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जल शक्ति मंत्रालय,
Ministry of Jal Shakti,
जल संसाधन, नदी विकास और गंगा संरक्षण विभाग,
Department of Water Resources,
River Development and
Ganga Rejuvenation

केंद्रीय भूमि जल बोर्ड
Central Ground Water Board

NAQUIM 2.0

जलभृत प्रबंधन योजना
Aquifer Management Plan
संबलपुर शहरी समूह, ओडिशा
Sambalpur Urban Agglomerate, Odisha

दक्षिण पूर्वी क्षेत्र
South Eastern Region (SER)
Bhubaneswar
2024

भारतसरकार

Government of India

जलशक्तिमंत्रालय

Ministry of Jal Shakti

जल संसाधन विभाग, नदी विकासऔरगंगा संरक्षण

Department of Water Resources

River Development andGanga Rejuvenation

केंद्रीयभूमिजलबोर्ड

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Aquifer Management Plan

संबलपुर शहरी समूह, ओडिशा

Sambalpur Urban Agglomerate, Odisha

प्राथमिकता प्रकार: शहरी समूह

Priority Type: Urban Agglomerate

E Office File No. MHQ/1/2024-M(HQ)-Part(15) – comp no. 17242

दक्षिण पूर्वी क्षेत्र

South Eastern Region (SER)

Bhubaneswar

2024

डॉ. सुनील कुमार अम्बष्ट
अध्यक्ष
Dr. Sunil Kumar Ambast
Chairman

सत्यमेव जयते

भारत सरकार
जल शक्ति मंत्रालय
जल संसाधन,
नदी विकास और गंगा संरक्षण विभाग
केन्द्रीय भूमि जल बोर्ड
Government of India
Ministry of Jal Shakti
Department of Water Resources,
River Development & Ganga Rejuvention
Central Ground Water Board

Message

National Aquifer Mapping and Management Programme (NAQUIM) was initiated by Central Ground Water Board (CGWB) in 2012 with the goal of mapping and managing aquifers across India to promote sustainable groundwater use. So far the entire mappable area of 25 lakh km^2 has been covered under the NAQUIM programme. While these initial efforts have been highly impactful, they faced certain limitations especially in terms of spatial resolution.

Taking it forward, CGWB has now initiated **NAQUIM 2.0,** the next phase of aquifer mapping designed to provide a deeper, more detailed understanding of India's groundwater systems. During 2023-24, CGWB had completed NAQUIM 2.0 studies in 68 study areas. The study areas were selected in consultation with the State/UT government agencies.

I am confident that this report of NAQUIM 2.0 study will serve as a critical resource for government agencies, research institutions, NGOs, and the general public. By fostering a collaborative approach to groundwater management, this report will play a key role in safeguarding and sustaining India's precious ground water resources.

(Dr. Sunil Kumar Ambast)

Chairman, CGWB

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N. Varadaraj
Member (East)

भारत सरकार
जल शक्ति मंत्रालय
जल संसाधन, नदी विकास
और गंगा संरक्षण विभाग
केंद्रीय भूजल बोर्ड
भुजल भवन, एन एच -IV, फरीदाबाद
Government of India
Ministry of Jal Shakti
Department of Water Resources, River
Development & Ganga Rejuvenation
Central Ground Water Board
Bhujal Bhawan, NH-IV,Faridabad.

FOREWORD

CGWB, SER, Bhubaneswar had completed the National Aquifer Mapping and Management (NAQUIM) study across the state of Odisha in March, 2023. Based on the broader recommendations of NAQUIM, CGWB, SER, Bhubaneswar took up a focused study in the Sambalpur urban and peri urban area of Sambalpur District. The NAQUIM 2.0 initiative aims to enhance our understanding of groundwater dynamics and quality in these priority regions, thereby supporting effective water resource management and sustainability. The study was undertaken in close collaboration with the State Water Resources Department, ensuring that the findings and recommendations are aligned with regional priorities and will effectively address local water management challenges.

It is with great pleasure that I present to you the report on NAQUIM 2.0 for the Sambalpur urban and peri urban area of Sambalpur District. This study represents a significant advancement in our ongoing efforts to understand and manage groundwater resources in the Urban Agglomerate.

The findings presented in this report are the result of rigorous research and analysis conducted by the Central Ground Water Board (CGWB), South Eastern Region (SER), Bhubaneswar. They provide critical insights into the aquifer systems and impact of rapid urbanisation on ground water regime in Sambalpur urban and peri urban area of Sambalpur District, offering valuable data for planning and implementing strategies to safeguard our vital water resources.

I extend my heartfelt thanks to The Regional Director and the team involved in this comprehensive study. Their dedication and expertise have been instrumental in achieving the milestones of this assignment. I also express my gratitude to the stakeholders and local communities for their cooperation and support throughout this process.

N. Varadaraj

Date: 14.11.2024 **(N. Varadaraj)**

Dr. B K Sahoo
Head of Office

भारत सरकार
जल शक्ति मंत्रालय
जल संसाधन, नदी विकास
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Government of India
Ministry of Jal Shakti
Department of Water Resources, River Development & Ganga Rejuvenation
Central Ground Water Board
South Eastern Region, Bhubaneswar
Odisha

PREFACE

Groundwater is a critical resource that sustains the livelihoods of people across regions. As population pressures increase, the demand for groundwater has surged to meet the requirements of agriculture, industry, and domestic use. Accordingly there has been a paradigm shift from ground water development to ground water management and with an aim to address such issues Central Ground Water Board (CGWB) has undertaken mapping of aquifers under NAQUIM (National Aquifer Mapping and Management) studies. After the successful completion of the 1st phase of the NAQUIM studies by CGWB for the entire state of Odisha which was carried out on regional scale, there has been a need to carry out the next phase of aquifer mapping (NAQUIM 2.0) studies in a more detailed manner with more data granularity for the identified problematic areas. This study is crucial for developing strategies for the optimal and sustainable management of ground water resources, particularly at the local level.

As part of the Annual Action Plan for 2023-24 under NAQUIM 2.0, an in-depth study was conducted in Sambalpur urban and peri urban area of Sambalpur District. The area covers 275 sq km falling in Sambalpur municipal corporation and parts of Dhankauda and Maneswar blocks of Sambalpur District. The drinking and irrigation requirement of the study area is met through surface water supplied from the Hirakud dam. The area is affected by High Fluoride, Nitrate and EC in patches. The area is characterized by a complex geological set up with a variety of rock types belonging mainly to Archaean, Precambrian and Permo-Carboniferous ages. A small patch of lower Gondwana comprising of shale and sandstone also occurs in the study area. The hard rocks consist of granite and its variants, and also fractured quartzites, shales and sandstones. The characterization of the heterogenous fractured aquifer system depicts the formations to have very low yield and low sustainability.

The selection of the study area was made with the approval of the Directorate of Ground Water Development, Department of Water Resources, Government of Odisha. The study involved the extensive collection, compilation, and analysis of field data, with contributions from state governmental agencies such as Agriculture, Odisha Lift Irrigation Corporation, Minor Irrigation, Rural Water Supply & Sanitation, and the Department of Economics & Statistics.

The present report is an outcome of the untiring efforts given by Sh. Rajeev Kumar Tripathy, Scientist-D, Sh. Raj Kishor Mohanty, Scientist-C, Sh. Rajesh Babu Annavarapu, Assistant Geophysist and Sh Biranchi Narayan Dehury, Assistant Chemist under the supervision of team lead led by Sh Sudhanshu Kumar Mohanty, Scientist-D. The report shall be of immense use for various user agencies, planners and managers as well as academicians/ researchers as a guide and reference volume in the field of management of ground water resource. It is expected that the report will also be helpful to the common people to make them aware of local groundwater issues and its sustainable management.

Bhubaneswar
14.08.2024

(Dr. B K Sahoo)
Head of Office

डॉ. बी के साहू
कार्यालय प्रमुख

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

प्रस्तावना

भूजल एक महत्वपूर्ण संसाधन है जो विभिन्न क्षेत्रों के लोगों की आजीविका को बनाए रखता है। जैसे-जैसे जनसंख्या का दबाव बढ़ता है, कृषि, उद्योग और घरेलू उपयोग की आवश्यकताओं को पूरा करने के लिए भूजल की मांग बढ़ गई है। तदनुसार, भूजल विकास से भूजल प्रबंधन की ओर एक आदर्श बदलाव हुआ है और इस तरह के मुद्दों के समाधान के उद्देश्य से केंद्रीय भूमिजल बोर्ड (CGWB) ने NAQUIM (राष्ट्रीय जलभृत मानचित्रण और प्रबंधन) अध्ययनों के तहत एक्वीफर्स का मानचित्रण किया है। ओडिशा के पूरे राज्य के लिए CGWB द्वारा NAQUIM अध्ययन के पहले चरण के सफल समापन के बाद, जो क्षेत्रीय स्तर पर किया गया था, पहचाने गए समस्याग्रस्त क्षेत्रों के लिए अधिक डेटा ग्रैन्युलैरिटी के साथ अधिक विस्तृत तरीके से एक्वीफर मैपिंग (NAQUIM 2.0) अध्ययन के अगले चरण को पूरा करने की आवश्यकता है।

NAQUIM 2.0 के तहत 2023-24 के लिए वार्षिक कार्य योजना के एक भाग के रूप में, संबलपुर जिले के संबलपुर शहरी और पेरी शहरी क्षेत्र में गहन अध्ययन किया गया। यह क्षेत्र 275 वर्ग किमी में फैला है, जो संबलपुर नगर निगम और संबलपुर जिले के धनकौड़ा और मानेस्वर ब्लॉक के कुछ हिस्सों में आता है। अध्ययन क्षेत्र की पेयजल और सिंचाई की आवश्यकता हीराकुंड बांध से आपूर्ति किए गए सतही जल से पूरी होती है। यह क्षेत्र कुछ हिस्सों में उच्च फ्लोराइड, नाइट्रेट और ईसी से प्रभावित है। यह क्षेत्र एक जटिल भूवैज्ञानिक संरचना की विशेषता है जिसमें विभिन्न प्रकार की चट्टानें हैं जो मुख्य रूप से आर्कियन, प्रीकैम्ब्रियन और परमो-कार्बोनिफेरस युगों से संबंधित हैं। अध्ययन क्षेत्र में शेल और बलुआ पत्थर से युक्त निचले गोंडवाना का एक छोटा सा टुकड़ा भी पाया जाता है।

अध्ययन क्षेत्र का चयन ओडिशा सरकार के जल संसाधन विभाग के भूजल विकास निदेशालय की मंजूरी से किया गया था। अध्ययन में कृषि, ओडिशा लिफ्ट सिंचाई निगम, लघु सिंचाई, ग्रामीण जल आपूर्ति और स्वच्छता तथा अर्थशास्त्र एवं सांख्यिकी विभाग जैसी राज्य सरकार की एजेंसियों के योगदान के साथ क्षेत्र के आंकड़ों का व्यापक संग्रह, संकलन और विश्लेषण शामिल था।

वर्तमान रिपोर्ट श्री राजीव कुमार त्रिपाठी, वैज्ञानिक-डी, श्री राज किशोर मोहंती, वैज्ञानिक-सी, श्री राजेश बाबू अन्नावरपु, सहायक भूभौतिकीविद् और श्री बिरंची नारायण देहुरी, सहायक रसायनज्ञ द्वारा श्री सुधांशु कुमार मोहंती, वैज्ञानिक-डी के नेतृत्व वाली टीम की देखरेख में किए गए अथक प्रयासों का परिणाम है। रिपोर्ट विभिन्न उपयोगकर्ता एजेंसियों, योजनाकारों और प्रबंधकों के साथ-साथ शिक्षाविदों/शोधकर्ताओं के लिए भूजल संसाधन के प्रबंधन के क्षेत्र में एक मार्गदर्शक और संदर्भ मात्रा के रूप में बहुत उपयोगी होगी। उम्मीद है कि यह रिपोर्ट आम लोगों को स्थानीय भूजल मुद्दों और इसके सतत प्रबंधन के बारे में जागरूक करने में भी मददगार होगी।

बि के साहू

भुवनेश्वर
14.08.2024

(डॉ. बी के साहू)
कार्यालय प्रमुख

NAQUIM 2.0/2023-24/Theme: Urban Agglomerate

Aquifer Management in Sambalpur Urban Agglomerate Odisha

Contributor's Page

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Executive Summary

National Aquifer Mapping Programme (NAQUIM 2.0) was taken up for detailed hydrogeological investigation, data-gap analysis, Aquifer Mapping and Management in the Sambalpur urban and Peri urban area of Sambalpur district. The total area under field investigation is 275 sq.km. The study area lies between 21^0 24'20.23'' to 21^0 33'31.97'' N latitudes and $83^0$51'2.79'' to 84^0 03'12.72'' E longitudes. The area falls on the Survey of India Topo-sheets Number 64O/13, 64O/14, 73 C/2 and 73 C/3.

The average annual rainfall is 1489mm. Mainly two types of soils found in the study area, i.e., Ultisoils consisting of red, yellow and lateritic soils and mixed grey soil; Alfisoils predominantly include red gravelly, sandy, loamy, red earth mixed with black soils. The district is underlain by Granite-gneiss and its variants and a small patch of Lower Gondwana formations, Alluvium and laterites.

The crystalline formations like Granite Gneiss, Khondalite and metabasics like shale are classified under Consolidated water bearing formations. The weathered residum of these rocks form the main repositories of ground water, which occurs under water table conditions and circulates through deeper fractures and fissures. Ground water occurs under confined to semi-confined condition in the deeper fractured zones. The Gondwana, sandstone and shale constitute the Semi-consolidated water bearing formations Groundwater occurs under water table condition in the shallow aquifers and in semi confined to confined condition in deeper aquifer. The alluvium deposits, silt, sand and gravels are classified under unconsolidated formations.

CGWB has constructed 07 EWs, 01 OW and 01 PZ, during the ground water exploration programme. For the monitoring of ground water level and quality CGWB has established 30 National Hydrograph Network Stations in the study area. The drinking and irrigation requirement of the study area is met through surface water supplied from the Hirakud dam.

The Depth to water level in pre-monsoon period (May 2023) varies from 1.1mbgl (Modipada) to 15.7mbgl (Burla) the average being 8.4mbgl. Depth to water level in post-monsoon period (Nov 2023) varies from 0.3mbgl (Khagsipada) to 13.3mbgl (Burla) the average being 6.8mbgl. The decedal water level flctuation varies from 1.80mbgl to 13.76mbgl the average being 7.78mbgl during premonsoon. The decedal water level flctuation varies from 0.10 mbgl to 12.06 mbgl the average being 6.35 mbgl during post monsoon. The deeper

water level is observed N-E part of the study area.

The estimated dynamic ground water resource is 1457 Ham and the stages of development of ground water is 25.4 %. The ground water resource is calculated on apportion basis.

Most groundwater samples are fresh, alkaline and hard to very hard in nature, and mostly dominated by bicarbonate ions. The fluoride contamination is observed at Remed, Pardhiapali, Naradihi, Dehripali, and A. Katapali in the study area. The high fluoride in groundwater samples may be due to the geogenic formation. The Uranium contamination was found in Hirakud Railway Station (hand pump Sample) (53.68 µg/l) in pre monsoon as per drinking water specification IS 10500:2012 while the post monsoon samples were free from U contamination, may be due to the dilution effect. Nitrate contamination is reported in the urban and peri-urban area of Sambalpur city. Maximum value of nitrate is observed at Bhalukonda as 242 mg/l. The root cause of groundwater pollution is anthropogenic, through which the nitrate rich material present on the earth percolates through soil to reach the groundwater table. The main sources for the nitrate contamination are livestock excreta, sewerage, organic garbage, indiscriminately inland disposal of solid wastes, and domestic sewage.

Resistivity VES data coupled with LithoLog data have been employed for the aquifer disposition/Sub surface lithology in the Sambalpur district. The data was incorporatedinto the vertical lithological distribution to demarcate the Weathered and Fractured zones governing theaquifer geometry. Based on geoelectrical layer parameters and the fractured zone analysis a few sites are recommended for borehole drilling or Shallow borehole or dug well.

कार्यकारी सारांश

संबलपुर जिले के संबलपुर शहरी और पेरी शहरी क्षेत्र में विस्तृत जल विज्ञान जांच, डेटा-अंतराल विश्लेषण, जलभृत मानचित्रण और प्रबंधन के लिए राष्ट्रीय जलभृत मानचित्रण कार्यक्रम (NAQUIM 2.0) शुरू किया गया था। क्षेत्र जांच के तहत कुल क्षेत्रफल 275 वर्ग किलोमीटर है। अध्ययन क्षेत्र 210 24'20.23'' से 210 33'31.97'' उत्तरी अक्षांश और 830 51'2.79'' से 840 03'12.72'' पूर्वी देशांतर के बीच स्थित है। यह क्षेत्र सर्वे ऑफ इंडिया टोपो-शीट संख्या 64O/13, 64O/14, 73 C/2 और 73 C/3 पर आता है।

औसत वार्षिक वर्षा 1489 मिमी है। अध्ययन क्षेत्र में मुख्य रूप से दो प्रकार की मिट्टी पाई जाती है, अर्थात् अल्टीसोइल्स जिसमें लाल, पीली और लैटेराइट मिट्टी और मिश्रित ग्रे मिट्टी शामिल है; अल्फीसोइल्स में मुख्य रूप से लाल बजरी, रेतीली, दोमट, लाल मिट्टी और काली मिट्टी शामिल है। यह जिला ग्रेनाइट-गनीस और उसके प्रकारों तथा निचले गोंडवाना संरचनाओं, जलोढ़ और लैटेराइट के एक छोटे से हिस्से से घिरा हुआ है।

ग्रेनाइट नीस, खोंडालाइट और मेटाबेसिक्स जैसे शेल जैसी क्रिस्टलीय संरचनाओं को समेकित जल धारण संरचनाओं के अंतर्गत वर्गीकृत किया गया है। इन चट्टानों के अपक्षयित अवशेष भूजल के मुख्य भंडार बनाते हैं, जो जल स्तर की स्थितियों में होता है और गहरी दरारों और दरारों के माध्यम से प्रसारित होता है। भूजल गहरे फ्रैक्चर वाले क्षेत्रों में सीमित से अर्ध-सीमित स्थिति में होता है। गोंडवाना, बलुआ पत्थर और शेल अर्ध-समेकित जल धारण संरचनाओं का निर्माण करते हैं। भूजल उथले जलभृतों में जल स्तर की स्थिति में और गहरे जलभृतों में अर्ध-सीमित से सीमित स्थिति में होता है। जलोढ़ जमा, गाद, रेत और बजरी को असंगठित संरचनाओं के अंतर्गत वर्गीकृत किया गया है।

भूजल अन्वेषण कार्यक्रम के दौरान सीजीडब्ल्यूबी ने 07 ईडब्ल्यू, 01 ओडब्ल्यू और 01 पीजेड का निर्माण किया है। भूजल स्तर और गुणवत्ता की निगरानी के लिए सीजीडब्ल्यूबी ने अध्ययन क्षेत्र में 30 राष्ट्रीय हाइड्रोग्राफ नेटवर्क स्टेशन स्थापित किए हैं। अध्ययन क्षेत्र की पेयजल एवं सिंचाई की आवश्यकता हीराकुंड बांध से आपूर्ति किये जाने वाले सतही जल से पूरी होती है। मानसून-पूर्व अवधि (मई 2023) में जल स्तर की गहराई 1.1mbgl (मोदीपाड़ा) से 15.7mbgl (बुर्ला) तक भिन्न होती है, जिसका औसत 8.4mbgl है। मानसून-पश्चात अवधि (नवंबर 2023) में जल स्तर की गहराई 0.3mbgl (खगसीपाड़ा) से 13.3mbgl (बुर्ला) तक भिन्न होती है, जिसका औसत 6.8mbgl है। दशकीय जल स्तर में उतार-चढ़ाव 1.80mbgl से 13.76mbgl तक भिन्न होता है, जिसका औसत मानसून-पूर्व अवधि में 7.78mbgl होता है। दशकीय जल स्तर में उतार-चढ़ाव 0.10 mbgl से 12.06 mbgl तक भिन्न होता है, जिसका औसत मानसून-पश्चात अवधि में 6.35 mbgl होता है। अध्ययन क्षेत्र के उत्तर-पूर्वी भाग में गहरा जल स्तर देखा जाता है। अनुमानित गतिशील भूजल संसाधन 1457 हैम है और भूजल के विकास के चरण 25.4% हैं। भूजल संसाधन की गणना आवंटन के आधार पर की जाती है।

अधिकांश भूजल नमूने ताजे, क्षारीय और प्रकृति में भारी होते हैं, और ज्यादातर

बाइकार्बोनेट आयनों की प्रधानता होती है। अध्ययन क्षेत्र में रेमेड, परधियापाली, नारदीही, देहरीपाली और ए. कटापाली में फ्लोराइड संदूषण देखा गया है। भूजल नमूनों में उच्च फ्लोराइड भूगर्भिक संरचना के कारण हो सकता है। पीने के पानी की विशिष्टता IS 10500:2012 के अनुसार हीराकुंड रेलवे स्टेशन (हैंडपंप नमूना) में यूरेनियम संदूषण (53.68 µg/l) प्री मानसून में पाया गया था, जबकि पोस्ट मानसून नमूने यूरेनियम संदूषण से मुक्त थे, यह कमजोर पड़ने के प्रभाव के कारण हो सकता है।संबलपुर शहर के शहरी और पेरी-शहरी क्षेत्र में नाइट्रेट संदूषण की सूचना मिली है। नाइट्रेट का अधिकतम मान भालुकोंडा में 242 mg/l के रूप में देखा गया है। भूजल प्रदूषण का मूल कारण मानवजनित है, जिसके माध्यम से पृथ्वी पर मौजूद नाइट्रेट युक्त पदार्थ मिट्टी के माध्यम से रिसकर भूजल स्तर तक पहुंच जाता है। नाइट्रेट संदूषण के मुख्य स्रोत पशुधन मलमूत्र, सीवरेज, जैविक कचरा, ठोस कचरे का अंधाधुंध अंतर्देशीय निपटान और घरेलू सीवेज हैं।

संबलपुर जिले में जलभृत निपटान/उप सतही लिथोलॉजी के लिए लिथोलॉग डेटा के साथ प्रतिरोधकता वीईएस डेटा का उपयोग किया गया है। जलभृत ज्यामिति को नियंत्रित करने वाले अपक्षयित और खंडित क्षेत्रों को सीमांकित करने के लिए डेटा को ऊर्ध्वाधर लिथोलॉजिकल वितरण में शामिल किया गया था। भू-विद्युत परत मापदंडों और खंडित क्षेत्र विश्लेषण के आधार पर बोरहोल ड्रिलिंग या उथले बोरहोल या खोदे गए कुओं के लिए कुछ साइटों की सिफारिश की जाती है।

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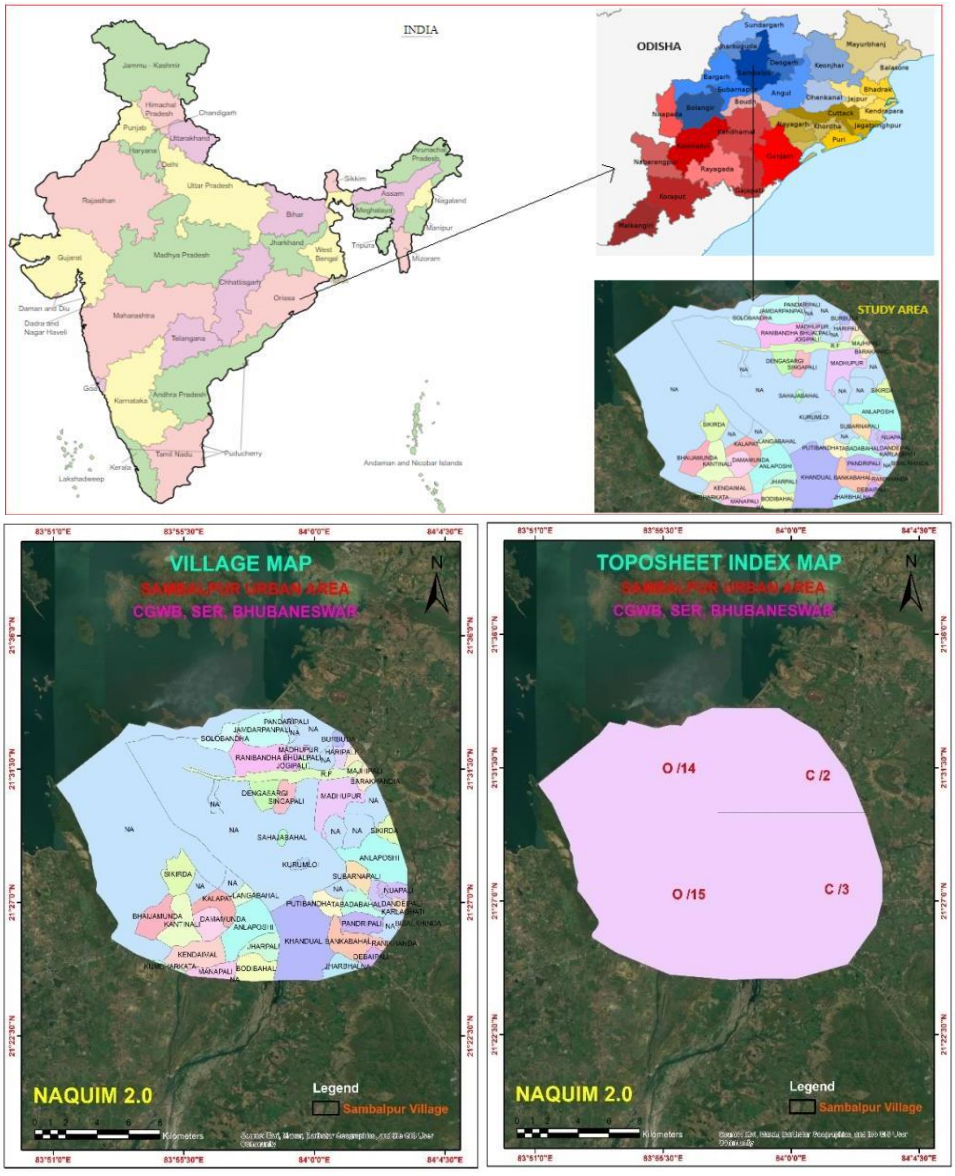
REPORT ON NATIONAL AQUIFER MAPPING AND MANAGEMENT (NAQUIM2.0)

SAMBALPUR URBAN AGGLOMERATE, ODISHA

1.0 INTRODUCTION

The study area covering mainly Sambalpur Urban and Peri-Urban area under NAQUIM2.0 is in parts of Sambalpur District (Fig-1). The total area under field investigation is around 275 sq.km. The study area lies between $21^0$24’20.23’’ to $21^0$33’31.97’’ N latitudes and $83^0$51’2.79’’ to $84^0$03’12.72’’ E longitudes. The area falls on the Survey of India Topo-sheets Number 64O/13, 64O/14, 73 1C/2 and 73 C/3. The location and base map of the study area are shown in Fig.1.1&1.2.



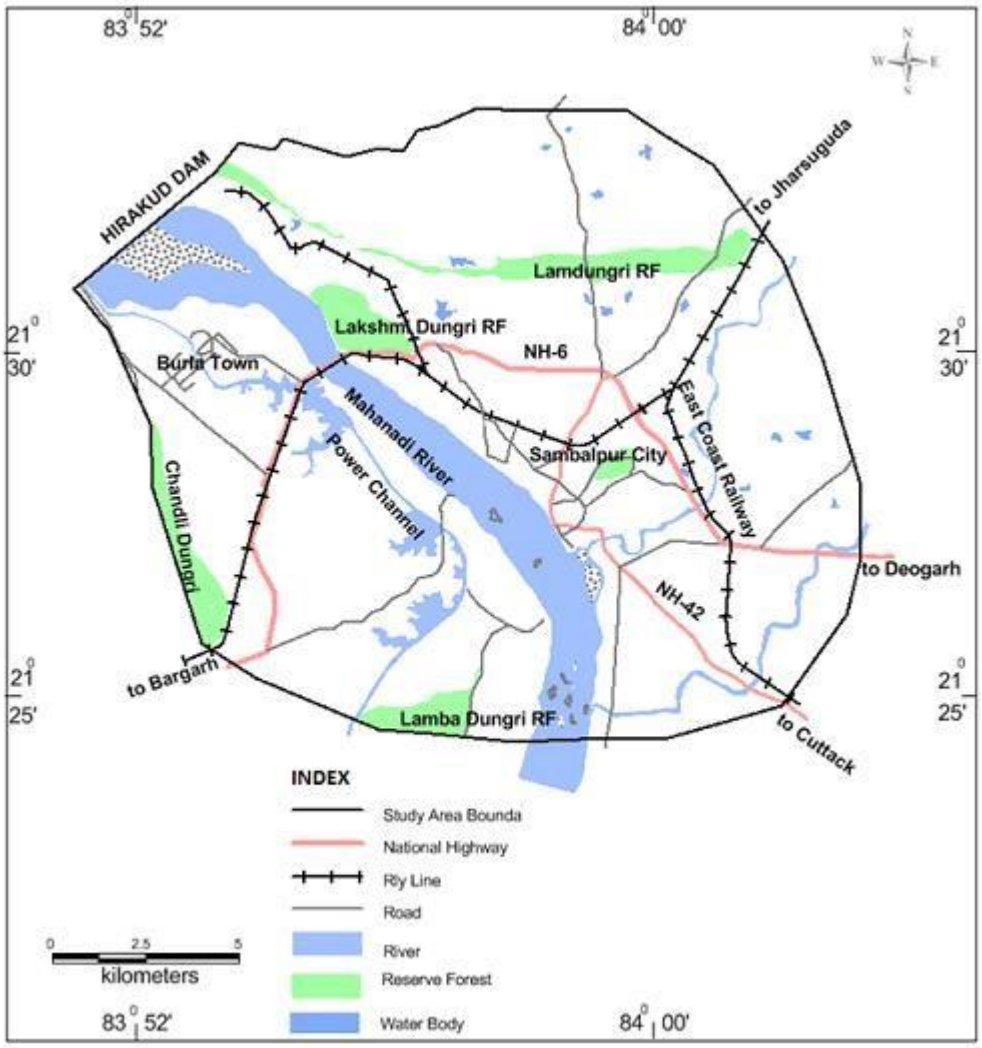


Fig.1.1 Location map of the study area.
Fig.1.2 Base map of the study area.

1.1 THE PRIORITY TYPES

NAQUIM 2.0 is designed to provide detailed information to support groundwater management decisions at ground level. NAQUIM 2.0 is proposed as issue specific and will be undertaken in prioritized focus areas. Broadly 11 identified priority area is based on ground water related issues as given below.**1**: Water Stressed Areas; **2**: Urban Agglomerate; **3**: Coastal Areas; **4**: Industrial Clusters and Mining Areas; **5**: Areas with springs as the principal source; **6**: Areas with Deeper Aquifers; **7**: Ground Water Contamination; **8**: Auto flow zones; **9**: Canal Command Areas, **10**: Areas with poor ground water quality, **11**: Other specific Issues. The area as signed for the present study come sunder urban agglomerate and canal command area.

1.2 PREVIOUS STUDY

Sambalpur District was geologically studied by the Geologically Survey of India and prepared the geological map of the district. The district was covered under Regional Systematic Hydrogeological Survey by the officers of CGWB, SER, Bhubaneswar during the year 1988-89. Ground Water exploration in the district was carried out during 1988-2005 and during 2019-23. NAQUIM study of Sambalpur District was carried out during AAP 2022-
23. District brochure has been compiled during 2007. Ground water resources assessment for the district was done for the year 2001,2004,2013,2017,2020 and 2022.

1.3 OBJECTIVES OF THE PRESENT STUDY

NAQUIM 2.0 studies will provide i) information in higher granularity with a focus on increasing density of dynamic data like ground water level, ground water quality etc. ii) issue based scientific inputs for ground water management up to panchayat level, iii) printed maps to the users and iv) a strategy putting in place to ensure implementation of the recommended strategies.

1.4 DATA GAP ANALYSIS AND NEW DATA GENERATION PLAN

The total number of exploratory well, NHS well, Key wells and VES are 30,4,2 and 6 numbers respectively.

Depending upon the availability of exploratory well, NHS well, Key wells and VES, the proposed Key wells, exploratory well, and VES in the study area are as follows.

1. **EW/OW:** -Depending upon the existing exploration data a data gap map is generated. Total 11 Exploratory wells are proposed in the study area (Fig.1.3).
2. **Key wells**: Total 30 National Hydrograph Network Stations (NHNS) are present in the study area. Depending upon the existing NHNS a data gap map is prepared. Total20 key wells (20 Dug wells and 10 borewells/hand pump) are proposed in the study area (Fig-1.4).
3. **VES:** 06 existing VES data is present, so another 17 VES is proposed in theNAQUIM study area. A data gap map is prepared based on existing data (Fig.1.5).

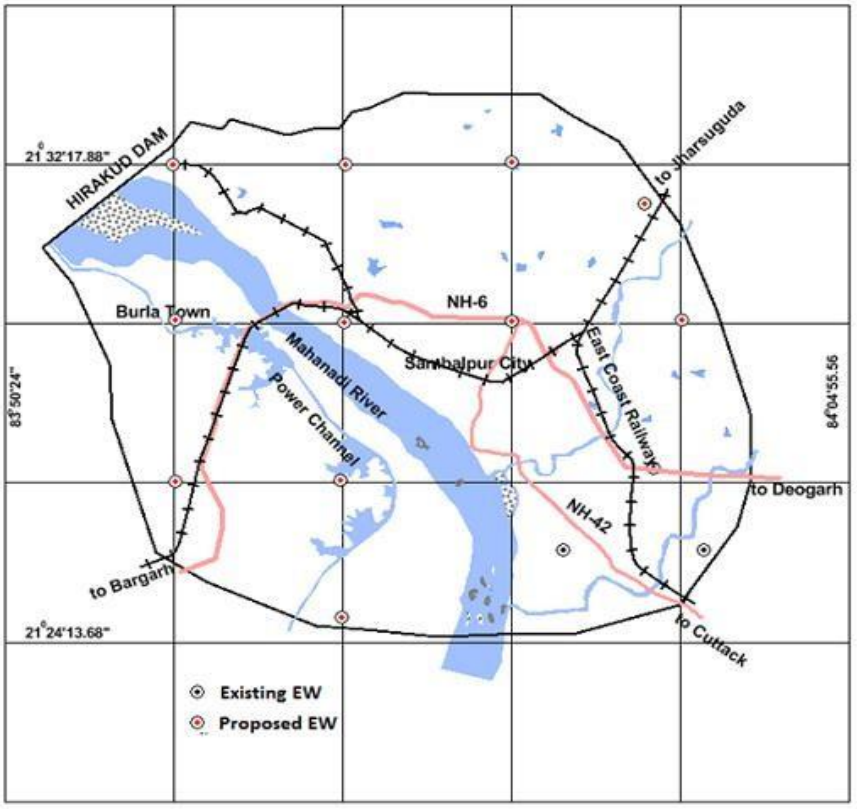


Fig.1.3 Data generation for proposed EW

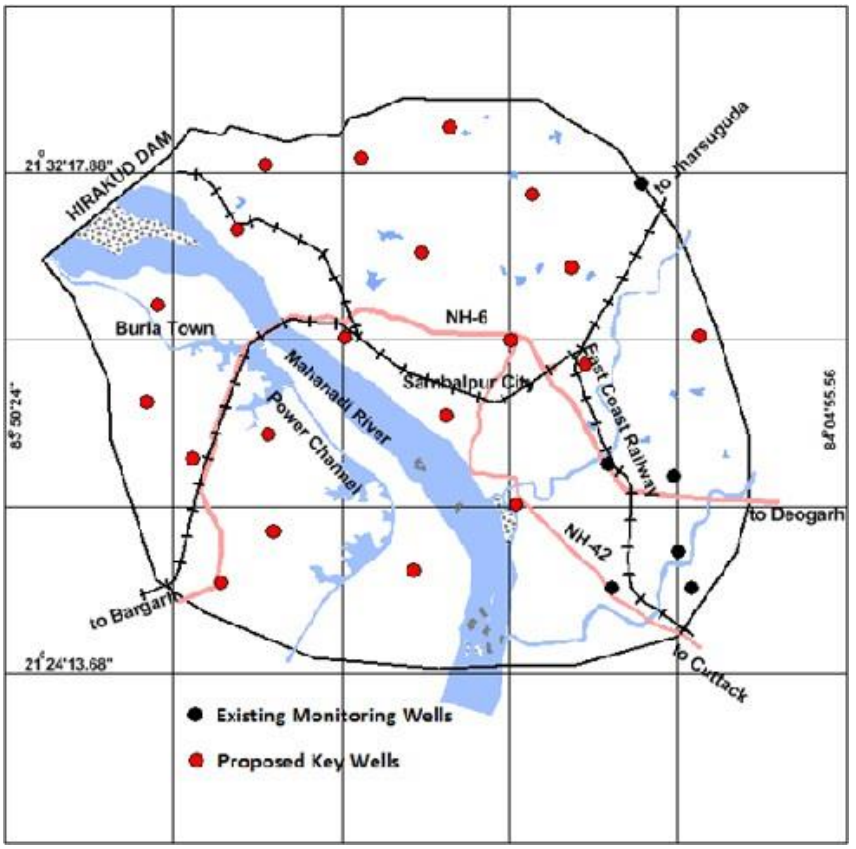


Fig.1.4 Data generation for proposed Keywells.

