भूमि जल संसाधन छत्तीसगढ़

DYNAMIC GROUND WATER RESOURCES OF CHHATTISGARH

2024

केंद्रीय भूमिजल बोर्ड ,
उत्तर मध्य छत्तीसगढ़ क्षेत्र, रायपुर
जल संसाधन, नदी विकास और गंगा संरक्षण विभाग
जल शक्ति मंत्रालय
भारत सरकार

भूजल सर्वेक्षण मंडल
जल संसाधन विभाग
छत्तीसगढ़ शासन

रायपुर
2024

DYNAMIC GROUND WATER RESOURCES OF CHHATTISGARH, 2024

Central Ground Water Board
North Central Chhattisgarh Region
Department of Water Resources,
River Development & Ganga Rejuvenation
Ministry of Jal Shakti
Government of India

Raipur
2024

Rajesh Sukumar Toppo
I.A.S.
Secretary

Government of Chhattisgarh
Water Resources Department

DO Letter No. - 75
Date - 29-01-2025

FOREWORD

Groundwater is not only a necessity for the human society but also an important catalyst for the economic and social advancement for the state of Chhattisgarh. In view of its ubiquitous presence, varied distribution and abstraction structures being under the direct control of the users, ground water becomes preferred source for meeting the water demand of various sectors. it also plays a crucial role, however often an overlooked role in sustaining wetlands and other ecosystem. A fundamental step in valuing groundwater is recognizing and quantifying its worth both when extracted from the ground and when left in place- its total economic values.

As per the national water policy, the development of groundwater resources is to be limited to utilization of the replenishable groundwater resources. Precise assessment of replenishable groundwater resources and its development in terms of area which can be irrigated in the framework of our land availability, cropping pattern etc. is therefore a key to our plans to develop groundwater resources for various uses in this state. In view of the rapidly increasing urban industrial and agriculture water demand, assessment of groundwater resources with best possible accuracy is a fundamental importance for planning the resource use on scientific and economic consideration.

The estimation of groundwater resources for all the 146 blocks of the state have been jointly carried out by the State Groundwater Survey, Govt. of Chhattisgarh and Central Ground Water Board, Govt. of India as per the prevailing methodology and guidelines set by the groundwater estimation committee 'GEC 15' of Govt. of India. In the assessment, the administrative block was taken as unit of assessment and command & non-command area in block was taken as subunit. The overall stage of ground water extraction of the state is 47.32% with 21 blocks falling under Semi-Critical and 5 blocks under Critical category in Chhattisgarh.

I put forward a word of accolade for the untiring efforts put by the officers of State Groundwater Survey, Govt. of Chhattisgarh and the Central Ground Water Board, Govt. of India in bringing out this report.

I am sure that this report will be of immense use to the administrators and planners of the state for ensuring appropriate strategy for development and management of groundwater resources in Chhattisgarh.

Rajesh Sukumar Toppo

(Rajesh Sukumar Toppo)

Room N. S1-15, First Floor, Mantralaya Mahanadi Bhavan, Nava Raipur, Atal Nagar 492002
Telephone : 0771-2510838, 0771-2510839 Email : secy-wrd.cg@gov.in

ACKNOWLEDGEMENT

I would like to express my sincere gratitude to Chairman, Central Ground Water Board, Ministry of Jal Shakti, Govt. of India for giving an opportunity to estimate the Ground Water Resource as on March 2024 for the state of Chhattisgarh.

I express my sincere thanks to Member (East) and Member (South), Central Ground Water Board, Ministry of Jal Shakti, Govt. of India for his valuable suggestions at the time of resource estimation.

I am deeply thankful to Dr. Prabir K. Naik, Regional Director, Central Ground Water Board, North Central Chhattisgarh Region, Raipur for his valuable guidance at the time for assessment of Dynamic Ground Water Resources (as on March 2024) of Chhattisgarh state.

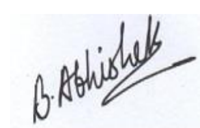
I am very much thankful to Shri I A Siddiqi, Suptd. Engineer for his co-operation and suggestions for resource assessment of the state. I would like to express my deepest thanks to Shri A.K. Shukla, Senior Geo-Hydrologist, (Divisional Ground Water Survey, Unit 8, Raipur) and N. Meshram, Senior Geo-Hydrologist (Divisional Ground Water Survey, Unit 9, Bilaspur) and their respective team for their valuable contribution in collection of data and resource assessment.

I would like to express my deepest thanks to Ms. Gurpreet Kaur (Scientist-B) for his consistent effort in data validation, analysis and preparation of this report. I also would like to express my thanks to Shri Sangam Samal (Scientist- B) of CGWB NCCR for their sincere effort throughout the assessment. I am also thankful to Shri Rajnikant Sharma (Scientist-D) for the help rendered in quality tagging of assessment units.

I am also thankful to Shri A K Sinha (Sc-D), Smt Priyanka B Sonbarse (Sc-C), Shri Sidhanta K Sahu (Sc-C) and Ms Sweta Mohanty (A-Hg) and Shri Uddeshya Kumar (Sc-C) for their valuable inputs during assessment. I am also thankful to Technical Section, CGWA, RODC and Chemical Section of CGWB NCCR Raipur along with departments and district offices of Govt. of Chhattisgarh for providing requisite data for assessment of groundwater resource.

We feel immensely thankful to members of State Level Ground Water Resource Re-Estimation Committee for their valuable suggestions and kind co-operation during Ground Water Resource Estimation as on March 2024.

The report processing and publication section for issuance of the report is also duly acknowledged.



B Abhishek
(Scientist 'C')
CGWB, NCCR, Raipur

प्रस्तावना

वर्तमान परिवेश में भूजल विभिन्न आवश्यकताओं को पूरा करने के लिए जल का एक महत्वपूर्ण स्रोत है। हालाँकि, अनियंत्रित उपयोग के परिणामस्वरूप जल स्तर में कमी आई है, विशेष रूप से कठोर चट्टानों में, जहाँ संसाधन सीमित हैं और वास्तव में मानसून की अनियमितताओं का खतरा है। भूजल की स्थिरता, भूजल की उपलब्धता और निष्कर्षण की स्थिति पर निर्भर है।

छत्तीसगढ़ राज्य सिंचाई और औद्योगिक गतिविधियों के क्षेत्र में तेजी से विकास की प्रक्रिया में है और भूजल राज्य की विकासात्मक गतिविधियों में महत्वपूर्ण स्थान रखता है। हालाँकि, भूजल एक पुनःपूर्ति योग्य संसाधन है, लेकिन भूजल पर अत्यधिक निर्भरता, बार-बार पड़ने वाले सूखे, विविध मानसून पैटर्न आदि के कारण ऐसी स्थिति पैदा हो रही है, जहाँ राज्य के कई ब्लॉकों को क्रिटिकल से लेकर सेमी क्रिटिकल श्रेणी में वर्गीकृत किया गया है।

विभिन्न उपयोगों के लिए उपलब्ध भूजल संसाधनों की सटीक मात्रा निर्धारित करने और जल आपूर्ति कार्यक्रमों के विकास के साथ-साथ खाद्य सुरक्षा सुनिश्चित करने की विवेकपूर्ण योजना बनाने के लिए, समय-समय पर भूजल संसाधनों का आकलन करने की आवश्यकता है। इसे ध्यान में रखते हुए, केंद्रीय भूजल बोर्ड और राज्य भूजल विभाग ने GEC'15 पद्धति के आधार पर छत्तीसगढ़ के गतिशील भूजल संसाधनों का आकलन करने का कार्य किया। संसाधन की गणना IN-GRES सॉफ़्टवेयर की मदद से की जाती है जो कि आईआईटी-हैदराबाद के सहयोग से केंद्रीय भूजल बोर्ड द्वारा विकसित वेब-आधारित एप्लिकेशन है।

"छत्तीसगढ़ के गतिशील भूजल संसाधन" (मार्च 2024 तक) पर रिपोर्ट केंद्रीय भूजल बोर्ड और राज्य भूजल सर्वेक्षण, जल संसाधन विभाग, छत्तीसगढ़ सरकार के संयुक्त प्रयासों का परिणाम है और उम्मीद है कि यह राज्य में भूजल विकास और योजना का आधार बनेगी। यह रिपोर्ट छत्तीसगढ़ के भूजल संसाधनों का आकलन प्रस्तुत करती है जिसकी गणना "भूजल संसाधन आकलन समिति 2015" द्वारा अनुशंसित पद्धति के आधार पर तार्किक और वैज्ञानिक दृष्टिकोण से की गई है। रिपोर्ट बताती है कि 146 ब्लॉकों में से 5 ब्लॉक क्रिटिकल हैं, 21 ब्लॉक "सेमी-क्रिटिकल" श्रेणी में आते हैं और शेष 120 ब्लॉक "सुरक्षित" श्रेणी में आते हैं। प्राप्त आंकड़े बहुत यथार्थवादी हैं, हालांकि भविष्य में उपयोग और सिंचाई क्षमता के लिए उपलब्ध भूजल संसाधन और परिणामी भूजल की मात्रा के संबंध में कार्यप्रणाली में सुधार और जानकारी के उन्नयन की गुंजाइश हमेशा बनी रहती है।

राज्य भूजल सर्वेक्षण, जल संसाधन विभाग, छत्तीसगढ़ सरकार के सभी अधिकारियों के प्रति गहरी कृतज्ञता व्यक्त की जाती है जो किसी न किसी स्तर पर इस कार्य से जुड़े थे। 'छत्तीसगढ़ के गतिशील भूजल संसाधन' पर रिपोर्ट तैयार करने के साथ-साथ परिणामों के सत्यापन और इनपुट डेटा के संकलन के लिए केंद्रीय भूजल बोर्ड के श्री बी अभिषेक (वैज्ञानिक 'सी' और नोडल अधिकारी) एवं अन्य टीम के सदस्यों द्वारा किया गया अथक प्रयास प्रशंसीय है।

मुझे आशा है कि, यह रिपोर्ट राज्य में भूजल की योजना और विकास में लगी सभी उपयोगकर्ता एजेंसियों के लिए उपयोगी होगी।

(डॉ. प्रबीर कु. नाइक)
सदस्य सचिव (SLC) एवं
क्षेत्रीय निदेशक, केंद्रीय भूजल बोर्ड, रायपुर

PREFACE

Ground Water has emerged as important source of water to meet the different requirements. However, uncontrolled use has resulted in depletion of water levels, more so in hard rocks, where the resource is limited and indeed prone to vagaries of monsoon. The sustainability of ground water is dependent upon ground water availability and prevailing development status.

The state of Chhattisgarh is in the process of an accelerated development in the fields of irrigation and industrial activities and ground water occupies a key position in the developmental activities of the state. Although, ground water is a replenishable resource, over dependence on ground water, recurrent droughts, varied monsoon pattern etc., are leading to a situation where in several blocks of the state have been categorized as critical to Semi- critical.

In order to precisely quantify the ground water resources available for various uses and judiciously plan the development of water supply programs as well as ensuring food security, there is a need for assessing the ground water resources periodically. Keeping this in view, Central Ground Water Board and State Ground Water Department took up the task of estimating the Dynamic Ground Water Resources of Chhattisgarh based on GEC’15 methodology. Resource computed with the help of IN-GRES Software which is Web-based Application developed by CGWB in collaboration with IIT-Hyderabad.

The report on “Dynamic Ground Water Resources of Chhattisgarh” (As on March 2024) is the outcome of the combined efforts of CGWB and State Ground Water Survey, Water Resources Department, Government of Chhattisgarh and is expected to form the basis for ground water development and planning in the state. This report presents the assessment of ground water resources of Chhattisgarh which have been computed with a logical and scientific approach based on methodology recommended by the “Ground Water Resource Estimation Committee 2015”. The report indicates that out of 146 blocks, 5 blocks are Critical, 21 blocks are falling under the “Semi-Critical” category and the remaining 120 blocks falls under “safe”. The figures arrived at are very realistic, however, there is always a scope for improvement in methodology and up-gradation of information regarding the quantum of ground water resource and resultant ground water available for future use and irrigation potential.

