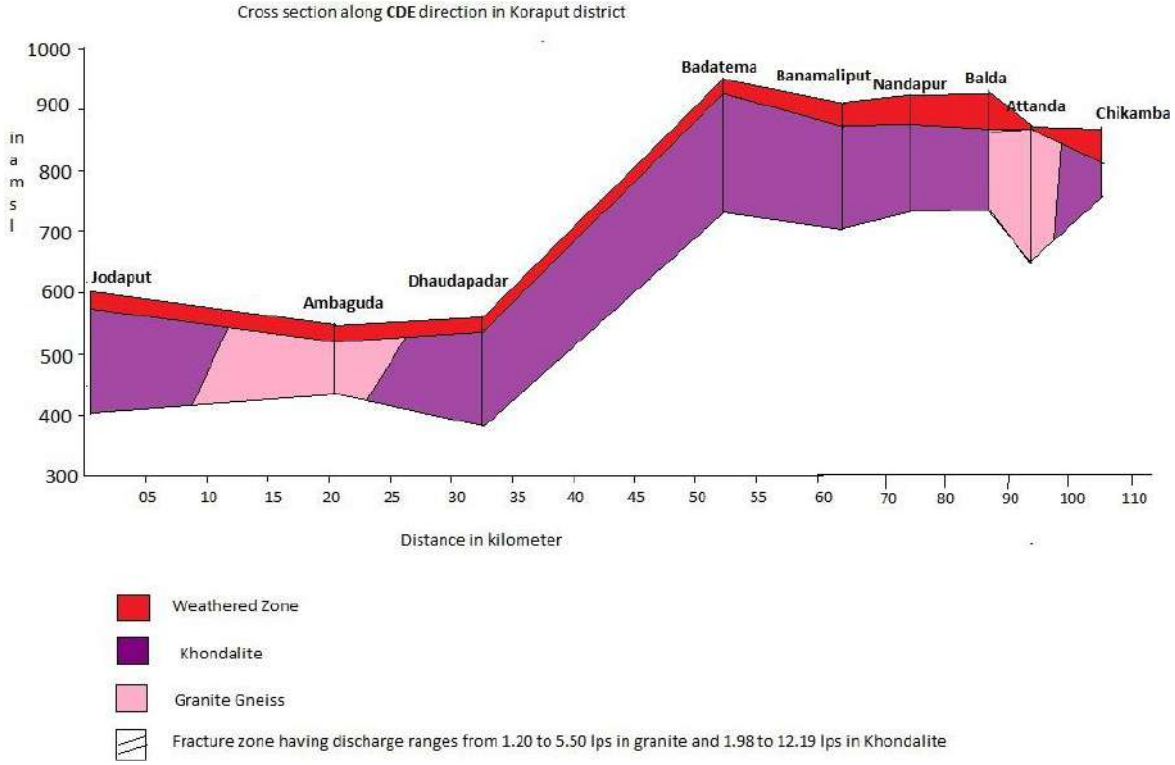


Fig.12f.Cross section along FG directions , Koraput District

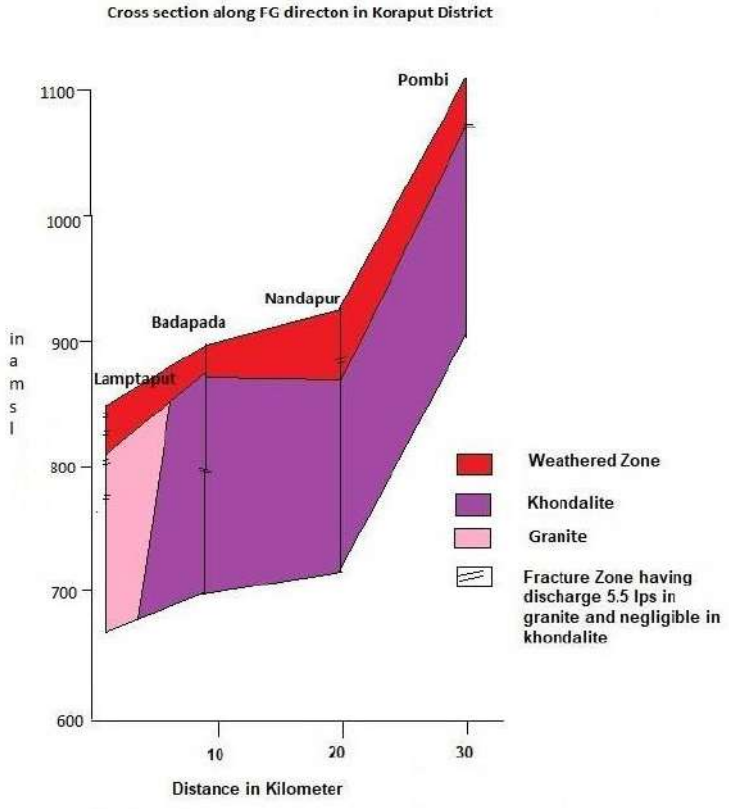


Fig.12g.Cross section along HI directions , Koraput District

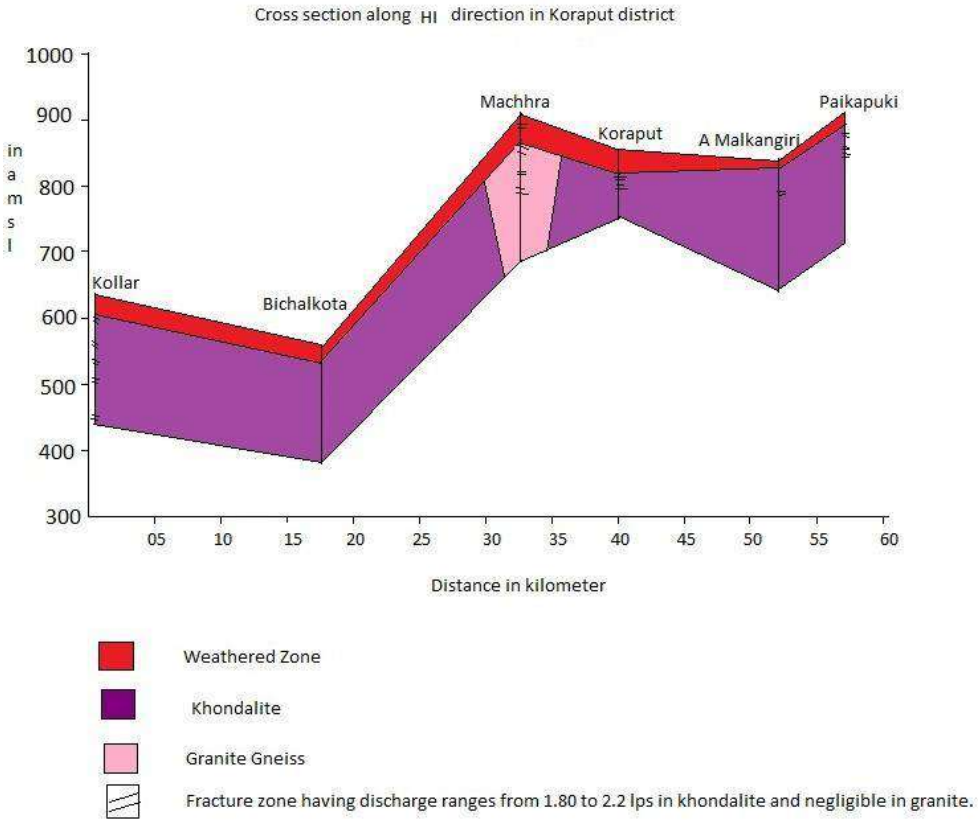


Fig.12h.Cross section along JK directions , Koraput District

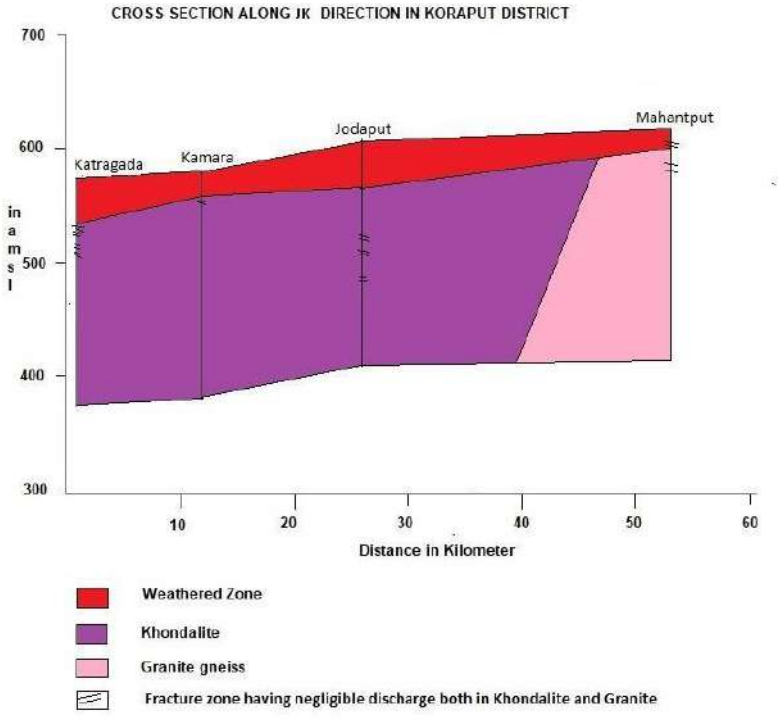


Fig.12i.Cross section along LM directions , Koraput District

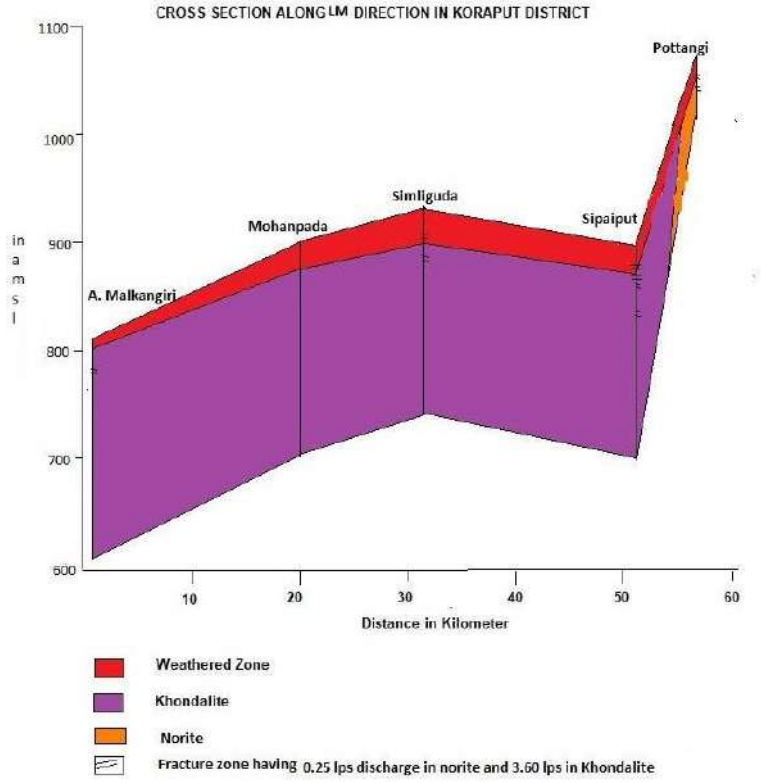


Fig.12j.Cross section along NO directions , Koraput District

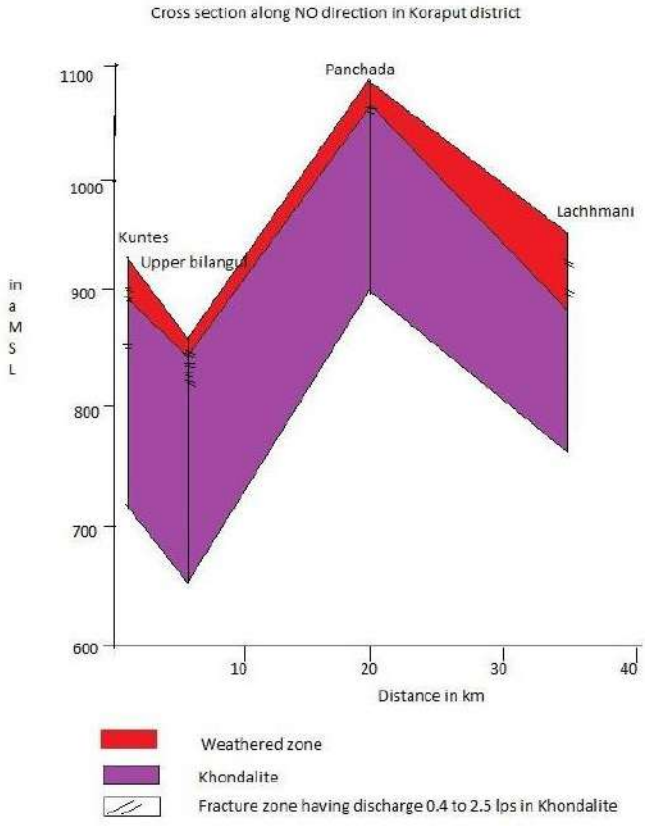
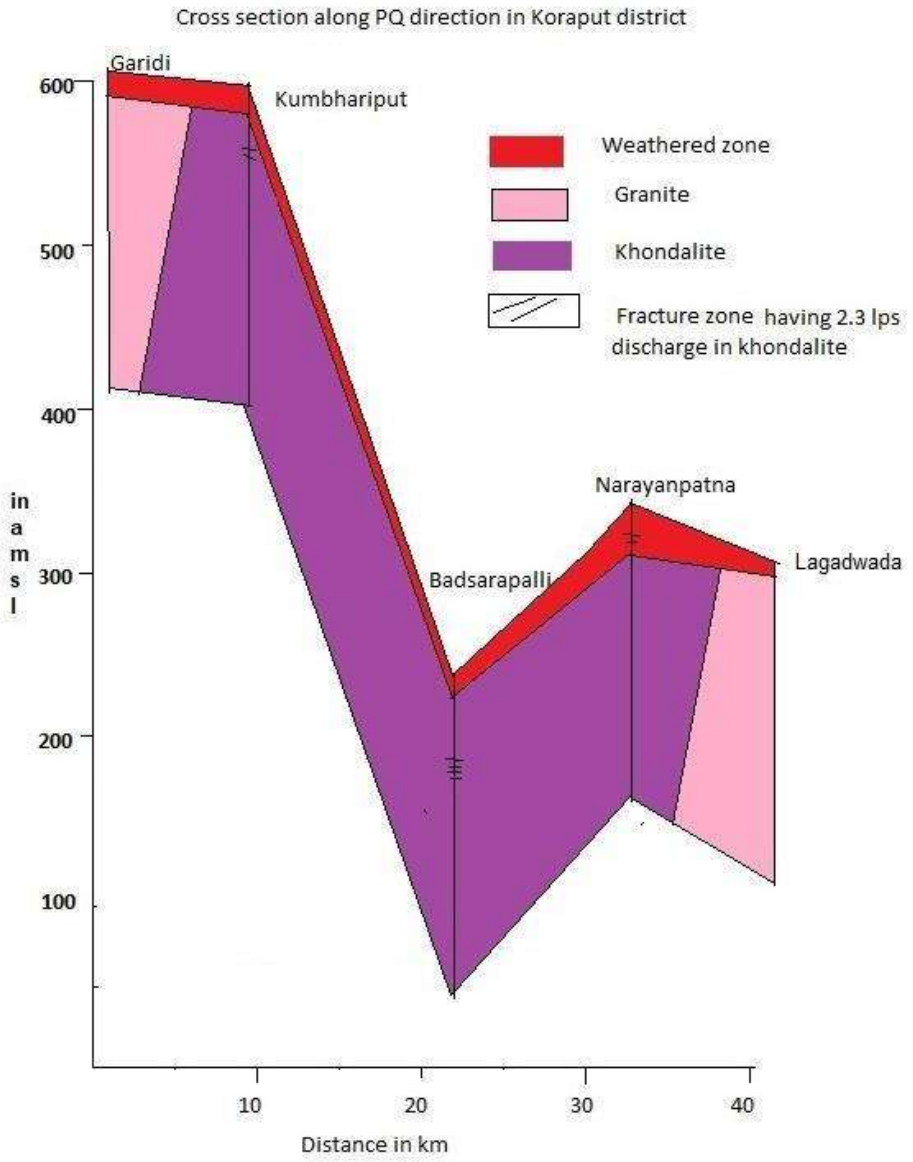