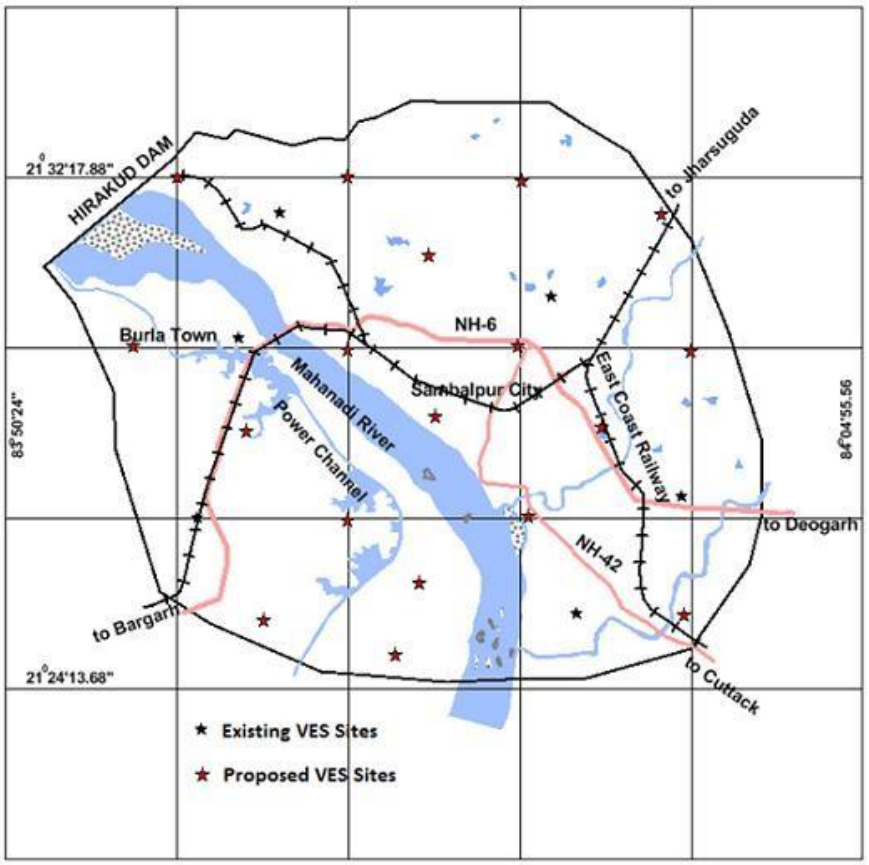


Fig.1.5 proposed site map for VES

NEW DATA GENERATION PLAN

1. 11 Exploratory Well are to be constructed with in the study area.
2. 30 numbers of key wells (20 dug well and 10 tube well/hand Pump) are to be establish for water level collection during pre and post monsoon time.
3. About 60number of water samples (ground water and surface water) are to be collected during pre- monsoon, monsoon and post-monsoon time only for heavy metal analysis from nearby industries. 45 number of water samples for basic analysis is also to be collected as per data gap.
4. 17 number of VES are a to be conducted.
5. Ground water abstraction data are to be collected from irrigation and RWSS wells.
6. To collect ground water abstraction and quality in different major industrial premises.
7. Collection of data of artificial recharge structure and water conservations tructure.
8. Data collection of water supply scheme in the study area.

1.5 GEOMORPHOLOGY:

Sambalpur urban and Peri-Urban study area has three common geomorphological features comprising of denundational hills, pediments and pediplains can be divided broadly in three units such as (i) Northern hilly terrain (ii) Southeastern plateau and (iii) Southeastern valley and plains of Sambalpur Sadar sub-division. Average elevation of major parts of the studyarearangesfrom100-300mpeaks having height up to 772 meters above mean sea level. The highest and lowest topographicelevation of the study area is 772 m and 96 mabove mean sea level respectively. Geomorphologically, the study area has beendivided into several units and subunits (viz., Buried pediment, plateau, gulley land, intermontane valley, paleochannel, pediment, structural hill, residual hill, linear ridge, valley fill). Fig.6 shows the Geomorphology of study area. Fig.1. 7, 1.8 &1.9 shows the Elevation, slope and contourmap of the study area.

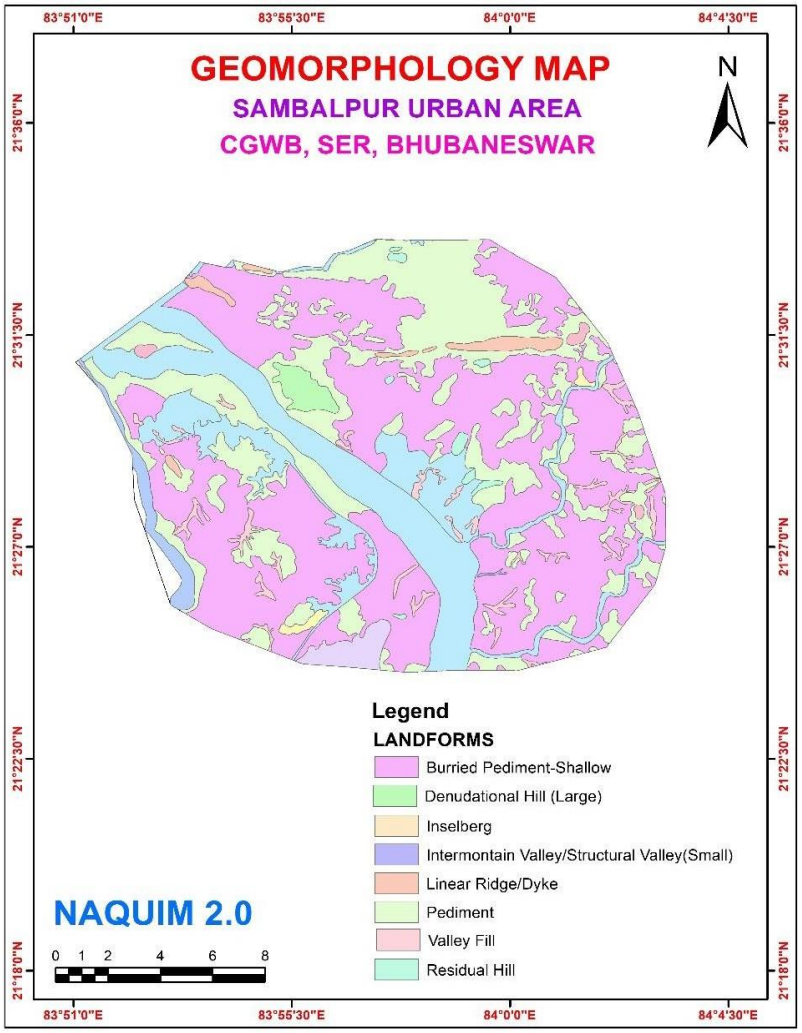


Fig.1.6 Geomorphology map of the study area.

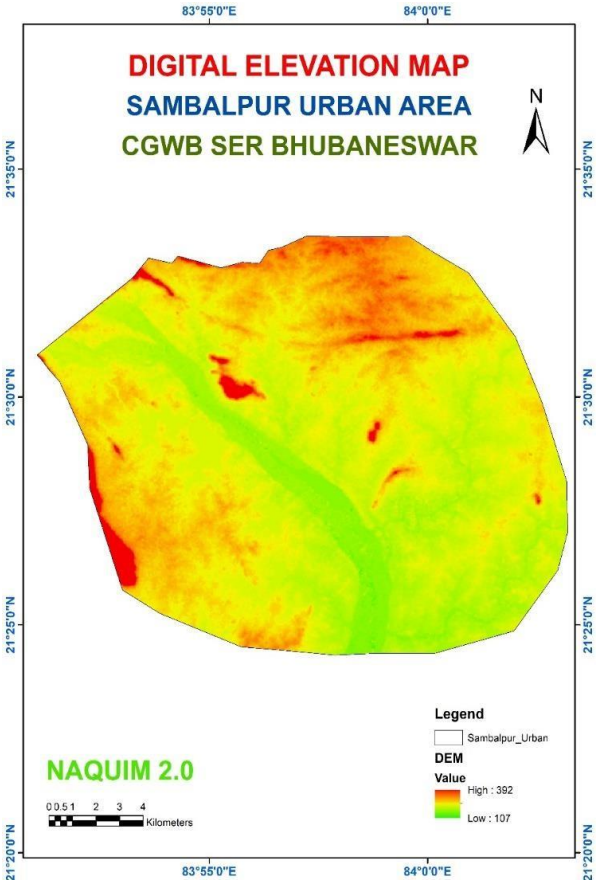


Fig.1.7 Elevation map of the study area.

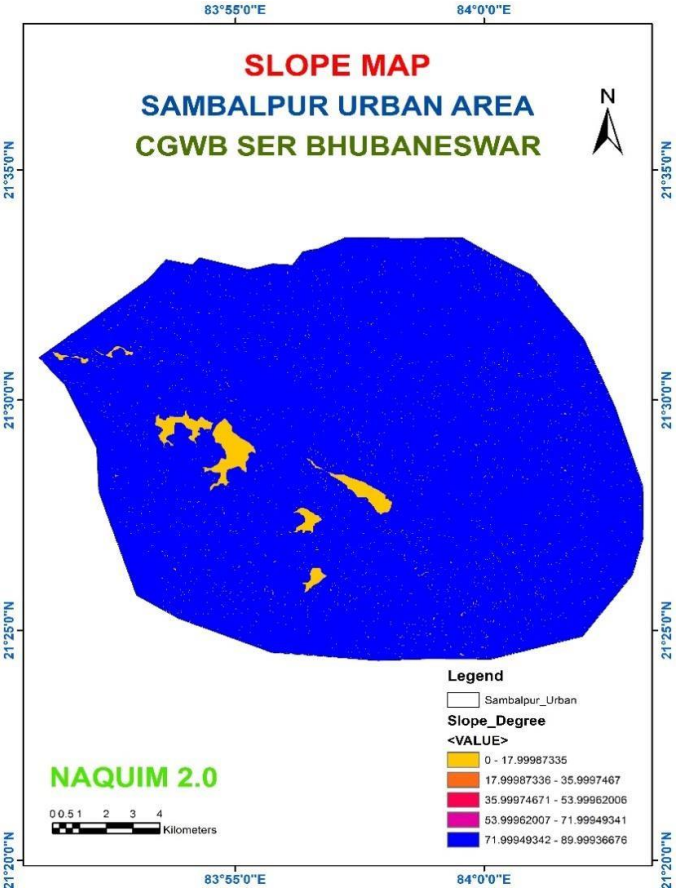


Fig.1.8 Slope map of the study area

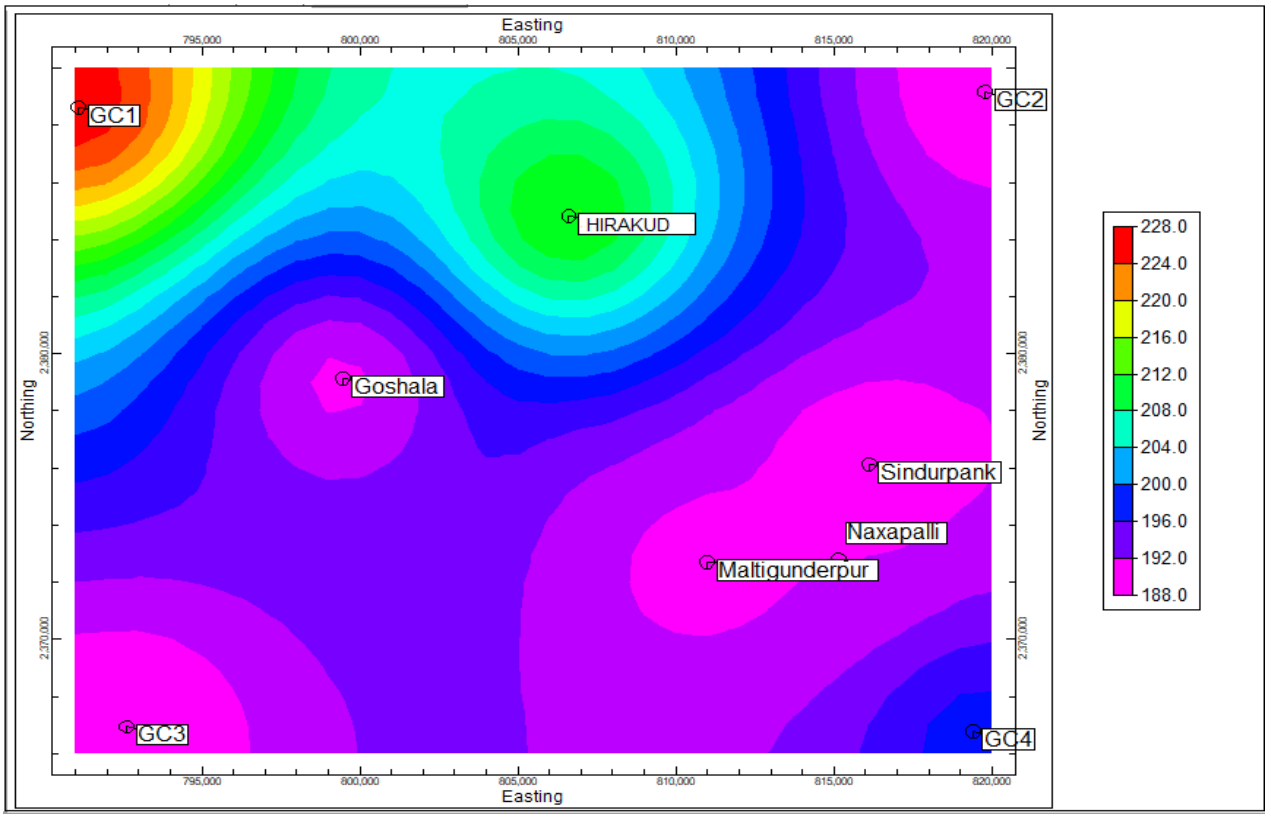


Fig.1.9 Contour map of the study area.

1.6 AGRICULTURE:

In the Peri-Urban Sambalpur study area crops are grown in kharif and rabi season. Crops are divided into cereals, pulses, oilseeds, vegetable, spices and sugarcane. Cereals crops are paddy, wheat, maize and ragi. Pulses crops are ground nut, till, sunflower and mustard. The major crops grown in the study area are cereals and pulses in Kharif season. In Rabi season, people grow cereals using available irrigation. Horticultural crops grown in both Rabi, Kharif and Summer season.

1.6 CROPPING PATTERN AND IRRIGATION:

During Kharif, major part of the irrigated area is used for growing cereals, followed by other crops. Further, major areas under rain-fed conditions are also used for growing cereals in Kharif. During Rabi season, major irrigated areas are used for other crops followed by cereal sand pulses are majorly grown in rain-fed conditions during Rabi season. Crop wise area covered under irrigated and rain-fed conditions during Kharif and Rabi is presented in the table cereals, followed by other crops.

Soil: The soil type ranges from medium to deep black, red and yellow. Mainly two types of soils found in the study area, i.e., Ultisoils consisting of red, yellow and lateritic soils and mixed grey soil; Alfisoils predominantly include red gravelly, sandy, loamy, red earth mixed with black soils. The alfisoils cover about 60% of the area and are devoid of any lime concretions with pH ranging from 6.5-7.3. These soils are fertile and suitable for agriculture.

Drainage: TheMahanadi river basin forms an important part of the study area geography. The details of major drainages are shown in the Fig.1.10.

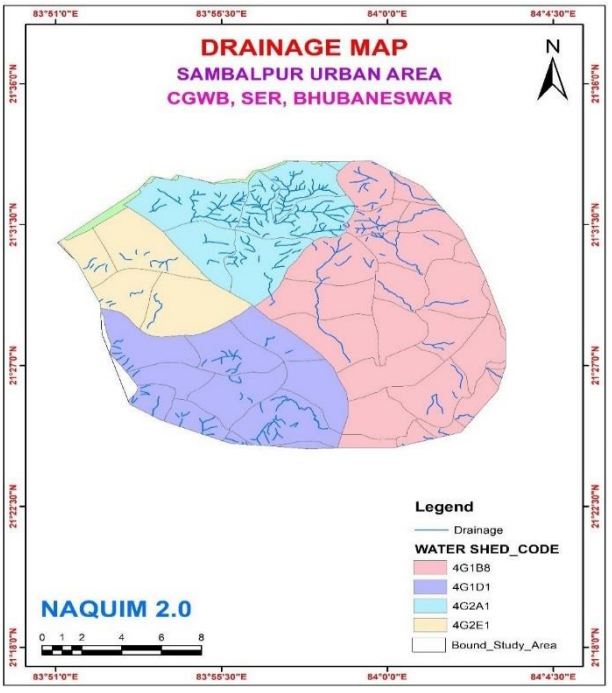


Fig.1.10 Drainage map of the study area

2.0 GEOLOGY

The area is characterized by a complex geological set up with a variety of rock types belonging mainly to Archaean, Pre Cambrian and Permo-Carboniferous ages. A small patch of lower Gondwana comprising of shale and sandstone alsooccurs in the study area. The hard rocks consist of granite & its variants, fractured quartzites, shales and sandstones.

Table 2.1 Generalized stratigraphic succession of Sambalpur District

Age	Rock types	Description
Recent to Sub-Recent	Alluvium	Sand, silt, clay in varying proportion
	Laterite	Laterite, sand, lateritic gravels
Paleozoic to Mesozoic	Lower Gondwana rocks	Mainly shale, sandstone sequence with Minor coal seams
Precambrian	Quartz & pegmatite veins, dykes etc. Metabasics (Epidiorite, amphibolite etc) Granite gneisses Quartz micaschist, phyllite, Carbonphyllite etc. Charnockite and khondalite suits of rocks	

Granite gneiss occupies nearly 60% of the study area under lain by consolidated rock formation and mostly occurring in undulating plains and valley areas. The thickness of weathered zone in granitic rocks usually ranges from 10 to 15 m and occasionally extends beyond 25 m depth. The yield factor of the phreatic aquifer in granite gneiss ranges from 06 to3.5 lpm/m^2 of the area/m of draw down with average value of 1 to2 lpm/ m^2/m drawdown. The yield factor is generally less in porphyritic granite gneiss than that of medium to coarse grained equigranular variety. They ield potentiality of deeper aquifer (upto200mbgl) varies from new it has rage yield of 2 to 5 lps. The specific capacity of the well varies from 2.32 lpm/ m drawdown to 44 lpm/ m of drawdown with the average value of 10 to 20 lpm/ m drawdown.

Gondwana group of rocks comprising mainly of shale, sandstone, siltstone, conglomerate etc. occur isolated pockets in the northern part of the study area. The Geology and lineament map of the study area is given in Fig.2.1 and 2.2 respectively.

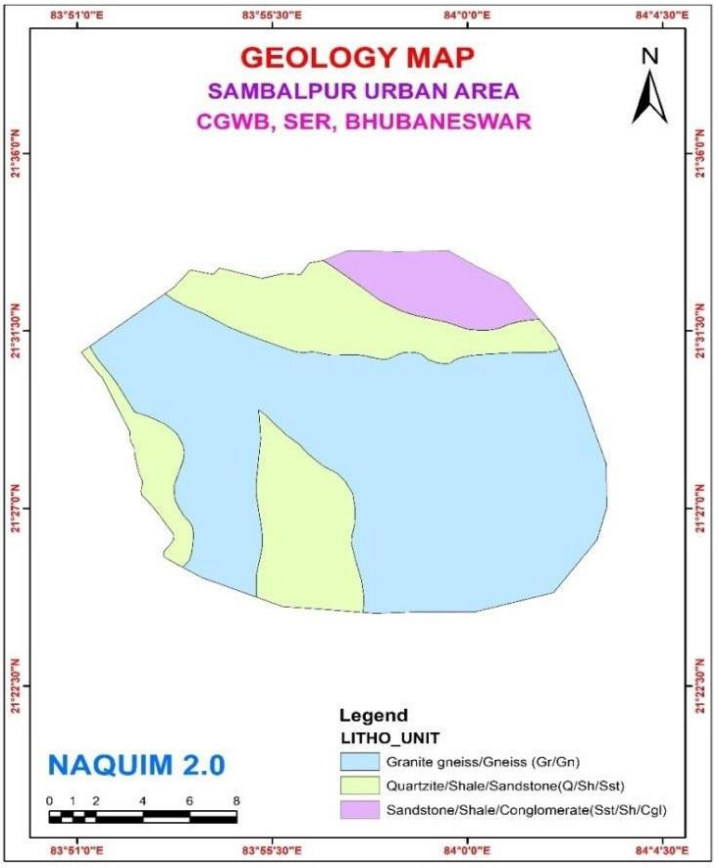


Fig.2.1 Geology map of the study area.

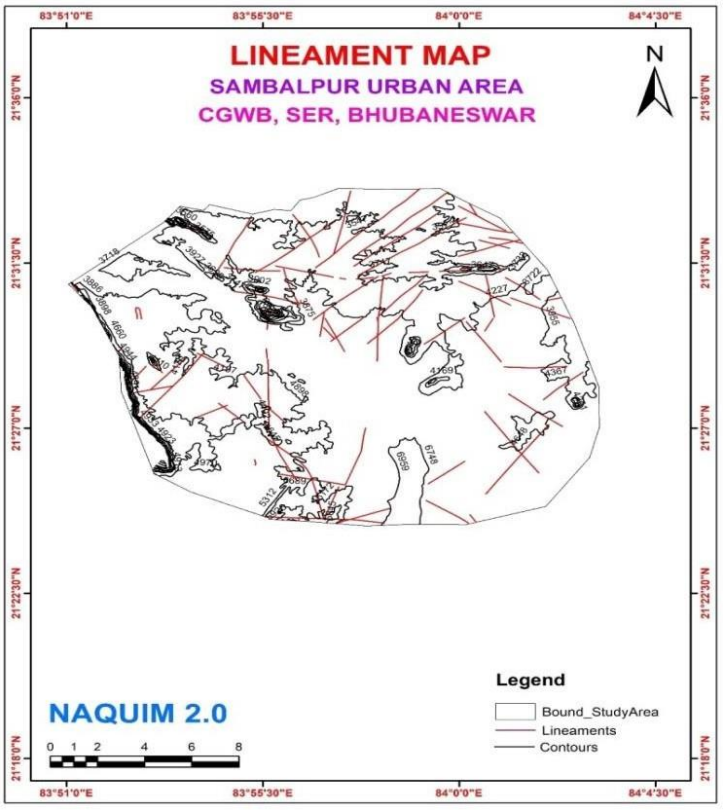


Fig.2.2 Line ament map of the study area.

3.0 HYDROGEOLOGY

Sambalpur urban study area can be divided into two major hydrogeological units, viz (1) Consolidated formations comprising of hard rocks of Precambrian age occupying 85% of the area and (2) Semi-consolidated rocks of Gondwana Super Group occurring in pockets in northern and southeastern parts. Consolidated formations include Granite Gneisses, Charnockites, Schistose rocks and Epidiorites. Secondary porosity forms the conduits for movement of groundwater and also acts as reservoir of groundwater. Under phreatic condition, groundwater occurs in upper weathered residuum of rock masses at shallower depth. At deeper level, in fractured and jointed rocks, it occurs under semi-confined to confined condition.

3.1 Consolidated formations*:* This includes all the hard rocks of Precambrian age such as Granite gneiss, Khondalites, Charnockites, Schists, Phyllite, epidiorite.

3.2 Semi consolidated formation: These includes Gondwana sedimentaries and lateritic deposits. The laterite occurs as capping over the country rocks with very limited thickness except in very isolated pockets where thickness around 4-5 m has been observed which form temporary shallow dug well zones. The yield from dug wells reported to be 30-35 m^3/day.

3.3 Unconsolidated formation: Alluvial deposits in the study area occur in very minor pockets along major rivers and stream courses with very limited thickness. The details of hydrogeological formations in Sambalpur Study area are summarized in Table.

3.4 AquiferGroupsandTheirDemarcation

Base done xtensive analysis of historical data, micro level hydrogeological survey data generated, and ground water exploration carried out in the area, the following two types of aquifers can be demarcated, and the details are given below:

Aquifer- I (Unconfined Aquifer): Unconfined aquifer, occurs in entire area except rocky outcrops, formed by the weathered mantle atop all crystalline as well as Gondwana formations and discontinuous alluvial tracts along major river channels. This aquifer generally occurs down to maximum depth of 30m bgl.

Aquifer-II(Semi-ConfinedtoConfinedAquifer): Semi-confined to confined aquifer occurs as fracture zone aquifers in the entire area irrespective of rock types. However, the aquifer properties, the yield of bore wells constructed in them depends on the rock type. As per the ground water exploration, carried out by CGWB. Aquifer-II in Granitic rocks have better yield in comparison to Gondwana formations, Charnockites and Khondalites. In general, most of the fracture zones are encountered within 30 to 180 mbgl and seldom beyond that. Thus, the maximum depth for the Aquifer-II has been taken as 200 mbgl.

Table 3.1: Characteristics of Aquifer Groupsin the study area

Typeof Aquifer Group	Formation	Depth range (mbgl)	Yield	Aquifer parameter	Suitability for drinking/ irrigation
Aquifer-I (Phreatic)	Unconsolidated and Weathered Recent: Soil, sand, Alluvium &Laterite Pre-Cambrian: GraniteGneiss, Charnockite, Khondalite,	0-30	12-580 m^3/day	SpecificCapacity Index: 0.5-10.26 lpm/m/m^2	Yesfor both
Aquifer-II (Semi-confinedto Confined)	Fractured Granite Gneiss, Charnockite, Khondalite, Gondwana	30-200	Negl.-22 lps	Transmissivity: 1.66-217.72	Yesfor both

3.5 Aquifer Disposition based on Ground water Exploration

The ground water exploration data has been used to generate the 3D disposition of the aquifer system. It comprises of all existing litho-units and the zones tapped during the groundwater exploration, forming anaquifer. The 3D disposit ion of the aquifer system in study are a are shownin Fig.3.1. The 2D schem atic sections are shown in Fig. 3.2,3.3,3.4,3.5 and 3.6 as per ground water exploration data.

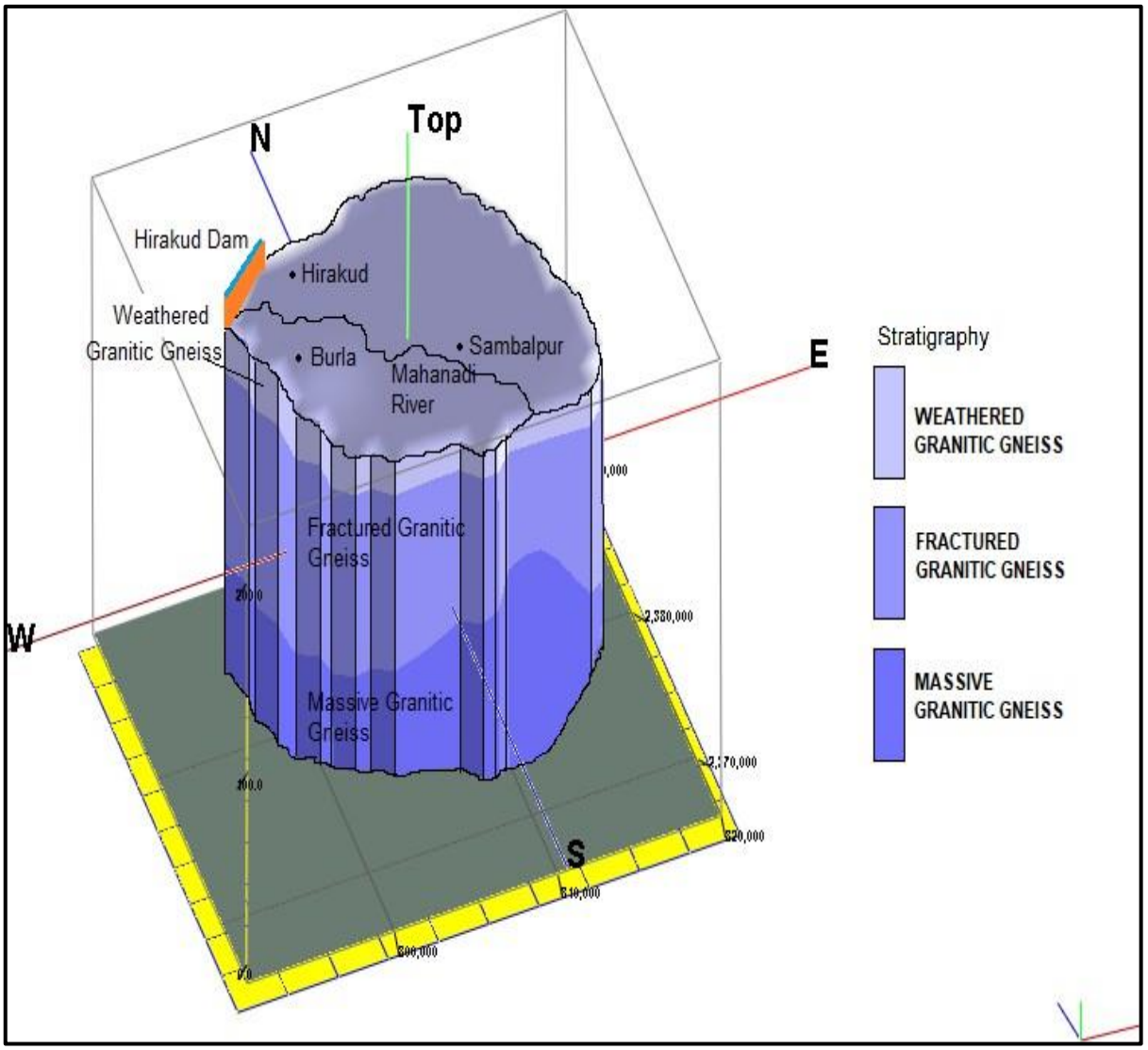


Fig.3.1 3D disposition of the aquifer system in study area.

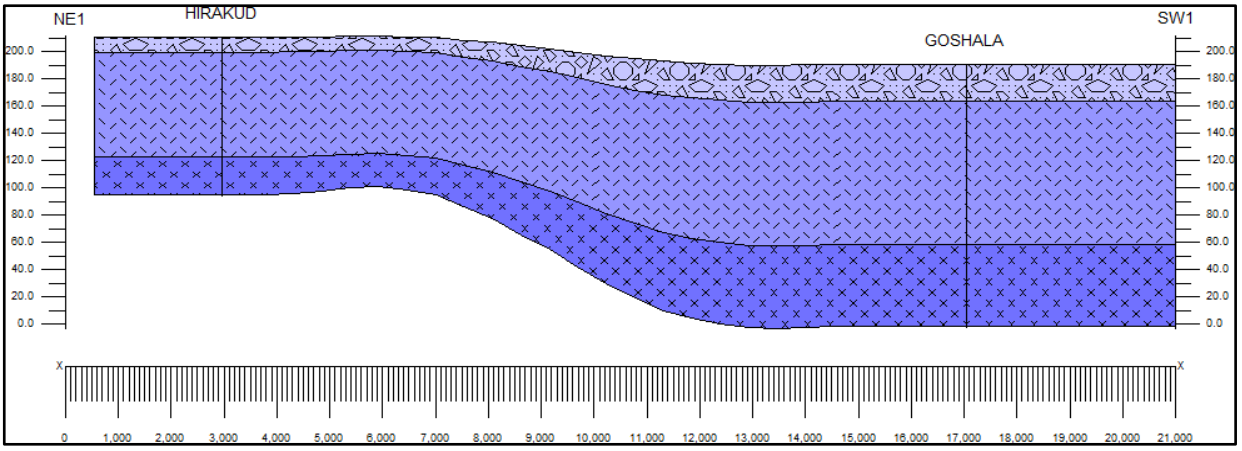


Fig.3.2 Schematic Aquifer Cross-Section along Hirakud-Goshala section of the study area.

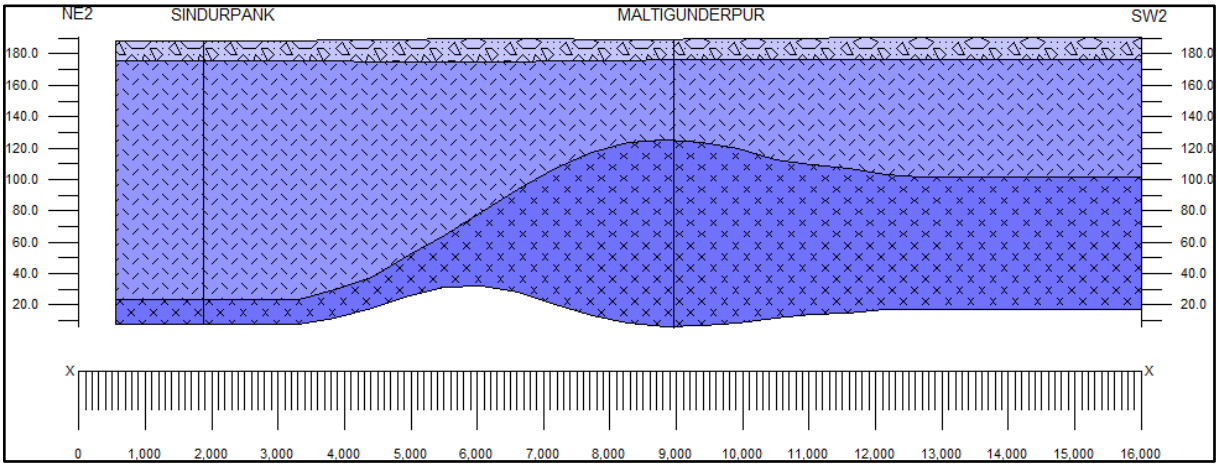


Fig.3.3 Schematic Aquifer Cross-Section along Sindurpank-Maltigunderpur section of the study area.

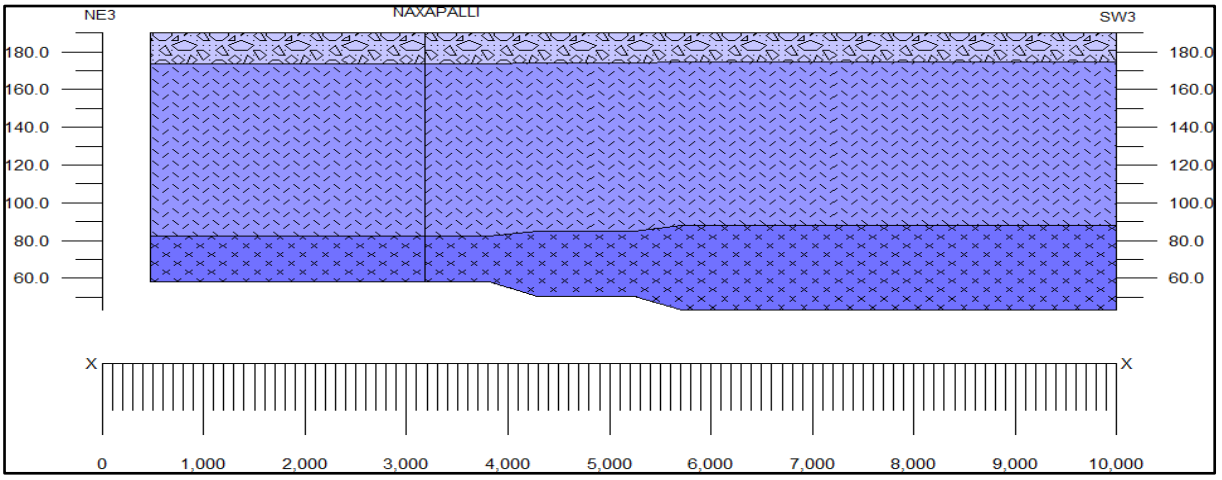


Fig.3.4 Schematic Aquifer Cross-Section along Naxapali section of the study area.

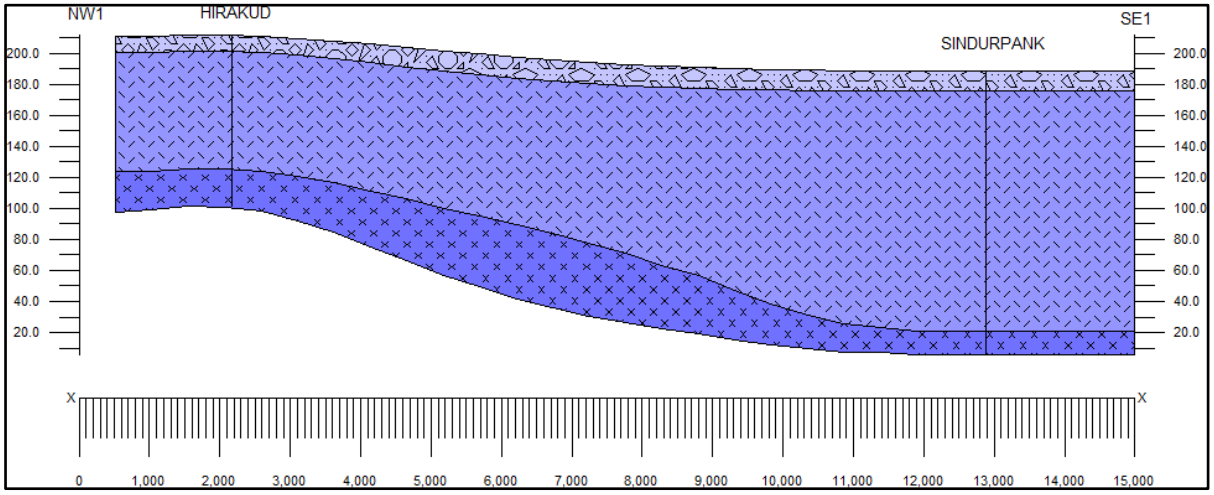


Fig.3.5 Schematic Aquifer Cross-Section along Hirakud-Sindurpank section of the study area**.**

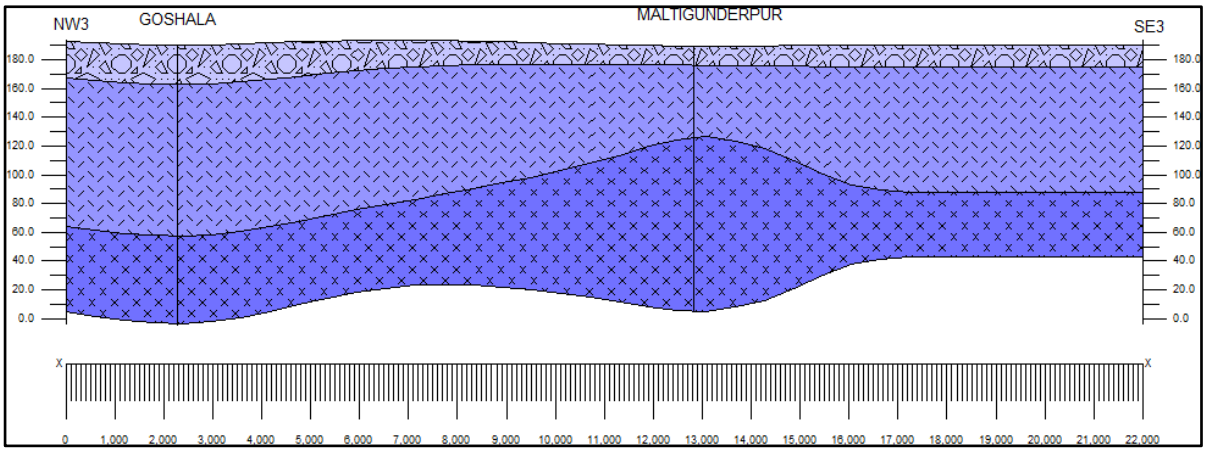


Fig.3.6 Schematic Aquifer Cross-Section along Goshala-MaltiGunderpur section of the study area.