A deep sense of gratitude is expressed to all the state Officers of State Ground Water Survey, Water Resources Department, Government of Chhattisgarh who was associated with this work at one stage or the other. A lot of effort was put in by the Shri B. Abhishek (Scientist ‘C’ & Nodal Officer) and other team members of Central Ground Water Board for compilation of data, validation and assessment along with preparation of report on ‘Dynamic Ground Water Resource of Chhattisgarh (As on March’ 2024) in the present form is appreciable.

I hope that, this report will be useful to all the user agencies engaged in planning and development of ground water in the state.

(Dr Prabir K. Naik)
Member Secretary (SLC) &
Regional Director CGWB, NCCR,
Raipur

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3.	Annual Ground Water Extraction	: 6.12 BCM
4.	Stage of Ground Water Extraction	: 47.32 %

CATEGORIZATION OF ASSESSMENT UNITS

(Blocks)

Sl.No	**Category**	**Number of Assessment Units**		**Recharge worthy Area**		**Annual Extractable Ground Water Resource**	
		Number	**%**	**in lakh sq. km**	%	**(in bcm)**	%
1	Safe	120	82.19	0.89	83.78	10.13	78.38
2	Semi Critical	21	14.39	0.14	13.28	2.33	18.06
3	Critical	5	3.42	0.03	2.94	0.46	3.56
4	Over-Exploited	NA	NA	NA	NA	NA	NA
5	Saline	NA	NA	NA	NA	NA	NA
	TOTAL	**146**	**100**	1.06	100	12.92	100

EXECUTIVE SUMMARY

Ground Water Resource Assessment is carried out at periodical intervals jointly by State Ground Water Departments and Central Ground Water Board under the guidance of the respective State Level Committee on Ground Water Assessment at State Levels and under the overall supervision of the Central Level Expert Group (CLEG). Such joint exercises have been taken up earlier in 1980, 1995, 2004, 2009, 2011, 2013, 2017, 2020, 2022, and 2023. From the year 2022, the exercise is being carried out annually. The assessment involves computation of dynamic ground water resources or Annual Extractable Ground Water Resource, Total Current Annual Ground Water Extraction (utilization) and the percentage of utilization with respect to annual extractable resources (stage of Ground Water Extraction). The assessment units (Talukas/blocks/mandals) are categorized based on Stage of Ground Water Extraction, which are then validated with long-term water level trends. The assessment prior to that of year 2017 were carried out following Ground Water Estimation Committee (GEC) 97 Methodology, whereas from 2017 onwards assessment are based on norms and guidelines of the GEC 2015 Methodology.

The main source of replenishable ground water resources is recharge from rainfall, which contributes to nearly 61.51 % of the total annual ground water recharge.

Over 83% of the annual rainfall is received in the four rainy months for June to September only thereby leading to large variations on temporal scale. Rainfall is the main source of ground water recharge in the state. However, distribution of rainfall has a slight variation both in space and time. The southern areas of Chhattisgarh receives maximum rainfall often greater than 1500 mm whereas in the central and northern Chhattisgarh the average rainfall ranges from 1000 to 1500 mm.

Type of rock formations and their storage and transmission characteristics have a significant influence on ground water recharge. Porous formations such as the alluvial formations along few km radius of the major river generally have high specific yields and are good repositories of ground water. Ground water occurrence in the fissured formations occupying 99.97% of the geographical area of the Chhattisgarh, on the other hand, is mostly limited to the weathered, jointed and fractured portions of the rocks.

In the present assessment, the total annual groundwater recharge in the state has been assessed as 14.18 bcm. Keeping an allocation for natural discharge, the annual extractable ground water resource has been assessed as 12.92 bcm. The annual groundwater extraction (as in 2024) is 6.11 bcm. The average stage of groundwater extraction for the state as a whole works out to be about 47.32 %. Out of 146 assessment units (blocks), 5 units (3.42 %) as 'Critical', 21 units (14.38 %) have been categorized as 'Semi-critical' and 120 units (82.19 %) as 'Safe' categories of assessment units. There are no 'Over-exploited' and 'Saline' categories of assessment units. Out of 106078.71 sq km recharge worthy area of the State, 3119.06 sq km (2.94 %) area are under 'Critical', 14090.19 sq km (13.28 %) under 'Semi-critical', 88869.46 sq km (83.78 %) under 'Safe' categories of assessment units. Out of total 13186.48 mcm annual extractable ground water resources of the State, 460.4 mcm (3.52 %) under 'Critical', 2334.88 mcm (18.06 %) under 'Semi-critical' and 10132.06 mcm (78.38 %) are under 'Safe' categories of assessment units.

In comparison to Dynamic Ground Water Resource Assessment 2023, the total annual ground water recharge has decreased marginally from 13.34 bcm to 14.18 bcm, The change is attributed mainly to change in recharge from 'Other Sources' specially reduction in return flow from irrigation. Accordingly, the annual extractable ground water resources has also increased marginally from 12.18 to 12.92 bcm. The ground water extraction has marginally increased from 5.74 bcm to 6.11 bcm. The overall stage of groundwater extraction has marginally increased from 47.17 % to 47.32 %.

CHAPTER - 1

1.0 INTRODUCTION

Groundwater is the backbone of India's agriculture and drinking water security in urban and rural areas. Nearly 90% of rural domestic water use is based on groundwater while 70% of water used in agriculture is pumped from aquifers. Ground water is an important source for meeting the water requirements for development of the state. Ground water is annually replenishable resource, but its availability is non-uniform in space and time. Hence, the sustainabledevelopment of ground water resources warrants precise quantitative assessment based on the reasonably valid scientific principles. Technically, dynamic ground water refers to the quantityof ground water available in the zone of water level fluctuation, which is active recharge zone andreplenished annually. In addition to the dynamic ground water resource, there exists a huge groundwater reservoir in the deeper zones below the active recharge zone and in the confined aquifers. The demand for ground water irrigation is increased more than 6 times in last decade. The majorityof ground water exploitation is confined in the shallow aquifer only. Hence, the development of shallow aquifers plays an important role, therefore correct assessment of dynamic ground water resources becomes significant for a planned agricultural growth.

Chhattisgarh is known as the state of 'Rice bowl', and 'Power hub' of the country, Chhattisgarh state is basically a backward and agrarian state, and it is abundantly endowed with natural resources and has a thick forest cover (about 44.8% of the total geographical area). Thestate extends from 17^0 47' to 24^0 6' North Latitudes and 80^0 15' to 84^0 24' East Longitudes in thecentral part of India. It has an area of about 135191 Sq. Km thus forming the 10^{th} largest state ofIndia with 4.12% of the country's area. Chhattisgarh is bounded by the states of Orissa in the east,Uttar Pradesh in the north, Jharkhand in the northeast, Andhra Pradesh in the south, Maharashtrain the south west and Madhya Pradesh in the north western part. The State has been divided into33 districts and 146 blocks (Figure-1). The population of state as per census 2011 is 25540196with a population density of 189 persons per sq.km area. Out of total population, 79.9 % is rural.The present report is an outcome of the concerted efforts made by the Central Ground Water Board, North Central Chhattisgarh Region, Raipur and the State Ground Water Survey, Water Resources Department, Govt of Chhattisgarh to bring out the status of dynamic ground water resources of the State based on the methodology recommended by Ground Water ResourcesEstimation Committee, 2015 (GEC-2015).

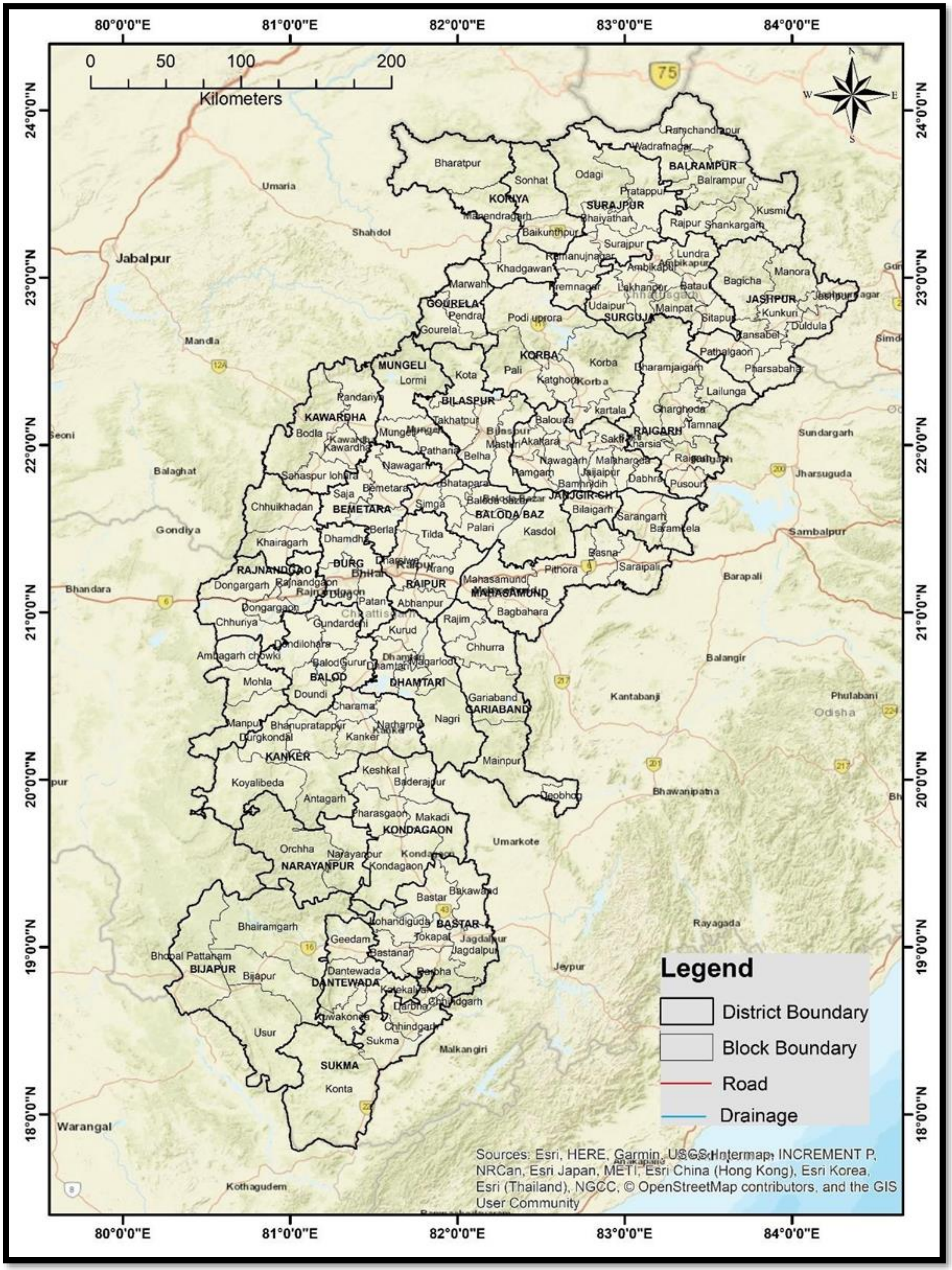

Figure 1 Administrative Divisions of Chhattisgarh

a) Background for re-estimating the ground water resources of the state

First attempt to estimate the ground water resources of the country was made in the year 1979. A Committee known as Ground Water Over-exploitation Committee was constituted by Agriculture Refinance and Development Corporation (ARDC) of Govt. of India. Based on the methodology and norms recommended by the above Committee, ground water resources of the country were assessed. Subsequently, the necessity was felt to refine the methodologies and the "Ground Water Estimation Committee (GEC)" headed by the Chairman, CGWB came into existence. Based on the detailed surveys and studies by the various offices and projects of CGWB, the Committee recommended a revised methodology in 1984 (GEC'84) for estimation of ground water resources. In 1997, the Ground Water Estimation Committee reviewed the previous studiesand work done in various states and suggested a modified methodology in 1997 (GEC'97) for computation of ground water resources. Again in 2015, the Ministry of Water Resources, River Development & Ganga Rejuvenation, Government of India, constituted a committee headed by Chairman, CGWB to review and revise the Ground Water Resource Estimation Methodology 1997 (GEC-97) and suggested a modified methodology GEC-2015 Subsequently, a few modifications have been made in the methodology as per the recommendations of the R&D Advisory Committee.