Fig.12k.Cross section along PQ directions , Koraput District



E. AQUIFER GROUPING: On the basis of data collection of exploratory wells it has observed that 7 bore well constructed within 100 mbgl depth and 67 bore wells constructed between 100-200 mbgl depth. Discharge of the tube wells having fracture zones within 100 meter depth varies from 0.25-3.3 lps and discharge of the tube wells having fracture zones upto 200 meter depth varies from 0.40 – 12.19 lps. On the basis of weathered zone and fracture zone details, aquifer grouping is summarized in the Table 13:

Table 13: Aquifer Grouping in Koraput District, Odisha

Aquifer Group		Depth Range (mbgl)		Thickness (m)	
		From	To	Min	Max
Aquifer I (Within 100 m)	(Weathered Zone)	5.5	49.2	0.5*	44.2*
	(Fracture Zone)	18	98	0.5	1.5
Aquifer II (100-200 m) (Fracture zone)		103	187	0.5	1

***Depth of mean water level, i.e., 5.00 mbgl will be considered as depth of unsaturated zone. Hence it will be subtracted from the total depth of weathered zone**.

F. WATER LEVEL, WATER TABLE, DECEDAL TREND: Pre-Monsoon Depth to Water Level during 2021 ranges from 1.9 mbgl to 12.01 mbgl (Fig.13a). Post-Monsoon Depth to Water Level during 2021 ranges from 0.1 mbgl to 11.7 mbgl(Fig.13b). Annual fluctuation of water level ranges 0.05 to 9.11 m rise in 85 wells and 0.12 to 4.18 m fall in 11 wells.

Long Term water level fluctuation in 10 yrs (2011-2021) in m-----0.0014 cm/ yr to >0.0289 cm rise, 0.044 cm/ yr to 0.008 cm/yr falling (Post-monsoon).

Ten years post monsoon mean (2011-21) ground water level ranges from 0.36 to 12.11 mbgl (Fig 13c).

Fig.13a. Depth to water level map (Pre monsoon, 2021), Koraput District

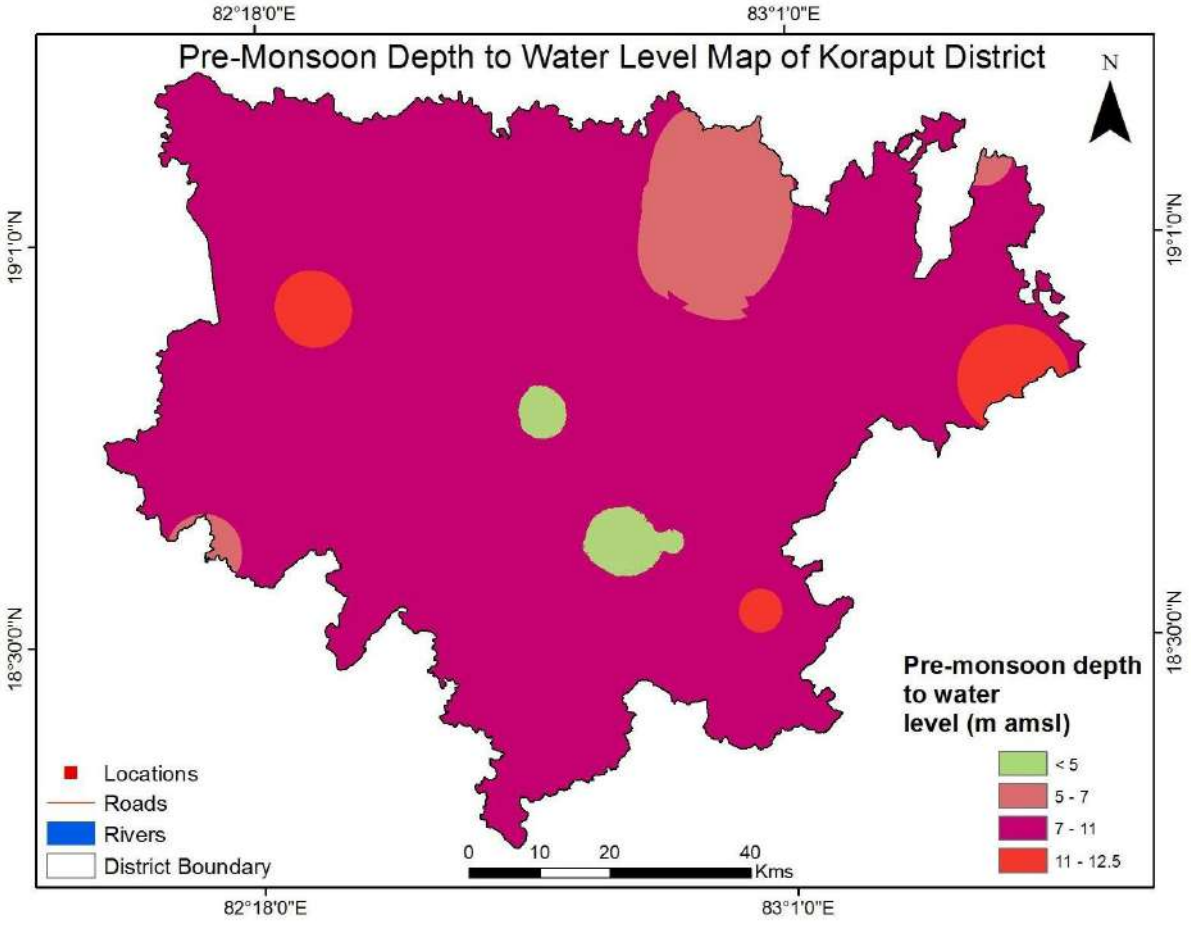


Fig.13b. Depth to water level map (Post monsoon, 2021), Koraput District

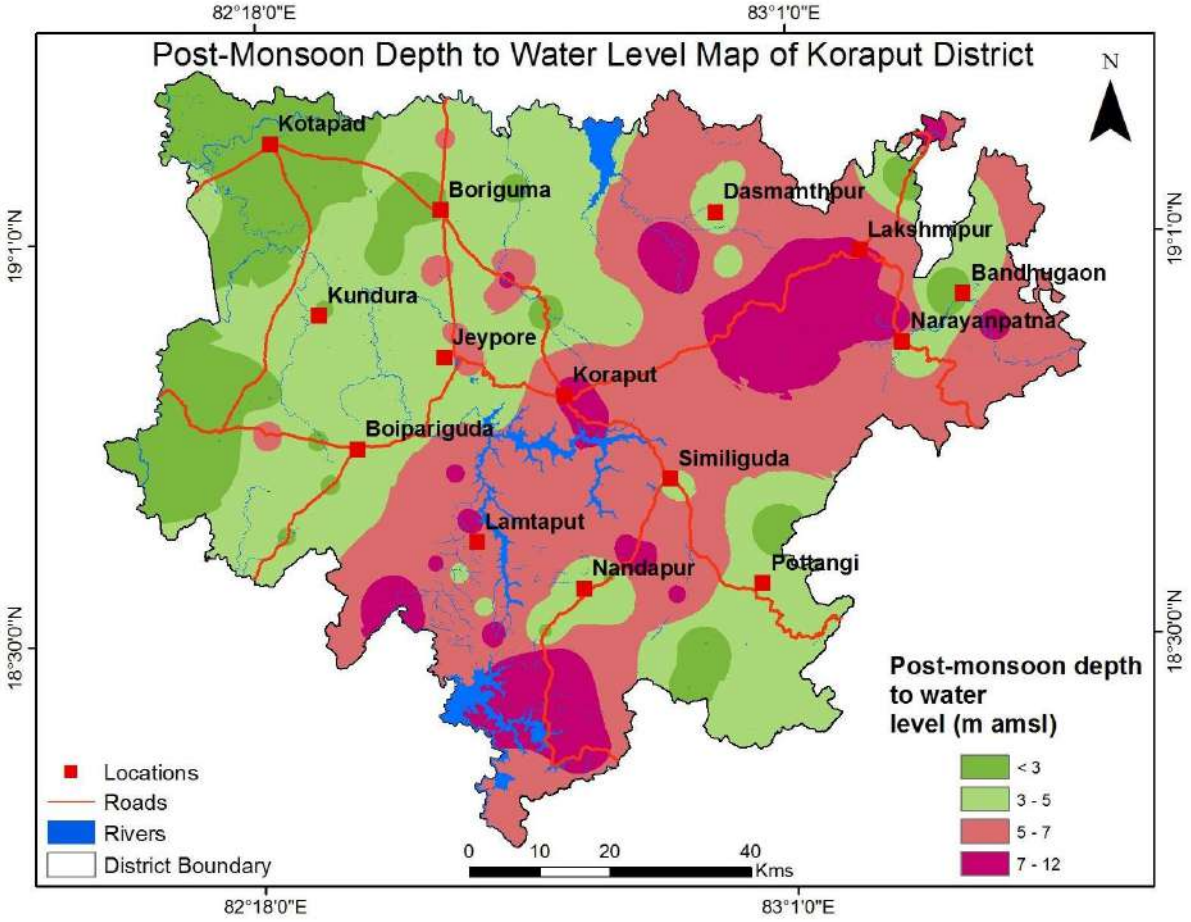


Fig.13c. Ten Years (2011-21) Post Monsoon Mean water level map, Koraput District, Odisha

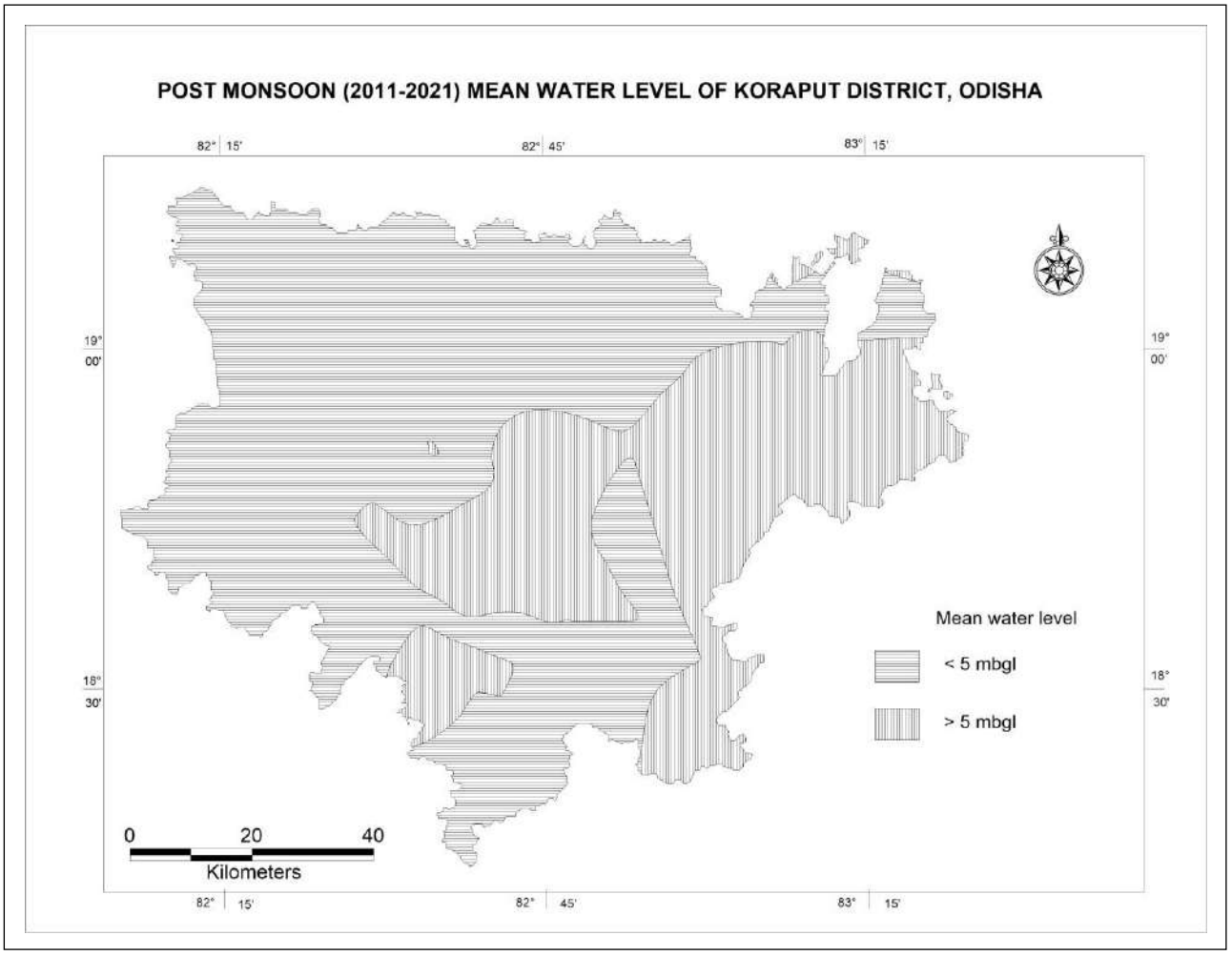


Fig.14. Ten years Post monsoon (2011-2021) water level trend map,Koraput District, Odisha