Table 3.2 Block-wise area in percent for different Hydrogeological Formations in theStudy area, Odisha

Name of Block	BHQ	Charnockite (Ch)	Granite gneiss/ Gneiss (Gr/Gn)	Khondalite, Khondalite/ Quartzite (Kh)(Kh/Q)	Micaceous Quartzite (MQtz)	Phyllite/ Limestone (Phy/Lst)	Quartzite (LR) (Q)	Quartzite/ Shale/ Sandstne (Q/Sh/Sst)	Sandstone/ Shale/ Conglomerate (Sst/Sh/Cgl)	Schist/ Quartzite/ Qt-schist (Sch/Q/Q. Sch)	Volcanics/ Lava Quartzite/ Volcanics (V)(Q/V)
Dhankauda	0	0	40.59	0	0	0	0	34.11	25.29	0	0
Manesar	0	0	74.78	19.71	0	0	0	0.04	5.47	0	0
Studyarea	0	0	115.37	19.71	0	0	0	34.15	30.76	0	0

Table:3.3 PreMonsoon and Postmonsoon wate rlevel, 2023 of the keywells established in the study area

Sl. No.	Location	Latitude	Longitude	Elevation (mamsl)	MP (magl)	DTWL (m) (Pre-Monsoon)	DTWL (m) (post-monsoon)	Seasonal Waterlevel Fluctuation
1	MalatiJhoratSubanpur	21.42218	83.99741	167	0.48	4.4	3.25	1.15
2	MalatiJhoratKhandual	21.4145	83.9848	168	0.45	4.9	3.1	1.8
3	Khagasipali	21.4395	83.9322	171	0.5	2.6	2.2	0.4
4	Mundoghat (Pardesipada)	21.4557	83.9497	164	0.6	4.1	3.5	0.6
5	Kutapali	21.468	83.9421	163	0.45	3.3	2.9	0.4
6	BhutapadaChhak	21.4601	83.9819	164	0.55	3.6	3.2	0.4
7	Chorbhati	21.4572	83.9866	168	0.5	2.7	2.4	0.3
8	Dhanupali	21.4475	83.9907	170	0.4	2.8	2.5	0.3
9	Khandual	21.4208	83.9969	163	0.5	2.4	2.1	0.3
10	Mathpali	21.4378	83.9907	167	0.6	7.4	7.1	0.3
11	Naxapali	21.4263	84.0149	168	0.68	6.8	6.3	0.5
12	Kanteipali	21.41984	84.03685	171	0.48	6.8	6.4	0.4
13	Mirgamunda	21.42437	84.003979	164	0.45	5.1	4.5	0.6
14	Putibandh	21.44971	83.99741	163	0.5	4.3	3.9	0.4
15	Dandeipali	21.45615	84.03103	164	0.6	4.1	3.6	0.5
16	Tumbesingha	21.45826	84.01231	168	0.45	4.5	4.1	0.4

17	Pardhiapali	21.51369	84.01415	170	0.55	11.5	10.2	1.3
18	Jogipali	21.52874	83.98133	163	0.5	8.7	7.3	1.4
19	Hirakud Rly station	21.48079	83.90552	167	0.4	10.1	9.1	1
20	Goshala	21.4251	83.9005	168	0.5	6.1	4.8	1.3
21	Chiplima	21.38705	83.8892	171	0.6	8.3	7.4	0.9
22	A.Katapali	21.4613	83.89929	164	0.68	8.2	7.3	0.9
23	Jyotivihar (Sambalpur University)	21.4784	83.8851	163	0.48	5.5	4.8	0.7
24	Jyotivihar (S.U)	21.48025	83.88	164	0.45	4.7	4.1	0.6
25	Sadeipali	21.4976	83.87332	168	0.5	1.7	1.3	0.4
26	BulaHospital (VIMSAR)	21.50083	83.88264	170	0.6	15.7	13.3	2.4
27	Remed	21.50755	83.9367	163	0.45	3.4	2.5	0.9
28	Hirakud	21.52897	83.89672	167	0.55	1.5	1.1	0.4
29	Jamadarpali	21.54938	83.97686	168	0.5	12.7	10.3	2.4
30	Larbanga	21.5572	83.95136	171	0.4	10.1	9.3	0.8
31	Burhakata	21.53575	83.9428	164	0.5	6.6	5.8	0.8
32	Modipada (Labourcolony)	21.47235	83.96831	163	0.6	1.1	1.2	-0.1
33	Samleswari temple	21.474	83.9586	164	0.68	8.1	7.5	0.6
34	REMED	21.50755	83.9367	168	0.48	3.56	2.5	1.06
35	LARPANKA	21.501	83.888	170	0.45	6.75	4.7	2.05
36	NARADIHI	21.505	83.903	163	0.5	4.5	2.46	2.04
37	GADMUNDA	21.461	83.9722	167	0.6	4.68	2.65	2.03
38	SOLPALI	21.5377	83.909	168	0.45	3.24	1.22	2.02
39	HIRAKUD	21.52897	83.89672	171	0.55	1.6	1.41	0.19
40	SOLABANDH	21.539	83.899	164	0.5	4.56	2.56	2
41	LARBHANGA	21.5572	83.95136	163	0.4	6.89	4.9	1.99
42	JAMADARPALI	21.54938	83.97686	164	0.5	11.98	10	1.98
43	PANDRIPALLI	21.528	83.981	168	0.6	5.55	3.58	1.97
44	MADHUPUR	21.539	83.899	170	0.68	6.34	4.38	1.96
45	BHALUKONDA	21.542	83.988	163	0.48	7.8	5.85	1.95
46	SINGHAPALLI	21.5133	83.9931	167	0.45	4.12	3.18	0.94
47	GOPALAPALLI	21.495	83.963	168	0.5	6.54	4.61	1.93

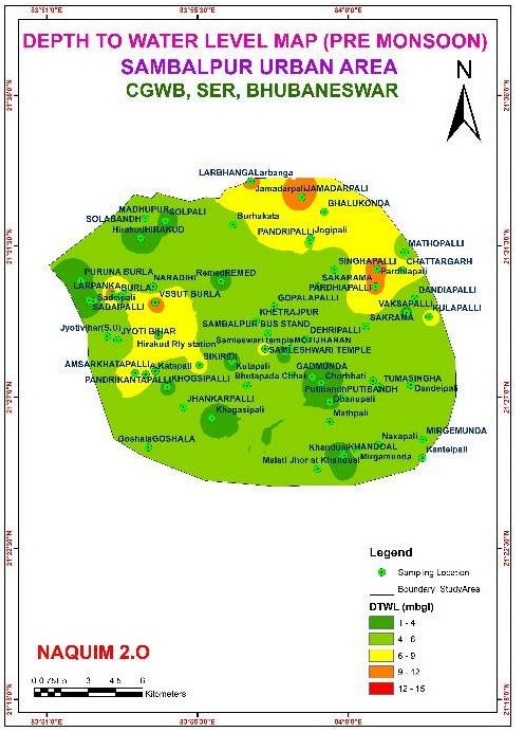
48	SAKARAMA	21.505	83.985	171	0.6	4.97	3.05	1.92
49	DEHRIPALLI	21.479	83.979	164	0.45	5.48	3.57	1.91
50	PURUNA BURLA	21.508	83.867	163	0.55	2.1	1.2	0.9
51	SADAIPALLI	21.498	83.871	164	0.5	1.5	1.39	0.11
52	BURLA	21.5	83.885	168	0.4	3.65	1.77	1.88
53	JYOTI BIHAR	21.4784	83.8851	170	0.5	4.5	2.63	1.87
54	AMSARKHATAPALLI	21.462	83.894	163	0.6	8.14	6.28	1.86
55	VSSUTBURLA	21.497	83.904	167	0.68	11.5	9.65	1.85
56	HIRAKUD RAILWAY STATION	21.48079	83.90552	168	0.48	10.21	8.37	1.84
57	SIKIRIDI	21.466	83.926	171	0.45	7.54	5.71	1.83
58	PANDRIKANTAPALLI	21.463	83.904	164	0.5	6.54	4.72	1.82
59	GOSHALA	21.4251	83.9005	163	0.6	6.2	4.39	1.81
60	KHOGSIPALLI	21.455	83.91	164	0.45	2.5	0.7	1.8
61	JHANKARPALLI	21.445	83.918	168	0.55	6.54	4.75	1.79
62	BARAMPURA	21.3441	83.929	170	0.5	5.87	4.09	1.78
63	KHETRAJPUR	21.488	83.954	163	0.4	6.54	4.77	1.77
64	SAMBALPURBUS STAND	21.482	83.96	167	0.5	5.48	3.72	1.76
65	SAMLESHWARI TEMPLE	21.474	83.9586	168	0.6	8.13	6.38	1.75
66	MOTIJHARAN	21.474	83.971	171	0.68	6.57	4.83	1.74
67	PUTIBANDH	21.44971	83.99741	164	0.48	4.5	2.77	1.73
68	MATHOPALLI	21.522	84.028	163	0.45	5.48	3.76	1.72
69	KHANDOAL	21.421	83.998	164	0.5	2.57	0.86	1.71
70	VAKSAPALLI	21.492	84.029	168	0.6	3.27	1.57	1.7
71	MIRGEMUNDA	21.429	84.037	170	0.45	5.2	3.51	1.69
72	DANDIAPALLI	21.499	84.033	163	0.55	3.98	2.3	1.68
73	TUMASINGHA	21.455	84.0155	167	0.5	4.3	2.63	1.67
74	SAKRAMA	21.4852	84.0088	168	0.4	6.59	4.93	1.66
75	KULAPALLI	21.49	84.04	171	0.5	7.56	5.91	1.65
76	PARDHIAPALLI	21.505	84.0136	164	0.6	10.85	9.21	1.64
77	CHATTARGARH	21.513	84.027	163	0.68	9.46	7.83	1.63

3.6 Aquifer wise Ground water levels

Almost the entire area is occupied by the consolidated formations comprising granites, gneiss, and Khondalites, Metabasics and shale. These rocks are very hard and compact and lack primary porosity. Ground water is stored mainly in the secondary porosity resulting from weathering and fracturing of the rocks. The aquifer materials are highly heterogeneous in character showing both vertical and lateral variations. The weathered residum form the main repositories of ground water, which occurs under water table conditions and circulates through deeper fractures and fissures. Ground water occurs under confined to semi-confined condition in the deeper fractured zones. The water yielding capacity of fractured rocks largely depends on the extent of fracturing, openness and size of fractures and extent of their interconnections into the near surface weathered zone.

3.7 Shallow Aquifer

Ground water occurs in phreatic condition in shallow aquifer sand is utilized by me ans ofdug well sor shallow tube wells. The depth of the dug wells used as observation points vary from 5.7 to 13.1 mbgl and their diameter ranges from 1.0 m to 6.5 m. The wells are generally lined to the total depth.



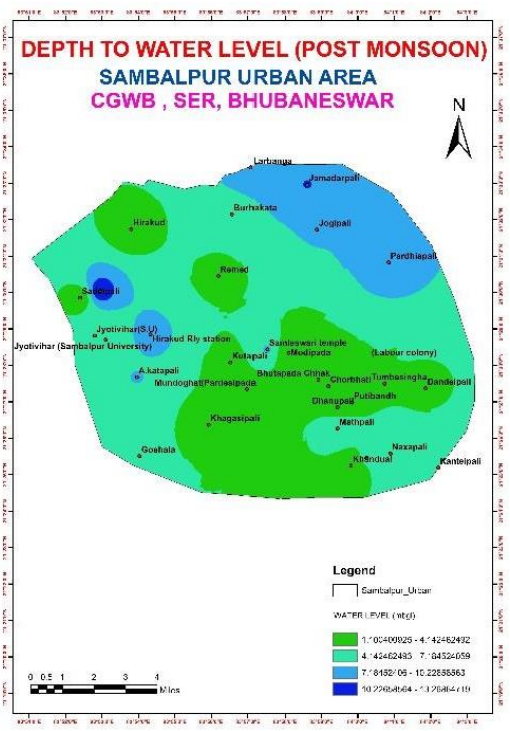


Fig.3.7 Depth to water level (premonsoon) **Fig.3.8** Depth to water level (post monsoon)

3.7.1 Pre-monsoonDepthtoWater Level

The Depth to water level in pre-monsoon period (May 2023) varies from 1.1 mbgl (modipada) to 15.7 mbgl (Burla), the average being 8.4mbgl. In general, the study area has the depth to water level in between 4 to 6mbgl during the pre-monsoon. Water logging condition (<3 mbgl) is found in western portion in Hirakud dam during the pre-monsoon. Shallower water level of 2-4 mbgl is observed in parts of Khagsipali, Chorbhati, Hirakud, Remed and Larpank. They are mainly due to adequate irrigation facility through the Hirakud Main Branch canal and its distributaries. Deeper water levels (>12mbgl) are found mostly in Pardhiapali, Burla, Jamadarpali and Sadeipali. The pre-monsoon depth to water level map is shown in **Fig. 3.7**.

3.7.2 Post-monsoonDepthtoWater Level

Depth to water level in post-monsoon period (Nov2023) varies from 0.7mbgl (Khogsipada) to 13.3mbgl (Burla),

the average being 7.0mbgl.The depth to water level of the study area during Nov 2023 is in general within 4- 7mbgl. The areas around Khagsipali, Remed, Hirakud, Dhanupali, sadeipli, Modipada and Putibandh show shallow water level of less than 4.0mbgl. The locations where the depth to water level is more than 10.0m bgl are Sadeipali and Jamadarpali. The post-monsoon depth to water level map is shown below in **Fig. 3.8**.

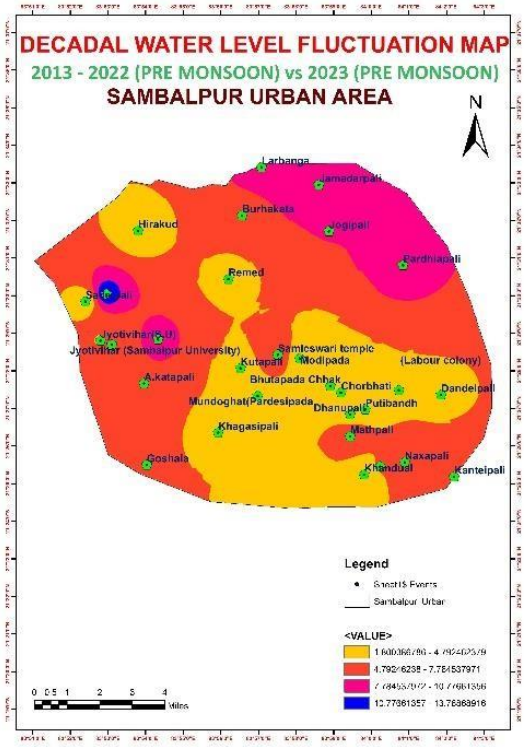


Fig.3.9 Decadal waterl evel Fluctuation Map (pre monsoon)

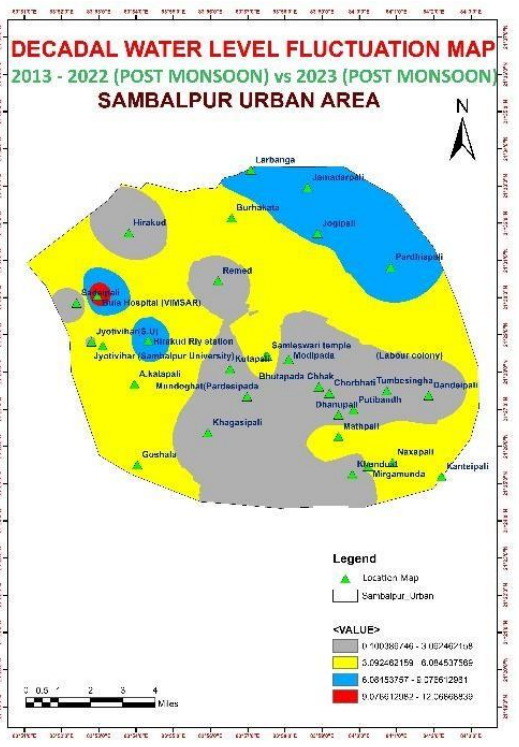


Fig.3.10 Decadal water level Fluctuation (postmonsoon)

3.7.3 Decadal Fluctuation of Water Level

The decadal water level Fluctuation 2013-22 Pre-monsoon Vs 2023 Pre-monsoonof shallow aquifer ranges from 1.80 mbgl to 13.76 mbgl and the decadal water level Fluctuation2013-22 Post-monsoon Vs 2023 Post monsoonof shallow aquifer ranges from 0.10mbgl to12.06 mbgl. The locations where the fluctuation of water level is more than 7 m during pre-monsoon are observed in Jamadarpali, Pardhiapali, Jogipali and Sadeipal. The locations where the fluctuation of water level is more than 6 m during post-monsoon are observed in Jamadarpali, Pardhiapali, Jogipali and Sadeipali.The shallow post-monsoon water level along with fluctuation pattern indicates that the annual replenishment of phreatic aquifer due to monsoon rainfall is adequate in the district but deeper summer level is due to rapidde watering of the phreatic aquifer due to steep gradient towards the Mahanadi. The decadalfluctuation of water level of Aquifer-I is shown in **Fig. 3.9 and 3.10**.

3.8 Deeper Aquifer

Unlike phreatic aquifer, ground water occurs under confined to semi-confined condition in the deeper aquifer. The deeper aquifer comprises of the jointed and fractured consolidated or crystalline formations as well as the semi-consolidated formations such as Gondwana. In general, it's confined on top by weathered formations and bottom by massive rocks.

CGWB has constructed 07 EWs, 01 OW and 01 PZ in the study area through its Ground Water Exploration Programme, whose depthsrange from 104.7 m bgl (Sambalpur city) to 200.3 mbgl (Maneswar). The staticwater level varies from 0.49 m bgl (Sambalpur) to 6.3 m bgl (Maneswar). The discharge of successful borewells varies from 0.23 lps (Sambalpurcity) to a maximum of 7.0 lps (Goshala). The drawdown varies from11.72m (Goshala) to 23.54 m (Sambalpur). The details of the exploratory wells are given in **Table-3.4.** Generally 1 to 4 potential fracture zones are encountered within the depth range of 135.0 m. The first promising zone occurs in the depth range of 15 to 45m, which is just below thezone of weathering. The depth range o fprime importance is from 40 to 100 m. Normally, the fracture zones in this depth range have high water yielding capabilities and majority of successful bore wells in the study area tapped zones within this depth range. The other potential fracture zones are found at the depth ranges of 40-65, 70-90, 95-115, 130-140 mbgl. Granite Gneiss suites rocks have more promising aquifers in comparison to other rocks like Charnockites and Khondalites. However, the success of bore wells is site specific and depends on topographic and hydrogeological conditions.

Table 3.4 Details of exploratory wells in study area

Sl. No	Block	Location	Lat	Long	Depth drilled (mbgl)	Depth constructed (mbgl)	Lithology	Depth to Bed rock (mbgl) Casing Pipe Lowered	Granular zones/ deciphered (mbgl)	SWL (mbgl)	Discharge (lps)	Ddn (m)
1	Maneswar	Sindurpank	21.46	84.05	190.1	190.1	Bio Gr. Gneiss	12.2	15,190	2	Nil	-
2	Maneswar	Maneswar	21.53	84.05	200.3	200.3	Bio Gr. Gneiss with Basic	4.1	178	6.3	0.3	-
3	Dhankauda	Gosala	21.49	83.89	158.6	158.6	Gr. Gneiss	31.5	45,78,135	4.29	7	11.91
4	Dhankauda	Gosala	21.49	83.89	196.8	196.8	Gr. Gneiss	28.1	51,69,94,103	5.49	7	11.72
5	Maneswar	Maltigunderpur	21.43	84	191	191	Gr. Gneiss	12.8	43,51	4.02	0.8	
6	Dhankavda	Sambalpur	21.54	83.96	200	200	Gr. Gneiss	10.8	15.9,164.3	0.49	0.88	23.54
7	Dhankauda	Chiplima	21.32	83.89	200	200	Gr. Gneiss	14.8			Ngt	
8	SambalpurCity	Sambalpur	21.45	84.98	104.7	104.7	Gr. Gneiss	9.5		6	0.23	

4.0 GOUND WATER RESOURCES

The dynamic ground water resource of the district was jointly carried out in 2023 by Central Ground Water Board (CGWB) and Ground Water Survey and Investigation (GWS&I) adopting the methodology recommended by GEC 2015. The ground water resource can be aquifer wise divided into Dynamic and Static resource. The dynamic resource is the part of resource within the water level fluctuation zone which is also the annual replenishable resource. The resource below the water level fluctuation zone is termed as the In-storage (Static) resource. Mainly the water level fluctuation method was adopted for calculation of recharge.

4.1 GROUND WATER RESOURCE ESTIMATION

- Total Area: 275 sq.km
- Unit Draft: Borewell:0.45ham
- Dug well:0.07ham
- Rainfall Recharge: 1185ham
- Recharge due to other sources: 512ham
- Total Recharge: 1697ham
- Extractable Ground water Resource: 1457ham
- Total Ground WaterExtraction: 407ham
- Stage of Ground Water Extraction:27.93%
- Stage of Ground Water Extraction (Apportion basis):25.4%

5.0 GROUND WATER QUALITY

5.1 Sample Collection

The representative groundwater samples were collected by keeping in mind to fulfill the objectives on NAQUIM 2.0 during pre monsoon and post monsoon. There are 75 groundwater samples collected during pre-monsoon and51 samplesin post- monsoon, from different Dug Wells, Hand Pumps, bore wells etc. to assess the quality of the region.

5.2 Analysis

The samples were analyzed for 15 basic parameters, including pH, Electrical Conductivity, Total Dissolved Solids (TDS), Total Hardness (TH), Alkalinity, Calcium (Ca), Magnesium (Mg), Sodium (Na), Potassium (K), Carbonate (CO_3), Bicarbonate (HCO_3), Chloride (Cl), Sulphate (SO_4),Nitrate (NO_3) fluoride (F), and Uranium(U) by following the standard methods for the examination of water and wastewater, prepared and published jointly byAPHA,AWWA,and WEF (24^{th}Edition,2023) and also for different heavy metals.

The correctnessof analysisis balanced as per thefollowing equationand the percentof errors restrictedto 5%.

$$\% \text{ Difference } = 100 \text{ X} \frac{\sum \text{Cations} - \sum \text{Anions}}{\sum \text{Cations} + \sum \text{Anions}}$$

The analytical results incorporating physical and chemical parameters of the ground water samples from the study area are presented in annexure I and II for pre monsoon and post monsoon respectively. The Quality of ground water in the study area exhibits significant variations due to factors such as physiography, soil texture, and underlying soil formations.

5.3 Ground water Quality of the Study Area

Quality of ground water varies widely depending on the physiographic set up as well as geological formation. The minimum, maximum, and mean of the measured physico-chemical characteristics of the groundwater samples are presented in Table- 1. A brief description of important physico-chemical attributes ofgroundwater is discussed.

Table 5.1 StatisticalSummarypremonsoonandPostMonsoonGroundwaterSamples

Parameters	Pre-Monsoon			Post-Monsoon		
	MIN	MAX	AVERAGE	MIN	MAX	AVERAGE
pH	6.48	8.09	7.49	6.46	7.66	7.08
ECµS/cm	341	3801	955	135	2534	748
TDSmg/l	173	1976	505	72	1403	405
Total Hardness mg/l, as $CaCO_3$	125	1500	339	61	821	281
Total Alkalinity mg/l, as $CaCO_3$	90	455	233	50	325	191
Ca^{++}mg/l	28	250	63	20	180	71
Mg^{++}mg/l	2	213	44	3	119	25
Na^{+}mg/l	8	192	59	2	206	40
K^{+}mg/l	1	44	4.77	0.4	79.1	4.46
CO_3mg/l	0	0	0	0	0	0
HCO_3mg/l	110	555	284	61	397	234

Parameters	Pre-Monsoon			Post-Monsoon		
	MIN	MAX	AVERAGE	MIN	MAX	AVERAGE
Cl^{-}mg/l	25	1007	140	4	616	84
SO_4mg/l	3	80	35	8	226	48
NO_3mg/l	0	242	19	0	174	17
F^{-}mg/l	0.14	2.11	0.73	0.19	2.18	0.6

The table 5.1 shows the mean values of calcium and sulphate is higher in post monsoon than pre monsoon values. The reported concentrations of nitrate are remarkably higher than the acceptable limit of drinking water specification, IS 10500:2012 may be due to the role of sewage discharge.

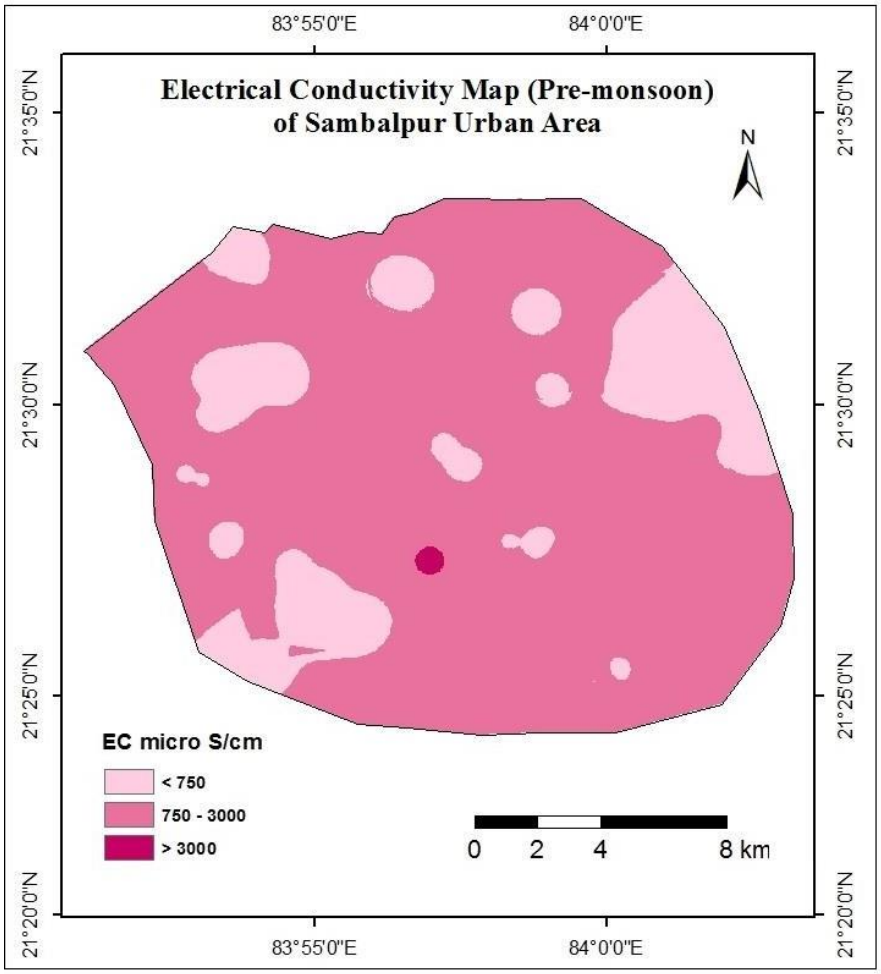
pH

The pH value ranges from 6.48 to 8.09 with a mean of 7.49 in pre monsoon season. The pH indicates the slightly acidic to highly alkaline in nature. The post monsoon samples are also acidic to alkaline, in the pH range between 6.46 and 7.66with mean 7.08.

Electrical Conductivity and Total Dissolved Solids

The electrical conductivity (EC) in the study area lies between 341 and 3801 µS/cm at 25°C during pre monsoon period. The mean EC in pre-monsoon is955µS/cm at 25°C, higher than the post-monsoon season (748 µS/cm at 25°C).The mean Total Dissolved Solids (TDS) are

505 and 405 mg/l during pre and post monsoon respectively. Thetotal dissolved solids vary between 173 and 1976 mg/l in the urban and peri- urban region of the Sambalpur city during pre monsoon. The distribution of electrical conductivity of groundwater for pre-monsoon



and post-monsoon are presented in the fig-5.1 and5.2 respectively.

Fig.5.1 Distribution of Electrical conductivity of Ground water in the study area during premonsoon

The fig 5. 1 and 5.2 show the electrical conductivity widely distributed and mostly cover the study arein the range of 750-3000 μS/cm at 25°C . The pre monsoon EC map shows the small pockets of electrical conductivity less than 750 μS/cm at 25°C . The post monsoon groundwater sample of the eastern and western part of the study area is fresher than the other parts. This may be due to the freshwater inflow into groundwater from the reservoir. The maximum TDS found was 1976 mg/l and 1403 mg/l at Mundoghat (Pardesipada) during pre and post monsoon respectively. The lower TDs in post-monsoon is due to the dilution effect. The major source for high TDS is mainly due to dissolved minerals in the area and leachate from the inappropriate disposed solid and municipal waste during the rainy season.

The classification of groundwater based on total dissolved solidsis summersied in the table 5.2for both seasons.

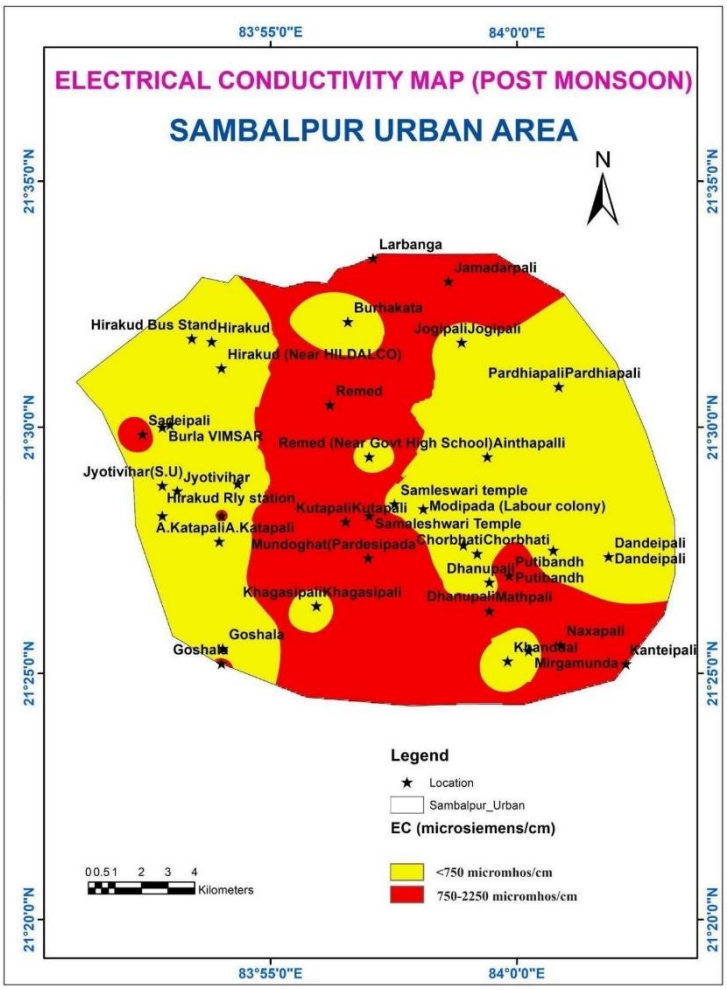


Fig.5.2 Distribution of Electricalc onductivity of Ground water in the study area during postmonsoon.

Table 5. 2 Classification of groundwater based on Total Dissolved Solids in the study area during pre monsoon and post monsoon (USGS,1958)

Sl. No	Total Dissolved Solids in mg/l	Description	Premonsoon (%)	Postmonsoon (%)
1	<1000	Fresh	95	96
2	1000-3000	Slightly Saline	5	4
3	3000-10000	Moderately Saline	0	0
4	10000-35000	VerySaline	0	0
5	>35000	Brine	0	0

The table 5.2 shows that almost all groundwater samples (95%) are fresh (TDS<1000 mg/l) in nature except few following locations which are slightly saline due to TDS in the range between 1000-3000 mg/l in pre monsoon and post monsoon. The locations having TDS more than 1000 mg/l is presented in table 5. 3.

Table 5.3 Locations having TDS more than 1000 mg/l

Sl. No.	Village	Source	EC μS/cm at 25°C	TDS mg/l	Na mg/l	Cl mg/l
Pre-monsoon						
1	Mundoghat	DW	3801	1976	161	1007
2	Hirakud Rly Station	HP	1949	1024	139	372
3	Bhalukonda	HP	1860	1098	96	284
4	Miremunda	HP	2268	1184	182	443
Postmonsoon						
1	Mundoghat	DW	2534	1403	206	616
2	Naxapali	HP	1759	1040	130	263

Total Hardness

Total hardness value is between 125 and 1500 mg/l as $CaCO_3$in pre monsoon. Most of the groundwateris hard to very hard (Table 5.4) in nature while the dilution improves the groundwater quality to soft in few samples in the study area during post monsoon (Table 5.4) and ranged between 61-821mg/l as$CaCO_3$.

Table 5. 4 Classification of groundwater based on hardness in the study area during pre monsoon and post monsoon (Durfor and Becker, 1964)

Sl. No.	Hardness in mg/l as $CacO_3$	Description	Premonsoon (%)	Postmonsoon (%)
1	0-60	Soft	0	2
2	61-120	Moderatelyhard	0	7
3	121-180	Hard	22	18
4	>181	Veryhard	78	73

Chloride

The maximum chloride content observed as 1007 mg/l and 616mg/l during pre monsoon and post monsoon respectively at Mundoghat. The lower concentration of the dissolved constituents in the postmonsoon season is due to the dilution effect. The spatial distribution of chloride maps for pre monsoon and post monsoon are shown in fig 5.3and 5.4 respectively. The fig 5.3 shows the range of 100-250 mg/l chloride covering most of the area except at Mundoghat. The Hirakud Dam Reservoir of left and right abutment area is low in chloride concentration and indicated the freshwater may be due to the natural recharge of fresh water from the reservoir. The groundwater may flow in the south and southwest direction. The fig 5.4shows the chloride less than 100 mg/l observed in the eastern and western part of the study area whereas the the ranged between 100 and 250 mg/l observed middle region with small pockets at Larbanga, Jamadarpali and Mundoghat, the chloride exceed 250 mg/l. Due to man-made reasons like dumping of solid wastes/municipal waste, improper sewage etc caused the high concentration of chloride at Mundoghat in both seasons.

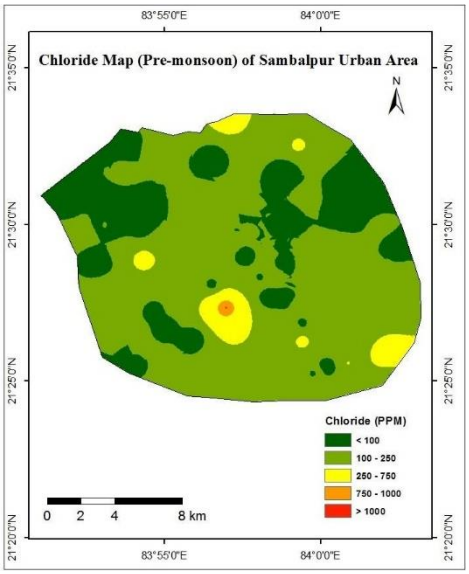


Fig.5.3 Distribution of Chloride of Ground water in the study area during premonsoon

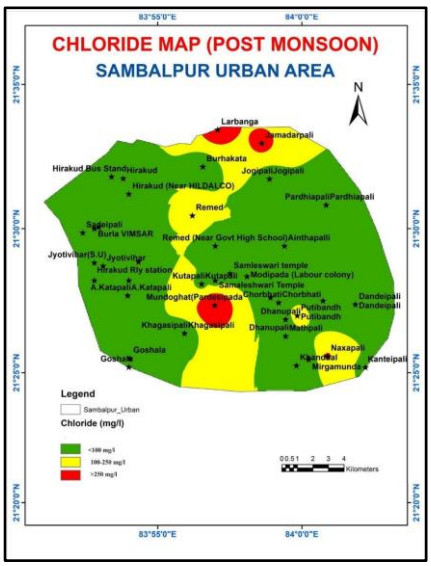


Fig.5.4 Distribution of Chloride of Ground water in the study area during postmonsoon.

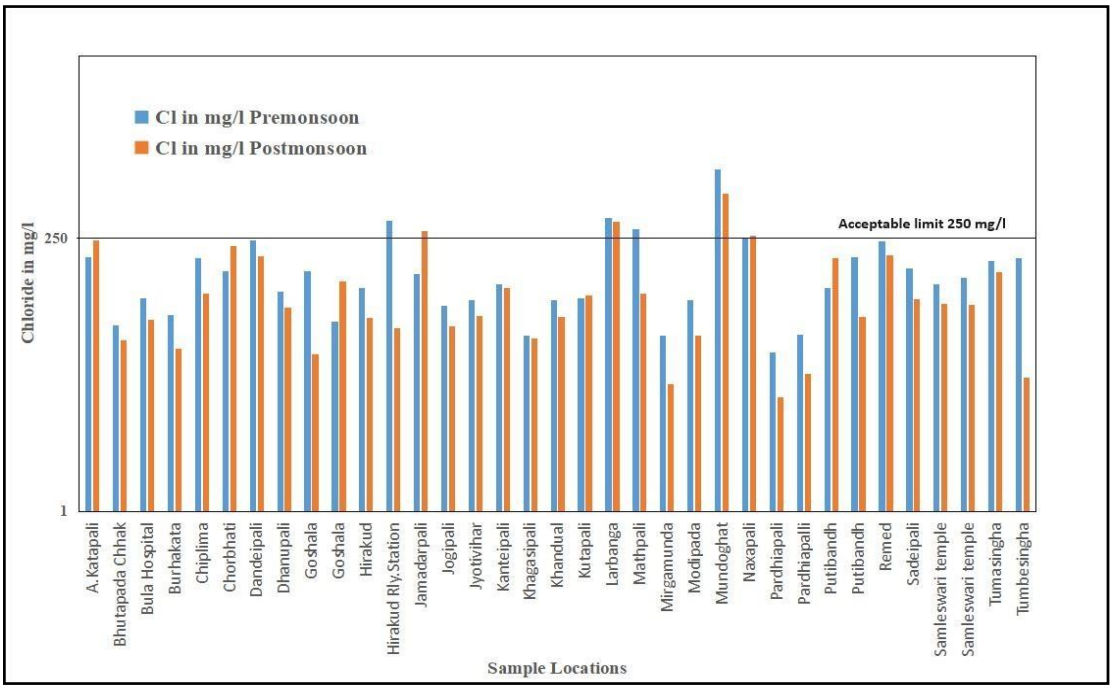


Fig.5.5 Location Wise distribution of Chloride in the study area during pre and post monsoon

The Fig5.5 shows, besides Mundoghat other locations like Hirakud Railway station, Larbanga, Bhalkonda, Miremunda, Jamadarpali and Naxapali locations where chloride also exceeds 250 mg/l in groundwater in pre monsoon and post monsoon samples.