The first ground water resource of Chhattisgarh after it's carved out of erstwhile Madhya Pradesh, was estimated for the year 2001-02 based on the revised methodology (GEC'97). These estimations were carried out jointly by Central Ground Water Board, NCCR, Raipur and State Ground Water Survey, Raipur. After approval by the State Level Committee and the recommendations of the standing Committee on R&D Advisory Committee, New Delhi, the finalreport was released during the year 2005. As per the guidelines of the Central Ground Water Board,Faridabad, the ground water resource has been estimated for the base year 2008-09, 2010-11, 2012-13, 2016-17, 2020-21, 2021-22, 2022-23 and 2023-24. This report has been prepared for the base year 2023-24 and resource has been assessed as on March'2024 by Central Ground Water Board in association withState Ground Water Survey, Water Resources Department, Govt. of Chhattisgarh. The report hasbeen prepared as per the format provided by Central Headquarter, Central Ground Water Board, Ministry of Water Resources, Faridabad.

b) Constitution of state-level ground water resources estimation committee

Water Resources Department, Govt of Chhattisgarh has constituted a Permanent State Level Committee vide letter no. F-9-21/2023/1/5 dated 06.07.2023 for Ground Water Resources Assessment for the state of Chhattisgarh as on March 2024 (Annexure-1) for assessment of annualreplenishable ground water resource of Chhattisgarh for the reference year March, 2024 and to estimate status of utilization of the annual replenishable ground water resources as on 31st March 2024 of Chhattisgarh State.

The composition of the committee is as follows:

1. Secretary, Water Resources Department, Govt. of Chhattisgarh - Chairman
2. Engineer-in-Chief, Water Resources Department, Govt. of Chhattisgarh - Member
3. Engineer-in-Chief, PHE Department, Govt. of Chhattisgarh - Member
4. Chief Engineer, Mahanadi Godavari Basin, WRD, Govt. of Chhattisgarh- Member
5. Director, Department of Agriculture, Govt. of Chhattisgarh - Member
6. Director, Department of Industries, Govt. of Chhattisgarh - Member
7. Chief General Manager NABARD, Nava Raipur, Atal Nagar - Member
8. Director, Economics & Statistics Department, Nava Raipur, Atal Nagar - Member
9. Regional Director, CGWB, NCCR, Raipur - Member Secretary

c) Proceedings of the resource estimation and outcome of various meetings

Ground water resources assessment for reference year 2024 have been carried out jointly by Ground Water Survey, Water Resource Departments, Raipur, Govt. of Chhattisgarh and Central Ground Water Board, North Central Chhattisgarh Region, Raipur under the supervision of State Level Committees in accordance with the GEC.

The first meeting (Annexure II, Minutes of Meeting) of the Permanent State Level Committee (SLC) for Ground Water Resources Assessment (GWRA) 2024 for Chhattisgarh State was held in office of Secretary, Water Resources, Mahanadi Bhawan, Govt of Chhattisgarh dated 19.04.2024 under chairmanship of Shri Rajesh Sukumar Toppo, Secretary, Water Resource Department, Govt. of Chhattisgarh. Second meeting of SLC for approval of "Dynamic Ground Water Resources of Chhattisgarh" (As on March 2024) held on dated 11 September 2024 (Annexure III, Minutes of Meeting) under Chairmanship of Shri Rajesh Sukumar Toppo (IAS & Secretary WRD, Govt. of Chhattisgarh). All the members of SLC appreciated the work carried out by CGWB and State Ground Water Department and finally committee approved the report.

CHAPTER - 2

2.0 GROUND WATER RESOURCE ESTIMATION METHODOLOGY

Ground water resource as in 2024 have been estimated following the guidelines mentioned in the GEC 2015 methodology using appropriate assumptions depending on data availability. The principal attributes of GEC 2015 methodology are given below:

It is also important to add that as it is advisable to restrict the groundwater development as far as possible to annual replenishable resources, the categorization also considers the relation between the annual replenishment and groundwater development. An area devoid of ground water potential may not be considered for development and may remain safe whereas an area with good groundwater potential may be developed and may become over exploited over a period. Thus, water augmentation efforts can be successful in such areas, where the groundwater potential is high and there is scope for augmentation.

2.1 GROUND WATER ASSESSMENT OF UNCONFINED AQUIFER

Though the assessment of ground water resources includes assessment of dynamic and in-storage resources, the development planning should mainly focus on dynamic resource as it gets replenished on an annual basis. Changes in static or in-storage resources normally reflect long-term impacts of ground water mining. Such resources may not be replenishable annually and may be allowed to be extracted only during exigencies with proper planning for augmentation in the succeeding excess rainfall years.

2.1.1. Assessment of Annually Replenishable or Dynamic Ground Water Resources

The methodology for ground water resources estimation is based on the principle of water balance as given below –

$$\boldsymbol{Inflow - Outflow = Change\ in\ Storage(of\ an\ aquifer)} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots..\mathbf{(1)}$$

Equation (1) can be further elaborated as –

$$\boldsymbol{\Delta S = R_{RF} + R_{STR} + R_C + R_{SWI} + R_{GWI} + R_{TP} + R_{WCS} \pm VF \pm LF - GE - T - E - B} \ldots\ldots..\mathbf{(2)}$$

Where,

ΔS - Change is storage

R_{RF} - Rainfall recharge

R_{STR} - Recharge from stream channels

R_C - Recharge from canals

R_{SWI} - Recharge from surface water irrigation

R_{GWI} - Recharge from ground water irrigation

R_{TP} - Recharge from Tanks & Ponds

R_{WCS} - Recharge from water conservation structures

VF - Vertical flow across the aquifer system

LF - Lateral flow along the aquifer system (through flow)

GE - Ground Water Extraction

T - Transpiration

E - Evaporation

B - Base flow

Due to lack of data for all the components in most of the assessment units, at present the water budget has been assessed based on major components only, taking into consideration certain reasonable assumptions. The estimation has been carried out using lumped parameter estimation approach keeping in mind that data from many more sources if available may be used for refining the assessment.

2.1.1.1. Rainfall Recharge

Ground water recharge has been estimated on ground water level fluctuation and specific yield approach since this method considers the response of ground water levels to ground water input and output components. In units or subareas where adequate data on ground water level fluctuations are not available, ground water recharge is estimated using rainfall infiltration factor method only. The rainfall recharge during non-monsoon season has been estimated using rainfall infiltration factor method only.

2.1.1.1.1.Ground Water Level Fluctuation Method

The ground water level fluctuation method is used for assessment of rainfall recharge in the monsoon season. The ground water balance equation in non-command areas is given by

$$\Delta \boldsymbol{S} = \boldsymbol{R_{RF}} + \boldsymbol{R_{STR}} + \boldsymbol{R_{SWI}} + \boldsymbol{R_{GWI}} + \boldsymbol{R_{TP}} + \boldsymbol{R_{WCS}} \pm \boldsymbol{VF} \pm \boldsymbol{LF} - \boldsymbol{GE} - \boldsymbol{T} - \boldsymbol{E} - \boldsymbol{B} \ldots\ldots\ldots\ldots\ldots\ldots\ldots..(\boldsymbol{3})$$

Where,

ΔS - Change is storage

R_{RF} - Rainfall recharge

R_{STR} - Recharge from stream channels

R_{SWI} - Recharge from surface water irrigation

R_{GWI} - Recharge from ground water irrigation

R_{TP} - Recharge from Tanks& Ponds

R_{WCS} - Recharge from water conservation structures

VF - Vertical flow across the aquifer system

LF - Lateral flow along the aquifer system (through flow)

GE - Ground water extraction

T - Transpiration

E - Evaporation

B - Base flow

Whereas the water balance equation in command area have another term i.e., Recharge due to canals (R_C) and the equation is as follows:

$$\Delta \boldsymbol{S} = \boldsymbol{R_{RF}} + \boldsymbol{R_{STR}} + \boldsymbol{R_C} + \boldsymbol{R_{SWI}} + \boldsymbol{R_{GWI}} + \boldsymbol{R_{TP}} + \boldsymbol{R_{WCS}} \pm \boldsymbol{VF} \pm \boldsymbol{LF} - \boldsymbol{GE} - \boldsymbol{T} - \boldsymbol{E} - \boldsymbol{B} \ldots\ldots\ldots\ldots\ldots (\boldsymbol{4})$$

The change in storage has been estimated using the following equation:

$$\Delta \boldsymbol{S} = \Delta \boldsymbol{h} \times \boldsymbol{A} \times \boldsymbol{S_Y} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (\boldsymbol{5})$$

Where,

ΔS - Change is storage

Δh - rise in water level in the monsoon season

A - Area for computation of recharge

S_Y - Specific Yield

Substituting the expression in equation (5) for storage increase ΔS in terms of water level fluctuation and specific yield, the equations (3) & (4) becomes (6) & (7) for non-command and command sub-units,

$$\boldsymbol{R_{RF}} = \Delta \boldsymbol{h} \times \boldsymbol{A} \times \boldsymbol{S_Y} - \boldsymbol{R_{STR}} - \boldsymbol{R_{SWI}} - \boldsymbol{R_{GWI}} - \boldsymbol{R_{TP}} - \boldsymbol{R_{WCS}} \pm \boldsymbol{VF} \pm \boldsymbol{LF} + \boldsymbol{GE} + \boldsymbol{T} + \boldsymbol{E} + \boldsymbol{B} \ldots\ldots\ldots\ldots\ldots (\boldsymbol{6})$$

$$\boldsymbol{R_{RF}} = \Delta \boldsymbol{h} \times \boldsymbol{A} \times \boldsymbol{S_Y} - \boldsymbol{R_{STR}} - \boldsymbol{R_C} - \boldsymbol{R_{SWI}} - \boldsymbol{R_{GWI}} - \boldsymbol{R_{TP}} - \boldsymbol{R_{WCS}} \pm \boldsymbol{VF} \pm \boldsymbol{LF} + \boldsymbol{GE} + \boldsymbol{T} + \boldsymbol{E} + \boldsymbol{B} \ldots\ldots\ldots (\boldsymbol{7})$$

Where base flow/ recharge to/from streams have not been estimated, the same is assumed to be zero. The rainfall recharge obtained by using equation (6) and (7) provides the recharge in any particular monsoon season for the associated monsoon season rainfall. This estimate has been normalized for the normal monsoon season rainfall as per the procedure indicated below.

Normalization of Rainfall Recharge

Let R_i be the rainfall recharge and r_i be the associated rainfall. The subscript "i" takes values 1 to N where N is the number of years for which data is available. This should be at least 5. The rainfall recharge, R_i is obtained as per equation (6) & equation (7) depending on the sub-unit for which the normalization is being done.

After the pairs of data on R_i and r_i have been obtained as described above, a normalisation procedure is carried out for obtaining the rainfall recharge corresponding to the normal monsoon season rainfall. Let r(normal) be the normal monsoon season rainfall obtained as the average of recent 30 to 50 years of monsoon season rainfall. Two methods are possible for the normalisation procedure. The first method is based on a linear relationship between recharge and rainfall of the form

$$\boldsymbol{R = ar} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots.(\mathbf{8})$$

Where,

R = Rainfall recharge during monsoon season

r = Monsoon season rainfall

a = a constant

The computational procedure is followed in the first method is as given below:

$$\boldsymbol{R_{RF}(normal) = \frac{\sum_{i=1}^{N}\left[R_i \frac{r(normal)}{r_i}\right]}{N}} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots..(\mathbf{9})$$

Where,

R_{RF}(normal) - Normalized Rainfall Recharge in the monsoon season

R_i- Rainfall Recharge in the monsoon season for the i^{th}year

r(normal) - Normal monsoon season rainfall

r_i- Rainfall in the monsoon season for the i^{th} year

N - No. of years for which data is available

The second method is also based on a linear relation between recharge and rainfall. However, this linear relationship is of the form,

$$\boldsymbol{R_{RF}(normal) = a \times r(normal) + b} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots..(\mathbf{10})$$

Where,

R_{RF}(normal) - Normalized Rainfall Recharge in the monsoon season

r(normal) - Normal monsoon season rainfall

a and b - Constants.