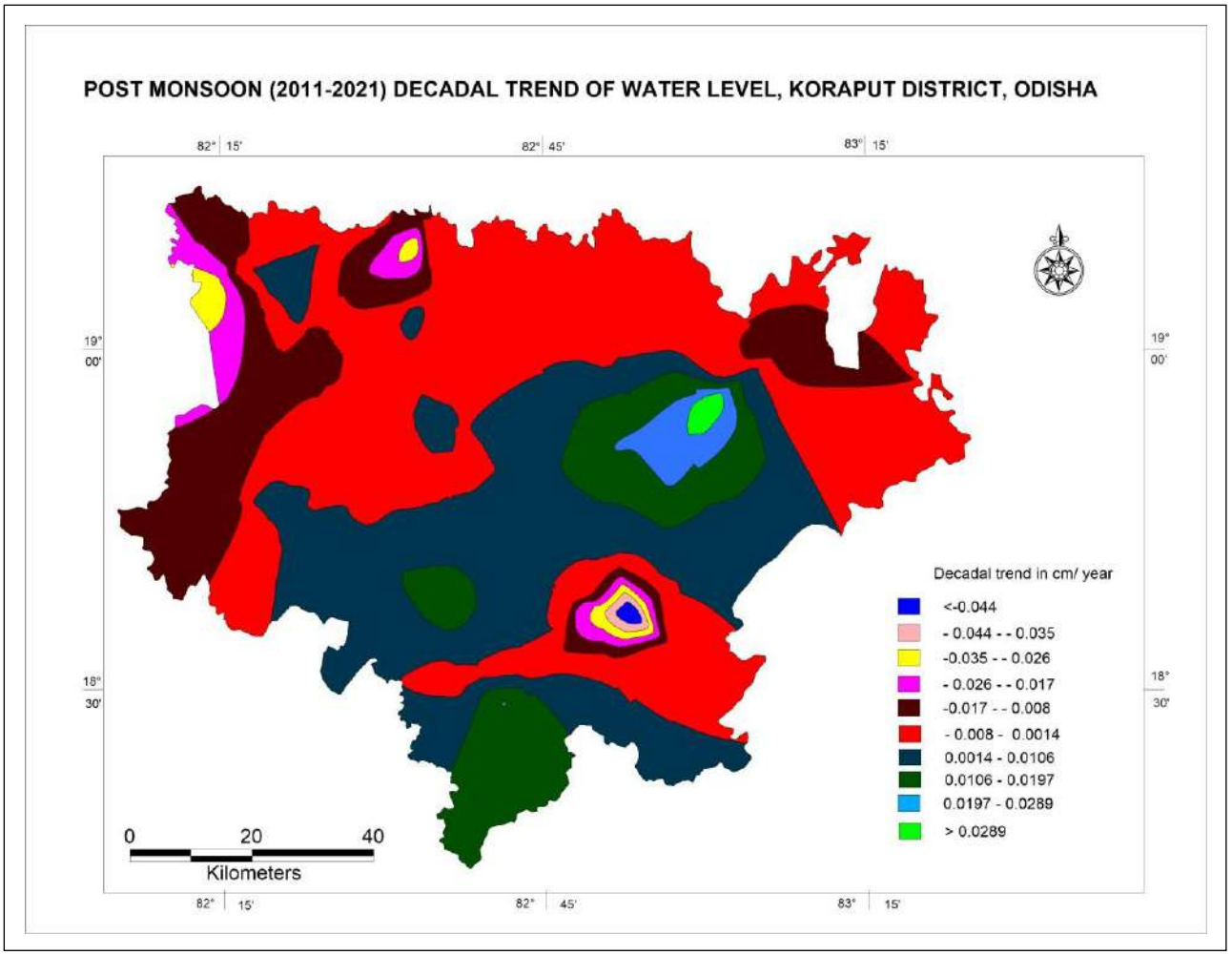
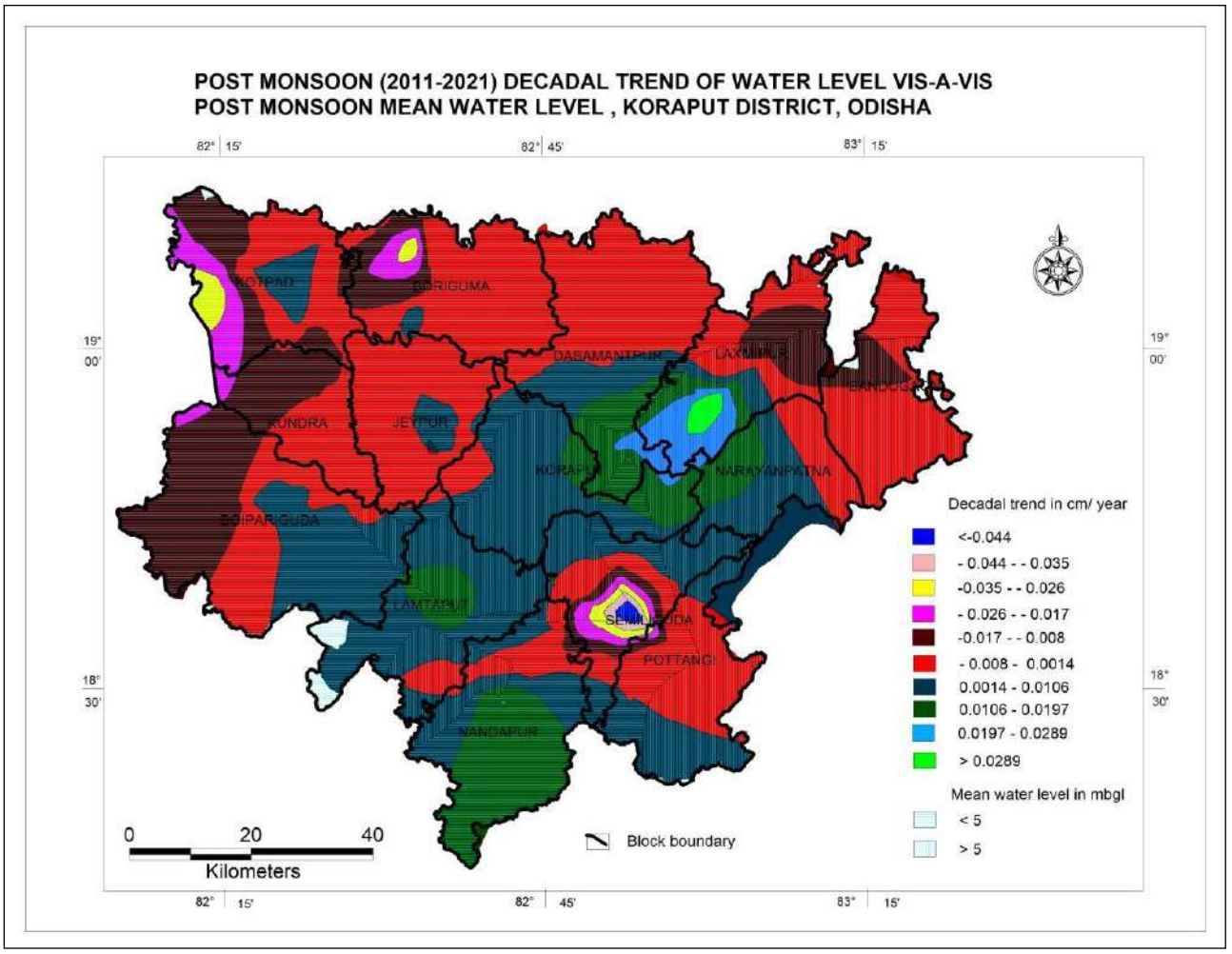


Fig.15. Ten years Post monsoon (2011-2021) water level trend map vis-à-vis post monsoon water level trend map ,Koraput District, Odisha



G. HYDROCHEMISTRY OF SHALLOW AND AQUIFER:

On the basis of chemical quality analysis of ground water samples from exploratory wells and key wells (including NHS) Piper Trilinear Diagram (Fig. 16a,c) and Wilcox diagram (Fig. 16b,d) have been prepared. The analytical details are summarized in the Table- 14a and 14b. Concentration of major cations in shallow and deep aquifers are characterized by Ca>Mg>Na>K and major anions are characterized by HCO_3^- >Cl^->SO_4^->NO_3^->F^- Type of water is bicarbonate type as well as chloride type and is also suitable of irrigation, drinking and industrial use. All elements are found within permissible limit for exploratory wells as for dug wells. But for phreatic aquifer nitrate concentration above permissible limit have been found at few places like Ganjaipadar in Koraput Block and Lula in Dasmantapur Block .Electrical conductivity contour map of both shallow and deep aquifer are shown in Fig. 16e and f.

Table-14a. Range of parameters in Deeper aquifer ground water samples.

Parameter	Unit	Min	Max
Ca	mg/l	8	92
Mg	mg/l	4.8	26.4
Na	mg/l	10	189
K	mg/l	0.9	32.4
Cl	mg/l	10	80
HCO^{3-}	mg/l	17.2	380
SO^{4-}	mg/l	12.4	172.1
F	mg/l	0.2	0.68
NO^{3-}	mg/l	3.1	9.4
TDS	mg/l	112	596
Silica	mg/l	1.6	7
Fe	mg/l	0.08	0.18
pH		6.87	8.53

Table-14b. Range of parameters in Phreatic aquifer ground water samples.

Parameter	Unit	Min	Max
Ca	mg/l	2	117
Mg	mg/l	0	68
Na	mg/l	2	80
K	mg/l	0.4	134.1
Cl	mg/l	2	291
HCO^{3-}	mg/l	9	299
SO^{4-}	mg/l	0	81
F	mg/l	0.02	1.1
NO^{3-}	mg/l	0	47.1
TDS	mg/l	12	690
TH	mg/l	8	435
U	ppb	BDL	4.1
pH		6.3	7.96