Nitrate

Nitrate contents range from below detection limit to 242 mg/l with a mean of 19 mg/l and 0 to 174 mg/lwith a mean of 17 mg/l in pre monsoon and post monsoon respectively. (Table-5.5) As per drinking water specification for nitrate, 45 mg/l is the acceptable limit (IS 10500:2012). 83% and 85% of nitrate concentration concentrations in groundwater collected in and around area of urban and Peri-Urban of Sambalpur city are within the acceptable limits and can be used for drinking purposes during pre monsoon andpost monsoon seasons respectively. There maining samples are notpotablefordrinkingpurposes dueto nitrate contamination and recommended to supply the drinking water from alternate sources in the area. The locations having high nitrate concentrations are presented in table 5 and 6. The enrichment of nitrate values in groundwater can be attributed to anthropogenic activities and varies from one location to another. Nitrate gets enriched in groundwater through various ways, domestic sewage, agricultural wastes and percolates into aquifers by use of nitrate bearing fertilizers.

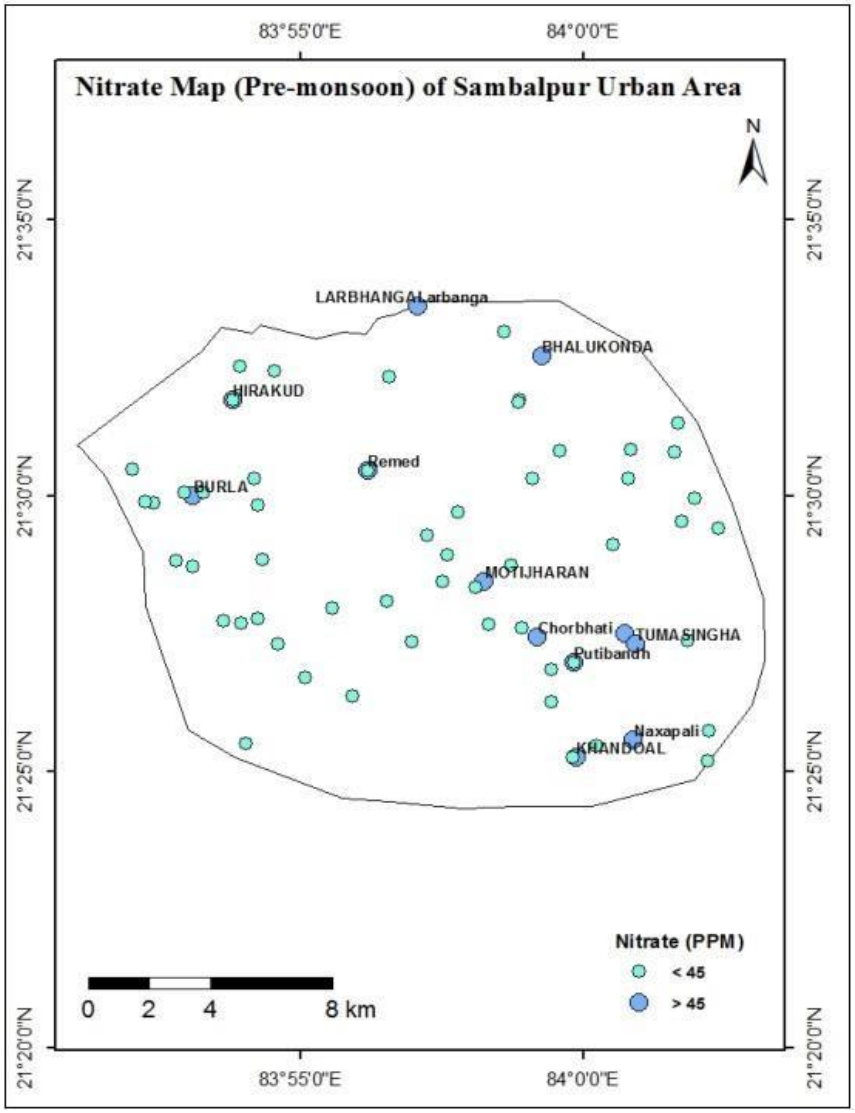


Fig.5.6 Locations having Nitrate concentration more than 45mg/l in Ground water of the study area during pre monsoon.

Table 5.5 Locations having Nitrate concentration more than 45mg/l in Ground water of the study area during Pre monsoon

Sl. No.	Dist.	Village	Source	NO_3mg/l
1	Sambalpur	Chorbhati	HP	57
2	Sambalpur	Naxapali	HP	75
3	Sambalpur	Putibandh	HP	61
4	Sambalpur	Tumbesingha	HP	98
5	Sambalpur	Remed	HP	48
6	Sambalpur	Larbanga	HP	70
7	Sambalpur	Hirakud	HP	60

8	Sambalpur	Larbanga	HP	74
9	Sambalpur	Bhalukonda	HP	242
10	Sambalpur	Burla	HP	55
11	Sambalpur	Motijharan	HP	69
12	Sambalpur	Khandoal	HP	71
13	Sambalpur	Tumasingha	HP	83

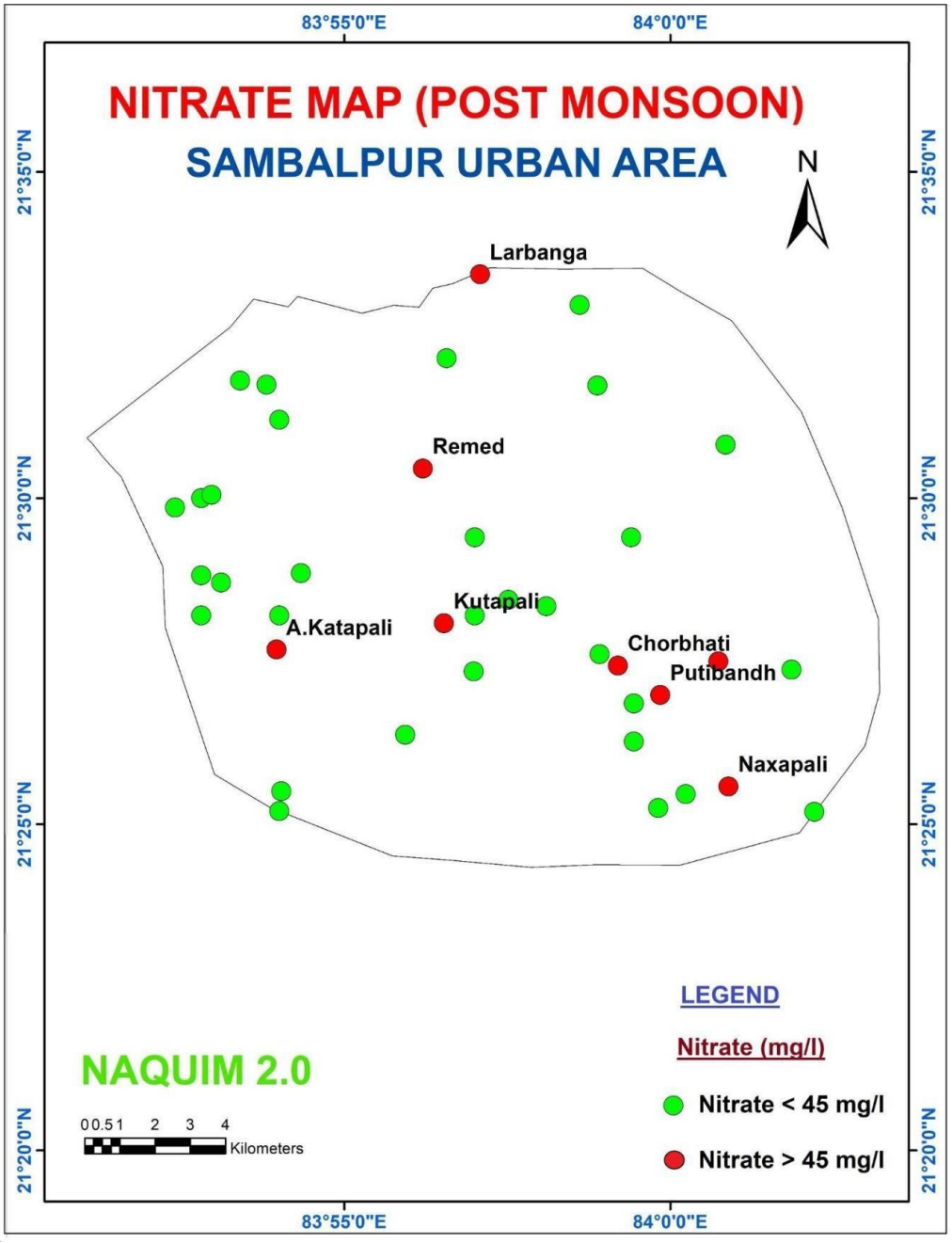


Fig.5.7 Locations having Nitrate concentration more than 45 mg/l in Ground water of the study area during Post monsoon

Table 5.6 Locations having Nitrate concentration more than 45 mg/l in Groundwater of the study area during Post monsoon

Sl. No.	Dist	Village	Source	NO_3mg/l
1	Sambalpur	Kutapali	DW	64
2	Sambalpur	Chorbhati	HP	59
3	Sambalpur	Naxapali	HP	174
4	Sambalpur	Putibandh	HP	69
5	Sambalpur	Tumbesingha	HP	81
6	Sambalpur	A.Katapali	HP	55
7	Sambalpur	Remed	HP	82
8	Sambalpur	Larbanga	HP	94

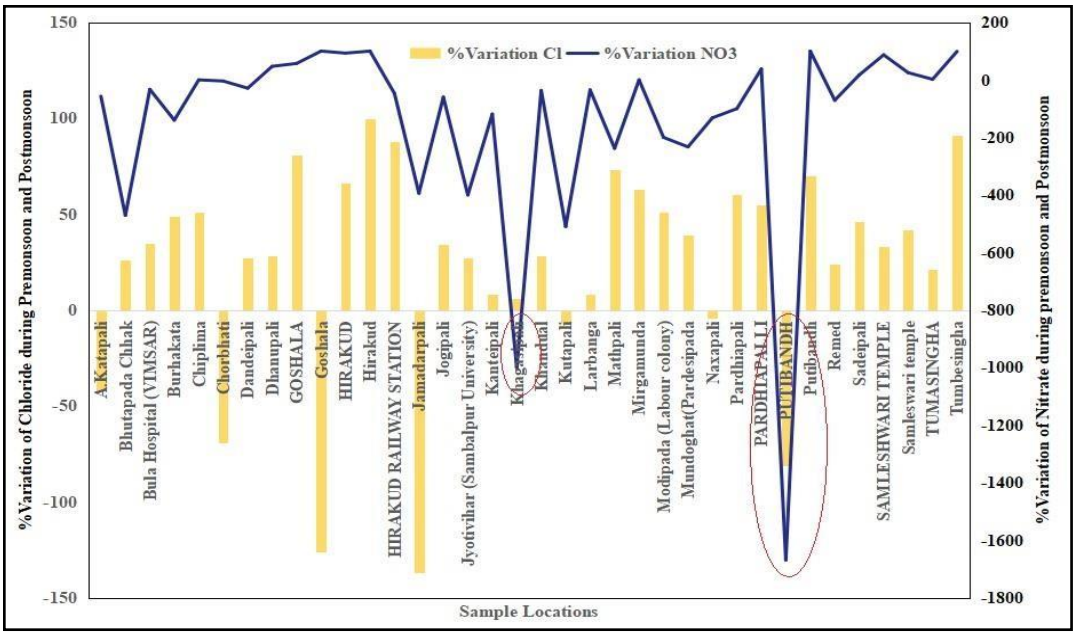


Fig.5.8 Variation o f Chloride and Nitrate between Pre monsoon and Post monsoon in the study area.

The fig 5.8 shows the nitrate contamination observed in the direction of groundwater flow.

Few locations having high chloride and nitrate contamination is summerised in table 5.7.

Table 5.7 Locations having high chloride and nitrate contamination

Season	District	Location	Sources	ECµS/cmat 25°C	Cl mg/l	NO_3 mg/l
Pre-Monsoon	Sambalpur	Bhalukonda	HP	1860	284	242
	Sambalpur	Larbanga	HP	1696	379	70
	Sambalpur	Naxapali	HP	1620	252	75
Post-Monsoon	Sambalpur	Larbanga	HP	1507	350	94
	Sambalpur	Naxapali	HP	1759	263	174

The table 7 shows the locations where the nitrate and chloride are exceeding the acceptable limit of BIS (2012) during pre-monsoon and post-monsoon which indicates the pollution is mainly man made. The indiscriminate inland disposal of solid wastes, domestic sewage andthe percolation of storm runoff in contact with animal wastes and other pollutants are the reasons for nitrate contamination as well as high concentration of chloride in groundwater.

Fluoride

The fluoride content in groundwater exhibits significant variability, ranging from 0.14 mg/l to 2.11 mg/l during pre monsoon season in the study area. The maximum F concentrations observed in ground water were 2.11 mg/l and 2.18 mg/l in pre monsoon and post monsoon season respectively at Remed. The maximum permissible limit (1.50mg/l) of drinking water specification of IS10500:2012has been exceeded in about 7% and 5% of the samples in pre and post monsoon respectively (Table 8).The locations exceed the maximum permissible limit (IS 10500:2012) of drinking water specification for Fluoride (1.50 mg/l) are Remed,Pardhiapali, Naradihi, Dehripali, A.Katapali found in the study area. The fig 9 and10 show the locations havingfluoride more than 1.50 mg/l in pre monsoon and post monsoon respectively and presented in table 5. 8.

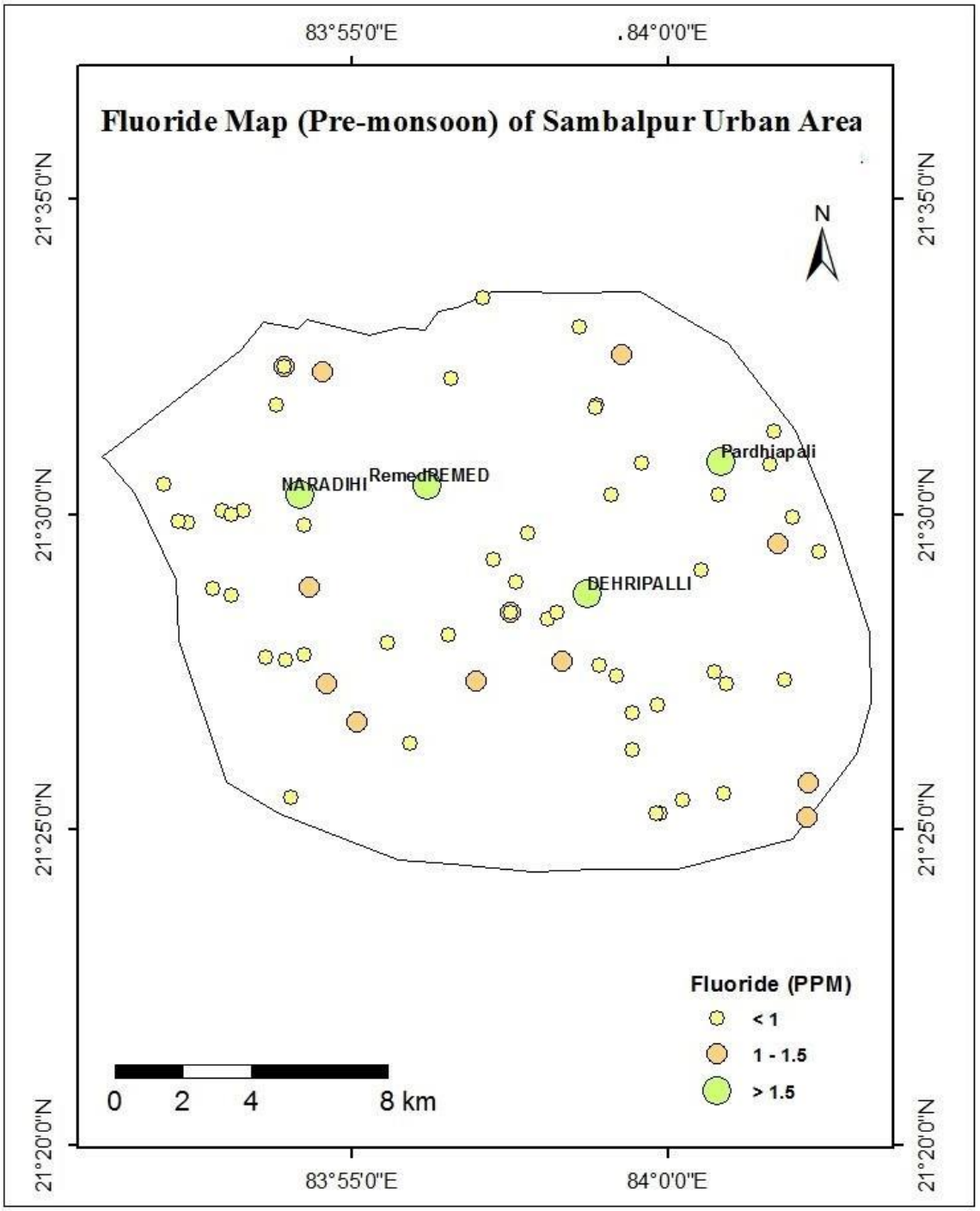


Fig. 5.9 Locations having Fluoride concentration more than 1.50 mg/l in Groundwater of the study area during pre monsoon

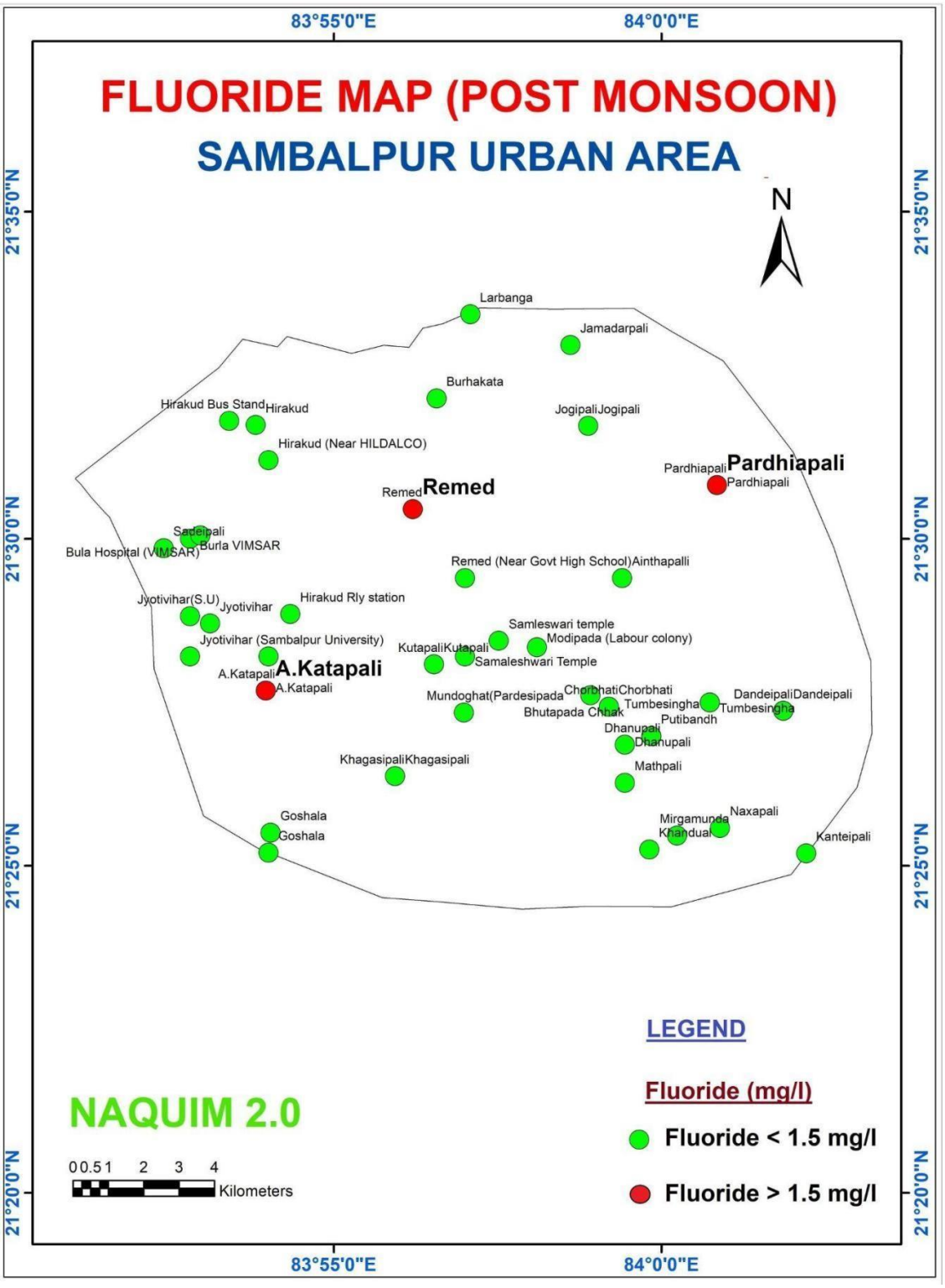


Fig.5.10 Locations having Fluoride concentration more than 1.50mg/l in Ground water of the study area during Post monsoon

Table5.8 Locations having Fluoride concentration more than1.50mg/l in Ground water during Pre and Post monsoon.

Season	Sl. No.	District	Village	Source	F (mg/l)
Premonsoon	1	Sambalpur	Pardhiapali	HP	1.57
	2	Sambalpur	Remed	HP	2.11
	3	Sambalpur	Remed	HP	1.9
	4	Sambalpur	Naradihi	HP	1.54
	5	Sambalpur	Dehripalli	HP	1.92
Postmonsoon	6	Sambalpur	A.Katapali	HP	1.52
	7	Sambalpur	Pardhiapali	HP	1.57
	8	Sambalpur	Remed	HP	2.18

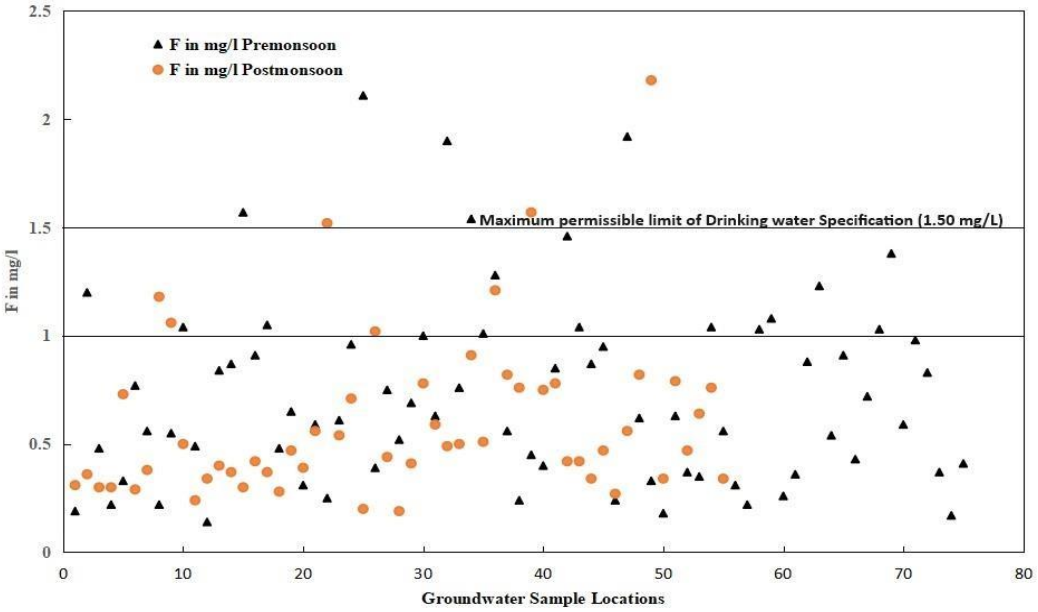


Fig.5.11 Distribution of F in ground water of the study area during pre and post monsoon.

Overall, the dissolved constituents' excess concentration reflects the influence of both nthropogenic and natural sources on the groundwater constituents in the study area.

Hydro chemical Facies

The hydrochemical evolution of groundwater can be understood by plotting the major cations and anions in the Piper trilinear diagram. The piper plot has been divided into six subcategories and summarized in the tablefor pre monsoon and post monsoon of the study area. The distribution of dominant ions is summarized in table 5.9. Table5.9shows most of

the samples do not exceed the 50% of cationic concentration in either season while bicarbonate is the dominant anion in both the seasons in the studyarea. Higher concentrations of bicarbonatein groundwater signify the strong interaction of infiltrating groundwater with underlying lithology, and mineral compositions. The slightly lower concentration of the dissolved constituents in the post monsoon season is due to the dilution effect.

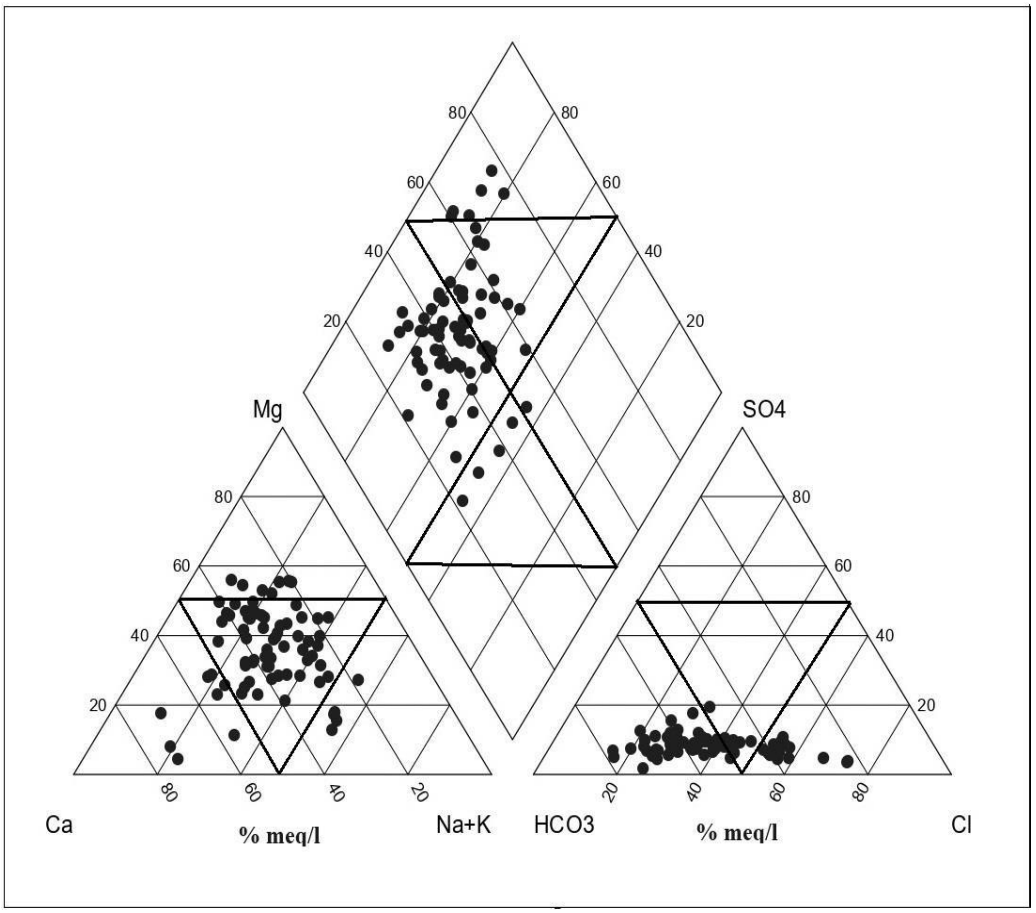


Table 5.9 Distribution of dominant ions in groundwater

Ions	Pre monsoon		Post Monsoon	
	NoofSamples	%of Samples	No of Samples	%ofSamples
CalciumType	8	11	30	55
MagnesiumType	7	9	0	0
SodiumType	5	7	2	4
Mixed	55	73	23	42
BicarbonateType	51	68	45	82
ChlorideType	15	20	5	9
SulphateType	0	0	0	0
Mixed	9	12	5	9

Table 5.10 Hydrochemical Facies of Ground water in the study area

Categories	Hydrochemical Facies	Premonsoon		Post Monsoon	
		No of Samples	% of Samples	No of Samples	% of Samples
Type-I	Ca+Mg	70	47	53	48
Type-II	Na+K	5	3	2	2
Type-III	CO_3+HCO_3	51	34	45	41
Type-IV	Cl+SO_4	24	16	10	9

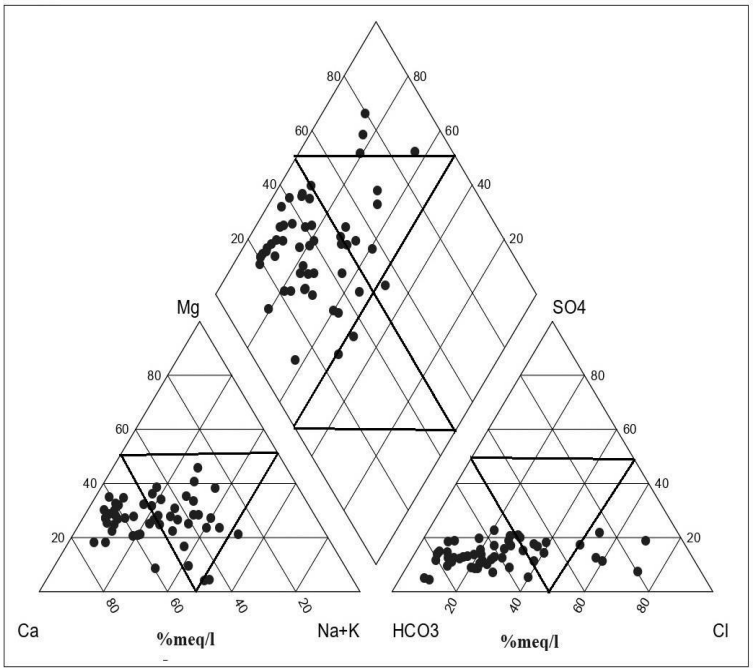


Fig 5.13 Piper Trilinear diagram of ground water samples collected during PostMonsoon

Table 5.11 Distribution of different water type pre monsoon and post monsoon seasons.

Categories	Water type	Premonsoon		PostMonsoon	
		No of Samples	% of Samples	No of Samples	% of Samples
Type-I	Ca-Mg-HCO_3	47	63	44	80
Type-II	Na-HCO_3	4	5	1	2
Type-III	Ca-Mg-Cl	23	31	9	16
Type-IV	Na-Cl	1	1	1	2
Type-V	Ca-Mg-SO_4	0	0	0	0
Type-VI	Na-HCO_3-Cl	0	0	0	0
	TOTAL	75	100	55	100

The table 5.11 shows that most groundwater samples are dominated by Ca-Mg-HCO_3followed by Ca-Mg-Cl type in both seasons. The percentage of Ca-Mg-HCO_3 is higher in post monsoon due to dilution of ground water by percolating rainwater. However, the Ca-Mg-Cl type observed may be due to anthropogenic activities in the urban area which can include the inappropriate disposal of solid wastes, dumping of urban wastes, and improper discharge of domestic wastes.

Gibb's diagram

Gibb'sdiagramisusedto plot TDS Vs. (Na+K)/(Na+K+Ca) (I) and TDS Vs. Cl/(Cl+HCO_3) (II) to understand water rock interactions for groundwater quality in the study area. Three distinct fields such as precipitation dominance, evaporation dominance and rock– water interaction dominance areas are shown in the Gibbs diagram (Fig. 5.15and 5.16) for pre and postmonsoon seasons. Gibb's ratio for I ranged from 0.14 to 0.75 and 0.07 to 0.65 for pre and post monsoon respectively in the study area. Gibb's ratio II ranged from 0.17 to 0.76 and 0.08 to 0.86meq/l in pre and post monsoon seasons respectively. The Gibb's diagram shows distribution of analyzed water samples in the study area mostly in rock weathering dominance field for both the seasons. Thus, the study reveals that groundwater is largely influenced by rock dominance, which indicates that the foremost mechanism is weathering ofthe rock forming minerals in the aquifers. A few groundwater locations have an affinity towards high Gibb's Ratio (Cl/(Cl+HCO_3)) which indicates theinfluence of anthropogenic sources, leading to an increase in concentration of Chloride and TDS.

Table 5.12 Comparison of Gibb's ratio between premonsoon and postmonsoon

Parameters	Premonsoon		PostMonsoon	
	(Na+K)/(Na+K+Ca)	$Cl/(Cl+HCO_3)$	(Na+K)/(Na+K+Ca)	$Cl/(Cl+HCO_3)$
Minimum	0.14	0.17	0.07	0.08
Maximum	0.75	0.76	0.65	0.86
Mean	0.44	0.41	0.29	0.3

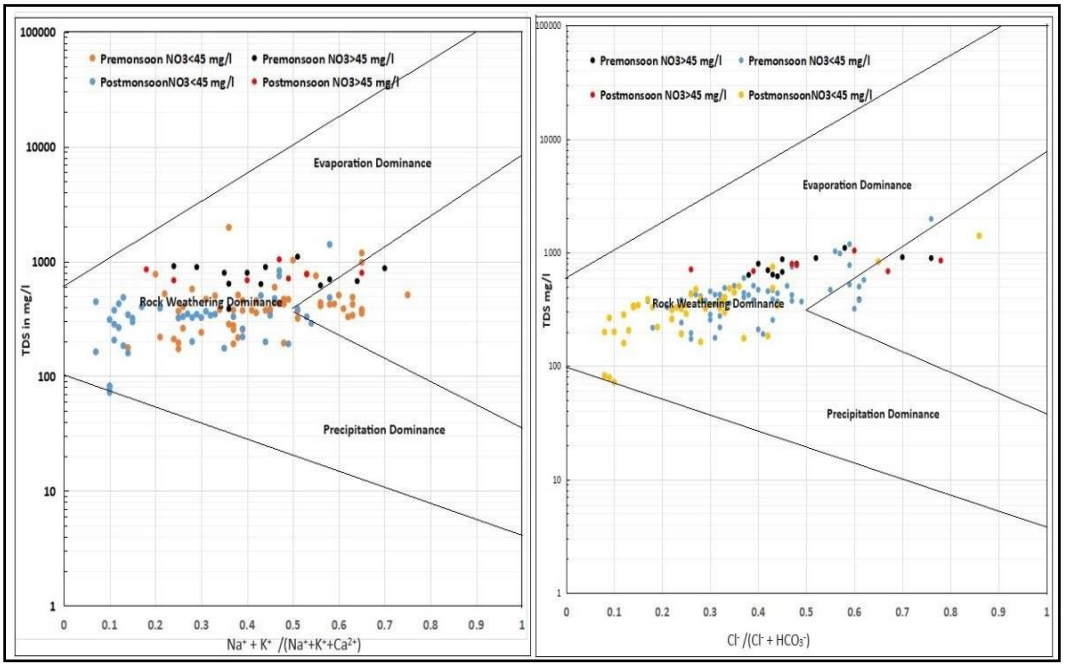


Fig.5.14 Gibb's plot ground water having nitrate contamination during pre and post monsoon

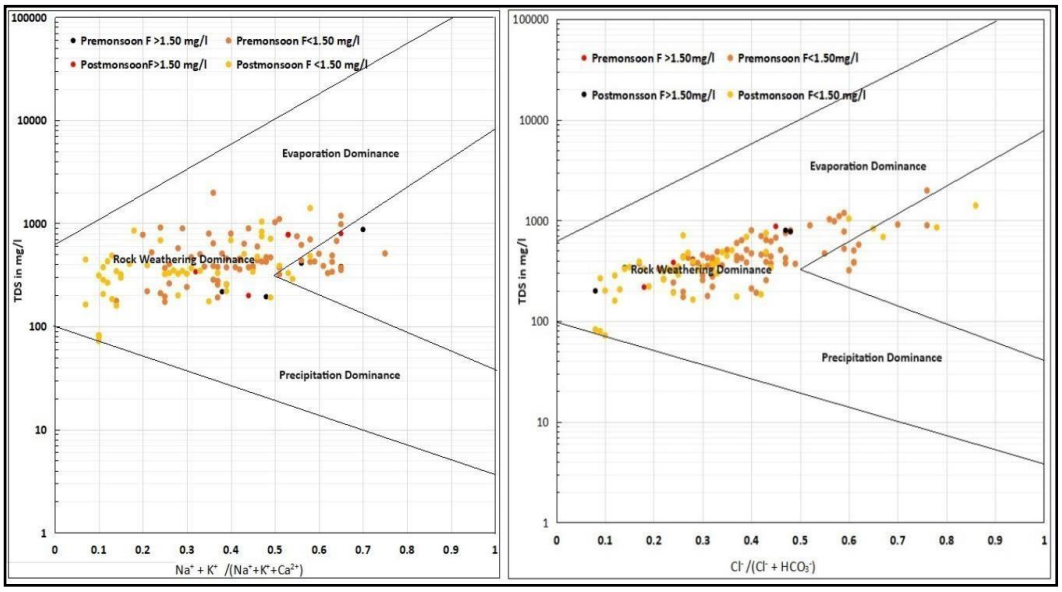


Fig.5.15 Gibb'splot ground water Fluoride contamination during pre and post monsoon

The correlation coefficients among the physicochemical parameters of the groundwater samples collected in and around the Sambalpur urban area is presented in table 5.13 and 5.14 for pre monsoon and post monsoon respectively. Theanalysis of correlation coefficient of major ions shows that EC and TDs have the significant positive correlation in both seasons. A positive correlation of bicarbonate with major anions and cations isan indicationof chemicalweathering asthe dominant source ofthe dissolved ions showed during pre monsoon season. A strong positive relation is observed within the alkaline earth elements, Ca and Mg in both seasons. As ignificant positive correlation of Cl with SO4 in both seasons and with HCO_3 in pre monsoon while with NO_3 in post monsoon season are observed in the study area. The positive correlation of Nitrate with K in pre Monsoon and Chloride in post monsoon signifies that the higher nitrate content in groundwater may be due to agriculture runoff containing fertilizers, discharge of sewage and indiscriminate distribution of solid waste/ municipal wastes in the study area.