The two constants 'a' and 'b' in the above equation are obtained through a linear regression analysis. The computational procedure has been followed in the second method is as given below:

$$\boldsymbol{a} = \frac{\boldsymbol{NS_4 - S_1S_2}}{\boldsymbol{NS_3 - S_1^2}} \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots (\mathbf{11})$$

$$\boldsymbol{b} = \frac{\boldsymbol{S_2 - aS_1}}{\boldsymbol{N}} \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots (\mathbf{12})$$

Where,

$$\boldsymbol{S_1} = \sum_{i=1}^{N} \boldsymbol{r_i} \ , \quad \boldsymbol{S_2} = \sum_{i=1}^{N} \boldsymbol{R_i} \ , \quad \boldsymbol{S_3} = \sum_{i=1}^{N} \boldsymbol{r_i^2} \ , \quad \boldsymbol{S_4} = \sum_{i=1}^{N} \boldsymbol{R_i r_i}$$

2.1.1.1.2.Rainfall Infiltration Factor Method

The rainfall recharge estimation based on Water level fluctuation method reflects actual field conditions since it takes into account the response of ground water level. However the ground water extraction estimation included in the computation of rainfall recharge using water level fluctuation approach is often subject to uncertainties. Therefore, the rainfall recharge obtained from water level fluctuation approach has been compared with that estimated using rainfall infiltration factor method. Recharge from rainfall is estimated by using the following relationship –

$$\boldsymbol{R_{RF}} = \boldsymbol{RFIF} \times \boldsymbol{A} \times \frac{\boldsymbol{(R - a)}}{\mathbf{1000}} \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots .. (\mathbf{13})$$

Where,

R_{RF} - Rainfall recharge in ham

A - Area in hectares

RFIF - Rainfall Infiltration Factor

R- Rainfall in mm

a - Minimum threshold value above which rainfall induces ground water recharge in mm

The threshold limit of minimum and maximum rainfall event which can induce recharge to the aquifer is considered while estimating ground water recharge using rainfall infiltration factor method. The minimum threshold limit is in accordance with the relation shown in equation (13) and the maximum threshold limit is based on the premise that after a certain limit, the rate of storm rain is too high to contribute to infiltration and they will only contribute to surface runoff. Thus, 10% of Normal annual rainfall has been taken as minimum rainfall threshold and 3000 mm as maximum rainfall limit. While computing the rainfall recharge, 10% of the normal annual rainfall has been deducted from the monsoon rainfall and balance rainfall is considered for computation of rainfall recharge. The same recharge factor is used for both monsoon and non-monsoon rainfall, with the condition that the recharge due to non-monsoon rainfall is taken as zero, if the normal rainfall during the non-monsoon season is less than 10% of normal annual rainfall. In using the method based on the specified norms, recharge due to both monsoon and non-monsoon rainfall has been estimated for normal rainfall, based on recent 30 to 50 years of data.

2.1.1.1.3.Percent Deviation

After computing the rainfall recharge for normal monsoon season rainfall using the ground water level fluctuation method and rainfall infiltration factor method these two estimates is compared with each other. A term, Percent Deviation (PD) which is the difference between the two expressed as a percentage of the later is computed as

$$\boldsymbol{PD = \frac{R_{RF}(normal, wtfm) - R_{RF}(normal, rifm)}{R_{RF}(normal, rifm)} \times 100 \ldots\ldots\ldots\ldots\ldots\ldots.\ldots\ldots\ldots.(14)}$$

Where,

R_{RF} (normal, wlfm) = Rainfall recharge for normal monsoon season rainfall estimated by the ground water level fluctuation method

R_{RF} (normal, rifm) = Rainfall recharge for normal monsoon season rainfall estimated by the rainfall infiltration factor method

The rainfall recharge for normal monsoon season rainfall is finally adopted as per the criteria given below:

- If PD is greater than or equal to -20%, and less than or equal to +20%, R_{RF} (normal) is taken as the value estimated by the ground water level fluctuation method.
- If PD is less than -20%, R_{RF} (normal) is taken as equal to 0.8 times the value estimated by the rainfall infiltration factor method.
- If PD is greater than +20%, R_{RF} (normal) is taken as equal to 1.2 times the value estimated by the rainfall infiltration factor method.

2.1.1.2. Recharge from Other Sources

Recharge from other sources constitutes recharges from canals, surface water irrigation, ground water irrigation, tanks & ponds and water conservation structures in command areas where as in non-command areas it constitutes the recharge due to surface water irrigation, ground water irrigation, tanks & ponds and water conservation structures. The methods of estimation of recharge from different sources are used in the assessment as follows.

Sl. No.	Source	Estimation Formula	Parameters
1	Recharge from Canals	$R_C = WA \times SF \times Days$	R_C = Recharge from Canals WA = Wetted Area SF = Seepage Factor Days = Number of Canal Running Days
2	Recharge from Surface Water Irrigation	$R_{SWI} = AD \times Days \times RFF$	R_{SWI} = Recharge due to applied surface water irrigation AD = Average Discharge Days = Number of days water is discharged to the Fields RFF = Return Flow Factor
3	Recharge from Ground Water Irrigation	$R_{GWI} = GE_{IRR} \times RFF$	R_{GWI} = Recharge due to applied ground water irrigation GE_{IRR} = Ground Water Extraction for Irrigation RFF = Return Flow Factor
4	Recharge due to Tanks & Ponds	$R_{TP} = AWSA \times N \times RF$	R_{TP} = Recharge due to Tanks & Ponds AWSA = Average Water Spread Area N = Number of days Water is available in the Tank/Pond RF = Recharge Factor
5	Recharge due to Water Conservation Structures	$R_{WCS} = GS \times RF$	RWCS = Recharge due to Water Conservation Structures GS = Gross Storage = Storage Capacity multiplied by number of fillings. RF = Recharge Factor

2.1.1.3. Evaporation and Transpiration

Evaporation is estimated for the aquifer in the assessment unit if water levels in the aquifer are within the capillary zone. For areas with water levels within 1.0mbgl, evaporation is estimated using the evaporation rates available for other adjoining areas. If depth to water level is more than 1.0mbgl, the evaporation losses from the aquifer is taken as zero.

Transpiration through vegetation has been estimated if water levels in the aquifer are within the maximum root zone of the local vegetation. If water levels are within 3.5mbgl, transpiration is estimated using the transpiration rates available for other areas. If it is greater than3.5m bgl, the transpiration has been taken as zero.

2.1.1.4. Recharge During Monsoon Season

The sum of normalized monsoon rainfall recharge and the recharge from other sources and lateral and vertical flows into & out of the sub unit and stream inflows & outflows during monsoon season is the total recharge/ accumulation during monsoon season for the sub unit. Similarly, this is to be computed for all the sub units available in the assessment unit.

2.1.1.5. Recharge During Non-Monsoon Season

The rainfall recharge during non-monsoon season is estimated using rainfall infiltration factor Method only when the non-monsoon season rainfall is more than 10% of normal annual rainfall. The sum of non-monsoon rainfall recharge and the recharge from other sources and lateral and vertical flows into & out of the sub unit and stream inflows & outflows during non-monsoon season is the total recharge/ accumulation during non-monsoon season for the sub unit. Similarly, this is to be computed for all the sub units available in the assessment unit.

2.1.1.6. Total Annual Ground Water Recharge

The sum of the recharge/ accumulations during monsoon and non-monsoon seasons is the total annual ground water recharge/ accumulations for the sub unit. Similarly, this is computed for all the sub units available in the assessment unit.

2.1.1.7. Annual Extractable Ground Water Resource (EGR)

The Annual Extractable Ground Water Resource (EGR) is computed by deducting the Total Annual Natural Discharge from Total Annual Ground Water Recharge.

In the water level fluctuation method, a significant portion of base flow is already accounted for by taking the post monsoon water level one month after the end of rainfall. The base flow in the remaining non-monsoon period is likely to be small, especially in hard rock areas. In the assessment units, where river stage data are not available and neither the detailed data for quantitative assessment of the natural discharge are available, allocation of unaccountable natural discharges to 5% or 10% of annual recharge is considered. If the rainfall recharge is assessed using water level fluctuation method this has been taken 5% of the annual recharge and if it is assessed using rainfall infiltration factor method, 10% of the annual recharge is considered. The balance is account for Annual Extractable Ground Water Resources (EGR).

2.1.1.8. Estimation of Ground Water Extraction

Ground water draft or extraction is assessed as follows.

$$GE_{ALL} = GE_{IRR} + GE_{DOM} + GE_{IND} \dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots (15)$$

Where,

GE_{ALL} = Ground water extraction for all uses

GE_{IRR} = Ground water extraction for irrigation

GE_{DOM} = Ground water extraction for domestic uses

GE_{IND} = Ground water extraction for industrial uses

2.1.1.8.1. Ground Water Extraction for Irrigation (GE_{IRR})

The methods for estimation of ground water extraction are as follows.

***Unit Draft Method:* –** In this method, season-wise unit draft of each type of well in an assessment unit is estimated. The unit draft of different types (eg. Dug well, Dug cum bore well, shallow tube well, deep tube well, bore well etc.) is multiplied with the number of wells of that particular type to obtain season-wise ground water extraction by that particular structure.

***Crop Water Requirement Method:* –** For each crop, the season-wise net irrigation water requirement is determined. This is then multiplied with the area irrigated by ground water abstraction structures. The database on crop area is obtained from Revenue records in Tehsil office, Agriculture Census and also by using Remote Sensing techniques.

***Power Consumption Method:* –**Ground water extraction for unit power consumption (electric) is determined. Extraction per unit power consumption is then multiplied with number of units of power consumed for agricultural pump sets to obtain total ground water extraction for irrigation.

2.1.1.8.2. Ground Water Extraction for Domestic Use (GE_{DOM})

There are several methods for estimation of extraction for domestic use(GEDOM). Some of the commonly adopted methods are described here.

***Unit Draft Method:* –** In this method, unit draft of each type of well is multiplied by the number of wells used for domestic purpose to obtain the domestic ground water extraction.

***Consumptive Use Method:* –** In this method, population is multiplied with per capita consumption usually expressed in litre per capita per day (lpcd). It can be expressed using following equation.

$$GE_{DOM} = Population \times Consumptive\ Requirement \times L_g \ldots\ldots\ldots\ldots\ldots.\ldots\ldots\ldots\ldots\ldots\ldots.(16)$$

Where,

L_g = Fractional Load on Ground Water for Domestic Water Supply.

The Load on Ground water can be obtained from the Information based on Civic water supply agencies in urban areas.

2.1.1.8.3. Ground Water Extraction for Industrial Use (GE_{IND})

The commonly adopted methods for estimating the extraction for industrial use are as below:

Unit Draft Method: - In this method, unit draft of each type of well is multiplied by the number of wells used for industrial purpose to obtain the industrial ground water extraction.

***Consumptive Use Pattern Method:* –** In this method, water consumption of different industrial units is determined. Numbers of Industrial units which are dependent on ground water are multiplied with unit water consumption to obtain ground water extraction for industrial use.

$$GE_{IND} = Number\ of\ Industrial\ Units \times Unit\ Water\ Consumption \times L_g \ldots\ldots\ldots..\ldots\ldots\ldots.(17)$$

Where,

L_g = Fractional load on ground water for industrial water supply.

The load on ground water for industrial water supply can be obtained from water supply agencies in the Industrial belt.

Ground water extraction obtained from different methods need to be compared and based on field checks, the seemingly best value may be adopted. At times, ground water extraction obtained by different methods may vary widely. In such cases, the value matching the field situation should be considered. The storage depletion during a season, where other recharges are negligible can be taken as ground water extraction during that particular period.

2.1.1.9. Stage of Ground Water Extraction

The stage of ground water extraction is defined by,

$$Stage\ of\ GW\ Extraction = \frac{Existing\ Gross\ GW\ Extraction\ for\ all\ Uses}{Annual\ Extractable\ GW\ Resources} \times 100 \ldots\ldots\ldots..\ldots(18)$$

The existing gross ground water extraction for all uses refers to the total of existing gross ground water extraction for irrigation and all other purposes. The stage of ground water extraction should be obtained separately for command areas, non-command areas and poor ground water quality areas.

2.1.1.10. Validation of Stage of Ground Water Extraction

The assessment based on the stage of ground water extraction has inherent uncertainties. In view of this, it is desirable to validate the 'Stage of Ground Water Extraction' with long term trend of ground water levels.