Fig.16a. Piper diagram for deeper aquifer, Koraput District

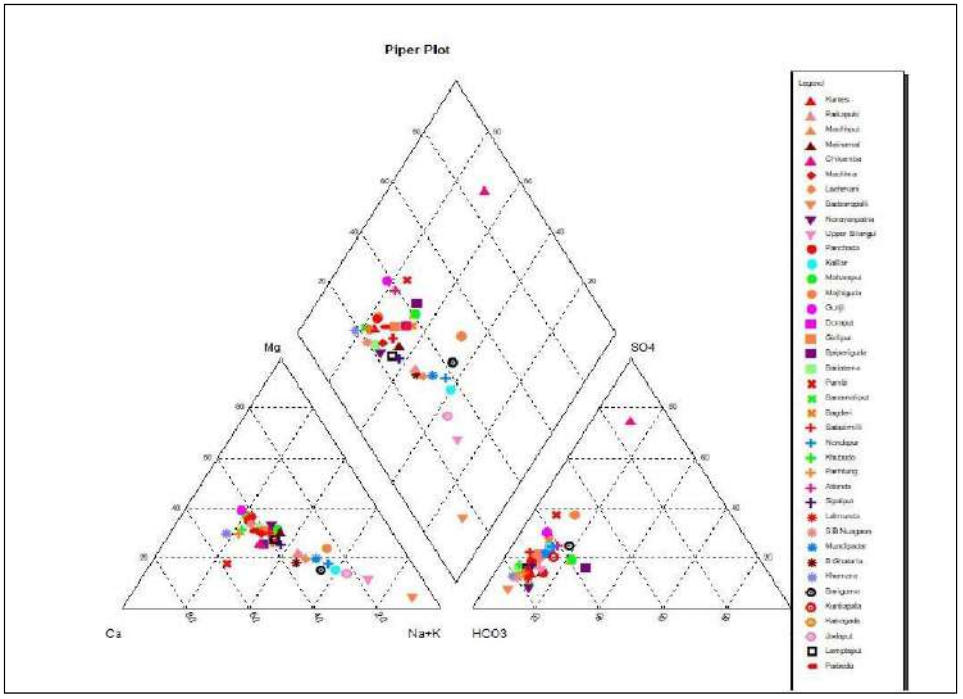


Fig.16b. Wilcox diagram for deeper aquifer, Koraput District

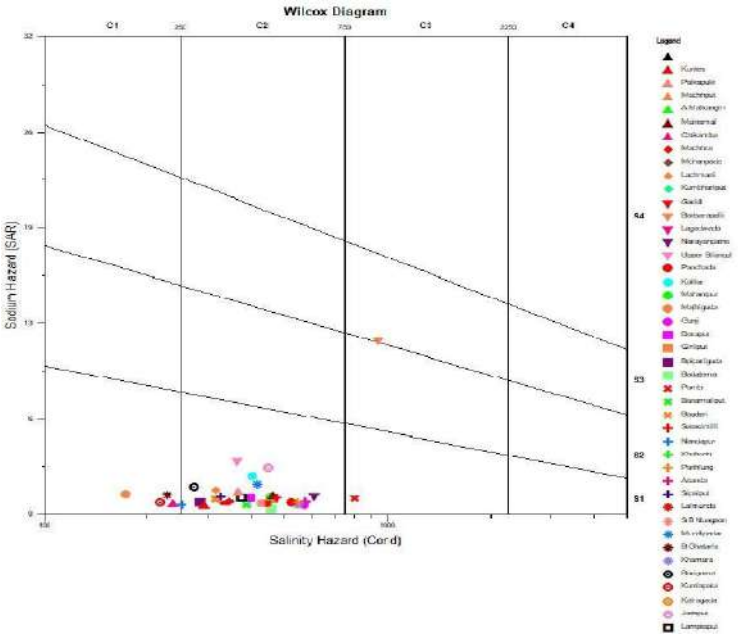


Fig.16c. Piper diagram for Shallow aquifer, Koraput District

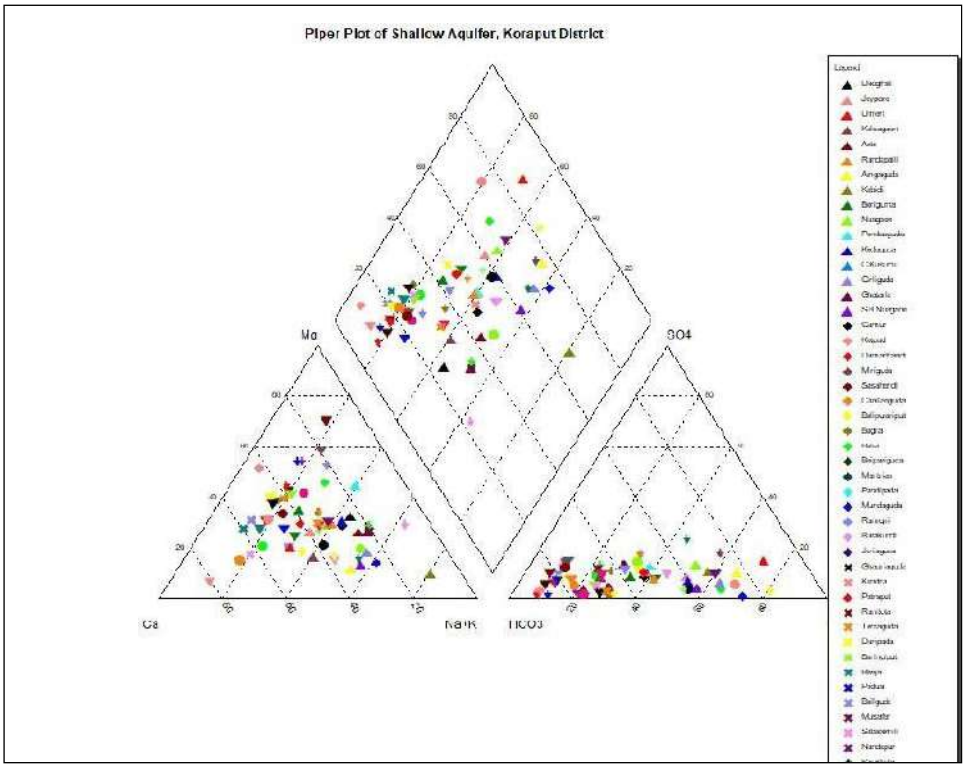


Fig.16d. Wilcox diagram for deeper aquifer, Koraput District

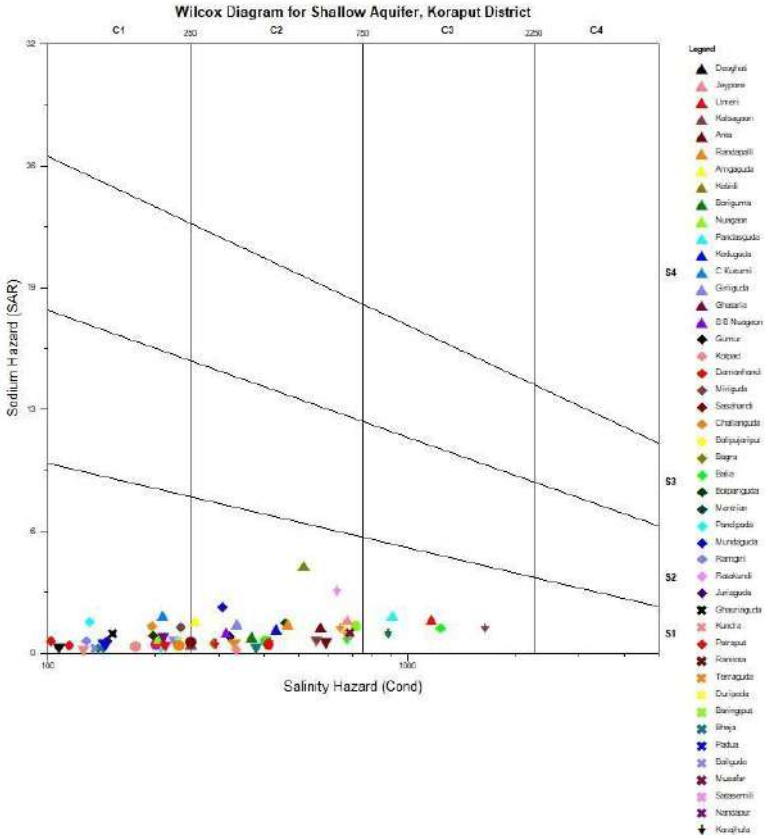


Fig.16e. EC contour map for shallow aquifer, Koraput District

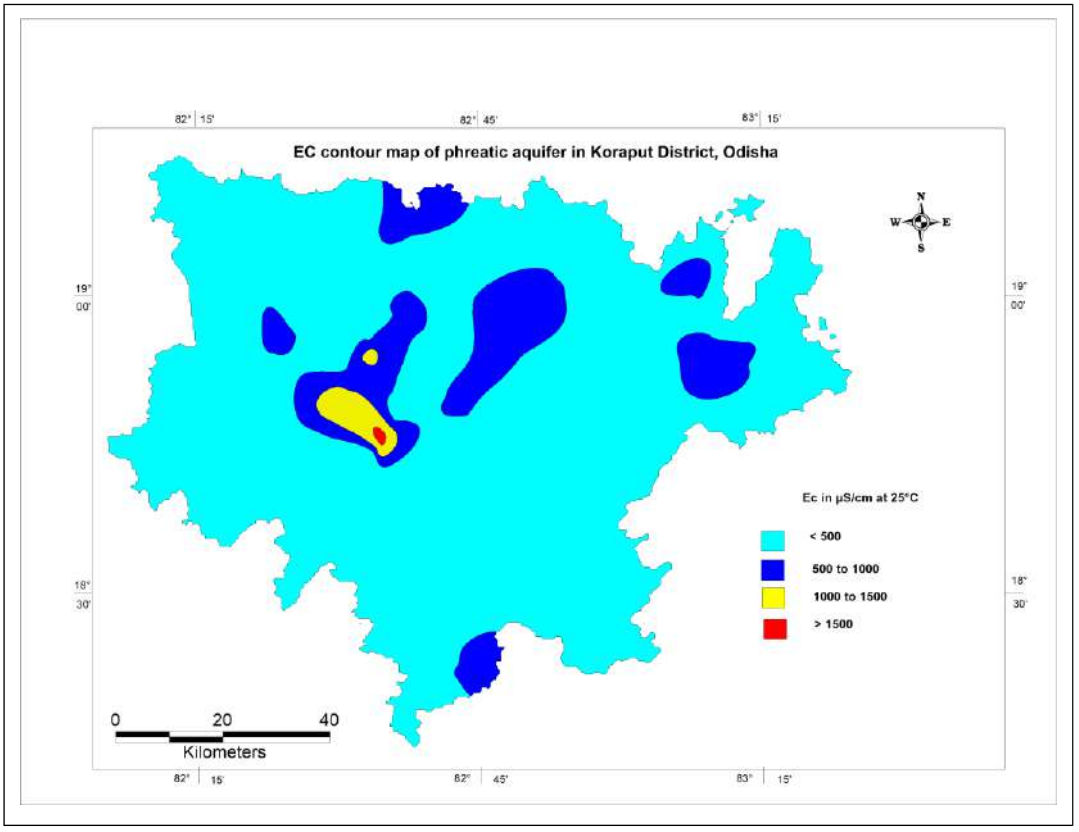
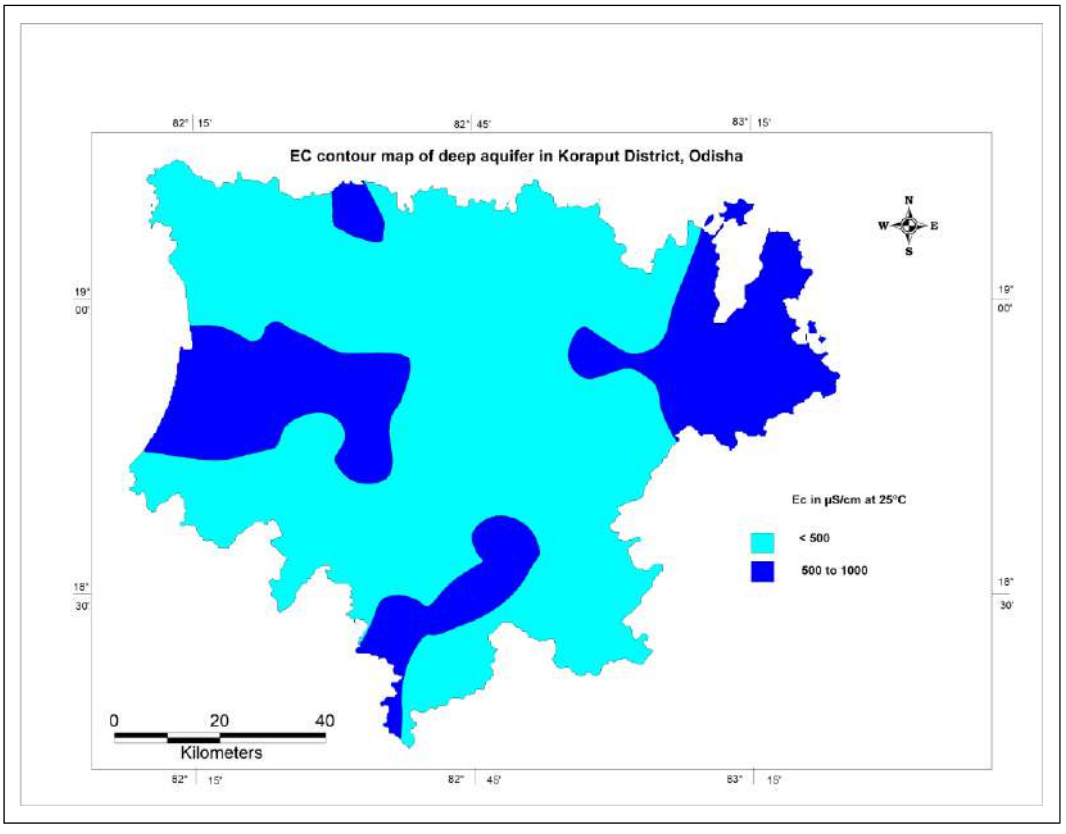


Fig.16f. EC contour map for deep aquifer, Koraput District



4. **GROUND WATER RESOURCES:** Block wise dynamic resources assesment (as on 31.03.2021) of Aquifer-I of Koraput district have been summarized in Table-15. Block wise static resources assessment of Aquifer-1 is also formulated in Table-16.

Table-15. Dynamic Ground Water Resources of Aquifer-1, Koraput District (As on 31.3.2021)

Sl No	Block	Utilizable Ground Water Resources	Gross Ground Water Draft for all uses	Balance Ground Water Resources	Allocation for Domestic Requirement for next 25 years	Net Ground Water Availability for Future Development	Stage of Ground Water Development	Category
		Ha. M	Ha. M	Ha. M	Ha. M	Ha. M	%	
1	BAIPARIGUDA	6208.97	854.79	5354.18	379.58	5310.71	13.76702	Safe
2	BANDHUGAON	1265.94	369.78	896.16	194.17	877.01	29.20992	Safe
3	BORIGUMA	6204.47	2166.38	4038.09	489.94	4005.83	34.91644	Safe
4	DASMANTAPUR	4518.04	569.5	3948.54	258.8	3926.92	12.60502	Safe
5	JEYPORE	3840.76	1346.16	2494.6	576.06	2432.38	35.04931	Safe
6	KORAPUT	4078.82	684.09	3394.73	502.34	3360.25	16.77176	Safe
7	KOTPAD	7418.25	1100.38	6317.87	401.83	6283.65	14.83342	Safe
8	KUNDRA	3980.63	926.48	3054.15	247.1	3025.22	23.27471	Safe
9	LAMTAPUT	3491.26	604.16	2887.1	175.4	2877.74	17.30493	Safe
10	LAXMIPUR	2025.26	496.36	1528.9	269.4	1503.09	24.50846	Safe
11	NANDAPUR	3344.7	342.73	3001.97	277.72	2983.38	10.24696	Safe
12	NARAYANAPATNA	551.32	172.09	379.23	136.47	368.44	31.21418	Safe
13	POTANGI	1412.19	270.53	1141.66	219.69	1123.38	19.15677	Safe
14	SIMILIGUDA	2593.54	971.89	1621.65	698.7	1498.03	37.47349	Safe
District Total		50934.15	10875.32	40058.83	4827.2	39576.03	21.35	**Safe**

From Table -15, it can be understand that stage of ground water development is minimum in Nandapur Block and maximum in Simliguda Block.

Static groundwater resources (Table-16) have been calculated of Aquifer-I considering effective aquifer thickness of only 5%, as fracture zones are very thin and heterogeneously distributed throughout 100-meter depth (i.e., the bottom of aquifer-1).

Table-16. Static Ground Water Resources of Aquifer -1, Koraput District (As on 31.3.2017)

Name of the Assessment Unit	Static Resources Area (ha)	Pre-monsoon water level (m)	Bottom of unconfined aquifer (m)	Difference (3-2) (m)	Effective Aquifer Thickness (m) {= (4) *5%}	Specific Yield (%)	Total Static Resources (ham) (7) = (1) *(5) *(6)
	1	2	3	4	5	6	7
Baipariguda	81057	7.7	100	92.3	4.61	0.02	7473.455
Bandhugaon	15705	6.5	100	93.5	4.67	0.03	2200.271
Boriguma	56430	6.17	100	93.83	4.69	0.02	5293.134
Dasmantapur	63481	5.63	100	94.37	4.71	0.03	8969.865

Jeypore	36037	3.27	100	96.73	4.83	0.03	5221.761
Koraput	55222	8.55	100	91.45	4.57	0.02	5047.291
Kotpad	63056	5.11	100	94.89	4.74	0.03	8966.563
Kundra	35337	8.64	100	91.36	4.56	0.02	3222.734
Lamtaput	57337	8.13	100	91.87	4.59	0.02	5263.537
Laxmipur	29623	7.67	100	92.33	4.61	0.03	4096.861
Nandapur	47041	7.5	100	92.5	4.62	0.03	6519.883
Narayanapatna	7275	12.01	100	87.99	4.39	0.03	958.1175
Potangi	16603	8.71	100	91.29	4.56	0.03	2271.29
Similiguda	36402	8.5	100	91.5	4.57	0.03	4990.714
Baipariguda	81057	7.7	100	92.3	4.61	0.02	7473.455
							77968.93

Block wise total groundwater resources of Aquifer-1 have been summarized in Table-17. Total dynamic groundwater resources has been observed as 395.76 mcm and total static ground water resources has been seen as 779.69 mcm for the whole Koraput district.

Table-17. Total Ground Water Resources (As on 31.3.2021), Koraput District

Name of the Assessment Unit	**Annual Extractable Ground Water Recharge of Aquifer -1**	**In storage Ground Water Resources of Aquifer-1**	**Total Ground Water Availability of Aquifer 1**
	Aquifer-1		
Baipariguda	5596.98	7481.56	13078.54
Bandhugaon	999.68	2202.63	3202.31
Boriguma	6787.98	5294.83	12082.81
Dasmantapur	4516.54	8986.05	13502.59
Jeypore	3749.14	5228.79	8977.93
Koraput	3526.47	5050.05	8576.52
Kotpad	7418.28	8975.08	16393.36
Kundra	3305.96	3228.39	6534.35
Lamtaput	3298.9	5267.55	8566.45
Laxmipur	1431.28	4102.64	5533.92
Nandapur	2643.31	6526.94	9170.25
Narayanapatna	412.24	960.19	1372.43
Potangi	1337.06	2273.53	3610.59
Similiguda	2584.6	4996.17	7580.77
Total	47608.42	70574.4	118182.8

Dynamic and static groundwater resources of Aquifer-2 could not be able to calculated due to nonavailability of sufficient tube well data like Specific yield and storage coefficient beyond 100 meter depth.