Higher positive correlation of HCO_3 with cations except K in pre monsoon than post monsoon season, signifies that the mineralisation occurs in the urban and Peri-Urban areas of Sambalpur Municipality and some impacts of municipality wastes/solid wastesmay occur on groundwater. Further, the positive correlation between Cl-SO_4 and Cl-NO_3 indicates anthropogenic sources of contamination of Nitrate in the studyarea.

Table 5.13 Correlation coefficient among the physico-chemical parameters of the groundwater samples during Pre-Monsoon

Parameters	*pH*	*EC*	*TDS*	*TH*	*TA*	*Ca*	*Mg*	*Na*	*K*	*HCO_3*	*Cl*	*SO_4*	*NO_3*	*F*
pH	1													
EC	-0.04	1												
TDS	-0.03	1	1											
TH	-0.14	0.96	0.96	1										
TA	0.06	0.82	0.81	0.71	1									
Ca	-0.17	**0.86**	**0.86**	**0.91**	0.59	1								
Mg	-0.11	**0.94**	**0.93**	**0.97**	0.73	0.79	1							
Na	0.22	0.75	0.76	0.55	0.81	0.45	0.56	1						
K	-0.09	0.3	0.34	0.29	0.19	0.27	0.27	0.13	1					
HCO_3	0.06	0.82	0.81	0.71	1	0.59	0.73	0.81	0.19	1				
Cl	-0.06	**0.95**	**0.94**	**0.95**	**0.63**	**0.87**	**0.92**	**0.63**	0.22	**0.63**	1			
SO_4	-0.22	0.72	0.73	0.63	0.74	0.51	0.65	0.67	0.39	**0.74**	0.55	1		
NO_3	0.01	0.4	0.45	0.39	0.25	0.36	0.37	0.23	0.65	0.25	0.28	0.4	1	
F	0.46	0.21	0.21	0.08	0.34	-0.02	0.13	0.48	0.05	0.34	0.14	0.17	-0.01	1

T**able 5.14** Correlation coefficient among the physicochemical parameters of the groundwater samples during Post-Monsoon

Parameters	*pH*	*EC*	*TDS*	*TH*	*TA*	*Ca*	*Mg*	*Na*	*K*	*HCO_3*	*Cl*	*SO_4*	*NO_3*	*F*
pH	1													
EC	0.03	1												
TDS	0.04	1	1											
TH	-0.06	0.95	0.94	1										
TA	-0.04	0.5	0.48	0.46	1									
Ca	-0.16	**0.83**	**0.83**	**0.93**	0.5	1								
Mg	0.05	**0.92**	**0.91**	**0.91**	0.34	0.69	1							

Na	0.18	0.84	0.85	0.65	0.4	0.47	0.73	1						
K	0.14	0.29	0.31	0.23	0.3	0.17	0.25	0.19	1					
HCO_3	-0.05	0.5	0.48	0.46	1	0.5	0.34	0.4	0.3	1				
Cl	0.03	**0.92**	**0.92**	**0.9**	0.16	**0.76**	**0.9**	0.76	0.12	0.16	1			
SO_4	-0.01	**0.9**	**0.9**	**0.82**	0.38	0.64	0.89	0.8	0.38	0.38	0.82	1		
NO_3	0.13	0.64	0.68	0.59	0.27	0.6	0.48	0.56	0.35	0.27	0.53	0.49	1	
F	0.25	0.35	0.34	0.21	0.37	0.1	0.29	0.54	-0.04	0.37	0.24	0.29	0.21	1

Suitability of ground water quality for drinking purposes

The groundwater suitability for drinking is assessed by comparing the characteristics with the acceptable and maximum permissible limits, prescribed by Bureau of Indian Standards, IS 10500:2012, for individual parameters. The status of suitability of groundwater for drinking purposes in the study areais presented in the Table- 5.15.

Table 5.15 Suitability of ground water for drinking purposes during pre monsoon and post monsoon season

Parameters	Pre-Monsoon			Post-Monsoon		
	Suitable %	Acceptable %	Unsuitable %	Suitable %	Acceptable %	Unsuitable %
pH	99	0	1	96	0	4
TDSmg/l	65	35	0	76	24	0
Total Hardness mg/l, as $CaCO_3$	25	65	9	25	71	4
Total Alkalinity mg/l, as $CaCO_3$	37	63	0	45	55	0
Ca^{++}mg/l	76	23	1	57	43	0
Mg^{++}mg/l	40	59	1	73	27	0
Cl-mg/l	88	11	1	92	8	0
SO_4mg/l	100	0	0	98	2	0
NO_3mg/l	83	0	17	84	0	16
F^-mg/l	75	19	7	86	8	6
	14	57	29	18	57	25

The study reveals that 29% (22 out of 75) of groundwater samples are unsuitable for drinking purposes during pre monsoon due low pH, high hardness, calcium, magnesium, chloride, Nitrate, Fluoride and Uranium (one sample). There are 17% of samples are unfit for drinking due to high nitrate and 7% due to high F in the study are during pre monsoon period.

During post monsoon, the quality of groundwater improves from hard to soft water in some locations due to dilution effect and lowers the nitrate, fluoride and uranium concentrations. The study also concluded that only 25% (13 out of 51) groundwater is unsuitable for drinking due to low pH, high hardness, Nitrate and Fluoride only. The present study concluded the nitrate contamination is 17% and 16% in pre monsoon and post monsoon respectively while approximately 7% samples are predicated fluoride contaminated water.

Table 5.16 List of locations in the study area unsuitable for drinking purposes during Pre-Monsoon

Sl. No.	District	SiteName	pH	Hardness as $CaCO_3$, mg/l	Ca^{++}	Mg^{++}	Cl^-	NO_3	F -
					mg/l				
Pre-Monsoon									
1	Sambalpur	Mundoghat	7.3	1500	250	213	1007	3	1.2
2	Sambalpur	Bhutapada Chhak	6.5	145	54	2	43	1.4	0.2
3	Sambalpur	Chorbhati	7.4	410	86	47	128	57	0.3
4	Sambalpur	Mathpali	7.1	710	128	95	298	7.4	0.2
5	Sambalpur	Naxapali	7.3	580	116	70	252	75	0.6
6	Sambalpur	Putibandh	7.2	355	50	56	170	61	0.1
7	Sambalpur	Tumbesingha	7.5	525	116	57	167	98	0.9
8	Sambalpur	Pardhiapali	7.7	155	40	13	25	0	1.6
9	Sambalpur	Hirakud Railway Station	7.5	650	120	85	372	3.8	1.1
10	Sambalpur	Remed	7.6	500	54	89	234	48	2.1
11	Sambalpur	Larbanga	7.5	730	144	90	379	70	0.5
12	Sambalpur	Remed	8.1	165	42	15	57	0	1.9
13	Sambalpur	Naradihi	7.7	125	28	13	28	0	1.5
14	Sambalpur	Hirakud	7.7	330	70	38	145	60	0.6
15	Sambalpur	Larbhanga	7.6	695	104	106	418	74	0.5
16	Sambalpur	Bhalukonda	7.7	645	100	96	284	242	1
17	Sambalpur	Dehripalli	8	260	42	38	74	6	1.9
18	Sambalpur	Burla	7.5	280	56	34	117	55	0.2
19	Sambalpur	Motijharan	7.3	600	106	81	223	69	0.5
20	Sambalpur	Khandoal	7.6	495	78	73	152	71	0.7
21	Sambalpur	Mirgemunda	7.8	715	86	1225	443	3	1.4
22	Sambalpur	Tumasingha	7.8	430	58	69	160	83	1

Table5.17 List of locations in the study area unsuitable for drinking purposes during Post monsoon

Sl. No.	District	SiteName	pH	Hardnessas $CaCO_3$, mg/l	Ca^{++}	Mg^{++}	Cl^-	NO_3	F -
					mg/l				
Post-Monsoon									
1	Sambalpur	Mundoghat	7.3	1500	250	213	1007	3	1.2
2	Sambalpur	Bhutapada Chhak	6.5	145	54	2	43	1.4	0.2
3	Sambalpur	Chorbhati	7.4	410	86	47	128	57	0.3
4	Sambalpur	Mathpali	7.1	710	128	95	298	7.4	0.2
5	Sambalpur	Naxapali	7.3	580	116	70	252	75	0.6
6	Sambalpur	Putibandh	7.2	355	50	56	170	61	0.1
7	Sambalpur	Tumbesingha	7.5	525	116	57	167	98	0.9
8	Sambalpur	Pardhiapali	7.7	155	40	13	25	0	1.6
9	Sambalpur	Hirakud Railway Station	7.5	650	120	85	372	3.8	1.1
10	Sambalpur	Remed	7.6	500	54	89	234	48	2.1
11	Sambalpur	Larbanga	7.5	730	144	90	379	70	0.5
12	Sambalpur	Remed	8.1	165	42	15	57	0	1.9
13	Sambalpur	Naradihi	7.7	125	28	13	28	0	1.5
14	Sambalpur	Hirakud	7.7	330	70	38	145	60	0.6
15	Sambalpur	Larbhanga	7.6	695	104	106	418	74	0.5
16	Sambalpur	Bhalukonda	7.7	645	100	96	284	242	1
17	Sambalpur	Dehripalli	8	260	42	38	74	6	1.9
18	Sambalpur	Burla	7.5	280	56	34	117	55	0.2
19	Sambalpur	Motijharan	7.3	600	106	81	223	69	0.5
20	Sambalpur	Khandoal	7.6	495	78	73	152	71	0.7
21	Sambalpur	Mirgemunda	7.8	715	86	1225	443	3	1.4
22	Sambalpur	Tumasingha	7.8	430	58	69	160	83	1

Suitability of ground water quality for Irrigation purposes

The water quality constraints for irrigation have been evaluated based on field experience and experiments. The irrigation status is carried out by calculating the indices like, Sodium Adsorption Ratio (SAR), Residual Sodium Carbonate (RSC), percentage of Sodium (% Na), Magenium Ratio (MR) and Kelly Ratio (KR). These parameters serve as indicators to evaluate the potential impact of the groundwater's chemical composition on soil and crop health during irrigation activities. The statistical summary of indices is presented in Table 5.18.

Table 5.18 Statistical Summary Irrigation Indices of Ground water

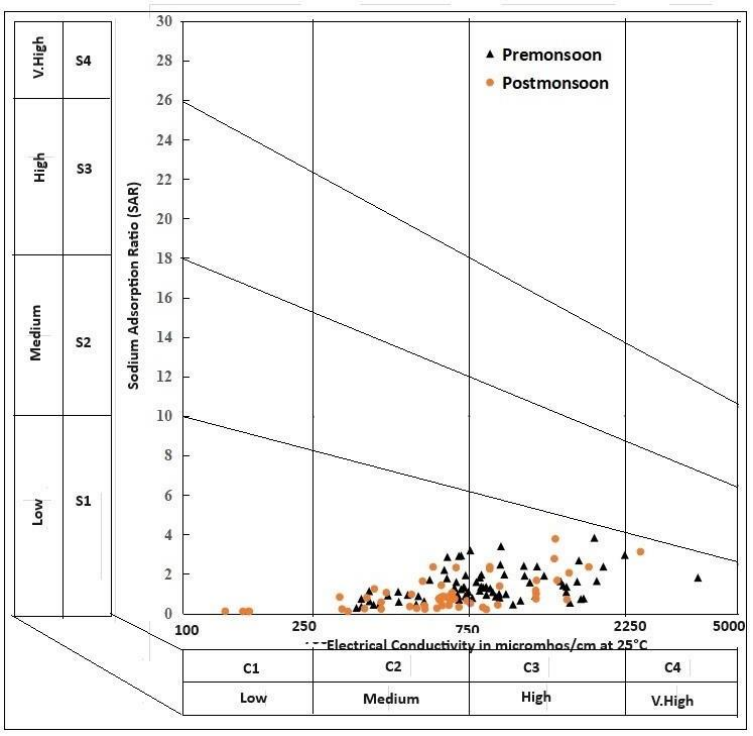
Indices	Pre-Monsoon			Post-Monsoon		
	Min	Max	Average	Min	Max	Average
SAR	0.28	3.83	1.43	0.1	3.77	0.98
%Na	9.09	54.11	27.37	3.96	49.89	20.31
RSC	-20.93	2.27	-2.15	-13.59	2.56	-1.79
MR	5.75	73.15	49.77	8.1	62.21	34.28
KR	0.1	1.21	0.42	0.04	1.02	0.3

All groundwater samples collected during pre and post monsoon seasons of calculated values of SAR are found within the range of excellent category (<10 SAR). Among samples evaluated for Na%, only 21% and 31% of the groundwater fall in the excellentpre-monsoon and post monsoon respectively. The Na% values in pre monsoon season are Higher than the post monsoon seasons. It may be due to dilution byrain water in post monsoon samples. About 90%of the samples collected in both monsoons showed suitable (1.25-2.50) for irrigation on considering the RSC values. Most of the samples (94%) have MR<50%during post monsoon samples indicating the suitability of groundwater for irrigation while the unsuitability for it is 55% (MR>50%) during pre monsoon period in the study area. Additionally, the calculated KR values show that most of the groundwater samples are found suitable (KR<1) for irrigation in both seasons.

Table 5.19 Suitability of ground water for Irrigation purposes.

Indices	Range	Classification	Pre-monsoon		Post-Monsoon	
			No of Samples	Samples %	No of Samples	Samples %
SAR	<10	S1	74	100	55	100
	Oct-18	S2	0	0	0	0
	18-26	S3	0	0	0	0
	>26	S4	0	0	0	0
%Na	<20	Excellent	21	28.38	31	56.36
	21-40	Good	45	60.81	19	34.55
	41-60	Permissible	8	10.81	5	9.09
	61-80	Doubtful	0	0	0	0
	>81	Unsuitable	0	0	0	0
RSC	<1.25	Safe	4	5.41	4	7.27
	1.26-2.50	Suitable	70	94.59	50	90.91
	>2.51	Unsuitable	0	0	1	1.82
MR	<50	Suitable	33	44.59	52	94.55
	>50	Unsuitable	41	55.41	3	5.45
KI	<1	Suitable	69	93.24	54	98.18
	>1	Unsuitable	5	6.76	1	1.82

Fig.5.17 USSL dia gram of the study area



In the study area groundwater samples have been classified as C2S1 and C3S1 as the dominant classes in respective seasons. Overall, about 50% of ground water samples from the study area are suitable for irrigation in both seasons.

6. 0 GEOPHYSICAL STUDIES

Geophysics is the application of method of physics to the study the Earth. The Rocks have different typesof properties. The Rocks don't differ only by their macroscopic or microscopic properties studied by field Geologists or Petrologists. Rocks also differ by their chemical and physical properties i.e. density, magnetisation, resistivity, etc. The Geophysical/Geo-electrical methods are best methods for groundwater exploration. These methods are also used in environmental application and other engineering applications. The study aims to combine the Vertical Electrical Sounding (VES) with the borehole lithology data that governs and regulates subsurface hydrogeological settings. In this regard total of 29 VES were designed to be surveyed in the study area using the Schlumberger method in hard rock formations. The study also aims to delineate the aquife rgroup model based on the geo-electric layer parameters inputs.

Fig.6.1 Map of the study area.

Geophysical Material sand Methods

The resistivity technique involves determining the resistivity of geo-electrical subsurface materials by transmitting direct electric current in the subsurface and recording the potential difference developed by the infused current.

The Vertical Electrical Sounding (VES) data collected by employing the Schlumberger configuration are plottedas a graph of the apparent resistivity (ρ) against the half-electrode spacing AB/2. Anapproximation for the depth of the interface suggested equal to (2/3) two-thirds of thespacing ofthe electrode atthe point of inflection (Vingoe 1972). In this context, the VES survey was accomplished using the linear four-electrodes Schlumberger configuration at 29 location stations have been employed to decipher the aquifer disposition, the location of VES shown on the map (Fig.2). The study aims to figure out the aquifer disposition the resistivity and thickness in terms of layer parameters are translated into corresponding hydrogeological parameters.

Vertical Electrical Sounding (VES)

The spacingof current electrodes ranges from 200m to 400m (AB), and0.5m to20m (MN) were used for potential electrodes. The separation of the half-current electrodes was AB/2=2,3,4,6,8,10,12,15,20,25,30,40,50, 60,70,80,90,100,120,140,160,180, and 200m, The potential electrode separation was MN/2 = 0.5, 2, 5,10and 20m.The expression for Schlumberger configuration apparent resistivity is:

$$\rho = G\,(\Delta V/I) \qquad \ldots (1)$$

G is known as the geometric factor

The locations of the VES data point and spread-out were designed depending on the feasible of space. The field resistivity survey was accomplished using ANVIC make CRM 20 instrument. The apparent resistivity measurement was plotted against the half-current electrode (AB/2) separation on the log-log graph. The VES curves obtained from the field were interpreted using a partial curve matching technique (Orellana and Mooney1966). The layer parameters obtained from curve matching have been used as initial model. The initial layer model is used as input in the IPI2win software to generate a final resistivity layer parameter model. Each layer's resistivity and thickness are delineated for available layers with the least Root Mean Square (R.M.S.) error between the calculated resistivity and field values. The inversion analyses for the sounding curves have been accomplished with an average of 5% fitting error.

The resistivity of geological formations may vary significantly based on the type of formation, degree of weathering, fracturing and connectivity of fractures of the formation. The resistivity layer parameters enable quantifying subsurface layers' thickness and resistivity and roughly estimating groundwater quality (i.e., salt content). Although, resistivity is the most varying geophysical parameter and is not unique even for the same material. The resistivity of water

also affects resistivity and may range from 0.2 Ω m to over 100.0 Ω m based on dissolved solids and their ionic concentration (Palacky1987).

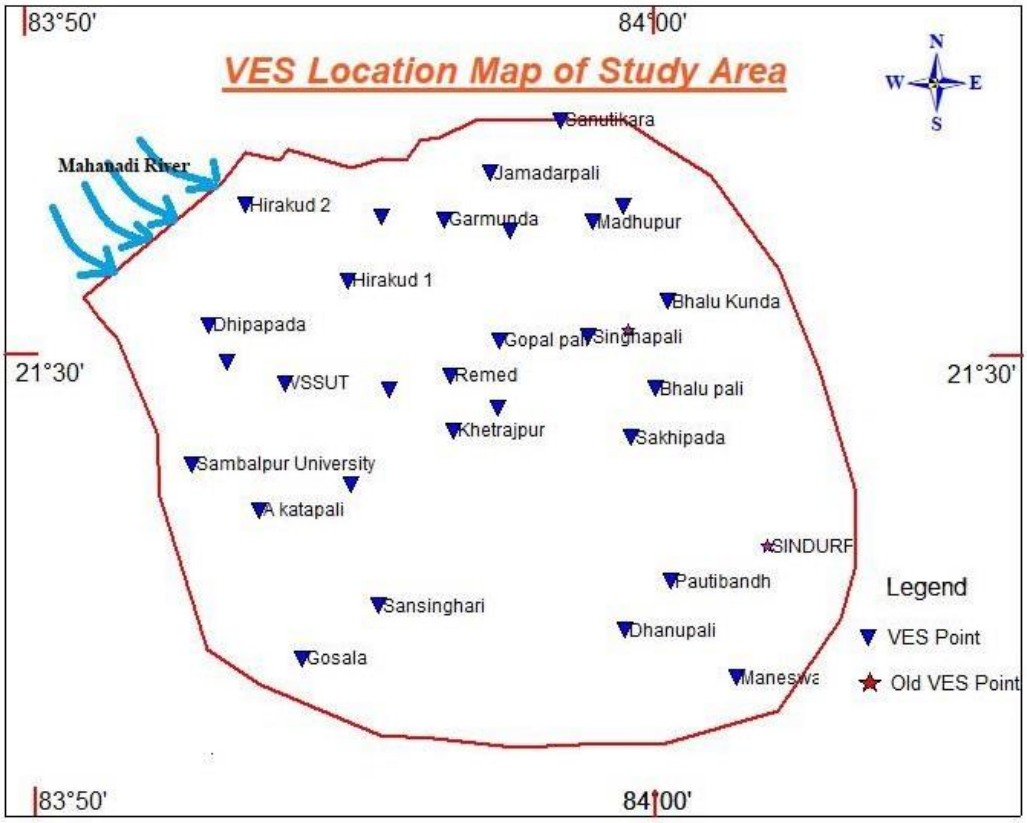


Fig.6.2 VES location map of the study area.

However, the limitation can be expected when resistivity methods are used if the ground heterogeneities and the anisotropy is present (Matias2002;Khalil 2010).Thus, optimizing layer parameter models for non- predictable biased interpretation is essential to correlate the results of VES with the known lithology obtained from nearby borehole lithology. A total of 05 borehole lithology correlated with interpreted VES data. The correlated resistivity results and borehole lithology were utilized to fix the resistivity range for lithological units obtained from the survey and conceptualize litho-geoelectric sections.

The borehole lithology calibrates the resistivity model per the local geological set-up. The resistivity data correlated with borehole lithology data have identified the subsurface vertical and lateral variations in hydrogeology, which are essential to understanding groundwater chemistry (quality) and rough quantity (Parketal.2007).

VES Data Interpretation

All the 29 VES were interpreted in terms of layer parameters. The field curves were obtained as H,S K,and A types. The long spread VES and Borehole logs spatially distributed were utilized for interpretation. VES analys is deline ates that the true resistivity of the TopSoil/Dry soil layer ranges from 17 to 707Ω.m.

This top layer varies in depth from 0.37 to 3.8m.

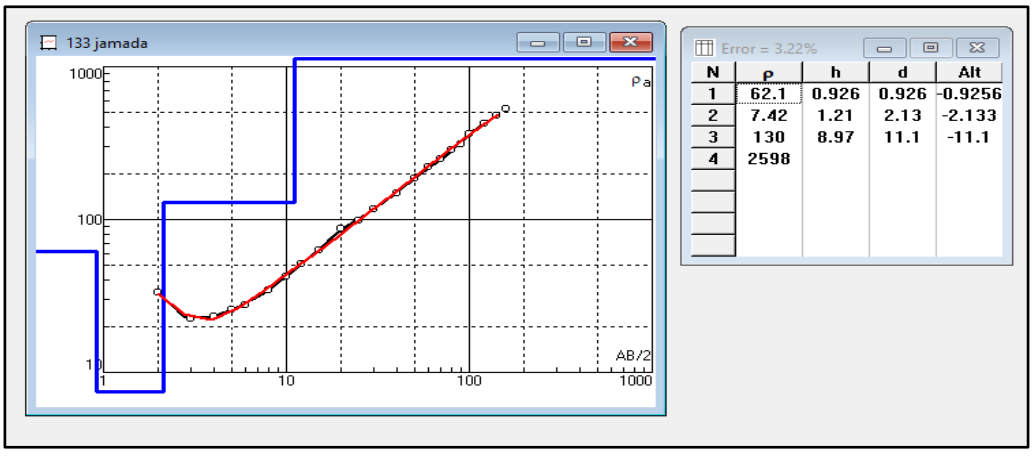
The mostly 2nd and occasionally third layer is Highly Weathered to Weathered Formation having a resistivity of less than 150Ω.m, bearing good quality ground water also.The depth of this layer varies from 3 to 22.8m. Mostly the 3rd or 4th geoelectric layer, occasionally the 2nd one with resistivities ranging from 150 to 800 Ohm m, occasionally exceeding to more than 800 Ohm m has been inferred as formation with fractures (Fractured granite). 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 geoelectriclayer inferred formation with fractures varies between 11.4 and 59.5 m.

Mostly the 4th or 5th geoelectric layer, occasionally, the 2nd or 6th one with resistivities ranging above 800 Ohmm, has been inferred as Granite Formation. Thedepthto bottom ofthislayeris, in general, varying from 2.94 to 200 m.

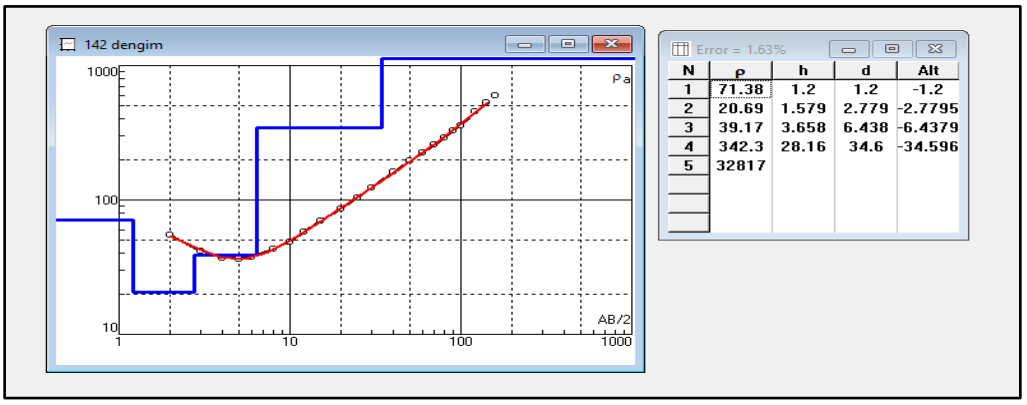
On the basis of geoelectrical layer parameters and the fractured zone analysis a few sites are recommended for borehole drilling or Shallow borehole or dug well. Some of the representative VES curves are presented in Fig.6.3.

Sl. No.	Lithology	ResistivityRange
1.	TopSoil/DrySoil	17to707Ω.m.
3	HighlyWeathered/WeatheredFormation	Lessthan150Ω.m
4.	Fracturedgranite	150to800Ω.m
4.	Granite	Above800Ω.m

Jamadarpali

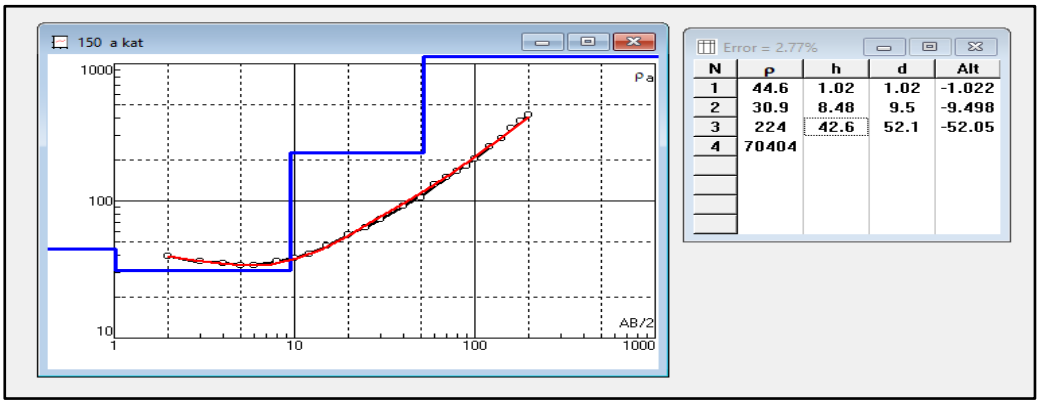


Dengimacha



N	ρ	h	d	Alt
1	71.38	1.2	1.2	-1.2
2	20.69	1.579	2.779	-2.7795
3	39.17	3.658	6.438	-6.4379
4	342.3	28.16	34.6	-34.596
5	32817			

A katapali



N	ρ	h	d	Alt
1	44.6	1.02	1.02	-1.022
2	30.9	8.48	9.5	-9.498
3	224	42.6	52.1	-52.05
4	70404			

Fig.6.3 Representative VES curve of the study area.

The Geophysical data interpretation has been used to generate the 3D disposition of the aquifer system. The VES location map is given in Fig.6.2.Four 2D schematic sections were drawn along lines A-A', B-B', C-C'and D-D' which are shown in plan view in Fig.6.4and the corresponding 2D schematic sections are shown in Fig. 6.5,6.6,6.7 and 6.8.The 3D dispositions of the aquifer system and fence diagram of the study area are shown in Fig.6.9 and 6.10.

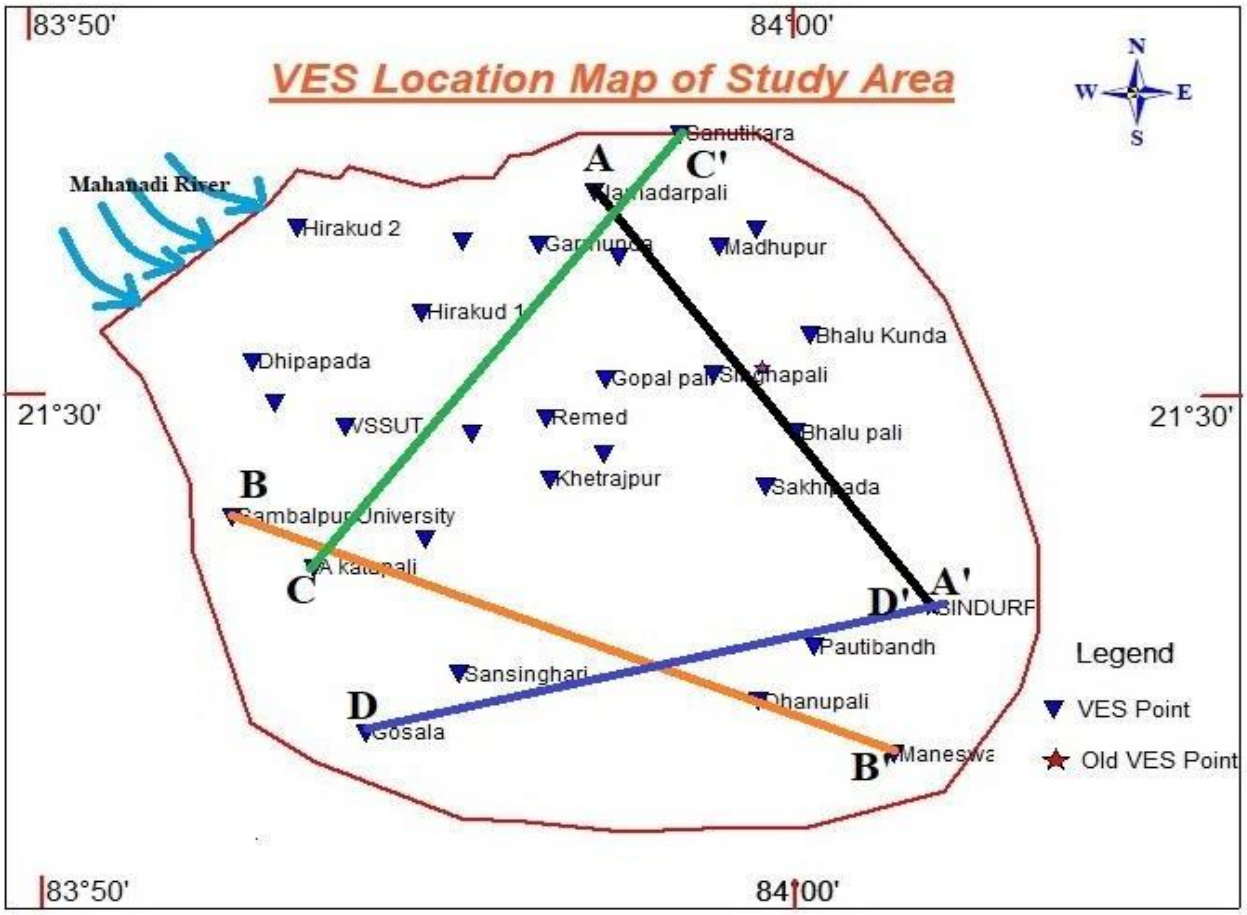


Fig.6.4 VES location map of Study area

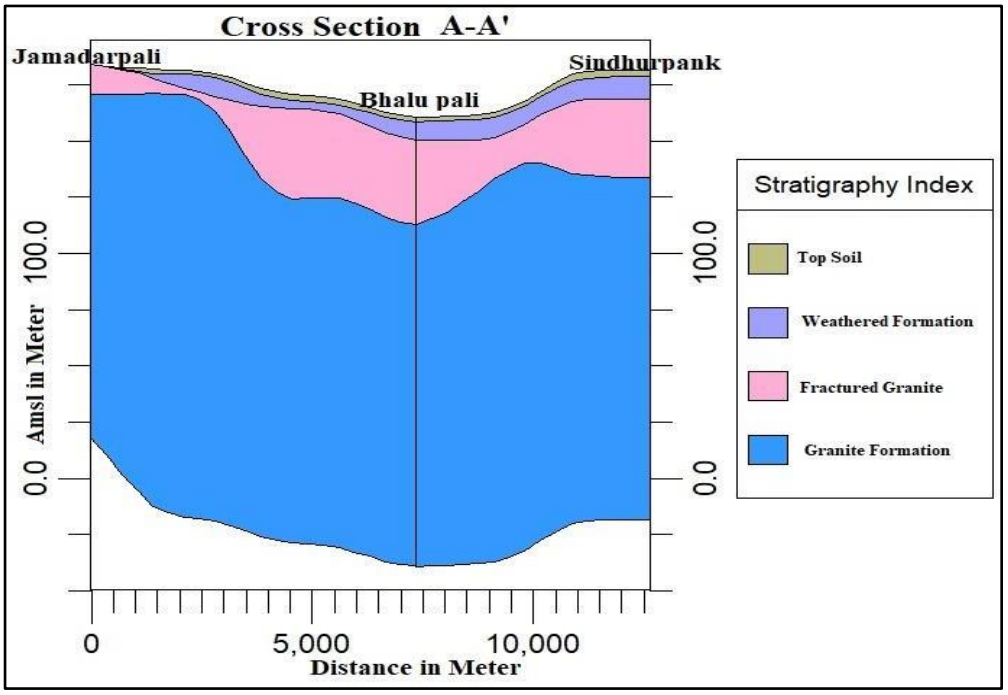


Fig.6.5 2D Cross section A-A’

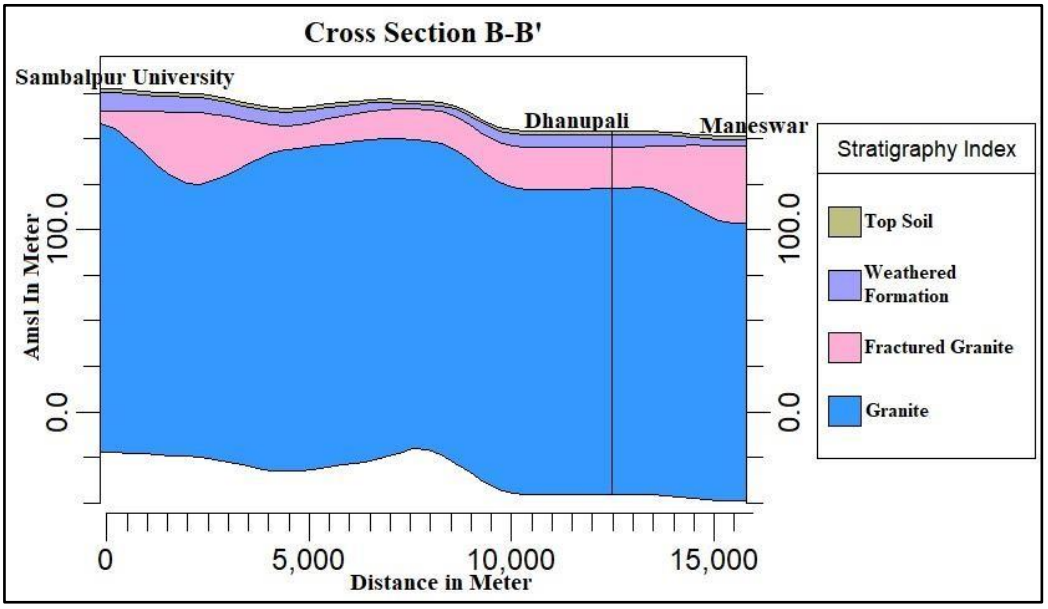


Fig.6.6 2D Cross section B-B’

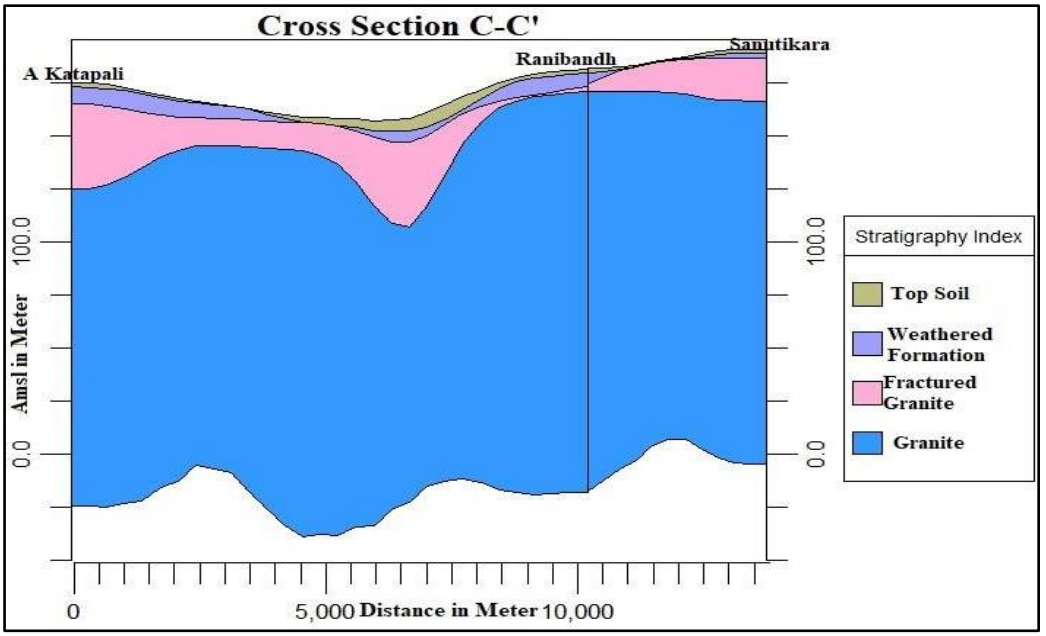


Fig.6.7 2D Cross section C-C’