Long term Water Level trends are prepared for a minimum period of 10 years for both pre-monsoon and post-monsoon period. If the ground water resource assessment and the trend of long term water levels contradict each other, this anomalous situation requires a review of the ground water resource computation, as well as the reliability of water level data. The mismatch conditions are enumerated below.

SOGWE	Ground Water Level Trend	Remarks
≤ 70%	Significant decline in trend in both pre-monsoon and post-monsoon	Not acceptable and needs reassessment
> 100%	No significant decline in both pre-monsoon and post-monsoon long term trend	Not acceptable and needs reassessment

2.1.1.11. Categorisation of Assessment Unit

2.1.1.11.1. Categorisation of Assessment Unit Based on Quantity

The categorisation based on status of ground water quantity is defined by Stage of Ground Water Extraction as given below:

Stage of Ground Water Extraction	Category
≤ 70%	Safe
> 70% and ≤90%	Semi-critical
> 90% and ≤100%	Critical
> 100%	Over Exploited

2.1.1.11.2. Categorisation of Assessment Unit Based on Quality

As it is not possible to categorize the assessment units in terms of the extent of quality hazard, based on the available water quality monitoring mechanism and database on ground water quality, the Committee recommends that each assessment unit, in addition to the Quantity based categorization (safe, semi-critical, critical and over-exploited) should bear a quality hazard identifier. If any of the three quality hazards in terms of Arsenic, Fluoride and Salinity are encountered in the assessment sub unit in mappable units, the assessment sub unit has been tagged with the particular Quality hazard.

2.1.1.12. Allocation of Ground Water Resource for Utilisation

The Annual Extractable Ground Water Resources are to be apportioned between domestic, industrial and irrigation uses. Among these, as per the National Water Policy, requirement for domestic water supply is to be accorded priority. This requirement based on population has been projected to the year 2025, per capita requirement of water for domestic use, and relative load on ground water for urban and rural water supply. In situations where adequate data is not available to make this estimate, the following empirical relation has been utilized.

$$\boldsymbol{Alloc = 22 \times N \times L_g mm\ per\ year} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots.\ldots\ldots\ldots\ldots\ldots\ldots\ldots.(\mathbf{19})$$

Where,

Alloc = Allocation for domestic water requirement

N = population density in the unit in thousands per sq. km.

L_g= fractional load on ground water for domestic water supply (≤ 1.0)

2.1.1.13. Net Annual Ground Water Availability for Future Use

The water available for future use is obtained by deducting the allocation for domestic use and current extraction for Irrigation and Industrial uses from the Annual Extractable Ground Water Recharge. The resulting ground water potential is termed as the net annual ground water availability for future use. The Net annual ground water availability for future use is calculated separately for non-command areas and command areas. As per the recommendations of the R&D Advisory committee, the ground water available for future use can never be negative. If it becomes negative, the future allocation of Domestic needs can be reduced to current extraction for domestic use. Even then if it is still negative, then the ground water available for future uses has been projected as zero.

2.1.1.14. Additional Potential Resources under Specific Conditions

2.1.1.14.1. Potential Resource Due to Spring Discharge

Spring discharge occurs at the places where ground water level cuts the surface topography. The spring discharge is equal to the ground water recharge minus the outflow through evaporation and evapotranspiration and vertical and lateral sub-surface flow. Thus, Spring Discharge is a form of ‘Annual Extractable Ground Water Recharge’. It is a renewable resource, though has not been used for Categorisation. Spring discharge measurement has been carried out by volumetric measurement of discharge of the springs. Spring discharges multiplied with time in days of each season will give the quantum of spring resources available during that season.

$$\boldsymbol{Potential\ ground\ water\ resource\ due\ to\ springs = Q \times No. of days} \dots\dots\dots\dots..\dots\dots.(\mathbf{20})$$

Where,

Q = Spring Discharge

No of days = No of days spring yields.

2.1.1.14.2.Potential Resource in Waterlogged and Shallow Water Table Areas

In the area where the ground water level is less than 5m below ground level or in waterlogged areas, the resources up to 5m below ground level are potential and would be available for development in addition to the annual recharge in the area. The computation of potential resource to ground water reservoir in shallow water table areas has been done by adopting the following equation:

$$\boldsymbol{Potential\ groundwater\ resource\ in\ shallow\ water\ table\ areas}$$
$$= (\mathbf{5 - D}) \times \boldsymbol{A} \times \boldsymbol{S_Y} \dots\dots\dots..(\mathbf{21})$$

Where,

D = Depth to water table below ground surface in pre-monsoon period in shallow aquifers.

A = Area of shallow water table zone.

S_Y = Specific Yield

2.1.1.14.3.Potential Resource in Flood Prone Areas

Ground water recharge from a flood plain is mainly the function of the following parameters-

- Areal extent of flood plain
- Retention period of flood
- Type of sub-soil strata and silt charge in the river water which gets deposited and controls seepage

Since collection of data on all these factors is time taking and difficult, in the meantime, the potential resource from flood plain may be estimated on the same norms as for ponds, tanks and lakes. This has been calculated over the water spread area and only for the retention period using the following formula.

$$\boldsymbol{Potential\ groundwater\ resource\ in\ Flood\ Prone\ Areas}$$
$$= \mathbf{1.4} \times \boldsymbol{N} \times \frac{\boldsymbol{A}}{\mathbf{1000}} \dots\dots\dots\dots\dots\dots\dots...(\mathbf{22})$$

Where,

N = No. of Days Water is Retained in the Area

A = Flood Prone Area

2.1.1.15. Apportioning of Ground Water Assessment from Watershed to Development Unit

Where the assessment unit is a watershed, there is a need to convert the ground water assessment in terms of an administrative unit such as block/ taluka/ mandal. This has been done as follows.

A block may comprise of one or more watersheds, in part or full. First, the ground water assessment in the subareas, command, non-command and poor ground water quality areas of the watershed has been converted into depth unit (mm), by dividing the annual recharge by the respective area. The contribution of this subarea of the watershed to the block, is now calculated by multiplying this depth with the area in the block occupied by this sub-area.

The total ground water resource of the block has been presented separately for each type of sub-area, namely for command areas, non-command areas and poor ground water quality areas, as in the case of the individual watersheds.

2.2 GROUND WATER ASSESSMENT IN URBAN AREAS

The Assessment of Ground Water Resources in urban areas is similar to that of rural areas. Because of the availability of draft data and slightly different infiltration process and recharge due to other sources, the following few points are to be considered.

- Even though the data on existing ground water abstraction structures are available, accuracy is somewhat doubtful and individuals cannot even enumerate the well census in urban areas. Hence the difference of the actual demand and the supply by surface water sources as the withdrawal from the ground water resources has been considered for the assessment.

- The urban areas are sometimes concrete jungles and rainfall infiltration is not equal to that of rural areas unless and until special measures are taken in the construction of roads and pavements. Hence, 30% of the rainfall infiltration factor has been taken into consideration for urban areas as an adhoc arrangement till field studies in these areas are done and documented field studies are available.

- Because of the water supply schemes, there are many pipelines available in the urban areas and the seepages from these channels or pipes are huge in some areas. Hence this component has been included in the other resources and the recharge has also been considered. The percent losses have been collected from the individual water supply agencies, 50% of which has been considered as recharge to the ground water system.

- In the urban areas in India, normally, there is no separate channels either open or sub surface for the drainage and flash floods. These channels also recharge to some extent the ground water reservoir. As on today, there is no documented field study to assess the recharge. The seepages from the sewerages, which normally contaminate the ground water resources with nitrate also contribute to the quantity of resources and hence same percent as in the case of water supply pipes has been taken as norm for the recharge on the quantity of sewerage when there is sub surface drainage system. If estimated flash flood data is available, the same percent has been used on the quantum of flash floods to estimate the recharge from the flash floods.

- Urban areas with population more than 10 lakhs, has been considered as urban assessment unit while assessing the dynamic ground water resources.

2.3 GROUND WATER ASSESSMENT IN WATER LEVEL DEPLETION ZONES

There are areas where ground water level shows a decline even in the monsoon season. The reasons for this may be any one of the following: (a) There is a genuine depletion in the ground water regime, with ground water extraction and natural ground water discharge in the monsoon season (outflow from the region and base flow) exceeding the recharge. (b) There may be an error in water level data due to inadequacy of observation wells.

If it is concluded that the water level data is erroneous, recharge assessment has been made based on rainfall infiltration factor method. If, on the other hand, water level data is assessed as reliable, the ground water level fluctuation method has been applied for recharge estimation. As ΔS in equation 3& 4 is negative, the estimated recharge will be less than the gross ground water extraction in the monsoon season. It must be noted that this recharge is the gross recharge minus the natural discharges in the monsoon season. The immediate conclusion from such an assessment in water depletion zones is that the area falls under the over-exploited category which requires micro level study.

2.4 NORMS HAS BEEN USED IN THE ASSESSMENT

Specific Yield

Recently under Aquifer Mapping Project, Central Ground Water Board has classified all the aquifers into 14 Principal Aquifers which in turn were divided into 42 Major Aquifers. Hence, it is required to assign

Specific Yield values to all these aquifer units. The values recommended in the ***Table - 1*** has been followed in the present assessments, unless sufficient data based on field studies are available to justify the minimum, maximum or other intermediate values

Table 1 Norms Recommended for Specific Yield

Sl. No.	Principal Aquifer	Major Aquifers		Age	Recommended (%)	Minimum (%)	Maximum (%)
		Code	Name				
1	Alluvium	AL01	Younger Alluvium (Clay/Silt/Sand/ Calcareous concretions)	Quaternary	10	8	12
2	Alluvium	AL02	Pebble / Gravel/ Bazada/ Kandi	Quaternary	16	12	20
3	Alluvium	AL03	Older Alluvium (Silt/Sand/Gravel/Lithomargic clay)	Quaternary	6	4	8
4	Alluvium	AL04	Aeolian Alluvium (Silt/ Sand)	Quaternary	16	12	20
5	Alluvium	AL05	Coastal Alluvium (Sand/Silt/Clay)	Quaternary	10	8	12
6	Alluvium	AL06	Valley Fills	Quaternary	16	12	20
7	Alluvium	AL07	Glacial Deposits	Quaternary	16	12	20
8	Laterite	LT01	Laterite / Ferruginous concretions	Quaternary	2.5	2	3
9	Basalt	BS01	Basic Rocks (Basalt) - Weathered, Vesicular or Jointed	Mesozoic to Cenozoic	2	1	3
10	Basalt	BS01	Basic Rocks (Basalt) - Massive Poorly Jointed	Mesozoic to Cenozoic	0.35	0.2	0.5
11	Basalt	BS02	Ultra Basic - Weathered, Vesicular or Jointed	Mesozoic to Cenozoic	2	1	3
12	Basalt	BS02	Ultra Basic - Massive Poorly Jointed	Mesozoic to Cenozoic	0.35	0.2	0.5
13	Sandstone	ST01	Sandstone/Conglomerate	Upper Paleozoic to Cenozoic	3	1	5
14	Sandstone	ST02	Sandstone with Shale	Upper Paleozoic to Cenozoic	3	1	5
15	Sandstone	ST03	Sandstone with shale/ coal beds	Upper Paleozoic to Cenozoic	3	1	5
16	Sandstone	ST04	Sandstone with Clay	Upper Paleozoic	3	1	5

Sl. No.	Principal Aquifer	Major Aquifers		Age	Recommended (%)	Minimum (%)	Maximum (%)
		Code	Name				
				to Cenozoic			
17	Sandstone	ST05	Sandstone/Conglomerate	Proterozoic to Cenozoic	3	1	5
18	Sandstone	ST06	Sandstone with Shale	Proterozoic to Cenozoic	3	1	5
19	Shale	SH01	Shale with limestone	Upper Paleozoic to Cenozoic	1.5	1	2
20	Shale	SH02	Shale with Sandstone	Upper Paleozoic to Cenozoic	1.5	1	2
21	Shale	SH03	Shale, limestone and sandstone	Upper Paleozoic to Cenozoic	1.5	1	2
22	Shale	SH04	Shale	Upper Paleozoic to Cenozoic	1.5	1	2
23	Shale	SH05	Shale/Shale with Sandstone	Proterozoic to Cenozoic	1.5	1	2
24	Shale	SH06	Shale with Limestone	Proterozoic to Cenozoic	1.5	1	2
25	Limestone	LS01	Miliolitic Limestone	Quaternary	2	1	3
26	Limestone	LS01	KarstifiedMiliolitic Limestone	Quaternary	10	5	15
27	Limestone	LS02	Limestone / Dolomite	Upper Paleozoic to Cenozoic	2	1	3
28	Limestone	LS02	Karstified Limestone / Dolomite	Upper Paleozoic to Cenozoic	10	5	15
29	Limestone	LS03	Limestone/Dolomite	Proterozoic	2	1	3
30	Limestone	LS03	Karstified Limestone/Dolomite	Proterozoic	10	5	15
31	Limestone	LS04	Limestone with Shale	Proterozoic	2	1	3
32	Limestone	LS04	Karstified Limestone with Shale	Proterozoic	10	5	15