5. **GROUNDWATER RELATED ISSUES:** Groundwater related issues can be broadly divided into two categories, viz., area feasibility of ground water development from Aquifer-I and areas not feasible for sufficient groundwater withdrawal from shallow as well as deeper aquifer. From the three-dimensional aquifer model, it is seen that groundwater is available in weathered zone and also fracture zones within 100 mbgl depth.

   On the basis of dynamic ground water resource assessment, it can be said that quantity of static ground water resources is more than the quantity of dynamic ground water resources for the whole district. Similarly, from dynamic ground water resources assessment over the years in all the blocks of Koraput district indicates a Stage of Ground Water development is only 21.35%.So there may be a posiibility of ground water development scope.

   Chemical quality of ground water sample shows all cations and anions of major elements are within permissible limit except nitrate at few places. As all the blocks are falling in safe category and more availability of static resources than dynamic resources ground water development can be possible in this district.

   But on the basis of long term water level trend and on the basis of long term mean water level only 659.1 sq.km area covering 313 villages in part of Semiliguda, Lamptaput, Nandpur, Potangi, Laxmipur, Bandhugaon, Narayanpatna Blocks are showing falling long term water level trend , as well as mean water level is more than 5 mbgl. This area may be avoided from huge ground water withdrawal.

   Crop water demand is 3.32 bcm during 2021 and projected crop water demand will be 4.07 bcm during 2025 and 5.95 bcm during 2035 (Table - 18).

WATER DEMAND, AVAILABILITY AND GAP ANALYSIS:

For calculation of water demand and gap analysis domestic water demand, crop water demand, livestock water demand data taken from PMKSY report of Koraput District (2016), Irrigation department, Odisha for the year 2011, 2021. Then on the basis of interpolation technique demand for 2025 and 2035 have been extrapolated. The ground water availability data taken from CGWB, Ground water resources assessment (2021).

i. **DOMESTIC WATER DEMAND:** Gross domestic water demand of all the blocks in Koraput district shall be **0.044498** bcm in 2021 for the projected population of 1337524 persons, **0.04707** bcm in 2025 for a projected population of 1400356 persons and **0.052298** bcm in 2035 for a projected population of 1557302 persons. Projection of population and domestic water demand for 2021, 2025 & 2035 in different Blocks have been elaborated in Table-18.

Table 18: Domestic water demand, Koraput District

District	Block Name	Projected Population			Water Demand (BCM) considering 100 lpcd		
		2021	2025	2035	2021	2025	2035
Koraput	Kotpad	109243	114943	129192	0.003987	0.004195	0.004716
	Boriguma	176097	185285	208254	0.006428	0.006763	0.007601
	Dasamantapur	93947	98849	111103	0.003429	0.003608	0.004055
	Lakshmipur	76613	80611	90604	0.002796	0.002942	0.003307
	Bandhugaon	67820.43	71359	80205	0.002475	0.002605	0.002927
	Narayanpatana	50111	52726	59262	0.001829	0.001924	0.002163
	Pottangi	59664	55769	46032	0.002178	0.002036	0.00168
	Semiliguda	93511	98390	110587	0.003413	0.003591	0.004036
	Koraput	86097	90589	101819	0.003143	0.003306	0.003716
	Jeypur	140666	148005	166353	0.005134	0.005402	0.006072
	Kundura	82373	86671	97415	0.003007	0.003163	0.003556
	Boipariguda	127358	134003	150615	0.004649	0.004891	0.005497
	Lamtaput	68854	72446	81427	0.002513	0.002644	0.002972
	Nandapur	105220	110710	124434	0.003841	0.004041	0.004542

In the similar manner crop water demand, live stock water demand and industrial water demand have been calculated. The details are given in Table 19.

Table 19: Total water demand of the district for various sectors

	Components for 2021 (In BCM)					Components for 2025 (In BCM)					Components for 2035 (In BCM)				
Block	Domestic	Crop	Livestock	Industrial	Total	Domestic	Crop	Livestock	Industrial	Total	Domestic	Crop	Livestock	Industrial	Total
Kotpad	0.003987	0.64593	0.000451	0.000539	0.650907	0.004195	0.78625	0.000457	0.00063	0.791532	0.004716	1.13705	0.000457	0.000859	1.143082
Boriguma	0.006428	0.496671	0.000701	0.000889	0.504689	0.00071	0.60788	0.00071	0.00104	0.61034	0.007601	0.885901	0.000731	0.001419	0.895652
Dasamantapur	0.003429	0.138544	0.000484	0.000463	0.14292	0.003608	0.17155	0.00049	0.00054	0.176188	0.004055	0.254064	0.000504	0.000733	0.259356
Lakshmipur	0.002796	0.111527	0.000434	0.007013	0.12177	0.00044	0.13695	0.00044	0.00973	0.14756	0.003307	0.200507	0.000454	0.016523	0.220791
Bandhugaon	0.002475	0.10688	0.000454	0.000333	0.110142	0.002605	0.13056	0.00046	0.00039	0.134015	0.002927	0.18976	0.000474	0.000533	0.193694
Narayanpatana	0.001829	0.068549	0.000404	0.000247	0.071029	0.001924	0.08404	0.00041	0.08404	0.170414	0.002163	0.122769	0.000424	0.122769	0.248125
Pottangi	0.002178	0.115193	0.000661	0.000394	0.118426	0.002036	0.14161	0.00067	0.00046	0.144776	0.00168	0.207653	0.000691	0.000624	0.210648
Semiliguda	0.003413	0.18341	0.000404	0.040691	0.227918	0.003591	0.22489	0.00041	0.05686	0.285751	0.004036	0.32859	0.000424	0.097281	0.430331
Koraput	0.003143	0.12171	0.000779	0.00046	0.126092	0.003306	0.15011	0.00079	0.00054	0.154746	0.003716	0.22111	0.000819	0.00074	0.226385
Jeypur	0.005134	0.718353	0.000387	0.000693	0.724567	0.005402	0.87323	0.00039	0.00081	0.879832	0.006072	1.260423	0.000397	0.001103	1.267995
Kundura	0.003007	0.278549	0.000217	0.000404	0.282177	0.003163	0.3414	0.00022	0.00047	0.345253	0.003556	0.498529	0.000227	0.000634	0.502946
Boipariguda	0.004649	0.118314	0.000501	0.000624	0.124088	0.004891	0.14842	0.00051	0.00073	0.154551	0.005497	0.223684	0.000531	0.000994	0.230706
Lamtaput	0.002513	0.08629	0.000327	0.000343	0.089473	0.002644	0.10837	0.00033	0.0004	0.111744	0.002972	0.16357	0.000337	0.000543	0.167422
Nandapur	0.003841	0.138819	0.000889	0.000729	0.144278	0.004041	0.17263	0.0009	0.0009	0.178471	0.004542	0.257159	0.000929	0.001329	0.263959
Total	0.048822	3.328739	0.007093	0.053822	**3.438476**	0.042556	4.07789	0.007187	0.15754	**4.285173**	0.05684	5.950769	0.007399	0.246084	**6.261092**

ii. **DEMAND, AVAILABILITY AND GAP:** Total water availability in Koraput district is 2.6 bcm, out of which 2.091 bcm is surface water & 0.509 bcm (Total dynamic Groundwater resources as on 31.03.2021) is ground water. Projected water demand for 2025, 2035 shall be 4.28 bcm, 6.26 bcm respectively. Supply gap will exist in 6 blocks in Koraput district as mentioned in Table- 20 .

Table 20: Water availability, water demand & gap, Koraput District

Table20: Blockwise water budget of Koraput district									
Blocks	Existing water availability(BCM)		Total (BCM)	Water demand(BCM)			Water gap(BCM)*		
	Surfac ewater	Groun dwate r		2021	2025	2035	2021	2025	2035
Kotpad	0.097	0.074	0.171	0.650907	0.79153	1.14308	0.47991	0.62053	0.97208
Boriguma	0.089	0.062	0.151	0.504689	0.61034	0.89565	0.35369	0.45934	0.74465
Dasamantapur	0.115	0.045	0.160	0.14292	0.17619	0.25936	No gap	0.01619	0.09936
Lakshmipur	0.096	0.020	0.116	0.12177	0.14756	0.22079	0.00577	0.03156	0.10479
Bandhugaon	0.106	0.013	0.119	0.110142	0.13402	0.19369	No gap	0.01502	0.07469
Narayanpatana	0.133	0.006	0.139	0.071029	0.17041	0.24813	No gap	0.03141	0.10913
Pottangi	0.147	0.014	0.161	0.118426	0.14478	0.21065	No gap	No gap	0.04965
Semiliguda	0.17	0.026	0.196	0.227918	0.28575	0.43033	0.03192	0.08975	0.23433
Koraput	0.134	0.041	0.175	0.126092	0.15475	0.22639	No gap	No gap	0.05139
Jeypur	0.141	0.038	0.179	0.724567	0.87983	1.268	0.54557	0.70083	1.089
Kundura	0.117	0.040	0.157	0.282177	0.34525	0.50295	0.12518	0.18825	0.34595
Boipariguda	0.331	0.062	0.393	0.124088	0.15455	0.23071	No gap	No gap	No gap
Lamtaput	0.188	0.035	0.223	0.089473	0.11174	0.16742	No gap	No gap	No gap
Nandapur	0.227	0.033	0.260	0.144278	0.17847	0.26396	No gap	No gap	0.00396
Total	**2.091**	**0.509**	**2.600**	**3.438476**	**4.28517**	**6.26109**	1.54203	2.15289	3.87896

6. **MANAGEMENT STRATEGIES:** As per water availability, water demand and gap analysis (Table-20) it is understand that water demand will gradually increasing from the year 2021 to 2035. This value came after considering existing dynamic and static groundwater resources (2021) of Aquifer-I and other surface water availability from the Irrigation Department, Govt. Of Odisha. Eight blocks out of fourteen blocks in Koraput District doesnot show any shortage of water during 2021.

   From the three-dimensional aquifer model, it can be seen that ground water present mostly in the weathered zone (avg. thickness 20 meter) and also in fracture zones within 100 mbgl depth in most of the consolidated formation areas.

But on the basis of long term water level trend and on the basis of long term mean water level only 659.1 sq.km area covering 313 villages in part of Semiliguda, Lamptaput, Nandpur, Potangi, Laxmipur, Bandhugaon, Narayanpatna Blocks are showing falling long term water level trend , as well as mean water level is more than 5 mbgl. This area may be avoided from huge ground water withdrawal.

i. **Ground Water Resources Enhancement:** On the basis of Census 2011 data, Village area, Block area, number of total households was taken. Then declining trend areas in part of Semiliguda, Lamptaput, Nandpur, Potangi, Laxmipur, Bandhugaon, Narayanpatna Blocks, have been selected for construction of farm pond (one pond per hector) to arrest the rainwater for recharge. Similarly, 10% household will be considered in a particular village (with average rooftop area 150 sq. Meter per house) for calculation of recharge from roof top rainwater. Average five years block wise rainfall (year 2017– year 2021) is taken for calculation. Coefficient of rainfall taken 15% for farm recharge and 80% for roof top rainfall recharge. Block wise details are summarized in Table 21 and 22.

Table-21. Enhancement of Groundwater Resources by adoption of Farm Recharge, in parts of Koraput District

Sr.No.	Name of Block	Total number of villages in particular block to be considered for artificial recharge	Total area of the village/ blocks (in hectares rounded up to one decimal place)	10%of village area taken for farm recharge(sq m)	Total number of recharge pits (1 recharge pit / hector) for 10% area	Annual recharge (MCM)= (Area*Runoff 15%*Avg. 5 yrs Rainfall for particular Block in mm/1000000)
1	**Semiliguda**	22	10250.6	10250600	1025.06	3.121
2	**Lamptaput**	13	5005	5005000	501	1.471
3	**Nandpur**	18	5119	5119000	511.9	1.198
4	**Potangi**	27	8033	8033000	803	1.783
5	**Laxmipur**	42	9024	9024000	902	1.963
6	**Bandhugaon**	153	22317	22317000	2232	5.189
7	**Narayanpatna**	38	6162	6162000	616	1.137
	Total	**313**	65910.6	65910600	6591	15.862

Table-22. Enhancement of Ground Water Resources by adoption of roof top rainwater harvesting structures in parts of Koraput District

Sr.No.	Name of Block	Total number of villages in particular block to be considered for artificial recharge	Number of households (2011 census)	No of Houses taken for Artificial Recharge (10% of total households)	Total No of AR Structures (one structure for 10 house holds)	Annual Rainfall runoff Available for recharge (MCM) (No of households x avg rooftop area(150 sqm) x runoff coefficient (80%) x avg. 5 yrs rainfall for particular Block in mm)
1	**Semiliguda**	22	4613	461.3	461.3	0.112
2	**Lamptaput**	13	1574	157.4	157.4	0.037
3	**Nandpur**	18	2064	206.4	206.4	0.039
4	**Potangi**	27	4340	434	434	0.080
5	**Laxmipur**	42	5502	550.2	550.2	0.096
6	**Bandhugaon**	153	12600	1260	1260	0.234
7	**Narayanpatna**	38	3878	387.8	387.8	0.057
	Total	**313**	34571	3457.1	3457.1	0.656

So, **16.518 mcm or 0.0165 bcm** amount of rainwater may be conserved annually after adoption of farm pond (6591 number) and roof top rainwater harvesting structure (3457 number) which can enhance the groundwater storage in Parts of Semiliguda, Lamptaput, Nandpur, Potangi, Laxmipur, Bandhugaon, Narayanpatna Blocks .In this way a partial fulfilment of the demand over the years can be possible.

ii. **Demand side Management:** For demand side ground water management, average crop water requirement for kharif and rabi season calculated on the basis of data obtained from Minor Irrigation census of Odisha (2014). As per ground water resources assessment 2021, total additional water availability for future irrigation have been considered. 50% of additional water for future irrigation, taken to calulate additional irrigation potential and on that basis 10248 number of bore well to be drilled upto 25 mbgl preferable at the valley fill sites may be suggested for construction for irrigation during rabi season. The details are given in the Table-23.