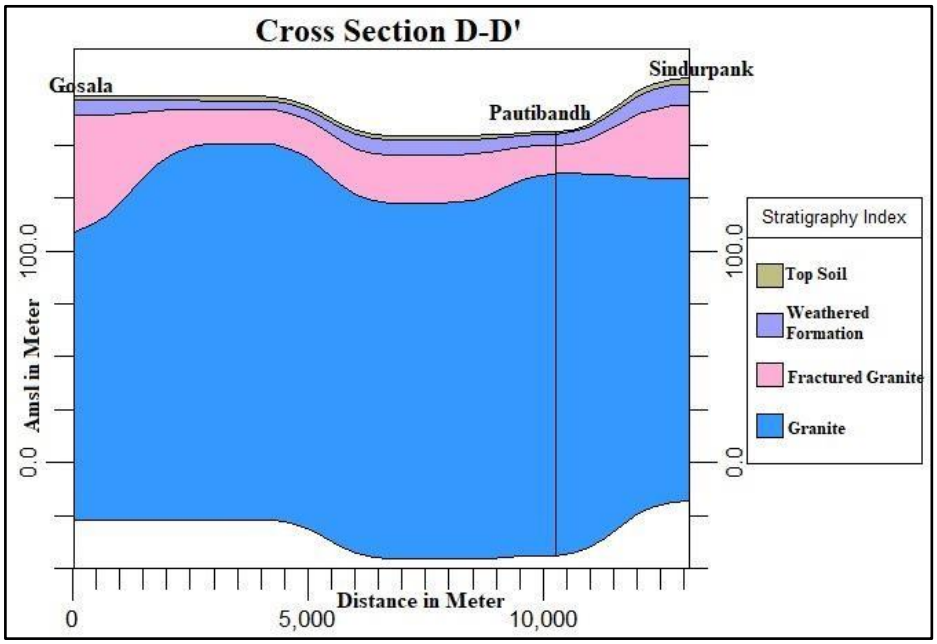


Fig.6.8 2D Cross section D-D'

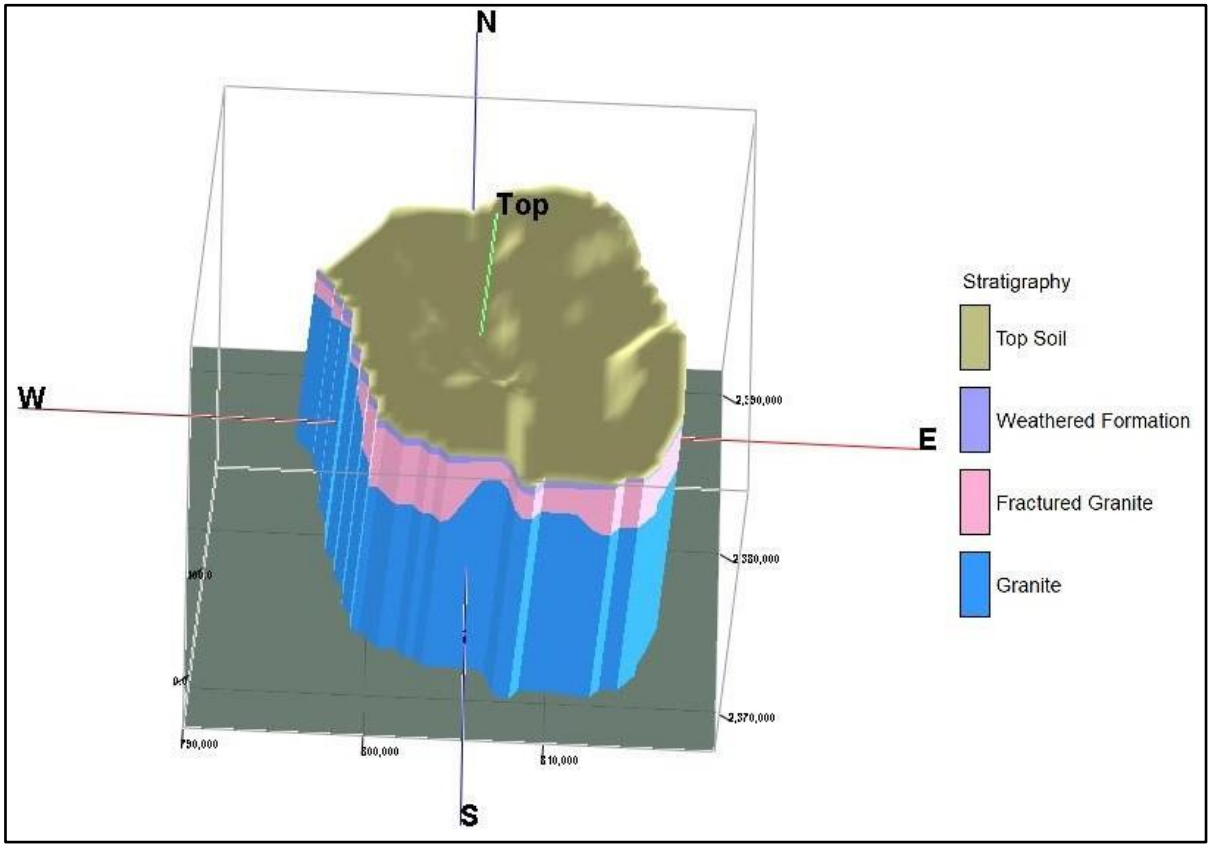


Fig.6.9 3D Stratigraphy model

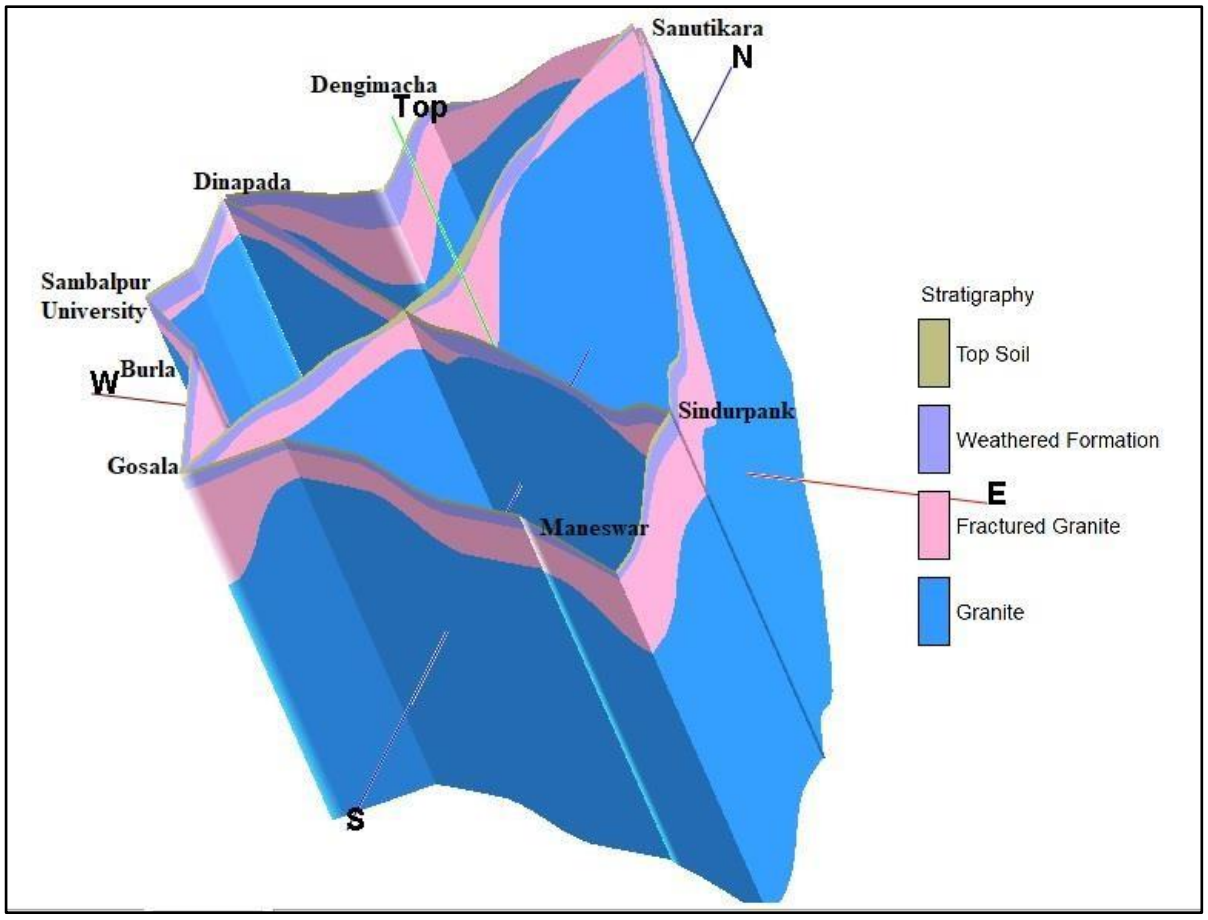


Fig.6.10 Fence Diagram

7.0 Acknowledgements:

The NAQUIM team is grateful to Ground Water Department, Odisha, Minor Irrigation Department, Mega lift irrigation department, Odisha Lift Irrigation Department, for supplying various data to compile the report.

The NAQUIM team is thankful to the Chairman, Member (East), Member (North & West), Member (South), Member HQ, Director Administration for their valuable suggestions and guidance to carry out NAQUIM 2.0 study.

The authors are also thankful to Sh.P. K. Mohapatra, Regional Director (retired) and Dr.B. K. Sahoo, Scientist-D (present Head of Office) for technical and administrative support to carry outthe work.

8.0 SUMMARY AND RECOMMENDATIONS

8.1 Summary

National Aquifer Mapping Programme (NAQUIM 2.0) was taken up for detailed hydrogeological investigation, data-gap analysis and Aquifer Mapping and Management in the Sambalpur urban and Peri-Urban area of Sambalpur district. (Fig-1).The total area under field investigation is 275sq.km. The study area lies between $21^0$24'20.23'' to $21^0$33'31.97'' N latitudes and$83^0$51'2.79'' to $84^0$03'12.72'' E longitudes. The area falls on the Survey of India Topo-sheets Number 64O/13, 64O/14, 73 C/2 and 73 C/3.

1. The average annual rain fall is 1489mm.
2. Mainly two types of soils found in the study area, i.e., Ultisoils consisting of red, yellow and lateritic soils and mixed grey soil; Alfisoils predominantly includered gravelly, sandy, loamy, redearth mixed with black soils.
3. The district is under lain by Granite-gneiss and its variants and a small patch of Lower Gondwana formations, Alluvium and later ites.
4. The crystalline formations like Granite Gneiss, Khondalite and metabasics like shale are classified under Consolidated water bearing formations. The weathered residum of these rocks form the main repositories of ground water, which occurs under water table conditions and circulates through deeper fractures and fissures. Ground water occur sunder confined to semi-confined condition in the deeper fractured zones. The Gondwana, sandstone and shale constitute the Semi-consolidated water bearing formations Groun dwater occurs under water table condition in the shallow aquifers and in semi confined to confined condition in deeper aquifer. The Alluvium deposits, silt, sand and gravel sare classified under unconsolidated formations.
5. CGWB has constructed 07 EWs,01 OW and 01 PZ, during the ground water exploration programme. For the monitoring of ground water level and quality CGWB has established 30 National Hydrograph Network Stations in the study area.
6. The drinking and irrigation requirement of the study area is met through surface water supplied from the Hirakud dam.
7. The Depth to water level in pre-monsoon period (May 2023) varies from 1.1mbgl (Modipada) to 15.7mbgl (Burla), the average being 8.4mbgl. Depth to water level in post-

monsoon period (Nov 2023) varies from 0.3mbgl (Khagsipada) to 13.3mbgl (Burla), the average being 6.8mbgl. The decadal water level fluctuation varies from 1.80m to 13.76m, the average being 7.78m during pre-monsoon. The decadal water level fluctuation varies from 0.10 m to 12.06 m, the average being 6.35 m during post- monsoon. The deeper water level is observed N-E part of the study area.

8. The estimated dynamic ground water resource is 1457 Ham and the stages of development of ground water is 25.4%. The ground water resource is calculated on apportion basis.
9. Most ground water samples are fresh, alkaline and hard to very hard in nature, and mostly dominated by bicarbonate ions.
10. The fluoride contamination is observed at Remed, Pardhiapali, Naradihi, Dehripali, and A. Katapali in the studyarea. The high fluoride in groundwater samples maygeogenic.
11. The Uranium contamination was found in Hirakud Railway Station (53.68 µg/l) in pre monsoon as per drinking water specification IS 10500:2012 while the post monsoon samples were free from U contamination, may be due to the dilution effect.
12. Nitrate contamination is reportedin the urban and peri-urban area of Sambalpur city. Maximum value of nitrate is observed at Bhalukonda as 242 mg/l. The root cause of groundwater pollution is anthropogenic, through which the nitrate rich material present on the earth percolates through soil to reach the groundwater table. The main sources for the nitrate contamination arelivestock excreta, sewerage, organic garbage, indiscriminately inland disposal of solid wastes, and domestic sewage.
13. Resistivity VES data coupled with Litho-Log data have been employed for the aquifer disposition/Sub surface lithology in Sambalpur district. The data was incorporated into the vertical lithological distribution to demarcate the Weathered and Fractured zones governing the aquifer geometry. Based on geo- electrical layer parameters and the fractured zone analysis a few sites are recommended for boreholedrilling or Shallow borehole or dug well.

8.2 RECOMMENDATIONS

For a sustainable ground water development in the area, a systematic, economically sound and politically feasible framework for groundwater management is required. Considering the local physiographical and hydrogeological set up the following ground water management strategy is suggested.

1. As there is large scope for development of ground water, suitable schemes may be

launched for development to boost agricultural production in the district. The financial institutions should generously finance such schemes.

2. Inwater logged areas like Hirakud command areas conjunctive use of surface and ground water should be done. Diversification of crops from paddy to non paddy crops like oil seed, pulses and vegetables during rabi season at least in the high land and part of medium land areas is essential.
3. Priority should be given to the phreatic aquifer for extraction of ground water through large diameter dugwells anddugcum bore well sathydro geologically suitable locations. Selection of proper site for drilling of bore wells, based on the favourable hydrogeological conditions must be done.
4. There should be Proper sealing and maintenance of sewerage lines to avoid leakage leading to contamination.
5. The dumping of the industrial effluents should be in the concrete platform.
6. The hand pumps having Fluoride, Uranium and Nitrate concentration more than permissible limit should be sealed.
7. The occurrence of fluoride is point specific and there are alternate sources available. Deeper aquifers form a better alternative source for the domestic use in this area.
8. Rainwater harvesting should be adopted in all govt. and public buildings.
9. The farmers should be educated through agricultural extension services for adopting suitable cropping patterns for optimal utilization of available ground water and surface water resources.
10. Industrial wastewater sand effluents should be treated and disposed off properly under an effective monitoring mechanism.
11. Safe disposal of nitrate contaminated wastes and organic municipality wastes, proper sewage systems in thearea must be developed so that the nitrate level brings down to accepted level of IS 10500:2012.

References:

1. National aquifer mapping and management plan of Sambalpur District (2023), CGWB, SER, Bhubaneswar.
2. Dynamic Ground Water Resources Assessment of Odisha, (2023), CGWB, SER, Bhubaneswar.
3. Ground water resources assessment of Odisha State; CGWB, SER, Bhubaneswar, 2017.
4. Ground water resources assessment of Odisha State; CGWB, SER, Bhubaneswar,2022.
5. District irrigation plan of Sambalpur, Odisha, PMKSY; Districtlevel implementation committee, Sambalpur, 2016.
6. Well completion report of exploratory wells constructed by CGWB, Sambalpur District, CGWB, SER, Bhubaneswar, 2022.
7. Basic data report of exploration in Sambalpur District by CGWB, SER, Bhubaneswar, 1987-2005.
8. Irrigation census 2018, Odisha, Ministry of Jal Shakti, Government of India.

Annexure:1. Laye rParameters of VES of Study area

SL NO.	LOCATION	Longitude	Latitude	DirectinterpretationofVESlayer parameters by software				Inferred lithology	Aquifer Charectristics		
				Layer	Resistivity(ohm.m)	Thickness(m)	Depth(m)		Aquifer	DepthRange(m)	Inferred aquifer water quality
1	Katapali	83.89383	21.44931	1	111.99	2.09	2.09	TopSoil			
				2	56.4	6.7	8.75	Highly Weathered Formation	Aquifer	2.09-8.75	potable
				3	1234			Granite Formation			
2	SINGHAPALI	83.99385	21.50751	1	53.3	2.78	2.78	Topsoil			
				2	194	2.92	5.71	Weathered Formation	Aquifer	2-14	Potable
				3	13	8.23	13.9	Highly Weathered Formation			
				4	VH			Granite Formation			
3	SINDURPANK	84.03057	21.45473	1	267.5	1.2	1.2	Topsoil			
				2	92.7	9.7	10.99	Weathered Formation	Aquifer	1.2-11	Potable
				3	1407	11.9	22.93	Granite Formation			
				4	510.3	24.95	47.89	Fractured Granite	Aquifer	22-47	Potable
				5	VH			Granite Formation			
4	Hirakud	83.91737	21.52981	1	26.2	2.25	2.25	Topsoil			
				2	11.8	8.47	10.7	Highly Weathered Formation	Aquifer	2-10	Potable
				3	VH			Granite Formation			
5	Burla	83.38719	21.48524	1	35.5	0.794	0.794	Topsoil			

				2	18.5	18.2	19	Highly Weathered Formation	Aquifer	1-19	Potable
				3	VH			Granite Formation			
New VES Points											
1	Jamadarpali	21.54592	83.95765	1	62	0.926	0.926	Topsoil			
				2	7.42	1.21	2.13	Highly Weathered Formation			
				3	130	8.97	11.1	Weathered Formation	Aquifer	2-11	Potable
				4	2598			Granite Formation			
2	Gopalpali	21.5049	83.96015	1	23.5	2.78	2.78	TopSoil			
				2	160	12.2	15	Fractured Granite	Aquifer	3-15	Potable
				3	2514			Granite Formation			
3	Sanutikara	21.56128	83.97672	1	341	0.487	0.487	Topsoil			
				2	748	1.15	1.63	Topsoil			
				3	9.4	2.67	4.31	Highly Weathered Formation			
				4	209	22.1	26.4	Fractured Granite	Aquifer	5-26	Potable
				5	2344			Granite Formation			
4	Madhupur	21.53386	83.98446	1	25	1.17	1.17	Topsoil			
				2	18.6	3.8	4.97	Weathered Formation			
				3	VH			Granite Formation			
5	Singhapali	21.50583	83.98337	1	26.73	2.53	2.53	Topsoil			
				2	19.09	2.804	5.335	Weathered Formation			
				3	661.2	44.69	50.03	Fractured Granite	Aquifer	6-50	Potable
				4	VH			Granite Formation			
6	Ranibandha	21.53168	83.96292	1	147	0.874	0.874	Topsoil			

				2	36.7	8.52	9.39	Weathered Formation	Aquifer	2-9	Potable
				3	VH			Granite Formation			
7	Garmunda	21.53458	83.94548	1	288	0.941	0.941	Topsoil			
				2	35.3	7.63	8.57	Weathered Formation	Aquifer	2-8	Potable
				3	VH			Granite Formation			
8	Hirakud1	21.51959	83.92019	1	82.3	1.77	1.77	Topsoil			
				2	26.7	21	22.8	Weathered Formation	Aquifer	2-22	Potable
				3	389	32.9	55.8	Fractured Granite	Aquifer	23-55	Potable
				4	VH			Granite Formation			
9	Hirakud2	21.538	83.89351	1	188	1.79	1.79	Topsoil			
				2	11	3.34	5.13	Weathered Formation			
				3	VH			Granite Formation			
10	Dengimacha	21.53517	83.92933	1	71.38	1.2	1.2	Topsoil			
				2	20.69	1.579	2.779	Weathered Formation			
				3	39.17	3.658	6.438				
				4	342	28.16	34.6	Fractured Granite	Aquifer	7-34	Potable
				5	VH			Granite Formation			
11	Maneswar	21.42253	84.02251	1	29.8	1.21	1.21	Topsoil			
				2	7	1.53	2.74	Highly Weathered Formation			
				3	263	45.3	48	Fractured Granite	Aquifer	3-48	Potable
				4	VH			Granite Formation			
12	Sakhipada	21.48115	83.99474	1	23.4	2.15	2.15	Topsoil			
				2	11.03	2.82	4.97	Weathered Formation			
				3	1988			Granite Formation			

13	Pautibandh	21.44617	84.00516	1	95.92	0.5502	0.5502	Topsoil			
				2	37.43	4.098	4.649	Weathered Formation			
				3	175.7	14.29	18.94	Fractured Granite	Aquifer	5-18	Potable
				4	7899			Granite Formation			
14	Dhanupali	21.43406	83.99322	1	58.4	1.2	1.2	Topsoil			
				2	7.58	1.26	2.46	Highly Weathered Formation	Aquifer	2-9	Potable
				3	52.3	6.71	9.18	Weathered Formation			
				4	431	22.4	31.6	Fractured Granite	Aquifer	10-31	Potable
				5	5870			Granite Formation			
15	VSSUT	21.49449	83.90387	1	447	0.9729	0.9729	Topsoil			
				2	149	1.001	1.974	Weathered Formation			
				3	314	12.8	14.78	Fractured Granite	Aquifer	2-14	Potable
				4	3617			Granite Formation			
16	Dhipapada	21.50867	83.88374	1	168	1.487	1.487	Topsoil			
				2	56	5.945	7.432	Weathered Formation			
				3	601	15.88	23.31	Fractured Granite	Aquifer	8-23	Potable
				4	2322			Granite Formation			
17	Sambalpur University	21.47462	83.87956	1	93	1.79	1.79	Topsoil			
				2	29.2	18	19.8	Weathered Formation	Aquifer	2-19	Potable
				3	VH			Granite Formation			
18	A katapali	21.46351	83.89684	1	44.6	1.02	1.02	Topsoil			
				2	30.9	8.48	9.5	Weathered Formation	Aquifer	2-9	Potable

				3	224	42.9	52.1	Fractured Granite	Aquifer	10-52	Potable
				4	VH			Granite Formation			
19	Gosala	21.42727	83.90848	1	282	1.439	1.439	Topsoil			
				2	55	7.071	8.51	Weathered Formation			
				3	200	56.5	65.01	Fractured Granite	Aquifer	9-65	Potable
				4	VH			Granite Formation			
20	Sansinghari	21.44007	83.92858	1	72.5	1.2	1.2	Topsoil			
				2	35	3.98	5.18	Weathered Formation			
				3	584	16.4	21.5	Fractured Granite	Aquifer	6-21	Potable
				4	5887			Granite Formation			
21	SamleiGudi	21.46965	83.92134	1	145	0.928	0.928	Topsoil			
				2	35	1.73	2.66	Highly Weathered Formation	Aquifer	2-10	Potable
				3	60	7.73	10.4	Weathered Formation			
				4	726	11.4	21.7	Fractured Granite	Aquifer	10-21	Potable
				5	VH			Granite Formation			
22	Remed	21.49636	83.94718	1	24.9	3.46	3.46	Topsoil			
				2	69	7.95	11.4	Weathered Formation	Aquifer	4-11	Potable
				3	300	59.5	70.9	Fractured Granite	Aquifer	12-70	Potable
				4	1071			Granite Formation			
23	RingRoad	21.49302	83.93114	1	74.1	0.777	0.777	Topsoil			
				2	15	1.43	2.21	Weathered Formation			
				3	601	11.5	13.7	Fractured Granite	Aquifer	3-13	Potable
				4	5264			Granite Formation			
24	Khetrajpur	21.48297	83.94823	1	26.21	3.884	3.884	Topsoil			

				2	85.	9.804	13.69	Weathered Formation	Aquifer	4-13	Potable
				3	588			Fractured Granite	Aquifer		
25	Nuapada	21.48848	83.95956	1	81	1.88	1.88	Topsoil			
				2	31.3	10.4	12.3	Weathered Formation	Aquifer	2-12	Potable
				3	VH			Granite Formation			
26	Bhalupali	21.4932	84.00118	1	36	1.2	1.2	TopSoil			
				2	12	1.308	2.508	Highly Weathered Formation			
				3	29	2.734	5.241	Highly Weathered Formation			
				4	88	5.713	10.95	Weathered Formation			
				5	405	40.64	51.6	Fractured Granite	Aquifer	11-51	Potable
				6	1725			Granite Formation			
27	BhaluKunda	21.51449	84.00424	1	91.8	0.372	0.372	TopSoil			
				2	9.03	4.46	4.83	Highly Weathered Formation			
				3	353	18.5	23.4	Fractured Granite	Aquifer	5-23	Potable
				4	VH			Granite Formation			
28	Madhupur	21.53788	83.99268	1	80	1.556	1.556	TopSoil			
				2	21	2.82	4.377	Weathered Formation			
				3	985	19.7	24.08	Fractured Granite	Aquifer	5-24	Potable
				4	VH			Granite Formation			
29	VimsarBurla	21.49977	83.88853	1	707	0.473	0.473	TopSoil			
				2	149	9.47	9.94	Weathered Formation	Aquifer	1-9	Potable
				3	3128			Granite Formation			
				4							

Annexure-2 Premonsoon and postmonsoon keywells monitoring data.

Sl No.	Location	LocationDetails	Latitude	Longitude	Elevation (mamsl)	MP (magl)	DTWL(m) (Pre-Monsoon)	DTWL(m) (Post Monsoon)	Seasonal Waterlevel Fluctuation
1	Malati Jhorat Subanpur	Malati Jhorat Subanpur	21.42218	83.99741	167	0.48	4.4	3.25	1.15
2	Malati Jhorat Khandual	Malati Jhor at Subanpur	21.4145	83.9848	168	0.45	4.9	3.1	1.8
3	Khagasipali	3km from Gosala, DW is in the H/O Sanjeev Naik	21.4395	83.9322	171	0.5	2.6	2.2	0.4
4	Mundoghat (Pardesipada	DW is in front of H/O Ramachandranearbamboo tree,50mfrommainroad.	21.4557	83.9497	164	0.6	4.1	3.5	0.6
5	Kutapali	DW is on RHS, 50m from Srikrishna Goshala in front of H/O Ghasi ram Bagh	21.468	83.9421	163	0.45	3.3	2.9	0.4
6	Bhutapada Chhak	HP is by the side of Shiv Mandir in front of ITCT computer education	21.4601	83.9819	164	0.55	3.6	3.2	0.4
7	Chorbhati	HP is in Chorbhati chhak fish market near Relax tailor	21.4572	83.9866	168	0.5	2.7	2.4	0.3
8	Dhanupali	HP is back side of Durga mandap, by RHS of road in front of Balaji Atta chaki	21.4475	83.9907	170	0.4	2.8	2.5	0.3
9	Khandual	HP is at the entry of village near Hanuman temple andbanyan tree.	21.4208	83.9969	163	0.5	2.4	2.1	0.3
10	Mathpali	Hp is near petol pump on LHS of road.	21.4378	83.9907	167	0.6	7.4	7.1	0.3
11	Naxapali	HP is in front of Gopalji temple.	21.4263	84.0149	168	0.68	6.8	6.3	0.5
12	Kanteipali	HP is in front of cement pipe factory.	21.41984	84.03685	171	0.48	6.8	6.4	0.4

13	Mirgamunda	3km from Maneswar, HP is near sign board Krisnanagar Mirgamunda	21.42437	84.003979	164	0.45	5.1	4.5	0.6
14	Putibandh	HP is near Hanuman Mandir, RHS of road at the entry of village	21.44971	83.99741	163	0.5	4.3	3.9	0.4
15	Dandeipali	HP is by the side of Primary school on RHS of road.	21.45615	84.03103	164	0.6	4.1	3.6	0.5
16	Tumbesingha	HP is by the side of Primary school on RHS of road.	21.45826	84.01231	168	0.45	4.5	4.1	0.4
17	Pardhiapali	4 km from Ainthapali on Jharsuguda road. HP is in entry of Village on RHS.	21.51369	84.01415	170	0.55	11.5	10.2	1.3
18	Jogipali	Jogipali is on Ainthapali-Jamadarpali Aerodromeroad. HP is 50m from Primary school at The back side.	21.52874	83.98133	163	0.5	8.7	7.3	1.4
19	HirakudRlystation	HP is opp to Rly station on RHS of road.	21.48079	83.90552	167	0.4	10.1	9.1	1
20	Goshala	HP is in front of Hari om clinic on RHS of Chiplima road.	21.4251	83.9005	168	0.5	6.1	4.8	1.3
21	Chiplima	HP is in front of cattle breeding firm Chiplima road	21.38705	83.8892	171	0.6	8.3	7.4	0.9
22	A. Katapali	HP is in front of Puja mandap, near Jagannath temple In village.	21.4613	83.89929	164	0.68	8.2	7.3	0.9
23	Jyotivihar (Sambalpur University)	DW is in firm house of Sabyasachi Panda inside Univ campus, behind dept of Life science,100m from V. Coffice	21.4784	83.8851	163	0.48	5.5	4.8	0.7

24	Jyotivihar (S.U)	HP is in front of Baitarani Ladies Hostel	21.48025	83.88	164	0.45	4.7	4.1	0.6
25	Sadeipali	HP is 50m from M.E school, in front of Puja Mandap Board colony.	21.4976	83.87332	168	0.5	1.7	1.3	0.4
26	Bula Hospital (VIMSAR)	HP is back side of Burla Medical (VIMSAR)	21.50083	83.88264	170	0.6	15.7	13.3	2.4
27	Remed	HP is 50m from Remed Chhakon RHS, in Larpan kon Hirakud road.	21.50755	83.9367	163	0.45	3.4	2.5	0.9
28	Hirakud	HP is located by the side of Hirakud municipality office in Fish market.	21.52897	83.89672	167	0.55	1.5	1.1	0.4
29	Jamadarpali	HP is in front of Meera fast food in middle of village.	21.54938	83.97686	168	0.5	12.7	10.3	2.4
30	Larbanga	HP is in front of pump house , near primary school	21.5572	83.95136	171	0.4	10.1	9.3	0.8
31	Burhakata	HP is in middle of village in front Of H/OAnandasahu, kirana store	21.53575	83.9428	164	0.5	6.6	5.8	0.8
32	Modipada (Labour colony)	HP is back side of Trinathmandir	21.47235	83.96831	163	0.6	1.1	1.2	-0.1
33	Samleswaritemple	HP is inside temple premises.	21.474	83.9586	164	0.68	8.1	7.5	0.6
34	REMED	HP is by the side of Primary school on RHS of road.	**21.50755**	**83.9367**	168	0.48	**3.56**	2.5	1.06
35	LARPANKA	Near shiv mandir	**21.501**	**83.888**	170	0.45	**6.75**	4.7	2.05
36	NARADIHI	HP is by the side of Primary school on RHS of road.	**21.505**	**83.903**	163	0.5	**4.5**	2.46	2.04
37	GADMUNDA	Adjacent to canal road gadmunda	**21.461**	**83.9722**	167	0.6	**4.68**	2.65	2.03

38	SOLPALI	HP is in front of pump house , near primary school	**21.5377**	**83.909**	168	0.45	**3.24**	1.22	2.02
39	HIRAKUD	HP is by the side of Primary school on RHS of road.	**21.52897**	**83.89672**	171	0.55	**1.6**	1.41	0.19
40	SOLABANDH	HP is inside temple premises.	**21.539**	**83.899**	164	0.5	**4.56**	2.56	2
41	LARBHANGA	HP is in front of pump house , near primary school	**21.5572**	**83.95136**	163	0.4	**6.89**	4.9	1.99
42	JAMADARPALI	Near Gram Panchayat office	**21.54938**	**83.97686**	164	0.5	**11.98**	10	1.98
43	PANDRIPALLI	HP is in front of pump house , near primary school	**21.528**	**83.981**	168	0.6	**5.55**	3.58	1.97
44	MADHUPUR	Near post office	**21.539**	**83.899**	170	0.68	**6.34**	4.38	1.96
45	BHALUKONDA	HP is inside temple premises.	**21.542**	**83.988**	163	0.48	**7.8**	5.85	1.95
46	SINGHAPALLI	Near water over head tank	**21.5133**	**83.9931**	167	0.45	**4.12**	3.18	0.94
47	GOPALAPALLI	HP is in front of pump house , near primary school	**21.495**	**83.963**	168	0.5	**6.54**	4.61	1.93
48	SAKARAMA	Near primary dispensary	**21.505**	**83.985**	171	0.6	**4.97**	3.05	1.92
49	DEHRIPALLI	HP is in front of pump house , near primary school	**21.479**	**83.979**	164	0.45	**5.48**	3.57	1.91
50	PURUNABURLA	HP is in front of pump house , near primary school	**21.508**	**83.867**	163	0.55	**2.1**	1.2	0.9
51	SADAIPALLI	Near Gram Panchayat office	**21.498**	**83.871**	164	0.5	**1.5**	1.39	0.11
52	BURLA	HP is inside temple premises.	**21.5**	**83.885**	168	0.4	**3.65**	1.77	1.88
53	JYOTIBIHAR	HP is by the side of Primary school on RHS of road.	**21.4784**	**83.8851**	170	0.5	**4.5**	2.63	1.87
54	AMSARKHATAPALLI	Amarshakata palli village chowk	**21.462**	**83.894**	163	0.6	**8.14**	6.28	1.86
55	VSSUTBURLA	Outside the main Campus	**21.497**	**83.904**	167	0.68	**11.5**	9.65	1.85
56	HIRAKUDRAILWAY STATION	Railway Station	**21.48079**	**83.90552**	168	0.48	**10.21**	8.37	1.84
57	SIKIRIDI	NearPrimary school	**21.466**	**83.926**	171	0.45	**7.54**	5.71	1.83

58	PANDRIKANTAPALLI	HP is inside temple premises.	**21.463**	**83.904**	164	0.5	**6.54**	4.72	1.82
59	GOSHALA	HP is in front of pump house , near primary school	**21.4251**	**83.9005**	163	0.6	**6.2**	4.39	1.81
60	KHOGSIPALLI	Near Gram Panchayat office	**21.455**	**83.91**	164	0.45	**2.5**	0.7	1.8
61	JHANKARPALLI	HP is inside temple premises.	**21.445**	**83.918**	168	0.55	**6.54**	4.75	1.79
62	BARAMPURA	HP is in front of pump house , near primary school	**21.3441**	**83.929**	170	0.5	**5.87**	4.09	1.78
63	KHETRAJPUR	Adjacenttomain road of Khetrajpur hirakud	**21.488**	**83.954**	163	0.4	**6.54**	4.77	1.77
64	SAMBALPURBUSSTAND	Near Primary school	**21.482**	**83.96**	167	0.5	**5.48**	3.72	1.76
65	SAMLESHWARITEMPLE	HP is in front of pump house , near primary school	**21.474**	**83.9586**	168	0.6	**8.13**	6.38	1.75
66	MOTIJHARAN	Near Gram Panchayat office	**21.474**	**83.971**	171	0.68	**6.57**	4.83	1.74
67	PUTIBANDH	HP is by the side of Primary school on RHS of road.	**21.44971**	**83.99741**	164	0.48	**4.5**	2.77	1.73
68	MATHOPALLI	Near Gram Panchayat office	**21.522**	**84.028**	163	0.45	**5.48**	3.76	1.72
69	KHANDOAL	HP is in front of pump house , near primary school	**21.421**	**83.998**	164	0.5	**2.57**	0.86	1.71
70	VAKSAPALLI	Near Primary school	**21.492**	**84.029**	168	0.6	**3.27**	1.57	1.7
71	MIRGEMUNDA	HP is in front of pump house ,near primary school	**21.429**	**84.037**	170	0.45	**5.2**	3.51	1.69
72	DANDIAPALLI	Near post office	**21.499**	**84.033**	163	0.55	**3.98**	2.3	1.68
73	TUMASINGHA	HP is in front of pump house , near primary school	**21.455**	**84.0155**	167	0.5	**4.3**	2.63	1.67
74	SAKRAMA	Near Primary school	**21.4852**	**84.0088**	168	0.4	**6.59**	4.93	1.66
75	KULAPALLI	Near Gram Panchayat office	**21.49**	**84.04**	171	0.5	**7.56**	5.91	1.65
76	PARDHIAPALLI	HP is in front of pump house , near primary school	**21.505**	**84.0136**	164	0.6	**10.85**	9.21	1.64
77	CHATTARGARH	HP is inside temple premises.	21.513	84.027	163	0.68	9.46	7.83	1.63