Sl. No.	Principal Aquifer	Major Aquifers		Age	Recommended (%)	Minimum (%)	Maximum (%)
		Code	Name				
33	Limestone	LS05	Marble	Azoic to Proterozoic	2	1	3
34	Limestone	LS05	Karstified Marble	Azoic to Proterozoic	10	5	15
35	Granite	GR01	Acidic Rocks (Granite,Syenite, Rhyolite etc.) - Weathered , Jointed	Mesozoic to Cenozoic	1.5	1	2
36	Granite	GR01	Acidic Rocks (Granite,Syenite, Rhyolite etc.)-Massive or Poorly Fractured	Mesozoic to Cenozoic	0.35	0.2	0.5
37	Granite	GR02	Acidic Rocks (Pegmatite, Granite, Syenite, Rhyolite etc.) - Weathered, Jointed	Proterozoic to Cenozoic	3	2	4
38	Granite	GR02	Acidic Rocks (Pegmatite, Granite, Syenite, Rhyolite etc.) - Massive, Poorly Fractured	Proterozoic to Cenozoic	0.35	0.2	0.5
39	Schist	SC01	Schist - Weathered, Jointed	Azoic to Proterozoic	1.5	1	2
40	Schist	SC01	Schist - Massive, Poorly Fractured	Azoic to Proterozoic	0.35	0.2	0.5
41	Schist	SC02	Phyllite	Azoic to Proterozoic	1.5	1	2
42	Schist	SC03	Slate	Azoic to Proterozoic	1.5	1	2
43	Quartzite	QZ01	Quartzite - Weathered, Jointed	Proterozoic to Cenozoic	1.5	1	2
44	Quartzite	QZ01	Quartzite - Massive, Poorly Fractured	Proterozoic to Cenozoic	0.3	0.2	0.4
45	Quartzite	QZ02	Quartzite - Weathered, Jointed	Azoic to Proterozoic	1.5	1	2
46	Quartzite	QZ02	Quartzite- Massive, Poorly Fractured	Azoic to Proterozoic	0.3	0.2	0.4
47	Charnockite	CK01	Charnockite - Weathered, Jointed	Azoic	3	2	4
48	Charnockite	CK01	Charnockite - Massive, Poorly Fractured	Azoic	0.3	0.2	0.4
49	Khondalite	KH01	Khondalites, Granulites - Weathered, Jointed	Azoic	1.5	1	2
50	Khondalite	KH01	Khondalites, Granulites - Mssive, Poorly Fractured	Azoic	0.3	0.2	0.4
51	Banded Gneissic Complex	BG01	Banded Gneissic Complex - Weathered, Jointed	Azoic	1.5	1	2

Sl. No.	Principal Aquifer	Major Aquifers		Age	Recommended (%)	Minimum (%)	Maximum (%)
		Code	Name				
52	Banded Gneissic Complex	BG01	Banded Gneissic Complex - Massive, Poorly Fractured	Azoic	0.3	0.2	0.4
53	Gneiss	GN01	Undifferentiated metasedimentaries/ Undifferentiated metamorphic - Weathered, Jointed	Azoic to Proterozoic	1.5	1	2
54	Gneiss	GN01	Undifferentiated metasedimentaries/ Undifferentiated metamorphic - Massive, Poorly Fractured	Azoic to Proterozoic	0.3	0.2	0.4
55	Gneiss	GN02	Gneiss -Weathered, Jointed	Azoic to Proterozoic	3	2	4
56	Gneiss	GN02	Gneiss-Massive, Poorly Fractured	Azoic to Proterozoic	0.3	0.2	0.4
57	Gneiss	GN03	Migmatitic Gneiss - Weathered, Jointed	Azoic	1.5	1	2
58	Gneiss	GN03	Migmatitic Gneiss - Massive, Poorly Fractured	Azoic	0.3	0.2	0.4
59	Intrusive	IN01	Basic Rocks (Dolerite, Anorthosite etc.) - Weathered, Jointed	Proterozoic to Cenozoic	2	1	3
60	Intrusive	IN01	Basic Rocks (Dolerite, Anorthosite etc.) - Massive, Poorly Fractured	Proterozoic to Cenozoic	0.35	0.2	0.5
61	Intrusive	IN02	Ultrabasics (Epidiorite, Granophyre etc.) - Weathered, Jointed	Proterozoic to Cenozoic	2	1	3
62	Intrusive	IN02	Ultrabasics (Epidiorite, Granophyre etc.) - Massive, Poorly Fractured	Proterozoic to Cenozoic	0.35	0.2	0.5

Rainfall Infiltration Factor

The values mentioned in ***Table-2*** has been used in the present assessment. The recommended Rainfall Infiltration Factor has been used for assessment, unless sufficient data based on field studies are available to justify the minimum, maximum or other intermediate values.

Table 2 Norms Recommended for Rainfall Infiltration Factor

Sl. No.	Principal Aquifer	Major Aquifers		Age	Recommended (%)	Minimum (%)	Maximum (%)
		Code	Name				
1	Alluvium	AL01	Younger Alluvium (Clay/Silt/Sand/ Calcareous concretions)	Quaternary	22	20	24
2	Alluvium	AL02	Pebble / Gravel/ Bazada/ Kandi	Quaternary	22	20	24
3	Alluvium	AL03	Older Alluvium (Silt/Sand/Gravel/Lithomargic clay)	Quaternary	22	20	24
4	Alluvium	AL04	Aeolian Alluvium (Silt/ Sand)	Quaternary	22	20	24
5	Alluvium	AL05	Coastal Alluvium (Sand/Silt/Clay) -East Coast	Quaternary	16	14	18
5	Alluvium	AL05	Coastal Alluvium (Sand/Silt/Clay) - West Coast	Quaternary	10	8	12
6	Alluvium	AL06	Valley Fills	Quaternary	22	20	24
7	Alluvium	AL07	Glacial Deposits	Quaternary	22	20	24
8	Laterite	LT01	Laterite / Ferruginous concretions	Quaternary	7	6	8
9	Basalt	BS01	Basic Rocks (Basalt) - Vesicular or Jointed	Mesozoic to Cenozoic	13	12	14
9	Basalt	BS01	Basic Rocks (Basalt) - Weathered	Mesozoic to Cenozoic	7	6	8
10	Basalt	BS01	Basic Rocks (Basalt) - Massive Poorly Jointed	Mesozoic to Cenozoic	2	1	3
11	Basalt	BS02	Ultra Basic - Vesicular or Jointed	Mesozoic to Cenozoic	13	12	14
11	Basalt	BS02	Ultra Basic - Weathered	Mesozoic to Cenozoic	7	6	8
12	Basalt	BS02	Ultra Basic - Massive Poorly Jointed	Mesozoic to Cenozoic	2	1	3
13	Sandstone	ST01	Sandstone/Conglomerate	Upper Paleozoic to Cenozoic	12	10	14
14	Sandstone	ST02	Sandstone with Shale	Upper Paleozoic to Cenozoic	12	10	14
15	Sandstone	ST03	Sandstone with shale/ coal beds	Upper Paleozoic	12	10	14

Sl. No.	Principal Aquifer	Major Aquifers		Age	Recommended (%)	Minimum (%)	Maximum (%)
		Code	Name				
				to Cenozoic			
16	Sandstone	ST04	Sandstone with Clay	Upper Paleozoic to Cenozoic	12	10	14
17	Sandstone	ST05	Sandstone/Conglomerate	Proterozoic to Cenozoic	6	5	7
18	Sandstone	ST06	Sandstone with Shale	Proterozoic to Cenozoic	6	5	7
19	Shale	SH01	Shale with limestone	Upper Paleozoic to Cenozoic	4	3	5
20	Shale	SH02	Shale with Sandstone	Upper Paleozoic to Cenozoic	4	3	5
21	Shale	SH03	Shale, limestone and sandstone	Upper Paleozoic to Cenozoic	4	3	5
22	Shale	SH04	Shale	Upper Paleozoic to Cenozoic	4	3	5
23	Shale	SH05	Shale/Shale with Sandstone	Proterozoic to Cenozoic	4	3	5
24	Shale	SH06	Shale with Limestone	Proterozoic to Cenozoic	4	3	5
25	Limestone	LS01	Miliolitic Limestone	Quaternary	6	5	7
27	Limestone	LS02	Limestone / Dolomite	Upper Paleozoic to Cenozoic	6	5	7
29	Limestone	LS03	Limestone/Dolomite	Proterozoic	6	5	7
31	Limestone	LS04	Limestone with Shale	Proterozoic	6	5	7
33	Limestone	LS05	Marble	Azoic to Proterozoic	6	5	7
35	Granite	GR01	Acidic Rocks (Granite,Syenite, Rhyolite etc.) - Weathered , Jointed	Mesozoic to Cenozoic	7	5	9

Sl. No.	Principal Aquifer	Major Aquifers		Age	Recommended (%)	Minimum (%)	Maximum (%)
		Code	Name				
36	Granite	GR01	Acidic Rocks (Granite,Syenite, Rhyolite etc.)-Massive or Poorly Fractured	Mesozoic to Cenozoic	2	1	3
37	Granite	GR02	Acidic Rocks (Pegmatite, Granite, Syenite, Rhyolite etc.) - Weathered, Jointed	Proterozoic to Cenozoic	11	10	12
38	Granite	GR02	Acidic Rocks (Pegmatite, Granite, Syenite, Rhyolite etc.) - Massive, Poorly Fractured	Proterozoic to Cenozoic	2	1	3
39	Schist	SC01	Schist - Weathered, Jointed	Azoic to Proterozoic	7	5	9
40	Schist	SC01	Schist - Massive, Poorly Fractured	Azoic to Proterozoic	2	1	3
41	Schist	SC02	Phyllite	Azoic to Proterozoic	4	3	5
42	Schist	SC03	Slate	Azoic to Proterozoic	4	3	5
43	Quartzite	QZ01	Quartzite - Weathered, Jointed	Proterozoic to Cenozoic	6	5	7
44	Quartzite	QZ01	Quartzite - Massive, Poorly Fractured	Proterozoic to Cenozoic	2	1	3
45	Quartzite	QZ02	Quartzite - Weathered, Jointed	Azoic to Proterozoic	6	5	7
46	Quartzite	QZ02	Quartzite- Massive, Poorly Fractured	Azoic to Proterozoic	2	1	3
47	Charnockite	CK01	Charnockite - Weathered, Jointed	Azoic	5	4	6
48	Charnockite	CK01	Charnockite - Massive, Poorly Fractured	Azoic	2	1	3
49	Khondalite	KH01	Khondalites, Granulites - Weathered, Jointed	Azoic	7	5	9
50	Khondalite	KH01	Khondalites, Granulites - Mssive, Poorly Fractured	Azoic	2	1	3
51	Banded Gneissic Complex	BG01	Banded Gneissic Complex - Weathered, Jointed	Azoic	7	5	9
52	Banded Gneissic Complex	BG01	Banded Gneissic Complex - Massive, Poorly Fractured	Azoic	2	1	3
53	Gneiss	GN01	Undifferentiated metasedimentaries/ Undifferentiated metamorphic - Weathered, Jointed	Azoic to Proterozoic	7	5	9

Sl. No.	Principal Aquifer	Major Aquifers		Age	Recommended (%)	Minimum (%)	Maximum (%)
		Code	Name				
54	Gneiss	GN01	Undifferentiated metasedimentaries/ Undifferentiated metamorphic - Massive, Poorly Fractured	Azoic to Proterozoic	2	1	3
55	Gneiss	GN02	Gneiss -Weathered, Jointed	Azoic to Proterozoic	11	10	12
56	Gneiss	GN02	Gneiss-Massive, Poorly Fractured	Azoic to Proterozoic	2	1	3
57	Gneiss	GN03	Migmatitic Gneiss - Weathered, Jointed	Azoic	7	5	9
58	Gneiss	GN03	Migmatitic Gneiss - Massive, Poorly Fractured	Azoic	2	1	3
59	Intrusive	IN01	Basic Rocks (Dolerite, Anorthosite etc.) - Weathered, Jointed	Proterozoic to Cenozoic	7	6	8
60	Intrusive	IN01	Basic Rocks (Dolerite, Anorthosite etc.) - Massive, Poorly Fractured	Proterozoic to Cenozoic	2	1	3
61	Intrusive	IN02	Ulrta Basics (Epidiorite, Granophyre etc.) - Weathered, Jointed	Proterozoic to Cenozoic	7	6	8
62	Intrusive	IN02	Ulrta Basics (Epidiorite, Granophyre etc.) - Massive, Poorly Fractured	Proterozoic to Cenozoic	2	1	3

Norms for Canal Recharge

The Norms suggested in ***Table-3*** has been used for estimating the recharge from Canals, where sufficient data based on field studies are not available.