Table 23. Additional Irrigation potential that can be created and feasible number of additional irrigations bore wells to be constructed, Koraput District

Block	Kharif crop area (ha*) (Certified Ayakut)	Average Water requirement @ 0.4 m/ha *(ham)	Rabi crop area (ha*) (Certified Ayakut)	Average Water requirement @ 0.8 m/ha* (ham)	Total Water requirement (ham)	Average crop Water requirement in a year (m)	Net GW Resources available for future irrigation (ham)**	Possible additional irrigation potential area that can be created with available resources (ha)	50% of the additional potential area taken for irrigation (ha)	Command area of one Bore Well (ha)	Number of Additional Shallow Bore Well to be constructed
1	2	3	4	5	6=(3+5)	7=[6/(2+4)]	8	9=(8/7)	10	12	13
Baipariguda	792.65	317.06	89	71.2	388.26	0.44	5310.71	12059.41	6030	4	1507
Boriguma	354.41	141.764	0	0	141.764	0.40	4005.83	10014.58	5007	4	1252
Jeypore	160.72	64.288	14	11.2	75.488	0.43	2432.38	5629.84	2815	4	704
Kotpad	56.67	22.668	0	0	22.668	0.40	6283.65	15709.13	7855	4	1964
Kundra	192.18	76.872	0	0	76.872	0.40	3025.22	7563.05	3782	4	945
Bandhugam	454.15	181.66	50	40	221.66	0.44	877.01	1994.70	997	4	249
Dasamanthpur	287.00	114.8	116	92.8	207.6	0.52	3926.92	7623.07	3812	4	953
Koraput	163.00	65.2	110	88	153.2	0.56	3360.25	5987.91	2994	4	748
Laxmipur	453.00	181.2	110	88	269.2	0.48	1503.09	3143.54	1572	4	393
Nandapur	306.85	122.74	67.2	53.76	176.5	0.47	2983.38	6322.57	3161	4	790
Narayan Patna	672.20	268.88	317	253.6	522.48	0.53	368.44	697.56	349	4	87
Pottangi	237.00	94.8	72.96	58.368	153.168	0.49	1123.38	2273.34	1137	4	284
Semiliguda	778.55	311.42	278	222.4	533.82	0.51	1498.03	2964.94	1482	4	371
Lamtapat	-		0	0	0	0.00	2877.74	0.00	0	4	0
Total	4910.38		1224.16				39576.03	81983.62	40992		10248

Source: *Minor Irrigation Census Odisha, 2014, **Ground water resources estimation of Orissa, 2021

From the cropping pattern in Koraput district, it has observed that during rabi season crop production is very low. So, from the excess available water for future irrigation (Table-28) subsurface drip irrigation practices may be adopted which can reduce at least 60% water consumption. Crops suitable for drip irrigation are as follows:

i. Fruit crops: Grapes, banana, pomegranates, mango, orange, cashew nuts, papaya, litchi, watermelon.
ii. Vegetable plants: Onion, brinjal, bitter gourd, ridge gourd, cucumber, tomato, chilly, capsicum etc.
iii. Oil seeds: Sunflower, oil palm.
iv. Forest crop: Bamboo, teakwood

Generally as per Ground water resources assessment 2021, total 39576 ham ground water resources will be kept for future ground water development. For calculating total number ground water structure for further ground water development we have taken 50% resources of 39576 ham , i.e., 19788 ham.

Therefore, after adopting subsurface irrigation technique technique, 60% of future irrigation potential, i.e,60% of 19788 ham = 11872 ham ground water resources will be saved. So, a total amount of (19788.06+11872)=31660.82 ham ground water will be kept for future ground water irrigation as on year 2025 in Koraput District.

Crop water demand is 3.32 bcm during 2021 and projected crop water demand will be 4.07 bcm during 2025 and 5.95 bcm during 2035. This can only be managed by installation of lined channels as distributor irrigation network which can save upto 25% of water. Similarly adoption of drip irrigation technique can save upto 60% of water. So total water demand for crop production will be minimized by 80-85%. So there may be no demand-supply gap exist during 2021 and 2025 except Narayanpatna . But still a cumulative gap of 0.2297 bcm which will exist in the year 2035 for Kotpad, Boriguma, Narayanpatna, Semiliguda and Jeypore Blocks of Koraput District (Table-24) which can be only be managed by crop diversification from high water intensive crops to low water intensive crops (Table-25).

Table24: Block wise water saving method to minimize the crop water demand in Koraput district

Blocks	Existing water availability(BCM)		Total (BCM)	Crop Water demand (BCM)			Quanty of water to be saved after adoption of lined channel and drip irrigation (BCM)		
	Surface water	Ground water		2021	2025	2035	2021	2025	2035
Kotpad	0.097	0.074	0.171	0.650907	0.79153	1.14308	0.55	0.67	0.97
Boriguma	0.089	0.062	0.151	0.504689	0.61034	0.89565	0.42	0.52	0.75
Dasamantapur	0.115	0.045	0.160	0.14292	0.17619	0.25936	0.12	0.15	0.22
Lakshmipur	0.096	0.020	0.116	0.12177	0.14756	0.22079	0.09	0.12	0.17
Bandhugaon	0.106	0.013	0.119	0.110142	0.13402	0.19369	0.09	0.11	0.16
Narayanpatana	0.133	0.006	0.139	0.071029	0.17041	0.24813	0.06	0.07	0.10
Pottangi	0.147	0.014	0.161	0.118426	0.14478	0.21065	0.10	0.12	0.18
Semiliguda	0.17	0.026	0.196	0.227918	0.28575	0.43033	0.16	0.19	0.28
Koraput	0.134	0.041	0.175	0.126092	0.15475	0.22639	0.10	0.13	0.19
Jeypur	0.141	0.038	0.179	0.724567	0.87983	1.268	0.61	0.74	1.07
Kundura	0.117	0.040	0.157	0.282177	0.34525	0.50295	0.24	0.29	0.42
Boipariguda	0.331	0.062	0.393	0.124088	0.15455	0.23071	0.10	0.13	0.19
Lamtaput	0.188	0.035	0.223	0.089473	0.11174	0.16742	0.07	0.09	0.14
Nandapur	0.227	0.033	0.260	0.144278	0.17847	0.26396	0.12	0.15	0.22
Total	**2.091**	**0.509**	**2.600**	**3.438476**	**4.28517**	**6.26109**	**2.83**	**3.47**	**5.06**

Table25: Blockwise water budget of Koraput district after water saving method

Blocks	Existing water availability(BCM)		Total (BCM)	Water demand(BCM)			Water gap(BCM)*		
	Surface water	Ground water		2021	2025	2035	2021	2025	2035
Kotpad	0.097	0.074	0.171	0.1059	0.1268	0.1791	No gap	No gap	0.0081
Boriguma	0.089	0.062	0.151	0.0927	0.0928	0.1554	No gap	No gap	0.0044
Dasamantapur	0.115	0.045	0.160	0.0273	0.0308	0.0447	No gap	No gap	No gap
Lakshmipur	0.096	0.020	0.116	0.0420	0.0382	0.0711	No gap	No gap	No gap
Bandhugaon	0.106	0.013	0.119	0.0234	0.0275	0.0376	No gap	No gap	No gap
Narayanpatana	0.133	0.006	0.139	0.0135	0.1868	0.2735	No gap	0.0478	0.1345
Pottangi	0.147	0.014	0.161	0.0217	0.0279	0.0336	No gap	No gap	No gap
Semiliguda	0.17	0.026	0.196	0.1124	0.1566	0.2521	No gap	No gap	0.0561
Koraput	0.134	0.041	0.175	0.0305	0.0294	0.0417	No gap	No gap	No gap
Jeypur	0.141	0.038	0.179	0.1208	0.1464	0.2056	No gap	No gap	0.0266
Kundura	0.117	0.040	0.157	0.0458	0.0591	0.0874	No gap	No gap	No gap
Boipariguda	0.331	0.062	0.393	0.0299	0.0307	0.0477	No gap	No gap	No gap
Lamtaput	0.188	0.035	0.223	0.0227	0.0251	0.0313	No gap	No gap	No gap
Nandapur	0.227	0.033	0.260	0.0297	0.0343	0.0508	No gap	No gap	No gap
Total	**2.091**	**0.509**	**2.600**	0.7182	1.0225	1.5114	No gap	No gap	No gap

To mitigate the wastage of water specially for commercial activity Department of Water Resources, Govt. of Odisha notifies a separate water pricing policy vide letter dated 24.4.2020. Concerned District Administration should strictly follow the water pricing policy for sustainable development of ground water (Annexure-I).

7. CONCLUSION:

i. Koraput District comprises with three types of hydrogeological formations. Consolidated formations (> 90% area) comprises mainly of granite gneisses, khondalites and charnockites with some basic intrusive wheseas unconsolidated formations are mainly alluvium and laterites.
ii. Ground water potentiality is very less in consolidated formation beyond 100-meter depth compared to shallow depth. Yield of tube wells is more in granite gneiss fracture zone in comparison to khondalite and charnockites. Potentiality of alluvial and laterite aquifer is better than fractured aquifer.
iii. Aquifer consists of two groups: Aquifer I and Aquifer II. Aquifer I consists of weathered zone and fracture zone. Aquifer II consists of only fracture zone. Thickness of weathered zone ranges from 5.5 meter to 49.2 meter. Thickness of fracture zone varies from 0.5 to 1.5 meter.
iv. Pre-Monsoon Depth to Water Level during 2021 ranges from 1.9 mbgl to 12.01 mbgl (Fig.12a). Post-Monsoon Depth to Water Level during 2021 ranges from 0.1 mbgl to 11.7 mbgl. Annual fluctuation of water level ranges 0.05 to 9.11 m rise in 85 wells and 0.12 to 4.18 m fall in 11 wells.Long Term water level fluctuation in 10 yrs (2011-2021) in m----- 0.0014 cm/ yr to >0.0289 cm rise, 0.044 cm/ yr to 0.008 cm/yr falling (Post-monsoon).Ten years post monsoon mean (2011-21) ground water level ranges from 0.36 to 12.11 mbgl .
v. But on the basis of long term water level trend and on the basis of long term mean water level, only 659.1 sq.km area covering 313 villages in part of Semiliguda, Lamptaput, Nandpur, Potangi, Laxmipur, Bandhugaon, Narayanpatna Blocks are showing falling long term water level trend , as well as mean water level is more than 5 mbgl. This area may be avoided

from huge ground water withdrawal. Ground water recharge technique is proposed in this area.

vi. **16.518 mcm or 0.0165 bcm** amount of rainwater may be conserved annually after adoption of farm pond (6591 number) and roof top rainwater harvesting structure (3457 number) which can enhance the groundwater storage in parts of Semiliguda, Lamptaput, Nandpur, Potangi, Laxmipur, Bandhugaon, Narayanpatna Blocks .In this way a partial fulfilment of the demand over the years can be possible.

vii. Stage of ground water extraction for the whole district is only 21.35 %. So there is a scope of ground water development for the Koraput District,

viii. Quality of ground water for the whole district is potable.Type of water is bicarbonate type in most of the cases.

ix. Total water availability in Koraput district is 2.6 bcm, out of which 2.091 bcm is surface water & 0.509 bcm (Total dynamic Groundwater resources as on 31.03.2021) is ground water. Projected water demand for 2025, 2035 shall be 4.28 bcm, 6.26 bcm respectively. Supply gap will increases from 2021 to 2035.

x. In Demand side management after taking average crop water requirement and 50.00% of additional future irrigation potential from dynamic ground water resources taken to calulate additional irrigation potential area and on that basis 10248 number of bore well (having command area 4 ha) to be drilled upto 25 mbgl preferable at the valley fill sites for construction for irrigation during rabi season.

xi. Therefore, after adopting subsurface irrigation technique technique, 60% of future irrigation potential, i.e,60% of 19788 ham = 11872 ham ground water resources will be saved. So, a total amount of (19788.06+11872)=31660.82 ham ground water will be kept for future ground water irrigation as on year 2025 in Koraput District.

xii. Crop water demand is 3.32 bcm during 2021 and projected crop water demand will be 4.07 bcm during 2025 and 5.95 bcm during 2035. This can only be managed by installation of lined channels as distributor irrigation network which can save upto 25% of water. Similarly adoption of drip irrigation technique can save upto 60% of water. So total water

demand for crop production will be minimized by 80-85% thereby minimizing the suppy gap during 2025 in most of the blocks.

8. ACKNOWLEDGEMENTS: The authors are very much thankful to Sh. Sunil Kumar,Chairman ,CGWB and Sh P K Mohapatra , Regional Director, CGWB, SER, Bhubaneswar for their valuable suggestion for compilation of the report. The authors are also very thankful to Dr. B.K.Sahoo, Scientist-E for his valuable observations during the compilation.

9. REFERENCES:

i. Ground water resources and development potentials of Koraput District, Orissa; CGWB, SER, Bhubaneswar, 2002.

ii. Ground water resources assessment of Odisha State; CGWB, SER, Bhubaneswar, 2017.

iii. Dynamic Ground water resources of Odisha State; CGWB, SER, Bhubaneswar, 2020.

iv. District irrigation plan of Koraput, Odisha, PMKSY; District level implementation committee, Koraput, 2016.

v. Minor irrigation projects in Orissa as on 31.12.13; Department of Water Resources, Odisha, 2014.

vi. Well completion report of exploratory wells constructed by CGWB, Koraput District, CGWB, SER, Bhubaneswar, 2020.

vii. Basic data report of exploration in Koraput District by CGWB,SER,Bhubaneswar, 1987-92.

ANNEXURE-I

Government of Odisha
Department of Water Resources
*****

No. 8561 /WR.. Date: 21/4/2020
Irr.-II-WRC-92/20

From
Sri. R. N. Chinara
Under Secretary to Government.

To
The EIC, WR, Secha Sadan, Bhubaneswar.

Sub: Enhancement of licence fee & special water rate w.e.f 01.04.2020.

Sir,

In inviting reference to your Letter No. 8464 / WE dated 13.03.2020 on the subject noted above, I am directed to say that as per amendment made in Rule-23-A (2) (f) of Odisha Irrigation Rules, 1961vide Odisha Irrigation (Amendment) Rules. 2016, the licence fees / special water rate for drawal and use of water shall be enhanced @ 10% per annum w.e.f. 1st day of April.

Accordingly, the 4th annual enhancement @ 10% will be effective from 01.04.2020 to 31.03.2021. The enhanced rate chart of special water rate & licence fee are annexed vide Schedule-II & Schedule-III respectively.

It is, therefore, requested to circulate the above licence fees / special water rate among all Sub-Ordinate Officers under your administrative control for further follow up action.

Encl.:-As above.

Yours faithfully,

22/04/2020
Under Secretary to Government

Memo No. 8562 **/ Dt.** 21/4/2020

Copy forwarded to the CE, Water Services, O/o the EIC, WR for information and necessary action.