Annexure3 ChemicalanalysisdataforPremonsoonwatersampling

Block	Village	Source	Lat	Long	Aquifer	DateofSam	pH	EC	TDS	TH	TA	Ca	Mg	Na	K	CO3	HCO3	Cl	SO4	NO3	F	U
Dhankauda	Khagasipali	DW	21.4395	83.9322	GraniteGneiss	20.6.23	7.15	460	241	180	155	50	13	18	10.5	0	189	35	21	0	0.19	BDL
Dhankauda	Mundoghat (Pardesipada	DW	21.4557	83.9497	GraniteGneiss	20.6.23	7.31	3801	1976	1500	455	250	213	161	5.49	0	555	1007	64	3	1.2	24.4
Dhankauda	Kutapali	DW	21.468	83.9421	GraniteGneiss	20.6.23	7.01	814	454	265	245	70	22	43	26.2	0	299	74	61	10.5	0.48	10.73
Dhankauda	Bhutapada	HP	21.4601	83.9819	GraniteGneiss	22.06.23	6.48	374	210	145	90	54	2	17	3.55	0	110	43	35	1.4	0.22	BDL
Dhankauda	Chorbhati	HP	21.4572	83.9866	GraniteGneiss	22.06.23	7.41	1160	634	410	295	86	47	73	5.16	0	360	128	61	57	0.33	12.49
Dhankauda	Dhanupali	HP	21.4475	83.9907	GraniteGneiss	22.06.23	7.33	833	426	300	255	54	40	53	3.27	0	311	85	34	3.8	0.77	BDL
Dhankauda	Khandual	HP	21.4208	83.9969	GraniteGneiss	22.06.23	7.46	704	368	290	210	76	24	27	3.64	0	256	71	35	5.1	0.56	BDL
Dhankauda	Mathpali	HP	21.4378	83.9907	GraniteGneiss	22.06.23	7.13	1540	773	710	295	128	95	33	5.07	0	360	298	30	7.4	0.22	BDL
Maneswar	Naxapali	HP	21.4263	84.0149	GraniteGneiss	22.06.23	7.3	1620	892	580	325	116	70	89	27.5	0	397	252	68	75	0.55	BDL
Maneswar	Kanteipali	HP	21.41984	84.03685	GraniteGneiss	22.06.23	7.32	980	509	395	255	66	56	45	2.57	0	311	99	80	6.4	1.04	BDL
Maneswar	Mirgamunda	HP	21.42437	84.003979	GraniteGneiss	22.06.23	7.42	520	261	225	175	42	29	16	2.01	0	214	35	31	0	0.49	BDL
Dhankauda	Putibandh	HP	21.44971	83.99741	GraniteGneiss	22.06.23	7.21	1221	673	355	290	50	56	103	2.06	0	354	170	58	60.5	0.14	5.58
Dhankauda	Dandeipali	HP	21.45615	84.03103	GraniteGneiss	22.06.23	7.24	1503	775	550	370	60	97	73	7.08	0	451	238	72	6.2	0.84	6.27
Dhankauda	Tumbesingha	HP	21.45826	84.01231	GraniteGneiss	22.06.23	7.47	1441	795	525	350	116	57	86	3.34	0	427	167	58	98	0.87	BDL
Dhankauda	Pardhiapali	HP	21.51369	84.01415	GraniteGneiss	22.06.23	7.69	426	217	155	165	40	13	26	2.88	0	201	25	10	0	1.57	BDL
Sambalpur Nagarnigam	Jogipali	HP	21.52874	83.98133	GraniteGneiss	22.06.23	6.93	646	339	195	190	30	29	57	3.4	0	232	64	39	2.5	0.91	BDL
Dhankauda	HirakudRly	HP	21.48079	83.90552	GraniteGneiss	23.06.23	7.47	1949	1024	650	405	120	85	139	2.07	0	494	372	59	3.8	1.05	53.68
Dhankauda	Goshala	HP	21.4251	83.9005	GraniteGneiss	23.06.23	7.13	490	255	180	150	40	19	29	1.24	0	183	46	28	1.6	0.48	BDL
BurlaNAC	Chiplima	HP	21.38705	83.8892	GraniteGneiss	23.06.23	7.08	934	469	375	190	44	64	44	5.02	0	232	167	31	0	0.65	BDL
BurlaNAC	A. katapali	HP	21.4613	83.89929	GraniteGneiss	23.06.23	6.73	937	501	385	155	66	53	36	2.08	0	189	170	46	35	0.31	BDL
BurlaNAC	(Sambalpur University)	DW	21.4784	83.8851	GraniteGneiss	23.06.23	7.49	744	375	300	215	50	43	38	2.19	0	262	71	41	1	0.59	BDL
BurlaNAC	Jyotivihar (S.U)	HP	21.48025	83.88	GraniteGneiss	23.06.23	7.03	735	374	280	245	38	45	34	1.16	0	299	67	25	17	0.25	BDL
BurlaNAC	Sadeipali	HP	21.4976	83.87332	GraniteGneiss	23.06.23	7.33	1118	595	360	330	84	36	83	1.18	0	403	135	40	18	0.61	BDL
BurlaNAC	BulaHospital (VIMSAR)	HP	21.50083	83.88264	GraniteGneiss	23.06.23	7.56	853	436	295	305	54	39	53	1	0	372	74	28	3	0.96	0.0096
Sambalpur Nagarnigam	Remed	HP	21.50755	83.9367	GraniteGneiss	23.06.23	7.6	1640	871	500	400	54	89	138	7.46	0	488	234	59	48	2.11	0.0211
HirakudNAC	Hirakud	HP	21.52897	83.89672	GraniteGneiss	23.06.23	7.06	773	402	315	220	82	27	32	1.95	0	268	92	32	3	0.39	0.0153
Sambalpur Nagarnigam	Jamadarpali	HP	21.54938	83.97686	GraniteGneiss	23.06.23	6.92	847	437	300	215	38	50	52	6.57	0	262	121	33	7.7	0.75	BDL
Sambalpur Nagarnigam	Larbanga	HP	21.5572	83.95136	GraniteGneiss	23.06.23	7.47	1696	909	730	225	144	90	47	8.57	0	275	379	35	69.6	0.52	0.0079
Sambalpur Nagarnigam	Burhakata	HP	21.53575	83.9428	GraniteGneiss	23.06.23	7.24	550	284	215	175	38	29	21	5.6	0	214	53	29	2.5	0.69	BDL
Sambalpur Nagarnigam	Modipada (Labour	HP	21.47235	83.96831	GraniteGneiss	23.06.23	7.4	751	377	290	250	66	30	43	1.65	0	305	71	15	0	1	BDL
Sambalpur Nagarnigam	Samleswari temple	HP	21.474	83.9586	GraniteGneiss	23.06.23	7.35	877	466	320	210	52	46	52	7.67	0	256	113	39	29.5	0.63	0.0194

SambalpurNagarnigam	Samleswaritemple	HP	21.474	83.9586	GraniteGneiss	23.06.23	7.35	877	466	320	210	52	46	52	7.67	0	256	113	39	29.5	0.63	0.0194
HirakudNAC	REMED	HANDPU	21.50755	83.9367	FRACTUREDGRANITICGNEISS	17.06.2023	8.09	714	381	165	250	42	15	87	1.5	0	305	57	27	0	1.9	0.0069
HirakudNAC	LARPANKA	HANDPU	21.501	83.888	FRACTUREDGRANITICGNEISS	17.06.2023	7.2	353	191	125	95	34	10	19	6.9	0	116	46	17	0	0.76	BDL
HirakudNAC	NARADIHI	HANDPU	21.505	83.903	FRACTUREDGRANITICGNEISS	17.06.2023	7.71	373	194	125	125	28	13	29	1.8	0	153	28	17	0	1.54	BDL
HirakudNAC	GADMUNDA	HANDPU	21.461	83.9722	FRACTUREDGRANITICGNEISS	17.06.2023	8.02	703	373	160	275	40	15	85	1	0	336	39	23	4	1.01	BDL
HirakudNAC	SOLPALI	HANDPU	21.5377	83.909	FRACTUREDGRANITICGNEISS	17.06.2023	7.89	946	510	210	265	34	30	113	2.4	0	323	121	49	2	1.28	BDL
HirakudNAC	HIRAKUD	HANDPU	21.52897	83.89672	FRACTUREDGRANITICGNEISS	17.06.2023	7.66	1112	617	330	260	70	38	101	1	0	317	145	46	60	0.56	0.0852
HirakudNAC	SOLABANDH	HANDPU	21.539	83.899	FRACTUREDGRANITICGNEISS	17.06.2023	7.43	385	195	165	125	36	18	13	1	0	153	32	20	0	0.24	BDL
HirakudNAC	LARBHANGA	HANDPU	21.5572	83.95136	FRACTUREDGRANITICGNEISS	17.06.2023	7.57	1663	892	695	185	104	106	44	6.7	0	226	418	28	74	0.45	0.0066
HirakudNAC	JAMADARPALI	HANDPU	21.54938	83.97686	FRACTUREDGRANITICGNEISS	17.06.2023	7.34	714	374	255	180	64	23	45	3	0	220	113	16	1	0.4	BDL
HirakudNAC	PANDRIPALLI	HANDPU	21.528	83.981	FRACTUREDGRANITICGNEISS	17.06.2023	7.41	648	352	145	200	38	12	79	4.3	0	244	64	33	1.8	0.85	BDL
HirakudNAC	MADHUPUR	HANDPU	21.539	83.899	FRACTUREDGRANITICGNEISS	17.06.2023	7.74	762	422	175	175	50	12	97	3.5	0	214	110	28	15	1.46	BDL
HirakudNAC	BHALUKONDA	DUG WEL	21.542	83.988	FRACTUREDGRANITICGNEISS	17.06.2023	7.74	1860	1098	645	290	100	96	96	44	0	354	284	62	242	1.04	0.0136
HirakudNAC	SINGHAPALLI	HANDPU	21.5133	83.9931	FRACTUREDGRANITICGNEISS	17.06.2023	7.61	969	507	305	240	48	45	79	4.6	0	293	145	36	5	0.87	0.0261
HirakudNAC	GOPALAPALLI	HANDPU	21.495	83.963	FRACTUREDGRANITICGNEISS	17.06.2023	7.92	942	487	270	290	48	36	93	3	0	354	103	29	1	0.95	BDL
HirakudNAC	SAKARAMA	HANDPU	21.505	83.985	FRACTUREDGRANITICGNEISS	17.06.2023	7.55	696	357	260	210	46	35	35	5.3	0	256	78	31	1.5	0.24	BDL
HirakudNAC	DEHRIPALLI	HANDPU	21.479	83.979	FRACTUREDGRANITICGNEISS	17.06.2023	7.96	795	410	260	265	42	38	59	3.9	0	323	74	26	6	1.92	BDL
BurlaNAC	PURUNABURLA	HANDPU	21.508	83.867	FRACTUREDGRANITICGNEISS	17.06.2023	7.7	822	424	300	245	52	41.3	54	1	0	298.9	77.99	32	19	0.62	0.0139
BurlaNAC	SADAIPALLI	HANDPU	21.498	83.871	FRACTUREDGRANITICGNEISS	17.06.2023	7.57	893	469	330	260	88	26.7	45	1.1	0	317.2	124.1	24	5	0.33	0.0062
BurlaNAC	BURLA	HANDPU	21.5	83.885	FRACTUREDGRANITICGNEISS																	

Dhankauda	TUMASINGHA	HANDPU	21.455	84.0155	FRACTUREDGRANITIC GNEISS	18.06.2023	7.77	1283	697	430	310	58	69.3	91	3.6	0	378.2	159.5	47	83	0.98	BDL
Dhankauda	SAKRAMA	HANDPU	21.4852	84.0088	FRACTUREDGRANITIC GNEISS	18.06.2023	7.62	1467	749	540	360	58	96	76	7.2	0	439.2	230.4	59	7	0.83	BDL
Dhankauda	KULAPALLI	HANDPU	21.49	84.04	FRACTUREDGRANITIC GNEISS	18.06.2023	7.83	402	219	155	130	56	3.65	14	4.7	0	158.6	42.54	15	5.7	0.37	BDL
Dhankauda	PARDHIAPALLI	HANDPU	21.505	84.0136	FRACTUREDGRANITIC GNEISS	18.06.2023	7.53	341	177	150	110	48	7.29	8	2.3	0	134.2	35.45	9	1.6	0.17	BDL
Dhankauda	CHATTARGARH	HANDPU	21.513	84.027	FRACTUREDGRANITIC GNEISS	18.06.2023	7.61	353	173	150	130	28	19.4	10	1	0	158.6	31.91	3	2	0.41	BDL

Annexure-4 Chemical Quality data for Post monsoon water Sampling

Block	Village	Source	Lat Decimal	Long Decimal	Aquifer	DateofSa	pH	EC	TDS	TH	TA	Ca	Mg	Na	K	CO3	HCO3	Cl	SO4	NO3	F	U
Dhankauda	Burla VIMSAR	HP	21.50	83.88	GraniteGneiss	05.12.23	7.15	625	319	274	220	76	20	15	0	0	268	50	26	0	0.73	BDL
Dhankauda	Goshala	HP	21.42	83.90	GraniteGneiss	6.12.23	6.87	853	445	375	270	103	29	9	1	0	329	104	38	0	0.29	BDL
Dhankauda	Khandala Dhaba, Near	HP	21.47	83.90	GraniteGneiss	10.12.23	6.86	762	404	321	240	94	21	21	1	0	293	83	15	26	0.38	BDL
Dhankauda	Hirakud (NearHILDALC	HP	21.52	83.90	GraniteGneiss	8.12.23	7.01	662	349	274	200	62	29	25	2	0	244	60	21	30	1.18	BDL
Dhankauda	Hirakud BusStand	HP	21.53	83.89	GraniteGneiss	6.12.23	6.84	617	324	248	180	53	28	23	1	0	220	60	48	3	1.06	BDL
Dhankauda	Remed (NearGovtHig	HP	21.49	83.95	GraniteGneiss	05.12.23	6.83	655	343	283	250	90	14	16	1	0	305	31	40	1	0.5	BDL
Dhankauda	Ainthapalli	HP	21.49	83.99	GraniteGneiss	8.12.23	6.91	553	283	249	215	64	21	8	2	0	262	20	40	0	0.24	BDL
Dhankauda	SamaleshwariTemple	HP	21.47	83.95	GraniteGneiss	10.12.23	7.14	832	428	379	275	103	30	14	3	0	336	67	45	1	0.34	BDL
Dhankauda	Jyotivihar (Sambalpur University)	HP	21.47	83.88	GraniteGneiss	6.12.23	6.7	497	262	223	155	64	15	12	1	0	189	30	46	2	0.4	BDL
Dhankauda	Putibandh	HP	21.45	84.00	GraniteGneiss	8.12.23	7.01	361	184	163	100	43	14	7	0	0	122	51	9	0	0.37	BDL
Dhankauda	Dandeipali	HP	21.46	84.03	GraniteGneiss	9.12.23	6.47	321	163	157	100	40	14	3	0	0	122	28	18	0	0.3	BDL
Dhankauda	Tumbesingha	HP	21.46	84.01	GraniteGneiss	05.12.23	6.83	522	265	229	220	60	19	9	1	0	268	15	30	0	0.42	BDL
Dhankauda	Pardhiapali	HP	21.51	84.01	GraniteGneiss	9.12.23	6.76	406	206	186	155	49	16	7	0	0	189	16	24	1	0.37	BDL
Dhankauda	Jogipali	HP	21.53	83.98	GraniteGneiss	6.12.23	6.5	308	159	141	110	35	13	6	1	0	134	11	28	0	0.28	BDL
Dhankauda	Khagasipali	HP	21.44	83.93	GraniteGneiss	10.12.23	6.69	925	485	411	235	114	31	20	1	0	287	128	51	0	0.47	BDL
Dhankauda	Kutapali	HP	21.47	83.94	GraniteGneiss	9.12.23	6.59	551	297	244	145	73	15	14	1	0	177	51	54	2	0.39	BDL
Dhankauda	Chiplima	HP	21.39	83.89	GraniteGneiss	8.12.23	6.7	703	375	315	195	91	21	13	0	0	238	68	64	1	0.56	BDL
Dhankauda	A. katapali	HP	21.46	83.90	GraniteGneiss	9.12.23	7.37	664	339	258	250	66	23	35	1	0	305	30	35	0	1.52	BDL
Dhankauda	Chorbhati	HP	21.46	83.99	GraniteGneiss	6.12.23	6.75	602	311	277	205	77	21	10	0	0	250	40	40	0	0.54	BDL
Dhankauda	Dhanupali	HP	21.45	83.99	GraniteGneiss	9.12.23	6.91	744	391	315	220	85	25	26	1	0	268	61	60	2	0.71	BDL
Dhankauda	Khagasipali	DW	21.4395	83.9322	GraniteGneiss	05.12.23	7.12	616	330	229	210	57	21	28	18	0	256	33	36	11	0.2	BDL
Dhankauda	Mundoghat (Pardesipada	DW	21.4557	83.9497	GraniteGneiss	05.12.23	7.19	2534	###	821	145	134	119	206	6	0	177	616	226	10	1.02	BDL
Dhankauda	Kutapali	DW	21.468	83.9421	GraniteGneiss	05.12.23	7.23	1209	709	395	310	89	42	53	79	0	378	79	118	64	0.44	BDL
Dhankauda	BhutapadaChhak	HP	21.4601	83.9819	GraniteGneiss	2.12.23	6.46	303	175	100	75	35	3	19	4	0	92	32	29	8	0.19	BDL
Dhankauda	Chorbhati	HP	21.4572	83.9866	GraniteGneiss	2.12.23	7.27	1212	696	500	140	123	47	38	11	0	171	216	118	59	0.41	BDL
Dhankauda	Dhanupali	HP	21.4475	83.9907	GraniteGneiss	2.12.23	7.22	544	289	163	180	36	18	48	3	0	220	43	29	5	0.78	BDL
Dhankauda	Khandual	HP	21.4208	83.9969	GraniteGneiss	2.12.23	7.45	660	346	257	220	70	20	31	3	0	268	51	32	7	0.59	BDL
Dhankauda	Mathpali	HP	21.4378	83.9907	GraniteGneiss	2.12.23	7.12	874	483	252	220	58	26	86	11	0	268	81	65	25	0.49	BDL
Maneswar	Naxapali	HP	21.4263	84.0149	GraniteGneiss	2.12.23	7.09	1759	###	578	245	133	60	130	10	0	299	263	123	174	0.5	BDL
Maneswar	Kanteipali	HP	21.41984	84.03685	GraniteGneiss	2.12.23	7.25	937	504	345	225	70	41	59	5	0	275	91	89	14	0.91	BDL
Maneswar	Mirgamunda	HP	21.42437	84.003979	GraniteGneiss	2.12.23	7.42	406	200	169	170	41	16	17	2	0	207	13	8	1	0.51	BDL

Dhankauda	Putibandh	HP	21.44971	83.99741	GraniteGneiss	2.12.23	7.13	1379	775	428	260	104	41	132	2	0	317	167	105	69	1.21	BDL
Dhankauda	Dandeipali	HP	21.45615	84.03103	GraniteGneiss	2.12.23	7.16	1407	746	511	325	89	70	87	7	0	397	174	116	8	0.82	BDL
Dhankauda	Tumbesingha	HP	21.45826	84.01231	GraniteGneiss	2.12.23	7.3	1216	685	433	275	108	40	80	7	0	336	126	78	81	0.76	BDL
Dhankauda	Pardhiapali	HP	21.51369	84.01415	GraniteGneiss	2.12.23	7.32	387	199	124	165	37	8	32	3	0	201	10	9	2	1.57	BDL
Sambalpur Nagarnigam	Jogipali	HP	21.52874	83.98133	GraniteGneiss	2.12.23	6.99	586	329	140	195	51	3	64	4	0	238	42	45	4	0.75	BDL
Dhankauda	HirakudRlystation	HP	21.48079	83.90552	GraniteGneiss	3.12.23	7.2	689	387	154	280	56	3	66	4	0	342	41	45	5	0.78	BDL
Dhankauda	Goshala	HP	21.4251	83.9005	GraniteGneiss	3.12.23	7.01	421	220	153	140	42	12	30	1	0	171	24	25	2	0.42	BDL
BurlaNAC	Chiplima	HP	21.38705	83.8892	GraniteGneiss	3.12.23	6.73	621	339	203	145	51	19	47	2	0	177	82	50	1	0.42	BDL
BurlaNAC	A. katapali	HP	21.4613	83.89929	GraniteGneiss	3.12.23	6.89	1213	684	486	165	146	30	51	2	0	201	241	61	55	0.34	BDL
BurlaNAC	Jyotivihar (Sambalpur University)	HP	21.4784	83.8851	GraniteGneiss	3.12.23	7.35	610	321	251	180	74	16	27	4	0	220	52	36	5	0.47	BDL
BurlaNAC	Jyotivihar (S.U)	HP	21.48025	83.88	GraniteGneiss	3.12.23	6.98	645	330	262	245	77	17	31	1	0	299	28	28	1	0.27	BDL
BurlaNAC	Sadeipali	HP	21.4976	83.87332	GraniteGneiss	3.12.23	7.12	874	474	258	275	86	10	83	2	0	336	73	41	15	0.56	BDL
BurlaNAC	BulaHospital (VIMSAR)	HP	21.50083	83.88264	GraniteGneiss	3.12.23	7.25	629	324	242	220	63	20	31	1	0	268	48	26	4	0.82	BDL
Sambalpur Nagarnigam	Remed	HP	21.50755	83.9367	GraniteGneiss	3.12.23	7.33	1389	795	343	285	77	36	160	7	0	348	178	85	82	2.18	BDL
Hirakud NAC	Hirakud	HP	21.52897	83.89672	GraniteGneiss	3.12.23	7	670	346	261	215	70	21	39	2	0	262	50	32	4	0.34	BDL
Sambalpur Nagarnigam	Jamadarpali	HP	21.54938	83.97686	GraniteGneiss	4.12.23	7.21	1530	830	545	215	112	64	110	6	0	262	287	85	38	0.79	BDL
Sambalpur Nagarnigam	Larbanga	HP	21.5572	83.95136	GraniteGneiss	4.12.23	7.12	1507	850	656	135	180	50	41	7	0	165	350	47	94	0.47	BDL
Sambalpur Nagarnigam	Burhakata	HP	21.53575	83.9428	GraniteGneiss	4.12.23	7.13	367	191	130	120	20	20	21	2	0	146	27	24	6	0.64	BDL
Sambalpur Nagarnigam	Modipada (Labourcolony)	HP	21.47235	83.96831	GraniteGneiss	4.12.23	7.4	503	258	186	175	43	19	30	2	0	214	35	21	3	0.76	BDL
Sambalpur Nagarnigam	Samleswaritemple	HP	21.474	83.9586	GraniteGneiss	4.12.23	7.32	682	367	267	195	61	28	28	7	0	238	65	39	22	0.34	BDL

Annexure 5 Details of exploratory wells in study area

Sl. No.	Block	Location	Latitude	Longitude	Depthdrilled(mbgl)	Depthconstructed(mbgl)	Lithology	DepthtoBedrock(mbgl)CasingPipe Lowered	Granularzones/ deciphered(mbgl)	SWL (mbgl)	Discharge(lps)	Drawdown(m)
1	Maneswar	Sindurpank	21.46	84.05	190.1	190.1	BioGr.Gneiss	12.2	15,190	2	Nil	-
2	Maneswar	Maneswar	21.53	84.05	200.3	200.3	BioGr.GneisswithBasic	4.1	178	6.3	0.3	-
3	Dhankauda	Gosala	21.49	83.89	158.6	158.6	Gr. Gneiss	31.5	45,78,135	4.29	7	11.91
4	Dhankauda	Gosala	21.49	83.89	196.8	196.8	Gr. Gneiss	28.1	51,69,94,103	5.49	7	11.72
5	Maneswar	Maltigunderpur	21.43	84	191	191	Gr. Gneiss	12.8	43,51	4.02	0.8	
6	Dhankavda	Sambalpur	21.54	83.96	200	200	Quartzite&Granite	10.8	15.9, 164.3	0.49	0.88	23.54
7	Dhankauda	Chiplima	21.32	83.89	200	200	GraniteGneiss	14.8			Ngt	
8	Sambalpur City	Sambalpur	21.45	84.98	104.7	104.7	Granite	9.5		6	0.23	

Annexure-6 (Farmer Feedback Form-1-14)

Farmer Feedback Form-1

Name	Bikash Kumar	
Village	Khagasipali	
Block	Dhankauda	
District	Sambalpur	
Address	Khagasipali, Sambalpur	
Mobile Number(optional)		
Type and number of structures		
Type	Borewell	
Number	01	
(coordinates of the structures are to be obtained by the field officer)	Latitude: 21.4395 Longitude: 83.9322	
Drill time discharge (lps)	3 lps.	
Depth of installation of pump	300 ft	
Casing depth (Borewells) HR	-	
Fracture encountered depth-HR	-	
Slotted pipe depths (TW)SR	150ft. above	
Average water levels–pre-monsoon	2.6 mbgl	
Average water levels–post-monsoon	2.2 mbgl	
The well isused for	Agricultural use.	
Is water available through out the year	Yes	
If not for how many months water is available	-	

PumpingDuration			
	Number of days pump is operated (days) of each well	What is the average pumping duration(inhours) of each well	Instantaneous Discharge Measurement (to be carried out by the field officer) in lps
Rabi (no of months to be specified)	-	-	-
Kharif (no of months to be specified)	5 months	2 hours	3
Others (no of months to be specified)	-	-	-

AreaIrrigated			
	Area Irrigated	Typeofcroptaken	Remarks
Rabi (no of months to be specified)	-	-	-
Khariff (no of months to be specified)	2 acres	Rice cultivation.	-
Others (no of months to be specified)	-	-	-
Cropping patterns (pastandpresent) in the village			
Traditional Cropping pattern in the village	**Kharif**	**Rabi**	**Other**
Type of Crop	Rice Cultivation	-	-
Area under crop	Farmland		-
Prevailing Cropping pattern in the village	**Kharif**	**Rabi**	**Other**
Type of Crop	Rice Cultivation	-	-
Area under crop	Farmland	-	-
Reasons for change in cropping pattern in last20 years.	Due to the profitability in the farming.	-	-
If the cropping pattern is to be changed, which are the Suitable crops that can be grown	Vegetables, Fruits, coconuts, Legumes, Millets, Clover and is recommended.		
Available Market for the crop	Local wholesale markets, Cooperative Societies, Online Platforms and processing units.		
Average unit cost of production			
Average unit cost of selling			
Existing MSP and other Related information	Crop wise details are to be collected		
Other subsidies, facilities, restrictions.			
Source of Energy			
Solar	○ Is it connected to grid ○ If yes how much incentive do you get per month on an average for feeding electricity to the grid (Rs per month)		

Electric	○ Do you get free electricity for irrigation? ○ Do you pay a fixed charge ○ If a fixed charge is paid, what is the per month charge ○ If unit-based charges are paid what is the average monthly charges in rupees ○ During kharif---- ○ During Rabi-----
Diesel	○ Average consumption of diesel(liters) per month ○ During Kharif ○ During Rabi
WaterMarket*	○ Do you share the pumped water with other farmers ○ If yes ○ For how many days do you share pumped water in Kharif ○ For how many days do you share pumped water in Rabi Period ○ On an average how much do you charge per annum (inRs)
	○ Do you receive additional water from bore holes of near by farmers ○ If yes ○ For how many days do you receive pumped water inKharif ○ For how many days do you receive pumped water in Rabi Period ○ On an average how much do you pay per annum (inRs)
Otherissues/Remarks	e.g. common problems in drilling of wells, common health issues in the area etc

Farmer Feedback Form-2

Name	DharmaBehera		
Village	Mundoghat (Pardesipada		
Block	Dhankauda		
District	Sambalpur		
Address	Mundoghat (Pardesipada, Sambalpur		
MobileNumber(optional)			
Typeandnumberofstructures			
Type	Borewell		
Number	01		
(Coordinates of the structures Are to be obtained by the field officer)	21.4557	83.9497	
Drill time discharge (lps)	2 lps.		
Depth of installation of pump	300 ft		
Casing depth (Borewells) HR	-		
Fracture encountered depth-HR	-		
Slotted pipe depths (TW)SR	150ft. above		
Average water levels–pre-monsoon	4.1 mbgl		
Average water levels–post-Monsoon	3.5 mbgl		
The well isused for	Agricultural use.		
Is water available through out the year	Yes		
If not for how many months water is available	-		

Pumping Duration			
	Number of days pump is operated (days) of each well	What is the average pumping duration(inhours) of each well	Instant aneous Discharge Measurement (to be carried out by the field officer) in lps
Rabi (no of months to be specified)	-	-	-
Kharif (no of months to be specified)	6 months	3 hours	2
Others (no of months to be specified)	-	-	-
AreaIrrigated			
	Area Irrigated	Type of crop taken	Remarks
Rabi (no of months to be specified)	-	-	-

Khariff (no of months to be specified)	3 acres	Rice cultivation.	-
Others (no of months to be specified)	-	-	-
Cropping patterns(pastandpresent) in the village			
Traditional Cropping pattern in the village	**Kharif**	**Rabi**	**Other**
Type of Crop	Rice Cultivation	-	-
Area under crop	Farmland		-
Prevailing Cropping pattern in the village	**Kharif**	**Rabi**	**Other**
Type of Crop	Rice Cultivation	-	-
Area under crop	Farmland	-	-
Reasons for change in cropping pattern in last 20 years.	Due to the profitabilityinthe farming.	-	-
If the cropping pattern is to be changed, which are the Suitable crops that can be grown	Vegetables, Fruits, coconuts, Legumes, Millets, Clover and is recommended.		
Available Market for the crop	Local wholesale markets, Cooperative Societies, Online Platforms and processingunits.		
Average unit cost of production			
Average unit cost of selling			
Existing MSP and other Related information	Crop wise details are to be collected		
Other subsidies, facilities, restrictions.			
Source of Energy			
Solar	○ Is it connected to grid ○ If yes how much incentive do you get per month on an average for feeding electricity to the grid (Rs per month)		

Electric	○ Do you get free electricity for irrigation? ○ Do you pay a fixed charge ○ If a fixed charge is paid, what is the per month charge ○ Ifunit-based charges are paid what is the average monthly charges in rupees ○ During kharif---- ○ During Rabi-----
Diesel	○ Average consumption of diesel (liters) per month ○ During Kharif ○ During Rabi
WaterMarket*	○ Do you share the pumped water with other farmers ○ If yes ○ For how many days do you share pumped water in Kharif ○ For how many days do you share pumped water in Rabi Period ○ On an average how much do you charge per annum (inRs)
	○ Do you receive additional water from bore hole sof near by farmers ○ If yes ○ For how many days do you receive pumped water inKharif ○ For how many days do you receive pumped water in Rabi Period ○ On an average how much do you pay per annum (inRs)
Otherissues/Remarks	e.g. common problems in drilling of wells, common health issues in the area etc

Farmer Feedback Form-3

Name	Jagadish Dehury		
Village	Kutapali		
Block	Dhankauda		
District	Sambalpur		
Address	Kutapali, Sambalpur		
Mobile Number(optional)			
Type and number of structures			
Type	Borewell		
Number	01		
(Coordinates of the structures Are to be obtained by the field officer)	21.468	83.9421	
Drill time discharge (lps)	2.5 lps.		
Depth of installation of pump	200 ft		
Casing depth (Borewells) HR	-		
Fractureencountereddepth-HR	-		
Slotted pipe depths (TW)SR	150ft. above		
Average waterlevels–pre-monsoon	3.3 mbgl		
Averagewaterlevels–post-monsoon	2.9 mbgl		
Thewellisused for	Agricultural use.		
Is water available throughout the year	Yes		
If not for how many months water is available	-		
PumpingDuration			
	Number of days pumpisoperated (days) of each well	What is the average pumping duration(inhours) of each well	Instantaneous Discharge Measurement (to be carriedoutbythefield officer) in lps
Rabi (noofmonthstobe specified)	-	-	-
Kharif (noofmonthstobe specified)	6 months	3 hours	2.5
Others (noofmonthstobe specified)	-	-	-
AreaIrrigated			
	Area Irrigated	Typeofcroptaken	Remarks
Rabi (noofmonthstobe specified)	-	-	-

Khariff (no of months to be specified)	4 acres	Rice cultivation.	-
Others (no of months to be specified)	-	-	-
Cropping patterns (past and present) in the village			
Traditional Cropping pattern in the village	**Kharif**	**Rabi**	**Other**
Type of Crop	Rice Cultivation	-	-
Area under crop	Farmland		-
Prevailing Cropping pattern in the village	**Kharif**	**Rabi**	**Other**
TypeofCrop	Rice Cultivation	-	-
Areaundercrop	FarmLand	-	-
Reasons for change in croppingpatterninlast20 years.	Due to the profitabilityinthe farming.	-	-
If the cropping pattern is to be changed, which are the Suitable crops that can be grown	Vegetables, Fruits, coconuts, Legumes, Millets, Clover and is recommended.		
Available Market for thecrop	Local wholesale markets, Cooperative Societies, Online Platforms and processingunits.		
Averageunitcostof production			
Averageunitcostofselling			
ExistingMSPandother relatedinformation	Cropwisedetails areto becollected		
Other subsidies, facilities, restrictions.			
Source of Energy			
Solar	○ Is it connected to grid ○ If yes how much incentive do you get per month on an average for feeding electricity to the grid (Rs per month)		

Electric	○ Do you get free electricity for irrigation? ○ Do you pay affixed charge ○ If affixed charge is paid, what is the per month charge ○ If unit-based charges are paid what is the average monthly charges in rupees ○ Duringkharif---- ○ DuringRabi-----
Diesel	○ Average consumption of diesel (liters) per month ○ During Kharif ○ During Rabi
WaterMarket*	○ Do you share the pumped water with other farmers ○ If yes ○ For how many days doyou share pumped waterin Kharif ○ For howmanydaysdoyousharepumpedwaterinRabi Period ○ On an average how much do you charge per annum (inRs)
	○ Do you receive additional water from boreholes of nearby farmers ○ If yes ○ For how many days do you receive pumped water inKharif ○ For how many days do you receive pumped water in Rabi Period ○ Onan average how much does you pay per annum (in Rs)
Otherissues/Remarks	e.g. common problems in drilling of wells, common health issues in the area etc

Farmer Feedback Form-4

Name	ManasDas		
Village	BhutapadaChhak		
Block	Dhankauda		
District	Sambalpur		
Address	Bhutapada Chhak, Sambalpur		
MobileNumber(optional)			
Typeandnumberofstructures			
Type	Borewell		
Number	01		
(Coordinates of the structures Are to be obtained by the field officer)	21.4601	83.9819	
Drilltimedischarge (lps)	1.5 lps.		
Depthofinstallationofpump	200 ft		
Casingdepth (Borewells) HR	-		
Fractureencountereddepth-HR	-		
Slotted pipe depths (TW)SR	150ft. above		
Average water levels–pre-monsoon	3.6 mbgl		
Averagewaterlevels–post-monsoon	3.2 mbgl		
The well is used for	Agricultural use.		
Is water available throughout the year	Yes		
If not for how many months water is available	-		

PumpingDuration			
	Number of days pump is operated (days) of each well	What is the average pumping duration(inhours) of each well	Instantaneous Discharge Measurement (to be carriedout by the field officer) in lps
Rabi (no of months to be specified)	-	-	-
Kharif (no of months to be specified)	6 months	3 hours	1.5
Others (no of months to be specified)	-	-	-
Area Irrigated			
	Area Irrigated	Type of crop taken	Remarks
Rabi (no of months to be specified)	-	-	-

Khariff (no of months to be specified)	2 acres	Rice cultivation.	-
Others (noofmonthstobe specified)	-	-	-
Croppingpatterns(pastandpresent)inthevillage			
Traditional Cropping pattern in the village	**Kharif**	**Rabi**	**Other**
Type of Crop	Rice Cultivation	-	-
Areaundercrop	FarmLand		-
Prevailing Cropping pattern in the village	**Kharif**	**Rabi**	**Other**
Type of Crop	Rice Cultivation	-	-
Area under crop	FarmLand	-	-
Reasons for change in cropping pattern in last 20 years.	Due to the profitability in the farming.	-	-
If the cropping pattern is to be changed, which are the Suitable crops that can be grown	Vegetables, Fruits, coconuts, Legumes, Millets, Clover and is recommended.		
Available Market for the crop	Localwholesale markets, Cooperative Societies, Online Platforms and processingunits.		
Averageunitcostof production			
Averageunitcostofselling			
ExistingMSPandother relatedinformation	Crop wise details are to be collected		
Other subsidies, facilities, restrictions.			
SourceofEnergy			
Solar	○ Isitconnectedtogrid ○ Ifyeshowmuchincentivedoyougetpermonthonan average for feeding electricity to the grid (Rs per month)		

Electric	○ Doyougetfreeelectricityfor irrigation? ○ Doyoupayafixedcharge ○ Ifafixedchargeispaid,whatisthepermonth charge ○ Ifunit-basedchargesarepaidwhatistheaveragemonthly charges in rupees ○ Duringkharif---- ○ DuringRabi-----
Diesel	○ Averageconsumptionofdiesel(liters)permonth ○ DuringKharif ○ DuringRabi
WaterMarket*	○ Doyousharethe pumpedwaterwith otherfarmers ○ If yes ○ Forhow manydays doyou sharepumped waterin Kharif ○ ForhowmanydaysdoyousharepumpedwaterinRabi Period ○ Onanaveragehowmuchdoyouchargeper annum (inRs)
	○ Do you receiveadditional waterfrom boreholesofnearby farmers ○ If yes ○ Forhowmanydaysdoyoureceivepumpedwater inKharif ○ ForhowmanydaysdoyoureceivepumpedwaterinRabi Period ○ Onan averagehowmuchdo youpayperannum (inRs)
Otherissues/Remarks	e.g.commonproblemsindrillingofwells,commonhealthissues in the area etc

Farmer Feedback Form-5

Name	DayanandaBehera		
Village	Chorbhati		
Block	Dhankauda		
District	Sambalpur		
Address	Chorbhati,Sambalpur		
MobileNumber(optional)			
Typeandnumberofstructures			
Type	Borewell		
Number	01		
(coordinatesofthe structures aretobeobtainedbythefield officer)	21.4572	83.9866	
Drilltimedischarge (lps)	3.5 lps.		
Depthofinstallationofpump	200 ft		
Casingdepth (Borewells) HR	-		
Fractureencountereddepth-HR	-		
Slottedpipedepths(TW)SR	150ft. above		
Averagewaterlevels–pre-monsoon	2.7 mbgl		
Averagewaterlevels–post-monsoon	2.4 mbgl		
Thewellisused for	Agricultural use.		
Iswateravailablethroughout the year	Yes		
Ifnotforhowmanymonths water is available	-		

PumpingDuration			
	Number of days pumpisoperated (days) of each well	What is the average pumping duration(inhours) of each well	Instantaneous Discharge Measurement (to be carriedoutbythefield officer) in lps
Rabi(noofmonthstobe specified)	-	-	-
Kharif(noofmonthstobe specified)	6 months	3 hours	3.5
Others(noofmonthstobe specified)	-	-	-
AreaIrrigated			
	Area Irrigated	Typeofcroptaken	Remarks
Rabi(noofmonthstobe specified)	-	-	-

Khariff(noofmonthstobe specified)	2.5 acre	Rice cultivation.	-
Others(noofmonthstobe specified)	-	-	-
Croppingpatterns(pastandpresent)inthevillage			
TraditionalCroppingpattern in the village	**Kharif**	**Rabi**	**Other**
TypeofCrop	Rice Cultivation	-	-
Areaundercrop	FarmLand		-
PrevailingCroppingpatternin the village	**Kharif**	**Rabi**	**Other**
TypeofCrop	Rice Cultivation	-	-
Areaundercrop	FarmLand	-	-
Reasons for change in croppingpatterninlast20 years.	Due to the profitabilityinthe farming.	-	-
Ifthecroppingpatternistobe changed, which are the suitablecropsthatcanbe grown	Vegetables, Fruits, coconuts,Legumes, Millets, Clover and is recommended.		
AvailableMarketforthecrop	Localwholesale markets, Cooperative Societies,Online Platforms and processingunits.		
Averageunitcostof production			
Averageunitcostofselling			
ExistingMSPandother relatedinformation	Cropwisedetails areto becollected		
Othersubsidies,facilities, restrictions.			
SourceofEnergy			
Solar	○ Isitconnectedtogrid ○ Ifyeshowmuchincentivedoyougetpermonthonan average for feeding electricity to the grid (Rs per month)		