Table 3 Norms Recommended for Recharge due to Canals

Formation	Canal Seepage factor ham/day/million square meters of wetted area		
	Recommended	Minimum	Maximum
Unlined canals in normal soils with some clay content along with sand	17.5	15	20
Unlined canals in sandy soil with some silt content	27.5	25	30
Lined canals in normal soils with some clay content along with sand	3.5	3	4
Lined canals in sandy soil with some silt content	5.5	5	6
All canals in hard rock area	3.5	3	4

2.1.2. Norms for Recharge Due to Irrigation

The Recommended Norms are presented in ***Table-4***.

Table 4 Norms Recommended for Recharge from Irrigation

DTW m bgl	Ground Water		Surface Water	
	Paddy	**Non-paddy**	**Paddy**	**Non-paddy**
≤ 10	45.0	25.0	50.0	30.0
11	43.3	23.7	48.3	28.7
12	40.4	22.1	45.1	26.8
13	37.7	20.6	42.1	25.0
14	35.2	19.2	39.3	23.3
15	32.9	17.9	36.7	21.7
16	30.7	16.7	34.3	20.3
17	28.7	15.6	32.0	18.9
18	26.8	14.6	29.9	17.6
19	25.0	13.6	27.9	16.4
20	23.3	12.7	26.0	15.3
21	21.7	11.9	24.3	14.3
22	20.3	11.1	22.7	13.3
23	18.9	10.4	21.2	12.4
24	17.6	9.7	19.8	11.6
≥ 25	20.0	5.0	25.0	10.0

Norms for Recharge due to Tanks & Ponds

As the data on the field studies for computing recharge from Tanks & Ponds are very limited, for Seepage from Tanks & Ponds has been used as 1.4 mm / day in the present assessment.

Norms for Recharge due to Water Conservation Structures

The data on the field studies for computing recharge from Water Conservation Structures are very limited, hence, the norm recommended by GEC-2015 for the seepage from Water Conservation Structures is 40% of gross storage during a year which means 20% during monsoon season and 20% during non-monsoon Season is adopted.

Unit Draft

The methodology recommends to use well census method for computing the ground water draft. The norm used for computing ground water draft is the unit draft. The unit draft can be computed by field studies. This method involves selecting representative abstraction structure and calculating the discharge from that particular type of structure and collecting the information on how many hours of pumping is being done in various seasons and number of such days during each season. The Unit Draft during a particular season is computed using the following equation:

$$\boldsymbol{Unit\ Draft = Discharge\ in\ m^3/hr \times No.of\ pumping\ hours\ in\ a\ day} \\ \times \boldsymbol{No.of\ days} \ldots\ldots\ldots(\mathbf{29})$$

But the procedure that is being followed for computing unit draft does not have any normalization procedure. Normally, if the year in which one collects the draft data in the field is an excess rainfall year, the abstraction from ground water will be less. Similarly, if the year of the computation of unit draft is a drought year the unit draft will be high. Hence, there is a requirement to devise a methodology that can be used for the normalization of unit draft figures. The following are the two simple techniques, which are followed for normalization of Unit Draft. Areas where, unit draft values for one rainfall cycle are available for at least 10 years second method shown in equation 31 is followed or else the first method shown in equation 30 has been used.

$$\boldsymbol{Normalised\ Unit\ Draft = \frac{Unit\ Draft \times Rainfall\ for\ the\ year}{Normal\ Rainfall}} \ldots\ldots\ldots\ldots\ldots\ldots\ldots.\ldots\ldots\ldots(\mathbf{30})$$

$$\boldsymbol{Normalised\ Unit\ Draft = \frac{\sum_{i=1}^{n} Unit\ Draft_i}{Number\ of\ Years}} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots..(\mathbf{31})$$

2.5 INDIA -GROUNDWATER RESOURCE ESTIMATION SYSTEM (IN-GRES)

"INDIA-GROUNDWATER RESOURCE ESTIMATION SYSTEM (IN-GRES) is a Software/Web-based Application developed by CGWB in collaboration with IIT-Hyderabad. It provides common and standardized platform for Ground Water Resource Estimation for the entire country and its pan-India operationalization (Central and State Governments). The system takes 'Data Input' through Excel as well as Forms, compute various ground water components (recharge, extraction etc.) and classify assessment units into appropriate categories (safe, semi-critical, critical and over-exploited). The Software uses GEC 2015 Methodology for estimation and calculation of Groundwater resources. It allows for unique and homogeneous representation of groundwater fluxes as well as categories for all the assessment units (AU) of the country.

URL of IN-GRES →http://ingres.iith.ac.in

CHAPTER - 3

3.0 RAINFALL

Normal Rainfall of the State/ UT

About 90% of the annual rainfall occurs during the south west monsoon periods from June to September. August is the rainiest month. The normal annual rainfall for the Region has been estimated as 1351 mm. The normal monsoon rainfall is 1201 mm. The rainfall decreases aswe move from South-East to North-West. The normal rainfall varies with highest 1481 in Bastar district to lowest 1112 mm in Rajnandgaon district.

District Wise Normal Rainfall of the State/UT

Table 5 District Wise Normal Rainfall of Chhattisgarh

District	**Monsoon Normal Rainfall (mm)**	**Non-Monsoon Normal Rainfall (mm)**	**Normal Annual Rainfall**
BALOD	1018.0	104.9	1122.9
BALODA BAZAR	1243.7	160.5	1404.3
BALRAMPUR	1179.0	138.0	1317.0
BASTAR	1154.2	208.4	1362.6
BEMETARA	1018.0	104.9	1122.9
BIJAPUR	1369.0	159.1	1528.1
BILASPUR	984.2	124.3	1108.5
DANTEWADA	1178.1	149.8	1327.9
DHAMTARI	1286.7	98.6	1385.3
DURG	1018.0	104.9	1122.9
GARIABAND	1286.7	98.6	1385.3
GOURELA-PENDRA-MARWAHI	1067.8	162.0	1229.8
JANJGIR-CHAMPA	1234.0	152.0	1386.0
JASHPUR	1307.5	180.0	1487.5
KABIRDHAM	962.0	183.8	1145.8
KANKER	1221.0	173.1	1394.1
KHAIRAGARH-CHHUIKHADAN_GANDAI	1076.0	132.7	1208.7
KONDAGAON	1154.0	208.4	1362.4
KORBA	1234.0	158.0	1392.0
KOREA	1179.0	138.0	1317.0
MAHASAMUND	1283.6	120.9	1404.4
MANENDRAGARH-CHIRMIRI_BHARATPUR	1179.0	138.0	1317.0
MOHLA-MANPUR_AMBAGARHCHOWKI	1076.0	132.7	1208.7
MUNGELI	1234.0	117.0	1351.0

NARAYANPUR	1227.0	177.1	1404.1
RAIGARH	1307.0	159.0	1466.0
RAIPUR	1264.6	112.3	1376.9
RAJNANDGAON	1076.0	132.7	1208.7
SAKTI	1234.0	152.0	1386.0
SARANGARH-BILAIRAGH	1257.7	170.3	1428.0
SUKMA	1270.7	133.0	1403.7
SURAJPUR	1110.1	123.5	1233.6
SURGUJA	1217.3	139.1	1356.3

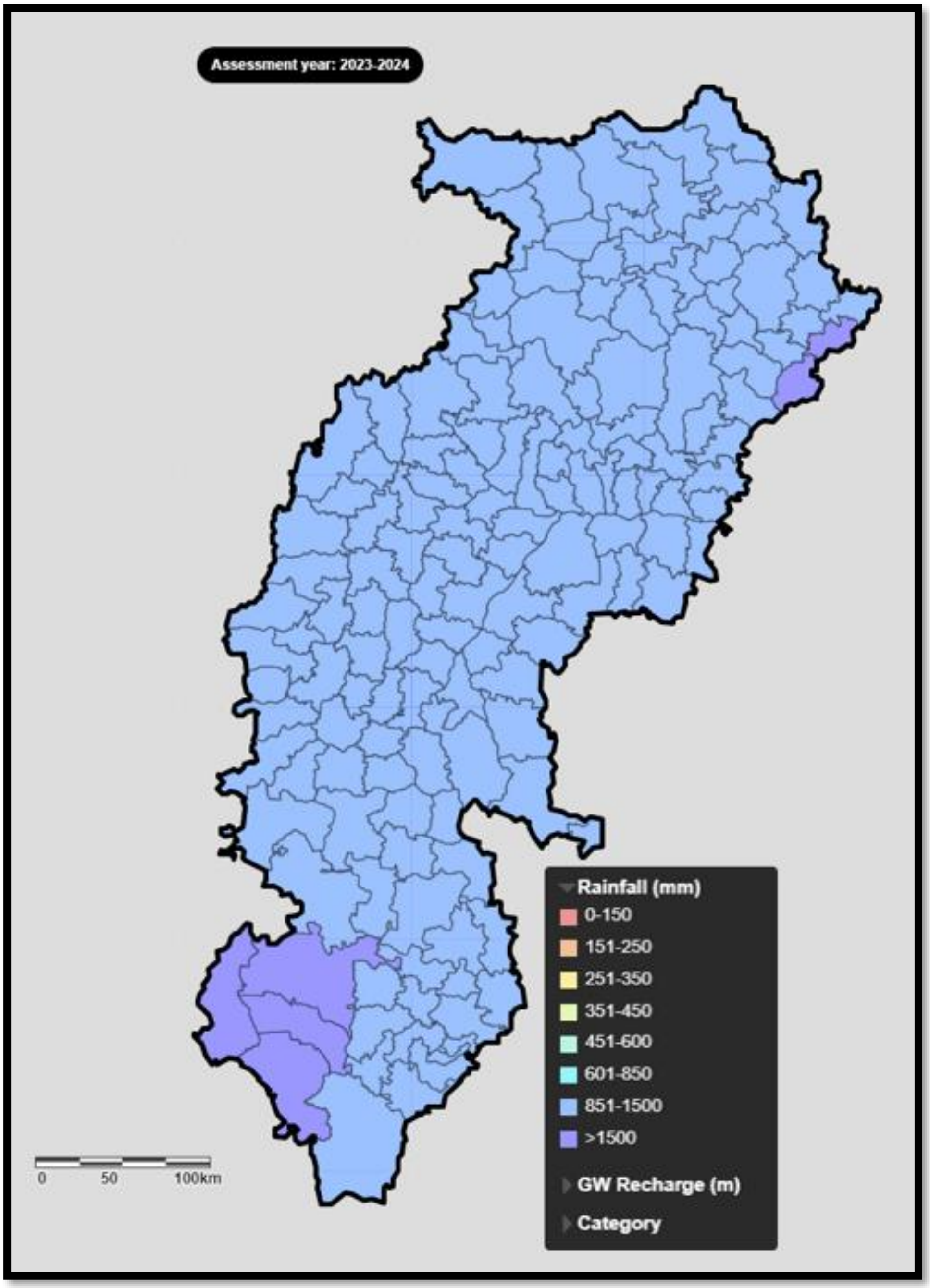

Figure 2 Annual Normal Rainfall in mm

Table 6 Rainfall during the Calendar Year 2023 for the State/UT and District Wise