22/04/2020
Under Secretary to Government

1402

SPECIAL WATER RATES UNDER SCHEDULE-II FOR THE PERIOD FROM 01.4.2019 TO 31.3.2020 AFTER THE ENHANCEMENT @ 10% PER ANNUM AS PER RULE-23A(2)(f) AND RULE 26 OF THE ODISHA IRRIGATION RULES, 1961 FOR THE PURPOSES OTHER THAN IRRIGATION(INDUSTRIAL/ COMMERCIAL USES OF WATER) FROM THE IRRIGATION WORKS

Item No	Purpose for which supply is given	Special water rates as per Schedule II from 01.10.2010 to 31.3.2017 (in Rupees) **(Base Rate)**	Enhanced special water rate **(for the period from 01.4.2019 to 31.03.2020)** (in Rupees)	**Enhanced special water rate (for the period from 01.4.2020 to 31.03.2021) (in Rupees)**	Quantity	Remarks
1	2	3	4	5	6	7
1	Bricks or tile making	30.00	39.00	**42.00**	1000 Bricks or Tiles	
2	**(i)For water actually drawn or allocated whichever is higher for industrial or commercial purpose**					
	Slab-I-Consumption not exceeding 5 cusecs	4.20	5.46	**5.88**	1000 liter (1 m^3)	
	Slab-II-Consumption of 5 cusecs or more	5.60	7.28	**7.84**	1000 liter (1 m^3)	
	(ii) For water used for Hydro Power Generation	0.01	0.013	**0.014**	1 KWH	
3	(i) For bulk supply to Municipalities and Notified Area Councils and other local authorities for drinking, washing etc.	0.25	0.325	**0.35**	1000 liter (1 m^3)	
	(ii) For bulk supply to Municipalities and Notified Area Councils and other local authorities and cluster of villages by industrial, commercial or other establishments actually drawn or allocated whichever is higher for drinking, washing etc.	0.50	0.65	**0.70**	1000 liter (1 m^3)	
4	Construction of commercial buildings	7.10	9.23	**9.94**	1000 liter (1 m^3)	
5	For filling tanks	0.10	0.13	**0.14**	1000 liter (1 m^3)	
6	For filling tanks mainly for drinking purposes	0.05	0.065	**0.07**	1000 liter (1 m^3)	

N.B:- The enhancement of licence fees and special water rates @ 10 per centum per annum with effect from the first day of April is as per the Odisha Irrigation (Amendment) Rules, 2016.

22/04/2020

Under Secretary to Government,
Department of Water Resources.

RATE OF LICENCE FEE UNDER SCHEDULE-III FOR THE PERIOD FROM 01.4.2019 TO 31.3.2020 AFTER THE ENHANCEMENT @ 10% PER ANNUM AS PER RULE-23A(2)(f) OF THE ODISHA IRRIGATION RULES, 1961

FOR INDUSTRIAL/ COMMERCIAL USES OF WATER FROM THE GOVERNMENT WATER SOURCES

Item No	Purpose for which supply is given	Licence fees as per Schedule III from 01.10.2010 to 31.3.2017(in Rupees)(Base Rate)	Enhanced Licence Fee for the period from **01.4.2019 to 31.3.2020** (in Rupees)	**Enhanced Licence Fee for the period from 01.4.2020 to 31.3.2021 (in Rupees)**	Quantity	Remarks
1	2	3	4	5	6	7
1	Bricks or tile making	25.00	32.50	**35.00**	1000 Bricks or Tiles	
2	(i)For water actually drawn or allocated whichever is higher for industrial or commercial purpose					
	Slab-I-Consumption not exceeding 5 cusecs	3.40	4.42	**4.76**	1000 liter (1 m^3)	
	Slab-II-Consumption of 5 cusecs or more	4.50	5.85	**6.30**	1000 liter (1 m^3)	
	(ii) For water used for Hydro Power Generation	0.01	0.013	**0.014**	1 KWH	
3	(i) For bulk supply to Municipalities and Notified Area Councils and other local authorities for drinking, washing etc.	0.20	0.26	**0.28**	1000 liter (1 m^3)	
	(ii) For bulk supply to Municipalities and Notified Area Councils and other local authorities and cluster of villages by industrial, commercial or other establishments actually drawn or allocated whichever is higher for drinking, washing etc.	0.40	0.52	**0.56**	1000 liter (1 m^3)	
4	Construction of commercial buildings	5.30	6.89	**7.42**	1000 liter (1 m^3)	
5	For sub soil water actually used and consumed for industrial /commerical purpose					
	Slab I Consumption not exceeding 5 cusecs	6.80	8.84	**9.52**	1000 liter (1 m^3)	
	Slab II Consumption of 5 cusecs or more	9.00	11.70	**12.60**	1000 liter (1 m^3)	

N.B:- The enhancement of licence fees and special water rates @ 10 per centum per annum with effect from the first day of April is as per the Odisha Irrigation (Amendment) Rules, 2016.

22/04/2020

Under Secretary to Government,
Department of Water Resources.

ANNEXURE-II

The resistivity characteristics of the near surface weathered rock and the underlying massive / fractured formation, Koraput district (Phase II), Odisha

Village		Weathered /Semi Weathered Zone (WZ/SWZ)		Compact Rock Formation (CR)				Fractured zone (FZ)	Bed Rock	GW Quality (GWQ)	Recommendations		
Name/(Geology: Granite and Granite Gneiss)	VES No	Resistivity (ohm.m)	Depth(m) to bottom of WZ/SWZ aquifer & /probable depth to ("groundwater first strike")	Less Compact (Resistivity less than compact, could be due to variations in rock composition also)		Compact		Probable occurrence of thin fractured zone aquifer based on factor analysis in compact rock in the depth range (m)	Depth (m) to Compact Rock (DCR)	Tentative in terms of salinity	Recommended for Dug Well(DW)/ Shallow Bore Well (SBW)/ Deep Bore Well (DBW)	Basis for Recommendation	Minimum Depth (m) of Dug well/ shallow well/ deep well construction, (probable depth of surface casing) and priority
				Resistivity (ohm. m)	Depth to top/bottom (m)	Resistivity (ohm. m)	Depth to top (m)						
Boipariguda	293	132	10.3	91	45.2	545	45.2	45-50, 60-150, 170-200	45.2	Potable	BW	Based on the apparent resistivities, layer resistivities, Factor flats, curve break and current increase	BW: 200m

Ramgiri	294	225	15.36	461	51.7	VH	51.7	15-25, 95-150,170-200	51.7	Potable	BW	Based on the apparent resistivities, layer resistivities, Factor flats, curve break and current increase	BW: 200m
Kenduguda	295	333	8.7	118	39.0	VH	39.0	110-180	39.0	Potable	BW	Based on the apparent resistivities, layer resistivities, Factor flats, curve break and current increase	BW: 200m
Tanginiguda	296	286	20.2	---	---	536	20.2	30-35, 55-60, 75-80, 110-120, 100150, 190-200	20.2	Potable	---	Based on the apparent resistivities, layer resistivities, Factor flats, curve break and current increase	---
Goipadar	297	---	---	225	55.1	VH	55.1	55-60, 70-80, 100-170, 190-200	55.1	Potable	BW	Based on the apparent resistivities, layer resistivities, Factor flats, curve break and current increase	BW: 200m
Chalanguda	298	260	6.6	392	50.1	VH	50.1	---	50.1	Potable	---	Based on the apparent resistivities, layer resistivities, curve break and current increase	---

Talur	299	132	9.9	509	51.7	VH	51.7	---	51.7	Potable	---	---	---
Luler	300	---	---	413	72.5	VH	72.5	---	72.5	Potable	---	---	---
Sarangpalli	301	349	12.7	---	---	VH	12.7	---	12.7	Potable	---	---	---
Bapaniguda	302	349	4.5	537	61.4	VH	61.4	---	61.4	Potable	---	---	---
Pokalpada	303	79	23.7	227	299.7	VH	299.7	30-35,60-70, 80-95, 160-170,	299.7	Potable	BW	Based on the apparent resistivities, layer resistivities, factor flats, curve break and current increase	BW: 200m
Totapada	304	164	4.4	269	23.2	VH	23.2	25-30, 40-50, 75-90,100-140, 170-200	23.2	Potable	SBW	Based on the apparent resistivities, layer resistivities, factor flats, curve break and current increase	SBW: 50m
Sugapadar	305	51	7.3	106-245	223.2	VH	223.2	15-25, 190-200	223.2	Potable	DW	Based on the apparent resistivities, layer resistivities, factor flats, curve break and current increase	DW: 10m

Hanjarhadalput	306	212	18.4	77	38.9	VH	38.9	----	38.9	Potable	SBW	Curve break not prominent. Based on the apparent resistivities, layer resistivities, factor flats, curve break and current increase	SBW: 40m
Murja	307	76	13.2	335	57.6	VH	57.6	15-28, 55-60, 110-120,150-160, 300-350	57.6	Potable	BW / SBW	Based on the apparent resistivities, layer resistivities, factor flats, curve break and current increase	BW: 150m; Casing : 15m; SBW: 60m
Hatasuku	308	88	18.3	----	----	VH	18.3	---	18.3	Potable	SBW	Curve break not prominent. Based on the apparent resistivities, layer resistivities, factor flats, curve break and current increase	SBW: 20m
Puki	309	137	17.3	669	135.1	VH	135.1	25-30, 60-65,100-110, 120-150, 180-200	135.1	Potable	SBW	Curve break not prominent. Based on the apparent resistivities, layer resistivities, factor flats, curve break and current increase	SBW: 65m

Tukum	310	135	8.6	174	38.8	VH	38.8	15-20, 30-35, 75-100, 120-180	38.8	Potable	BW / SBW	Based on the apparent resistivities, layer resistivities, factor flats, curve break and current increase	BW: 200m; Casing: 10m; SBW: 40m
Mesingput	311	148	10.3	91.8	64.3	VH	64.3	60-85, 140-170	64.3	Potable	BW	Based on the apparent resistivities, layer resistivities, factor flats, curve break and current increase	BW: 200m
Bilaput	312	311	20.9	---	---	VH	20.9	---	20.9	Potable	---	---	---
Bondhapoda	313	296	39.1	---	---	VH	39.1	35-80, 100-120, 140-180	39.1	Potable	SBW	Curve break not prominent. Based on the apparent resistivities, layer resistivities, factor flats, curve break and current increase	SBW : 80m
Badigada	314	318	18.7	---	---	VH	18.7	---	18.7	Potable	---	Curve break not prominent. Based on the apparent resistivities, layer resistivities, factor flats, curve break and current increase	---

Nandapur	315	15	10.2	103-238	>200	?	?	35-45,100-110, 140-180	?	Potable	BW / DW	Based on the apparent resistivities, layer resistivities, factor flats, curve break and current increase	BW: 200m; Casing:11 m; DW: 10m
Badel	316	41	8.6	200	40.5	VH	40.5	100-110, 300-350	40.5	Potable	DW	Based on the apparent resistivities, layer resistivities, factor flats, curve break (not prominent) and current increase	DW: 10m
Paduwa	317	136	6.2	341	50.9	VH	50.9	55-60, 120-130, 160-180	50.9	Potable	BW / SBW	Thin FZs may exist at depth ranges between 55-60, 120-130, 160-180 m Based on Curve break (not prominent), factor flats current increase and layer resistivities (high)	BW: 200m; Low priority; SBW: 60m
Aringi	318	226	4.9	---	---	VH	4.9	----	4.9	Potable	---	Based on Curve break , factor flats current increase and layer resistivities (high)	---
Kuda (Granite / Granite Gneiss)	319	68	5.3	---	---	519	5.3	----	5.3	Potable	---	Layer resistivities are high	----
Kona	320	---	---	107	40.8	VH	40.8	60-70, 85-90,120-150	40.8	Potable	BW / SBW	Curve breaknot prominent. No Current Increase	BW: 150m; SBW: 70m,

Kalari	321	210	2.27	---	---	VH	2.27	---	2.27	Potable	---	Based on Layer resistivities and pparent resistivities.	--
Pottangi	322	42.2	21.2	---	---	VH	21.2	---	21.2	Potable	SBW	Based on Layer resistivities and apparent resistivities.	SBW: 22m
Sunki	323	116	10.7	---	---	VH	10.7	----	10.7	Potable	---	Based on Layer resistivities and apparent resistivities.	---
Sambai	324	52	4	612	54.2	VH	54.2	20-25, 30-35, 100-120	54.2	Potable	BW / SBW	Based on the apparent resistivities, layer resistivities, factor flats, curve break and current increase	BW: 150m, Casing: 5m, Low priority; SBW: 40m
Chintal Manjari	325	----	----	----	----	VH	2.3	----	2.3	----	----	Based on the layer resistivities and apparent resistivities	----
Sorada	326	----	----	196	39.4	VH	39.4	70-90, 110-140,	39.4	Potable	BW	Based on the apparent resistivities, layer resistivities, factor flats, curve break and current increase	BW: 150m
Deopottangi	327	219	10	636	114.6	VH	114.6	---	114.6	Potable	----	Based on the layer resistivities and apparent resistivities	---

Semiliguda	328	----	----	224	68.2	VH	68.2	45-65, 80-85, 110-120, 160-200	68.2	Potable	BW	Based on the apparent resistivities, layer resistivities, factor flats, curve break and current increase	BW: 200m
Kulab	329	111	10.5	160-480	>200	?	>200	20-30, 100-200	>200	Potable	BW	Based on the apparent resistivities, layer resistivities, factor flats, curve break and current increase	BW: 200m
Kutugam	330	134	7.1	105	36	652	36	55-85, 95-130, 180-190	36	Potable	BW	Based on the apparent resistivities, layer resistivities, factor flats, curve break and current increase	BW: 200m
Sangamguda	331	----	----	417	43.1	VH	43.1	----	43.1	Potable	---	Based on the apparent resistivities and layer resistivities,	---
Renga	332	----	----	191	32.1	VH	32.1	40-60, 80-85, 95-160,190-200	32.1	Potable	BW SBW	Based on the apparent resistivities, layer resistivities, factor flats, curve break and current increase	BW: 200m; SBW: 60m

Gopalput	333	187	13.4	893	311	VH	311	45-50, 65-70, 190-200	311	Potable	BW / SBW	Based on the apparent resistivities, layer resistivities, factor flats, curve break and current increase	BW: 200m; Low Priority; SBW: 70m
Pakhanaput	334	31	24.4	----	----	638	24.4	15-20, 30-35, 80-120, 140-150, 170-200	24.4	Potable	BW / SBW	No current increase. Based on the apparent resistivities, layer resistivities, factor flats, curve break and current increase	BW: 200m; Low priority; SBW: 80m
Barakunti	335	----	----	----	----	VH	3.1	----	3.1	Potable	----	Based on the apparent resistivities, layer resistivities	----
Koraput	336	96	4.7	131-226	94.5	VH	94.5	80-85, 110-200	94.5	Potable	BW	Based on the apparent resistivities, layer resistivities, factor flats, curve break and current increase	BE: 200m
Deogati	337	43	22.8	261	250.8	VH	250.8	40-50, 65-70, 80-160	250.8	Potable	BW / SBW	Based on the apparent resistivities, layer resistivities, factor flats, curve break and current increase	BW: 200m; SBW:50m