Electric	○ Doyougetfreeelectricityfor irrigation? ○ Doyoupayafixedcharge ○ Ifafixedchargeispaid,whatisthepermonth charge ○ Ifunit-basedchargesarepaidwhatistheaveragemonthly charges in rupees ○ Duringkharif---- ○ DuringRabi-----
Diesel	○ Averageconsumptionofdiesel(liters)permonth ○ DuringKharif ○ DuringRabi
WaterMarket*	○ Doyousharethe pumpedwaterwith otherfarmers ○ If yes ○ Forhow manydays doyou sharepumped waterin Kharif ○ ForhowmanydaysdoyousharepumpedwaterinRabi Period ○ Onanaveragehowmuchdoyouchargeper annum (inRs)
	○ Do you receiveadditional waterfrom boreholesofnearby farmers ○ If yes ○ Forhowmanydaysdoyoureceivepumpedwater inKharif ○ ForhowmanydaysdoyoureceivepumpedwaterinRabi Period ○ Onan averagehowmuchdo youpayperannum (inRs)
Otherissues/Remarks	e.g.commonproblemsindrillingofwells,commonhealthissues in the area etc

Farmer Feedback Form-6

Name	GyaniNayak		
Village	Dhanupali		
Block	Dhankauda		
District	Sambalpur		
Address	Dhanupali,Sambalpur		
MobileNumber(optional)			
Typeandnumberofstructures			
Type	Borewell		
Number	01		
(coordinatesofthe structures aretobeobtainedbythefield officer)	21.4475	83.9907	
Drilltimedischarge (lps)	1.5 lps.		
Depthofinstallationofpump	200 ft		
Casingdepth (Borewells) HR	-		
Fractureencountereddepth-HR	-		
Slottedpipedepths(TW)SR	150ft. above		
Averagewaterlevels–pre-monsoon	2.7 mbgl		
Averagewaterlevels–post-monsoon	2.4 mbgl		
Thewellisused for	Agricultural use.		
Iswateravailablethroughout the year	Yes		
Ifnotforhowmanymonths water is available	-		

PumpingDuration			
	Number of days pumpisoperated (days) of each well	What is the average pumping duration(inhours) of each well	Instantaneous Discharge Measurement (to be carriedoutbythefield officer) in lps
Rabi(noofmonthstobe specified)	-	-	-
Kharif(noofmonthstobe specified)	6 months	3 hours	1.5
Others(noofmonthstobe specified)	-	-	-

AreaIrrigated			
	Area Irrigated	Typeofcroptaken	Remarks
Rabi(noofmonthstobe specified)	-	-	-

Khariff(noofmonthstobe specified)	3.5 acre	Rice cultivation.	-
Others(noofmonthstobe specified)	-	-	-
Croppingpatterns(pastandpresent)inthevillage			
TraditionalCroppingpattern in the village	**Kharif**	**Rabi**	**Other**
TypeofCrop	Rice Cultivation	-	-
Areaundercrop	FarmLand		-
PrevailingCroppingpatternin the village	**Kharif**	**Rabi**	**Other**
TypeofCrop	Rice Cultivation	-	-
Areaundercrop	FarmLand	-	-
Reasons for change in croppingpatterninlast20 years.	Due to the profitabilityinthe farming.	-	-
Ifthecroppingpatternistobe changed, which are the suitablecropsthatcanbe grown	Vegetables, Fruits, coconuts,Legumes, Millets, Clover and is recommended.		
AvailableMarketforthecrop	Localwholesale markets, Cooperative Societies,Online Platforms and processingunits.		
Averageunitcostof production			
Averageunitcostofselling			
ExistingMSPandother relatedinformation	Cropwisedetails areto becollected		
Othersubsidies,facilities, restrictions.			
SourceofEnergy			
Solar	○ Isitconnectedtogrid ○ Ifyeshowmuchincentivedoyougetpermonthonan average for feeding electricity to the grid (Rs per month)		

Electric	○ Doyougetfreeelectricityfor irrigation? ○ Doyoupayafixedcharge ○ Ifafixedchargeispaid,whatisthepermonth charge ○ Ifunit-basedchargesarepaidwhatistheaveragemonthly charges in rupees ○ Duringkharif---- ○ DuringRabi-----
Diesel	○ Averageconsumptionofdiesel(liters)permonth ○ DuringKharif ○ DuringRabi
WaterMarket*	○ Doyousharethe pumpedwaterwith otherfarmers ○ If yes ○ Forhow manydays doyou sharepumped waterin Kharif ○ ForhowmanydaysdoyousharepumpedwaterinRabi Period ○ Onanaveragehowmuchdoyouchargeper annum (inRs)
	○ Do you receiveadditional waterfrom boreholesofnearby farmers ○ If yes ○ Forhowmanydaysdoyoureceivepumpedwater inKharif ○ ForhowmanydaysdoyoureceivepumpedwaterinRabi Period ○ Onan averagehowmuchdo youpayperannum (inRs)
Otherissues/Remarks	e.g.commonproblemsindrillingofwells,commonhealthissues in the area etc

Farmer Feedback Form-7

Name	DharanidharBehera		
Village	Khandual		
Block	Dhankauda		
District	Sambalpur		
Address	Khandual,Sambalpur		
MobileNumber(optional)			
Typeandnumberofstructures			
Type	Borewell		
Number	01		
(coordinatesofthe structures aretobeobtainedbythefield officer)	21.4208	83.9969	
Drilltimedischarge (lps)	2 lps.		
Depthofinstallationofpump	200 ft		
Casingdepth (Borewells) HR	-		
Fractureencountereddepth-HR	-		
Slottedpipedepths(TW)SR	150ft. above		
Averagewaterlevels–pre-monsoon	2.4 mbgl		
Averagewaterlevels–post-monsoon	2.1mbgl		
Thewellisused for	Agricultural use.		
Iswateravailablethroughout the year	Yes		
Ifnotforhowmanymonths water is available	-		
PumpingDuration			
	Number of days pumpisoperated (days) of each well	What is the average pumping duration(inhours) of each well	Instantaneous Discharge Measurement (to be carriedoutbythefield officer) in lps
Rabi(noofmonthstobe specified)	-	-	-
Kharif(noofmonthstobe specified)	5months	4hours	2
Others(noofmonthstobe specified)	-	-	-
AreaIrrigated			
	Area Irrigated	Typeofcroptaken	Remarks
Rabi(noofmonthstobe specified)	-	-	-

Khariff(noofmonthstobe specified)	5 acre	Rice cultivation.	-
Others(noofmonthstobe specified)	-	-	-
Croppingpatterns(pastandpresent)inthevillage			
TraditionalCroppingpattern in the village	**Kharif**	**Rabi**	**Other**
TypeofCrop	Rice Cultivation	-	-
Areaundercrop	FarmLand		-
PrevailingCroppingpatternin the village	**Kharif**	**Rabi**	**Other**
TypeofCrop	Rice Cultivation	-	-
Areaundercrop	FarmLand	-	-
Reasons for change in croppingpatterninlast20 years.	Due to the profitabilityinthe farming.	-	-
Ifthecroppingpatternistobe changed, which are the suitablecropsthatcanbe grown	Vegetables, Fruits, coconuts,Legumes, Millets, Clover and is recommended.		
AvailableMarketforthecrop	Localwholesale markets, Cooperative Societies,Online Platforms and processingunits.		
Averageunitcostof production			
Averageunitcostofselling			
ExistingMSPandother relatedinformation	Cropwisedetails areto becollected		
Othersubsidies,facilities, restrictions.			
SourceofEnergy			
Solar	○ Isitconnectedtogrid ○ Ifyeshowmuchincentivedoyougetpermonthonan average for feeding electricity to the grid (Rs per month)		

Electric	○ Doyougetfreeelectricityfor irrigation? ○ Doyoupayafixedcharge ○ Ifafixedchargeispaid,whatisthepermonth charge ○ Ifunit-basedchargesarepaidwhatistheaveragemonthly charges in rupees ○ Duringkharif---- ○ DuringRabi-----
Diesel	○ Averageconsumptionofdiesel(liters)permonth ○ DuringKharif ○ DuringRabi
WaterMarket*	○ Doyousharethe pumpedwaterwith otherfarmers ○ If yes ○ Forhow manydays doyou sharepumped waterin Kharif ○ ForhowmanydaysdoyousharepumpedwaterinRabi Period ○ Onanaveragehowmuchdoyouchargeper annum (inRs)
	○ Do you receiveadditional waterfrom boreholesofnearby farmers ○ If yes ○ Forhowmanydaysdoyoureceivepumpedwater inKharif ○ ForhowmanydaysdoyoureceivepumpedwaterinRabi Period ○ Onan averagehowmuchdo youpayperannum (inRs)
Otherissues/Remarks	e.g.commonproblemsindrillingofwells,commonhealthissues in the area etc

Farmer Feedback Form-8

Name	Kusuma Sahoo		
Village	Mathpali		
Block	Dhankauda		
District	Sambalpur		
Address	Mathpali,Sambalpur		
MobileNumber(optional)			
Typeandnumberofstructures			
Type	Borewell		
Number	01		
(coordinatesofthe structures aretobeobtainedbythefield officer)	21.4378	83.9907	
Drilltimedischarge (lps)	2.5 lps.		
Depthofinstallationofpump	200 ft		
Casingdepth (Borewells) HR	-		
Fractureencountereddepth-HR	-		
Slottedpipedepths(TW)SR	150ft. above		
Averagewaterlevels–pre-monsoon	7.4 mbgl		
Averagewaterlevels–post-monsoon	7.1mbgl		
Thewellisused for	Agricultural use.		
Iswateravailablethroughout the year	Yes		
Ifnotforhowmanymonths water is available	-		

PumpingDuration			
	Number of days pumpisoperated (days) of each well	What is the average pumping duration(inhours) of each well	Instantaneous Discharge Measurement (to be carriedoutbythefield officer) in lps
Rabi(noofmonthstobe specified)	-	-	-
Kharif(noofmonthstobe specified)	4 months	3 hours	2.5
Others(noofmonthstobe specified)	-	-	-

AreaIrrigated			
	Area Irrigated	Typeofcroptaken	Remarks
Rabi(noofmonthstobe specified)	-	-	-

Khariff(noofmonthstobe specified)	5.5 acre	Rice cultivation.	-
Others(noofmonthstobe specified)	-	-	-
Croppingpatterns(pastandpresent)inthevillage			
TraditionalCroppingpattern in the village	**Kharif**	**Rabi**	**Other**
TypeofCrop	Rice Cultivation	-	-
Areaundercrop	FarmLand		-
PrevailingCroppingpatternin the village	**Kharif**	**Rabi**	**Other**
TypeofCrop	Rice Cultivation	-	-
Areaundercrop	FarmLand	-	-
Reasons for change in croppingpatterninlast20 years.	Due to the profitabilityinthe farming.	-	-
Ifthecroppingpatternistobe changed, which are the suitablecropsthatcanbe grown	Vegetables, Fruits, coconuts,Legumes, Millets, Clover and is recommended.		
AvailableMarketforthecrop	Localwholesale markets, Cooperative Societies,Online Platforms and processingunits.		
Averageunitcostof production			
Averageunitcostofselling			
ExistingMSPandother relatedinformation	Cropwisedetails areto becollected		
Othersubsidies,facilities, restrictions.			
SourceofEnergy			
Solar	○ Isitconnectedtogrid ○ Ifyeshowmuchincentivedoyougetpermonthonan average for feeding electricity to the grid (Rs per month)		

Electric	○ Doyougetfreeelectricityfor irrigation? ○ Doyoupayafixedcharge ○ Ifafixedchargeispaid,whatisthepermonth charge ○ Ifunit-basedchargesarepaidwhatistheaveragemonthly charges in rupees ○ Duringkharif---- ○ DuringRabi-----
Diesel	○ Averageconsumptionofdiesel(liters)permonth ○ DuringKharif ○ DuringRabi
WaterMarket*	○ Doyousharethe pumpedwaterwith otherfarmers ○ If yes ○ Forhow manydays doyou sharepumped waterin Kharif ○ ForhowmanydaysdoyousharepumpedwaterinRabi Period ○ Onanaveragehowmuchdoyouchargeper annum (inRs)
	○ Do you receiveadditional waterfrom boreholesofnearby farmers ○ If yes ○ Forhowmanydaysdoyoureceivepumpedwater inKharif ○ ForhowmanydaysdoyoureceivepumpedwaterinRabi Period ○ Onan averagehowmuchdo youpayperannum (inRs)
Otherissues/Remarks	e.g.commonproblemsindrillingofwells,commonhealthissues in the area etc

FarmerFeedbackForm-9

Name	Mayadhar		
Village	Naxapali		
Block	Dhankauda		
District	Sambalpur		
Address	NaxapaliSambalpur		
MobileNumber(optional)			
Typeandnumberofstructures			
Type	Borewell		
Number	01		
(coordinatesofthe structures aretobeobtainedbythefield officer)	21.4263	84.0149	
Drilltimedischarge (lps)	2.5 lps.		
Depthofinstallationofpump	250 ft		
Casingdepth (Borewells) HR	-		
Fractureencountereddepth-HR	-		
Slottedpipedepths(TW)SR	150ft. above		
Averagewaterlevels–pre-monsoon	6.8 mbgl		
Averagewaterlevels–post-monsoon	6.3 mbgl		
Thewellisused for	Agricultural use.		
Iswateravailablethroughout the year	Yes		
Ifnotforhowmanymonths water is available	-		

PumpingDuration			
	Number of days pumpisoperated (days) of each well	What is the average pumping duration(inhours) of each well	Instantaneous Discharge Measurement (to be carriedoutbythefield officer) in lps
Rabi(noofmonthstobe specified)	-	-	-
Kharif(noofmonthstobe specified)	4 months	3 hours	2.5
Others(noofmonthstobe specified)	-	-	-

AreaIrrigated			
	Area Irrigated	Typeofcroptaken	Remarks
Rabi(noofmonthstobe specified)	-	-	-

Khariff(noofmonthstobe specified)	3 acre	Rice cultivation.	-
Others(noofmonthstobe specified)	-	-	-
Croppingpatterns(pastandpresent)inthevillage			
TraditionalCroppingpattern in the village	**Kharif**	**Rabi**	**Other**
TypeofCrop	Rice Cultivation	-	-
Areaundercrop	FarmLand		-
PrevailingCroppingpatternin the village	**Kharif**	**Rabi**	**Other**
TypeofCrop	Rice Cultivation	-	-
Areaundercrop	FarmLand	-	-
Reasons for change in croppingpatterninlast20 years.	Due to the profitabilityinthe farming.	-	-
Ifthecroppingpatternistobe changed, which are the suitablecropsthatcanbe grown	Vegetables, Fruits, coconuts,Legumes, Millets, Clover and is recommended.		
AvailableMarketforthecrop	Localwholesale markets, Cooperative Societies,Online Platforms and processingunits.		
Averageunitcostof production			
Averageunitcostofselling			
ExistingMSPandother relatedinformation	Cropwisedetails areto becollected		
Othersubsidies,facilities, restrictions.			
SourceofEnergy			
Solar	○ Isitconnectedtogrid ○ Ifyeshowmuchincentivedoyougetpermonthonan average for feeding electricity to the grid (Rs per month)		

Electric	○ Doyougetfreeelectricityfor irrigation? ○ Doyoupayafixedcharge ○ Ifafixedchargeispaid,whatisthepermonth charge ○ Ifunit-basedchargesarepaidwhatistheaveragemonthly charges in rupees ○ Duringkharif---- ○ DuringRabi-----
Diesel	○ Averageconsumptionofdiesel(liters)permonth ○ DuringKharif ○ DuringRabi
WaterMarket*	○ Doyousharethe pumpedwaterwith otherfarmers ○ If yes ○ Forhow manydays doyou sharepumped waterin Kharif ○ ForhowmanydaysdoyousharepumpedwaterinRabi Period ○ Onanaveragehowmuchdoyouchargeper annum (inRs)
	○ Do you receiveadditional waterfrom boreholesofnearby farmers ○ If yes ○ Forhowmanydaysdoyoureceivepumpedwater inKharif ○ ForhowmanydaysdoyoureceivepumpedwaterinRabi Period ○ Onan averagehowmuchdo youpayperannum (inRs)
Otherissues/Remarks	e.g.commonproblemsindrillingofwells,commonhealthissues in the area etc

FarmerFeedbackForm-10

Name	Mayadhar		
Village	Naxapali		
Block	Dhankauda		
District	Sambalpur		
Address	NaxapaliSambalpur		
MobileNumber(optional)			
Typeandnumberofstructures			
Type	Borewell		
Number	01		
(coordinatesofthe structures aretobeobtainedbythefield officer)	21.4263	84.0149	
Drilltimedischarge (lps)	2.5 lps.		
Depthofinstallationofpump	250 ft		
Casingdepth (Borewells) HR	-		
Fractureencountereddepth-HR	-		
Slottedpipedepths(TW)SR	150ft. above		
Averagewaterlevels–pre-monsoon	6.8 mbgl		
Averagewaterlevels–post-monsoon	6.3 mbgl		
Thewellisused for	Agricultural use.		
Iswateravailablethroughout the year	Yes		
Ifnotforhowmanymonths water is available	-		

PumpingDuration			
	Number of days pumpisoperated (days) of each well	What is the average pumping duration(inhours) of each well	Instantaneous Discharge Measurement (to be carriedoutbythefield officer) in lps
Rabi(noofmonthstobe specified)	-	-	-
Kharif(noofmonthstobe specified)	4 months	3 hours	2.5
Others(noofmonthstobe specified)	-	-	-

AreaIrrigated			
	Area Irrigated	Typeofcroptaken	Remarks
Rabi(noofmonthstobe specified)	-	-	-

Khariff(noofmonthstobe specified)	3 acre	Rice cultivation.	-
Others(noofmonthstobe specified)	-	-	-
Croppingpatterns(pastandpresent)inthevillage			
TraditionalCroppingpattern in the village	**Kharif**	**Rabi**	**Other**
TypeofCrop	Rice Cultivation	-	-
Areaundercrop	FarmLand		-
PrevailingCroppingpatternin the village	**Kharif**	**Rabi**	**Other**
TypeofCrop	Rice Cultivation	-	-
Areaundercrop	FarmLand	-	-
Reasons for change in croppingpatterninlast20 years.	Due to the profitabilityinthe farming.	-	-
Ifthecroppingpatternistobe changed, which are the suitablecropsthatcanbe grown	Vegetables, Fruits, coconuts,Legumes, Millets, Clover and is recommended.		
AvailableMarketforthecrop	Localwholesale markets, Cooperative Societies,Online Platforms and processingunits.		
Averageunitcostof production			
Averageunitcostofselling			
ExistingMSPandother relatedinformation	Cropwisedetails areto becollected		
Othersubsidies,facilities, restrictions.			
SourceofEnergy			
Solar	○ Isitconnectedtogrid ○ Ifyeshowmuchincentivedoyougetpermonthonan average for feeding electricity to the grid (Rs per month)		

Electric	○ Doyougetfreeelectricityfor irrigation? ○ Doyoupayafixedcharge ○ Ifafixedchargeispaid,whatisthepermonth charge ○ Ifunit-basedchargesarepaidwhatistheaveragemonthly charges in rupees ○ Duringkharif---- ○ DuringRabi-----
Diesel	○ Averageconsumptionofdiesel(liters)permonth ○ DuringKharif ○ DuringRabi
WaterMarket*	○ Doyousharethe pumpedwaterwith otherfarmers ○ If yes ○ Forhow manydays doyou sharepumped waterin Kharif ○ ForhowmanydaysdoyousharepumpedwaterinRabi Period ○ Onanaveragehowmuchdoyouchargeper annum (inRs)
	○ Do you receiveadditional waterfrom boreholesofnearby farmers ○ If yes ○ Forhowmanydaysdoyoureceivepumpedwater inKharif ○ ForhowmanydaysdoyoureceivepumpedwaterinRabi Period ○ Onan averagehowmuchdo youpayperannum (inRs)
Otherissues/Remarks	e.g.commonproblemsindrillingofwells,commonhealthissues in the area etc

FarmerFeedbackForm-11

Name	VinayakDas		
Village	Kanteipali		
Block	Dhankauda		
District	Sambalpur		
Address	Kanteipali,Sambalpur		
MobileNumber(optional)			
Typeandnumberofstructures			
Type	Borewell		
Number	01		
(coordinatesofthe structures aretobeobtainedbythefield officer)	21.4198	84.03685	
Drilltimedischarge (lps)	1.5 lps.		
Depthofinstallationofpump	200 ft		
Casingdepth (Borewells) HR	-		
Fractureencountereddepth-HR	-		
Slottedpipedepths(TW)SR	150ft. above		
Averagewaterlevels–pre-monsoon	6.8 mbgl		
Averagewaterlevels–post-monsoon	6.4 mbgl		
Thewellisused for	Agricultural use.		
Iswateravailablethroughout the year	Yes		
Ifnotforhowmanymonths water is available	-		

PumpingDuration			
	Number of days pumpisoperated (days) of each well	What is the average pumping duration(inhours) of each well	Instantaneous Discharge Measurement (to be carriedoutbythefield officer) in lps
Rabi(noofmonthstobe specified)	-	-	-
Kharif(noofmonthstobe specified)	5 months	3 hours	1.5
Others(noofmonthstobe specified)	-	-	-

AreaIrrigated			
	Area Irrigated	Typeofcroptaken	Remarks
Rabi(noofmonthstobe specified)	-	-	-

Khariff(noofmonthstobe specified)	4 acre	Rice cultivation.	-
Others(noofmonthstobe specified)	-	-	-
Croppingpatterns(pastandpresent)inthevillage			
TraditionalCroppingpattern in the village	**Kharif**	**Rabi**	**Other**
TypeofCrop	Rice Cultivation	-	-
Areaundercrop	FarmLand		-
PrevailingCroppingpatternin the village	**Kharif**	**Rabi**	**Other**
TypeofCrop	Rice Cultivation	-	-
Areaundercrop	FarmLand	-	-
Reasons for change in croppingpatterninlast20 years.	Due to the profitabilityinthe farming.	-	-
Ifthecroppingpatternistobe changed, which are the suitablecropsthatcanbe grown	Vegetables, Fruits, coconuts,Legumes, Millets, Clover and is recommended.		
AvailableMarketforthecrop	Localwholesale markets, Cooperative Societies,Online Platforms and processingunits.		
Averageunitcostof production			
Averageunitcostofselling			
ExistingMSPandother relatedinformation	Cropwisedetails areto becollected		
Othersubsidies,facilities, restrictions.			
SourceofEnergy			
Solar	○ Isitconnectedtogrid ○ Ifyeshowmuchincentivedoyougetpermonthonan average for feeding electricity to the grid (Rs per month)		

Electric	○ Doyougetfreeelectricityfor irrigation? ○ Doyoupayafixedcharge ○ Ifafixedchargeispaid,whatisthepermonth charge ○ Ifunit-basedchargesarepaidwhatistheaveragemonthly charges in rupees ○ Duringkharif---- ○ DuringRabi-----
Diesel	○ Averageconsumptionofdiesel(liters)permonth ○ DuringKharif ○ DuringRabi
WaterMarket*	○ Doyousharethe pumpedwaterwith otherfarmers ○ If yes ○ Forhow manydays doyou sharepumped waterin Kharif ○ ForhowmanydaysdoyousharepumpedwaterinRabi Period ○ Onanaveragehowmuchdoyouchargeper annum (inRs)
	○ Do you receiveadditional waterfrom boreholesofnearby farmers ○ If yes ○ Forhowmanydaysdoyoureceivepumpedwater inKharif ○ ForhowmanydaysdoyoureceivepumpedwaterinRabi Period ○ Onan averagehowmuchdo youpayperannum (inRs)
Otherissues/Remarks	e.g.commonproblemsindrillingofwells,commonhealthissues in the area etc

Farmer Feedback Form-12

Name	RamakanataBehera		
Village	Mirgamunda		
Block	Dhankauda		
District	Sambalpur		
Address	Mirgamunda,Sambalpur		
MobileNumber(optional)			
Typeandnumberofstructures			
Type	Borewell		
Number	01		
(coordinatesofthe structures aretobeobtainedbythefield officer)	21.4243	84.00397	
Drilltimedischarge (lps)	3.5 lps.		
Depthofinstallationofpump	200 ft		
Casingdepth (Borewells) HR	-		
Fractureencountereddepth-HR	-		
Slottedpipedepths(TW)SR	150ft. above		
Averagewaterlevels–pre-monsoon	5.1 mbgl		
Averagewaterlevels–post-monsoon	4.5 mbgl		
Thewellisused for	Agricultural use.		
Iswateravailablethroughout the year	Yes		
Ifnotforhowmanymonths water is available	-		

PumpingDuration			
	Number of days pumpisoperated (days) of each well	What is the average pumping duration(inhours) of each well	Instantaneous Discharge Measurement (to be carriedoutbythefield officer) in lps
Rabi(noofmonthstobe specified)	-	-	-
Kharif(noofmonthstobe specified)	5 months	3 hours	3.5
Others(noofmonthstobe specified)	-	-	-
AreaIrrigated			
	Area Irrigated	Typeofcroptaken	Remarks
Rabi(noofmonthstobe specified)	-	-	-

Khariff(noofmonthstobe specified)	3 acre	Rice cultivation.	-
Others(noofmonthstobe specified)	-	-	-
Croppingpatterns(pastandpresent)inthevillage			
TraditionalCroppingpattern in the village	**Kharif**	**Rabi**	**Other**
TypeofCrop	Rice Cultivation	-	-
Areaundercrop	FarmLand		-
PrevailingCroppingpatternin the village	**Kharif**	**Rabi**	**Other**
TypeofCrop	Rice Cultivation	-	-
Areaundercrop	FarmLand	-	-
Reasons for change in croppingpatterninlast20 years.	Due to the profitabilityinthe farming.	-	-
Ifthecroppingpatternistobe changed, which are the suitablecropsthatcanbe grown	Vegetables, Fruits, coconuts,Legumes, Millets, Clover and is recommended.		
AvailableMarketforthecrop	Localwholesale markets, Cooperative Societies,Online Platforms and processingunits.		
Averageunitcostof production			
Averageunitcostofselling			
ExistingMSPandother relatedinformation	Cropwisedetails areto becollected		
Othersubsidies,facilities, restrictions.			
SourceofEnergy			
Solar	○ Isitconnectedtogrid ○ Ifyeshowmuchincentivedoyougetpermonthonan average for feeding electricity to the grid (Rs per month)		

Electric	○ Doyougetfreeelectricityfor irrigation? ○ Doyoupayafixedcharge ○ Ifafixedchargeispaid,whatisthepermonth charge ○ Ifunit-basedchargesarepaidwhatistheaveragemonthly charges in rupees ○ Duringkharif---- ○ DuringRabi-----
Diesel	○ Averageconsumptionofdiesel(liters)permonth ○ DuringKharif ○ DuringRabi
WaterMarket*	○ Doyousharethe pumpedwaterwith otherfarmers ○ If yes ○ Forhow manydays doyou sharepumped waterin Kharif ○ ForhowmanydaysdoyousharepumpedwaterinRabi Period ○ Onanaveragehowmuchdoyouchargeper annum (inRs)
	○ Do you receiveadditional waterfrom boreholesofnearby farmers ○ If yes ○ Forhowmanydaysdoyoureceivepumpedwater inKharif ○ ForhowmanydaysdoyoureceivepumpedwaterinRabi Period ○ Onan averagehowmuchdo youpayperannum (inRs)
Otherissues/Remarks	e.g.commonproblemsindrillingofwells,commonhealthissues in the area etc

Farmer Feedback Form-13

Name	Deepak Nayak		
Village	Putibandh		
Block	Dhankauda		
District	Sambalpur		
Address	PutibandhSambalpur		
MobileNumber(optional)			
Typeandnumberofstructures			
Type	Borewell		
Number	01		
(coordinatesofthe structures aretobeobtainedbythefield officer)	21.44971	83.99741	
Drilltimedischarge (lps)	2.5 lps.		
Depthofinstallationofpump	250 ft		
Casingdepth (Borewells) HR	-		
Fractureencountereddepth-HR	-		
Slottedpipedepths(TW)SR	150ft. above		
Averagewaterlevels–pre-monsoon	4.3 mbgl		
Averagewaterlevels–post-monsoon	3.9 mbgl		
Thewellisused for	Agricultural use.		
Iswateravailablethroughout the year	Yes		
Ifnotforhowmanymonths water is available	-		
PumpingDuration			
	Number of days pumpisoperated (days) of each well	What is the average pumping duration(inhours) of each well	Instantaneous Discharge Measurement (to be carriedoutbythefield officer) in lps
Rabi(noofmonthstobe specified)	-	-	-
Kharif(noofmonthstobe specified)	5 months	3 hours	2.5
Others(noofmonthstobe specified)	-	-	-
AreaIrrigated			
	Area Irrigated	Typeofcroptaken	Remarks
Rabi(noofmonthstobe specified)	-	-	-

Khariff(noofmonthstobe specified)	2 acre	Rice cultivation.	-
Others(noofmonthstobe specified)	-	-	-
Croppingpatterns(pastandpresent)inthevillage			
TraditionalCroppingpattern in the village	**Kharif**	**Rabi**	**Other**
TypeofCrop	Rice Cultivation	-	-
Areaundercrop	FarmLand		-
PrevailingCroppingpatternin the village	**Kharif**	**Rabi**	**Other**
TypeofCrop	Rice Cultivation	-	-
Areaundercrop	FarmLand	-	-
Reasons for change in croppingpatterninlast20 years.	Due to the profitabilityinthe farming.	-	-
Ifthecroppingpatternistobe changed, which are the suitablecropsthatcanbe grown	Vegetables, Fruits, coconuts,Legumes, Millets, Clover and is recommended.		
AvailableMarketforthecrop	Localwholesale markets, Cooperative Societies,Online Platforms and processingunits.		
Averageunitcostof production			
Averageunitcostofselling			
ExistingMSPandother relatedinformation	Cropwisedetails areto becollected		
Othersubsidies,facilities, restrictions.			
SourceofEnergy			
Solar	○ Isitconnectedtogrid ○ Ifyeshowmuchincentivedoyougetpermonthonan average for feeding electricity to the grid (Rs per month)		

Electric	○ Doyougetfreeelectricityfor irrigation? ○ Doyoupayafixedcharge ○ Ifafixedchargeispaid,whatisthepermonth charge ○ Ifunit-basedchargesarepaidwhatistheaveragemonthly charges in rupees ○ Duringkharif---- ○ DuringRabi-----
Diesel	○ Averageconsumptionofdiesel(liters)permonth ○ DuringKharif ○ DuringRabi
WaterMarket*	○ Doyousharethe pumpedwaterwith otherfarmers ○ If yes ○ Forhow manydays doyou sharepumped waterin Kharif ○ ForhowmanydaysdoyousharepumpedwaterinRabi Period ○ Onanaveragehowmuchdoyouchargeper annum (inRs)
	○ Do you receiveadditional waterfrom boreholesofnearby farmers ○ If yes ○ Forhowmanydaysdoyoureceivepumpedwater inKharif ○ ForhowmanydaysdoyoureceivepumpedwaterinRabi Period ○ Onan averagehowmuchdo youpayperannum (inRs)
Otherissues/Remarks	e.g.commonproblemsindrillingofwells,commonhealthissues in the area etc

Farmer Feedback Form-14

Name	BasiMurmu		
Village	Dandeipali		
Block	Dhankauda		
District	Sambalpur		
Address	DandeipaliSambalpur		
MobileNumber(optional)			
Typeandnumberofstructures			
Type	Borewell		
Number	01		
(coordinatesofthe structures aretobeobtainedbythefield officer)	21.45615	84.03103	
Drilltimedischarge (lps)	2.5 lps.		
Depthofinstallationofpump	250 ft		
Casingdepth (Borewells) HR	-		
Fractureencountereddepth-HR	-		
Slottedpipedepths(TW)SR	150ft. above		
Averagewaterlevels–pre-monsoon	4.1 mbgl		
Averagewaterlevels–post-monsoon	3.6 mbgl		
Thewellisused for	Agricultural use.		
Iswateravailablethroughout theyear	Yes		
Ifnotforhowmanymonths water is available	-		

PumpingDuration			
	Number of days pumpisoperated (days) of each well	What is the average pumping duration(inhours) of each well	Instantaneous Discharge Measurement (to be carriedoutbythefield officer) in lps
Rabi(noofmonthstobe specified)	-	-	-
Kharif(noofmonthstobe specified)	5 months	3 hours	2.5
Others(noofmonthstobe specified)	-	-	-

AreaIrrigated			
	Area Irrigated	Typeofcroptaken	Remarks
Rabi(noofmonthstobe specified)	-	-	-

Khariff(noofmonthstobe specified)	3 acre	Rice cultivation.	-
Others(noofmonthstobe specified)	-	-	-
Croppingpatterns(pastandpresent)inthevillage			
TraditionalCroppingpattern in the village	**Kharif**	**Rabi**	**Other**
TypeofCrop	Rice Cultivation	-	-
Areaundercrop	FarmLand		-
PrevailingCroppingpatternin the village	**Kharif**	**Rabi**	**Other**
TypeofCrop	Rice Cultivation	-	-
Areaundercrop	FarmLand	-	-
Reasons for change in croppingpatterninlast20 years.	Due to the profitabilityinthe farming.	-	-
Ifthecroppingpatternistobe changed, which are the suitablecropsthatcanbe grown	Vegetables, Fruits, coconuts,Legumes, Millets, Clover and is recommended.		
AvailableMarketforthecrop	Localwholesale markets, Cooperative Societies,Online Platforms and processingunits.		
Averageunitcostof production			
Averageunitcostofselling			
ExistingMSPandother relatedinformation	Cropwisedetails areto becollected		
Othersubsidies,facilities, restrictions.			
SourceofEnergy			
Solar	○ Isitconnectedtogrid ○ Ifyeshowmuchincentivedoyougetpermonthonan average for feeding electricity to the grid (Rs per month)		

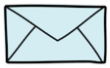
Electric	○ Doyougetfreeelectricityfor irrigation? ○ Doyoupayafixedcharge ○ Ifafixedchargeispaid,whatisthepermonth charge ○ Ifunit-basedchargesarepaidwhatistheaveragemonthly charges in rupees ○ Duringkharif---- ○ DuringRabi-----
Diesel	○ Averageconsumptionofdiesel(liters)permonth ○ DuringKharif ○ DuringRabi
WaterMarket*	○ Doyousharethe pumpedwaterwith otherfarmers ○ If yes ○ Forhow manydays doyou sharepumped waterin Kharif ○ ForhowmanydaysdoyousharepumpedwaterinRabi Period ○ Onanaveragehowmuchdoyouchargeper annum (inRs)
	○ Do you receiveadditional waterfrom boreholesofnearby farmers ○ If yes ○ Forhowmanydaysdoyoureceivepumpedwater inKharif ○ ForhowmanydaysdoyoureceivepumpedwaterinRabi Period ○ Onan averagehowmuchdo youpayperannum (inRs)
Otherissues/Remarks	e.g.commonproblemsindrillingofwells,commonhealthissues in the area etc

Farmer Feedback Form-14

Name	JagjitDas		
Village	Goshala		
Block	Dhankauda		
District	Sambalpur		
Address	GoshalaSambalpur		
MobileNumber(optional)			
Typeandnumberofstructures			
Type	Borewell		
Number	01		
(coordinatesofthe structures aretobeobtainedbythefield officer)	21.4251	83.9005	
Drilltimedischarge (lps)	1.5 lps.		
Depthofinstallationofpump	200 ft		
Casingdepth (Borewells) HR	-		
Fractureencountereddepth-HR	-		
Slottedpipedepths(TW)SR	150ft. above		
Averagewaterlevels–pre-monsoon	6.1 mbgl		
Averagewaterlevels–post-monsoon	4.8 mbgl		
Thewellisused for	Agricultural use.		
Iswateravailablethroughout theyear	Yes		
Ifnotforhowmanymonths water is available	-		
PumpingDuration			
	Number of days pumpisoperated (days) of each well	What is the average pumping duration(inhours) of each well	Instantaneous Discharge Measurement (to be carriedoutbythefield officer) in lps
Rabi(no of months to be specified)	-	-	-
Kharif(no of months to be specified)	5 months	3 hours	1.5
Others(no of months to be specified)	-	-	-
AreaIrrigated			
	Area Irrigated	Type of crop taken	Remarks
Rabi(no of months to be specified)	-	-	-

Khariff(no of months to be specified)	4 acre	Rice cultivation.	-
Others(no of months to be specified)	-	-	-
Croppingpatterns(pastandpresent)inthevillage			
Traditional Cropping pattern in the village	**Kharif**	**Rabi**	**Other**
Type of Crop	Rice Cultivation	-	-
Area under crop	Farm Land		-
Prevailing Cropping pattern in the village	**Kharif**	**Rabi**	**Other**
Type of Crop	Rice Cultivation	-	-
Area under crop	Farm Land	-	-
Reasons for change in cropping pattern in last 20 years.	Due to the profit ability in the farming.	-	-
If the cropping pattern is to be changed, which are the Suitable crops that can be grown	Vegetables, Fruits, coconuts,Legumes, Millets, Clover and is recommended.		
Available Market for the crop	Local whole sale markets, Cooperative Societies,Online Platforms and processingunits.		
Average unit cost of production			
Average unit cost of selling			
Existing MSP and other Related information	Crop wise details are to becollected		
Other subsidies,facilities, restrictions.			
Source of Energy			
Solar	○ Is it connected to grid ○ If yes how much incentive do you get per month on an average for feeding electricity to the grid (Rs per month)		

Electric	○ Do you get free electricity for irrigation? ○ Do you pay a fixed charge ○ If a fixed charge is paid, what is the per month charge ○ Ifunit-based charges are paid what is the average monthly charges in rupees ○ During kharif---- ○ During Rabi-----
Diesel	○ Average consumption of diesel (liters) per month ○ During Kharif ○ During Rabi
Water Market*	○ Do you share the pumped water with other farmers ○ If yes ○ For how manydays doyou share pumped water in Kharif ○ For how many days do you share pumped water in Rabi Period ○ On an average how much do you charge per annum (inRs)
	○ Do you receive additional water from bore hole sof near by farmers ○ If yes ○ For how many days do you receive pumped water inKharif ○ For how many days do you receive pumped water in Rabi Period ○ Onan average how much do you pay per annum (inRs)
Other issues/Remarks	e.g. common problems in drilling of wells, common health issues in the area etc



Central Ground Water Board
South Eastern Region
Bhujal Bhawan
Khandagiri
Bhubaneswar
Odisha - 751030.
Email: rdser-cgwb@nic.in