Dakara	338	27	11.8	226-429	>200	VH	>200	75-85, 100-140	>200	Potable	BW	Based on the apparent resistivities, layer resistivities, factor flats, curve break and current increase	BW: 150m; SBW:90m
Kusumuli	339	---	---	468	30.1	VH	30.1	---	30.1	Potable	SBW	Based on the apparent resistivities and layer resistivities	SBW: 30m
Dumuriguda	340	---	---	290	19.5	VH	19.5	---	19.5	Potable	SBW	Based on the apparent resistivities and layer resistivities	SBW: 30m
Litiguda	341	145	3.8	318	100.2	VH	100.2	---	100.2	Potable	BW / SBW	Layer and apparent resistivities are high	BW: 150m; Low priority SBW: 20m
Phampuni	342	180	15	579	40.7	VH	40.7	---	40.7	Potable	---	Layer and apparent resistivities are high	---
Gunjiguda	343	200	11.2	65	34.4	VH	34.4	45-50, 60-65, 80-100,120-190	34.4	Potable	BW / SBW	Based on the apparent resistivities, layer resistivities, factor flats, curve break and current increase	BW: 200m, Low priority SBW: 50m

Bankpbija	344	35	1.2	94	33.5	VH	33.5	20-30,40-45, 55-75, 85-140,	33.5	Potable	BW	Based on the apparent resistivities, layer resistivities, factor flats, curve break and current increase	BW: 150m
Haridaput	345	9	23.6	---	--	VH	23.6	55-60, 120-130, 150-200	23.6	Potable	BW	Based on the apparent resistivities, layer resistivities, factor flats, curve break and current increase	BW: 200m
Jeypore	346	25	37.6	261	>200	VH	>200	35-40, 75-85,95-120, 140-160	>200	Potable	BW	No current increase. Based on the apparent resistivities, layer resistivities, factor flats and curve break	BW: 160m
Konga	347	---	--	281	30.4	606	30.4	----	30.4	Potable	SBW	Based on layer resistivities and apparent resistivities	SBW: 30m
Balaput	348	53	21.3	324	350.3	VH	350.3	35-40, 55-90, 100-120, 190-200	350.3	Potable	BW	Based on the apparent resistivities, layer resistivities, factor flats, curve break and current increase	BW: 200m

Sargiguda	349	62	21.7	216	137.1	VH	137.1	35-40, 55-90, 100-120, 190-200	137.1	Potable	BW	Based on the apparent resistivities, layer resistivities, factor flats, curve break and current increase	BW: 200m
Kundra	350	24	12.7	---	--	VH	12.7	45-55,75-85, 100-120	12.7	Potable	BW	Based on the apparent resistivities, layer resistivities, factor flats, curve break and current increase (NO Current increase	BW: 150m
Digapur	351	57	18.5	112	50.6	471	50.6	25-30, 55-70, 120-160	50.6	Potable	BW	Based on the apparent resistivities, layer resistivities, factor flats, curve break and current increase (NO Current increase	BW: 150m
Asana	352	247	7.8	367	77.8	VH	77.8	110-190	77.8	Potable	BW	Based on the apparent resistivities, layer resistivities, factor flats, curve break and current increase	BW: 150m ; Low Priority

Tumbapadar	353	90	27.3	382	198.3	VH	198.3	30-35, 85-130, 150-180	198.3	Potable	BW	Based on the apparent resistivities, layer resistivities, factor flats, curve break and current increase	BW: 200m
Krupakote	354	96	24.9	---	--	VH	24.9	25-30, 35-55, 100-110, 130-200	24.9	Potable	BW	Based on the apparent resistivities, layer resistivities, factor flats, curve break and current increase	BW: 200m
Bhatiguda	355	---	--	472	65.1	VH	65.1	----	65.1	Potable	----	Based on the apparent resistivities, layer resistivities	----
Kotpad	356	422	18.4	118-519	175.5	VH	175.5	65-70, 90-100, 120-130, 150-190	175.5	Potable	BW	Based on the apparent resistivities, layer resistivities, factor flats, curve break and current increase	BW: 200m
Chitra	357	39	8.9	66	38.8	VH	38.8	25-30, 50-80, 95-100, 140-160, 180-190	38.8	Potable	BW / SBW	Based on the apparent resistivities, layer resistivities, factor flats, curve break and current increase	BW: 200; Low Priority; SBW: 40m

Surli	358	25	10.6	78	68.7	VH	68.7	35-40, 100-110,	68.7	Potable	SBW	Based on the apparent resistivities, layer resistivities, factor flats, curve break and current increase	SBW: 70m
Mundaguda	359	291	12.1	219	106.2	VH	106.2	80-90, 110-150, 190-200	106.2	Potable	BW	Based on the apparent resistivities, layer resistivities, factor flats, curve break and current increase	BW: 200m
Sandhagan	360	39	10.9	---	---	VH	10.9	---	10.9	Potable	DW	Curve Break is not Prominent	DW: 11m
Batasona	361	163	18.3	69	38.9	VH	38.9	45-65, 70-80, 90-100, 120-200	38.9	Potable	BW	Based on the apparent resistivities, layer resistivities, factor flats, curve break and current increase	BW: 200m
Sankarda	362	139	24.5	---	---	956	24.5	45-50, 70-130, 150-170, 190-200	24.5	?	BW / SBW	Based on the apparent resistivities, layer resistivities, factor flats, curve break and current increase	BW: Low priority SBW: 100m

Neigam	363	36	4.1	67	40.0	VH	40.0	75-100, 130-170, 190-200	40.0	Potable	BW	Based on the apparent resistivities, layer resistivities, factor flats, curve break and current increase	BW: 200m
Hardoli	364	61	15.9	---	---	VH	15.9	---	15.9	Potable	DW	Based on Layer resistivities (high) and curve Break (not prominent)	DW: 16m
Borigumma	365	9	19.2	337	>200	VH	>200	40-50, 75-200	>200	Potable	BW	Based on the apparent resistivities, layer resistivities, factor flats, curve break and current increase	BW: 200m
Aunil	366	22	23.2	---	---	VH	23.2	---	23.2	Potable	SBW	Based on Layer resistivities (high) and curve Break (not prominent)	SBW:25m
Kamata (Granite / Granite Gneiss) Close to the NW-SE Lineament	367	145	38.9	83	82.5	581	82.5	45-50, 80-90, 120-170, 190-200	82.5	Potable	BW / SBW	Thin FZs may exist at depth ranges between 45-50, 80-90, 120-170, 190-200 m Based on Curve break, factor flats current increase and layer resistivities	BW: 200m SBW: 50m

Tenkal	368	59	7.7	316	68.5	VH	68.5	25-30, 40-45, 190-200	68.5	Potable	BW	Based on Curve break, factor flats current increase and layer resistivities	BW: 200m
Kamara	369	47	14.3	18	25.1	VH	25.1	30-45, 80-100, 130-140, 170-190	25.1	Potable	BW	No current increase. Based on Curve break, factor flats current increase and layer resistivities	BW: 200m
Kerakenda	370	159	5.4	63	19.4	VH	19.4	35-85, 95-130	19.4	Potable	BW	No current increase. Based on Curve break, factor flats current increase and layer resistivities	BW: 200m
Chaupadi (Granite / Granite Gneiss)	371	66-93	39	147	177.8	VH	177.8	15-20, 65-130, 170-200	177.8	Potable	BW / SBW	Thin FZs may exist at depth ranges between 15-20, 65-130, 170-200m. Based on Curve break, factor flats current increase and layer resistivities	BW: 200m SBW: 40m;
Bhairabsingipur (Charnockite/Khondalite/Calc Silicate)	372	15-32	25.0	---	---	VH	25.0	35-45, 80-90, 140-180	25.0	Potable	BW	Based om factor flat, curve break and current increase.	BW: 190m Casing : 25m.; DW: 13m; SBW: 25m

Bhalumohul	373	35	35.8	292	263.1	VH	263.1	60-65, 80-95, 140-160, 180-200	263.1	Potable	BW	Based om factor flat, curve break and current increase.	BW: 190m Casing : 25m.; DW: 13m; SBW: 25m
podagada	374	---	---	---	---	VH	0.9	---	0.9	---	---	Based on Layer resistivities and apparent Resistivities	---
Chakarliput (Granite / Granite Gneiss)	375	---	---	88	82.8	503	82.8	40-45, 55-60, 75-200	82.8	Potable	BW	Based om factor flat, curve break and current increase.	BW: 200m,
Bilangsil	376	---	---	439	109.5	VH	109.5	90-100, 160-180,	109.5	Potable	SBW	Based om factor flat, curve break and current increase.	BW: 200m, Low priority SBW: 100m
Bajaragarh (Granite / Granite Gneiss)	377	---	---	139	35.7	803	35.7	12-15, 95-120, 170-180	35.7	Potable	BW / SBW	Based om factor flat, curve break and current increase.	BW: 190m SBW: 40m,
Chaulkanti (Granite / Granite Gneiss)	378	---	---	---	---	377	1.9	----	1.9	Potable	----	Based on aparent resistivities and layer resistivities (high)	---
Cherampadar (Charnockite/Khondalite/Calc Silicate)	379	---	---	---	---	668	0.1	----	4.1	Potable	----	Based on aparent resistivities and layer resistivities (high)	---

Roiambo (Charnockite/Khondalite/Calc Silicate)	380	---	---	---	---	398	1.9	---	1.9	Potable	---	Based on aparent resistivities and layer resistivities (high)	----
Upargadala (Charnockite/Khondalite/Calc Silicate)	381	38	18.3	---	---	560	18.3	55-70, 75-90, 110-120, 150-160, 180-190	18.3	Potable	BW	Based on the Layer resistivities, factor flat, current increase and curve break	BW: 200m Casing : 20m .
Lulla (Granite / Granite Gneiss)	382	63	32.7	---	---	VH	32.7	55-60, 95-190	32.7	Potable	BW / SBW	Based on the Layer resistivities, factor flat, current increase and curve break	BW: 200m; SBW: 35m
Jodipai (Granite / Granite Gneiss)	383	---	---	273	20.2	593	20.2	----	20.2	Potable	---	Based on aparent resistivities and layer resistivities (high)	---
Laxmipur	384	389	8.9	---	---	VH	8.9	---	8.9	Potable	---	Based on aparent resistivities and layer resistivities (high). Curve Break not promnent	---
Kuda	385	219	21.1	---	---	VH	21.1	---	21.1	Potable	---	Based on aparent resistivities and layer resistivities (high). Curve Break not promnent	---

Kakiriguma	386	---	---	269	39.1	VH	39.1	60-70, 80-120, 140-190	39.1	Potable	SBW	Based on aparent resistivities and layer resistivities (high). Curve Break not promnent	SBW: 70m
Uprakuttinga	387	62	21.1	748	190.1	VH	190.1	55-75, 110-130, 150-160, 190-200	190.1	Potable	BW	Based on aparent resistivities and layer resistivities (high), Curve Break and factor flats	BW: 200m
Chuchukona	388	---	---	294	41.8	VH	41.8	35-40, 55-75, 85-90, 120-160, 190-200	41.8	Potable	SBW	Based on aparent resistivities and layer resistivities (high), Curve Break and factor flats	SBW:42m
Singaram (Khondalite / Granite Gneiss)	389	470	39.3	798	82.9	800	82.9	12-15, 95-110, 130-140,	82.9	Potable	SBW	Based on aparent resistivities and layer resistivities (high), Curve Break and factor flats	SBW:40m
Kuntes (Granite / Granite Gneiss)	390	184	12.8	317	152.6	VH	152.6	12-20, 110-120, 140-150, 170-180	152.6	Potable	BW	Based on the Layer resistivities, factor flat, current increase and curve break	BW: 200m
Kundra	391	---	---	67	54.6	VH	54.6	70-75, 85-110, 170-180	54.6	Potable	BW	Based on the Layer resistivities, factor flat, current increase and curve break	BW: 200m

Bandhugaon	392	29	16.6	10	35.7	VH	35.7	60-75,90-110, 140-160, 190-200	35.7	Potable	BW	Based on the Layer resistivities, factor flat, current increase and curve break	BW: 200m
Idugumabalsa	393	7.8	5.3	15.7	25.5	VH	25.5	12-15, 35-40, 50-75, 120-130, 160-170,	25.5	Potable	SBW	Based on the Layer resistivities, factor flat, current increase and curve break. Curve brak not prominent	BW: Low priority; SBW: 40m
Bagam	394	---	---	338	39.2	VH	39.2	65-80,110-170, 190-200	39.2	Potable	SBW	Based on the Layer resistivities, factor flat, current increase and curve break. Curve brak not prominent	SBW: 80m
Boriput	395	260	27.8	40	67.8	VH	67.8	85-100,	67.8	Potable	SBW	Based on the Layer resistivities, factor flat, current increase and curve break. Curve brak not prominent	SBW: 70m
Rutupai	396	9.8	4.5	40	53	VH	53	12-25, 55-60, 70-75, 85-95, 130-150	53	Potable	BW	Based on the Layer resistivities, factor flat, current increase and curve break.	BW: 150m; Casing: 5m

Dihura	397	16	3.6	23	40.8	VH	40.8	---	40.8	Potable	SBW	Curve brak not prominent. Based on the Layer resistivities, factor flat, current increase and curve break.	SBW: 50m
Palapusilabari	398	9	29.1	---	---	VH	29.1	----	29.1	Potable	SBW	Curve brak not prominent. Based on the Layer resistivities, factor flat, current increase and curve break.	SBW: 30m
Singijhola	399	51	11.6	275	178.6	VH	178.6	15-20, 35-50, 100-140	178.6	Potable	BW	Curve brak not prominent. Based on the Layer resistivities, factor flat, current increase and curve break.	BW: 150m
Dalaipeta	400	---	---	76.5	26.4	VH	26.4	---	26.4	Potable	SBW	Curve brak not prominent. Based on the Layer resistivities, current increase and curve break.	SBW: 30m
Narayanpatna	401	---	---	81	25.7	VH	25.7	---	25.7	Potable	SBW	Curve brak not prominent. Based on the Layer resistivities, current increase and curve break.	SBW: 30m

Rangapani	402	287	18.5	89-253	176	VH	176	75-95, 110-120, 150-160, 180-190	176	Potable	BW	Based on the Layer resistivities, factor flats, current increase and curve break.	BW: 200m
Bijaghati	403	60	16.5	---	---	VH	16.5	----	16.5	Potable	SBW	Based on the Layer resistivities and curve break.	SBW: 20m
Upargumunda	404	166	8.8	230	18.4	VH	18.4	40-45,100-120,	18.4	Potable	BW / SBW	Based on the Layer resistivities, factor flats , current increase and curve break.	BW: 150m, Low priority; SBW: 20m
Karodapai	405	87	13.9	882	139.2	VH	139.2	40-45, 100-130,	139.2	Potable	SBW	Based on the Layer resistivities, factor flats , current increase and curve break.	BW:150m ; Low Priority, SBW: 50m
Bapalisala	406	59	29.8	452	188.8	VH	188.8	---	188.8	Potable	SBW	Based on the Layer resistivities, curve break (not prominent).	BW:200m ; Low Priority; SBW: 30m
Mankipi	407	101	2.2	---	---	VH	2.2	---	2.2	---	---	Based on the apparent resistivities and layer resistivities	---