S.No	**STATE/ UT**	**DISTRICT**	**Rainfall (mm)**		
			Monsoon	**Non-Monsoon**	**Total**
1	CHHATTISGARH	BALOD	1137.66	497.02	1634.67
2	CHHATTISGARH	BALODA BAZAR	1232.22	198.86	1431.08
3	CHHATTISGARH	BALRAMPUR	968.72	241.85	1210.57
4	CHHATTISGARH	BASTAR	1063.34	306.79	1370.13
5	CHHATTISGARH	BEMETARA	1560.28	342.25	1902.53
6	CHHATTISGARH	BIJAPUR	1479.34	258.38	1737.71
7	CHHATTISGARH	BILASPUR	1292.80	181.08	1473.88
8	CHHATTISGARH	DANTEWADA	1522.34	335.74	1858.07
9	CHHATTISGARH	DHAMTARI	988.73	140.63	1129.35
10	CHHATTISGARH	DURG	1352.43	583.20	1935.63
11	CHHATTISGARH	GARIABAND	1016.66	188.36	1205.02
12	CHHATTISGARH	GOURELA-PENDRA-MARWAHI	986.84	173.44	1160.28
13	CHHATTISGARH	JANJGIR-CHAMPA	1227.70	135.98	1363.68
14	CHHATTISGARH	JASHPUR	867.69	110.46	978.15
15	CHHATTISGARH	KABIRDHAM	997.00	172.80	1169.80
16	CHHATTISGARH	KANKER	1032.10	172.61	1204.71
17	CHHATTISGARH	KHAIRAGARH-CHHUIKHADAN_GANDAI	962.34	155.04	1117.37
18	CHHATTISGARH	KONDAGAON	988.83	383.61	1372.44
19	CHHATTISGARH	KORBA	1058.02	504.32	1562.34
20	CHHATTISGARH	KOREA	900.30	170.25	1070.55
21	CHHATTISGARH	MAHASAMUND	1137.47	174.87	1312.34
22	CHHATTISGARH	MANENDRAGARH-CHIRMIRI_BHARATPUR	905.37	101.13	1006.50
23	CHHATTISGARH	MOHLA-MANPUR_AMBAGARHCHOWKI	1106.75	158.24	1264.99
24	CHHATTISGARH	MUNGELI	1303.77	138.03	1441.80
25	CHHATTISGARH	NARAYANPUR	1089.28	217.39	1306.67
26	CHHATTISGARH	RAIGARH	1189.83	143.59	1333.41
27	CHHATTISGARH	RAIPUR	937.93	83.25	1021.18
28	CHHATTISGARH	RAJNANDGAON	1132.46	159.49	1291.95
29	CHHATTISGARH	SAKTI	1018.20	83.08	1101.28
30	CHHATTISGARH	SARANGARH-BILAIRAGH	1113.12	122.00	1235.11
31	CHHATTISGARH	SUKMA	1207.59	378.78	1586.38
32	CHHATTISGARH	SURAJPUR	766.13	199.55	965.68
33	CHHATTISGARH	SURGUJA	498.63	105.13	603.76

Table 7 Rainfall during Ground Water Assessment Year 2023-24 for the State/UT and District wise

District	**Rainfall (mm)**
BALOD	1122.9
BALODA BAZAR	1396.6
BALRAMPUR	1317
BASTAR	1368.9
BEMETARA	1122.9
BIJAPUR	1528.1
BILASPUR	1114.46
DANTEWADA	1327.9
DHAMTARI	1385.3
DURG	1122.9
GARIABAND	1385.3
GOURELA-PENDRA-MARWAHI	1229.8
JANJGIR-CHAMPA	1386
JASHPUR	1480.03
KABIRDHAM	1117
KANKER	1397.50
KHAIRAGARH-CHHUIKHADAN_GANDAI	1208.7
KONDAGAON	1362.4
KORBA	1392
KOREA	1317
MAHASAMUND	1406.2
MANENDRAGARH-CHIRMIRI_BHARATPUR	1317
MOHLA-MANPUR_AMBAGARHCHOWKI	1208.7
MUNGELI	1351
NARAYANPUR	1404.1
RAIGARH	1466
RAIPUR	1376.3
RAJNANDGAON	1208.7
SAKTI	1386
SARANGARH-BILAIRAGH	1418.4
SUKMA	1403.8
SURAJPUR	1241.8
SURGUJA	1369.1

CHAPTER - 4

4.0 HYDROGEOLOGICAL SETUP OF CHHATTISGARH STATE

The state is underlain by various rock types of different geological ages from Pre-Cambrianto Recent age. These include the Archaean Crystalline, Precambrian Sedimentaries, Gondwanas, Deccan Traps and Unconsolidated Sediments (Figure-2). There exists a huge diversity in the distribution of groundwater in the state due to the varied hydrogeological characters of the rock types, which ultimately forms the aquifers. To understand the regional hydrogeological behavior of Chhattisgarh State, the complex hydrogeological setup has been classified into two groups based on their characters viz. Fissured Formations and Porous Formations.

DESCRIPTION OF ROCK TYPES

POROUS FORMATION

Porous formations have been further subdivided into unconsolidated and Semi- consolidated formations.

UNCONSOLIDATED FORMATION

Unconsolidated formations of Quaternary age include alluvium, clay, silt, and laterite etc. Quaternary alluvium forms thin unconfined aquifers with maximum thickness up to 40 m bgl. Extent of such formation is very much limited to 338 sq. km. which is 0.44 % area of the state, butthey form potential aquifers in localized areas. They occur in several isolated patches mainly alongmajor river courses like Mahanadi, Arpa, Hasdeo, Seonath, Kharun, Mand, Kelo etc. These aquifers have good potential for ground water yield and are being developed through dug wells, shallow bore wells and filter point wells. Potential alluvial aquifer, which is highly developed, found in Bilaspur and Janjgir–Champa district. Laterites also occur in detached patches over various rock types. Wells tapping laterite profile can be seen mostly on traps in Surguja and Jashpur districts. Ground water occurs in these rocks in phreatic condition and is restricted up to the upper level of the lithomargic clays. Ground water in this province is developed mainly throughdug wells. Laterite aquifers are having moderately good yield.

SEMI-CONSOLIDATED FORMATION

The rocks belonging to Gondwana Super Group are found mostly in Raigarh, Korba, Surguja and Koriya districts. A small part is also found in Bilaspur and Kawardha districts. They cover nearly 12 % of area in the state.

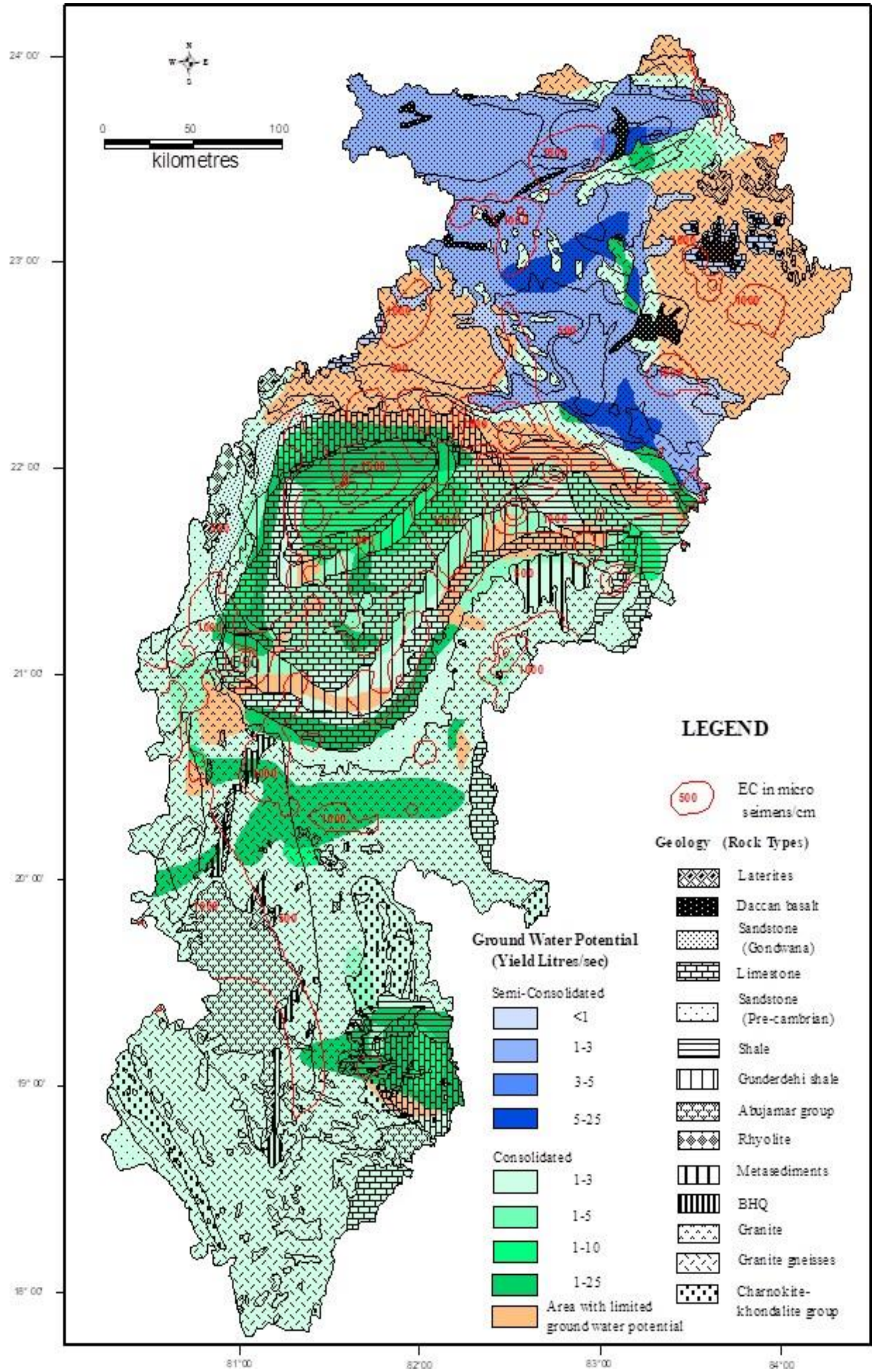

Figure 3 Hydrogeology of Chhattisgarh

These consist mainly of sandstone, shale, clay, siltstone and coal seams. The Gondwana sandstones have primary and occasional secondary porosity. They form thick and extensive unconfined to confined aquifers down to 300 m bgl. Groundwater, sometimes, occurs under flowing conditions in localised belts. The Barakar sandstones, which occupy the largest part withinGondwana area, are good productive aquifers with discharge ranges from 1 to 10 lps. Thick shaleand clay beds of Barakar formation act as confining layer. At places high groundwater temperatureeven up to 50^{o} C have been recorded. Ground water development in these formations is through dug wells as well as through bore wells and tube wells.

FISSURED FORMATIONS (CONSOLIDATED FORMATIONS)

The consolidated formations occupy nearly 87% of the area of the State. The occurrence of ground water in these rocks is largely controlled by fracture patterns and brittleness developedin them due to various tectonic activities or due to solution cavities formed by fluid activities. From the hydro-geological point of view the fissured rocks (having fractures) are broadly dividedinto three types, viz. Igneous and metamorphic, and carbonate rocks, Volcanic rocks and consolidated sedimentary rocks excluding carbonate rocks and Carbonate rocks.

The various rock formations with distinctive hydrogeological characteristics act as different aquifer systems of various dimensions. The various major rock formations of India can be broadly categorized in to 14 Principal aquifer Systems based on their broad hydrogeological properties. A brief account of the Principal Aquifer Systems is discussed in the followingparagraphs. The principal Aquifer systems as identified by Central Ground Water Board are shownin Figure-4**.** The Principal Aquifers are further divided into 42 Major Aquifers (Table-4) depending on their distinctive hydrological characteristics and their spatial distribution.

DESCRIPTION OF HYDROGEOLOGICAL UNITS

The hydrogeological framework of Chhattisgarh state consists both fracture and porous aquifer media. Based on the prevailing porosity type, the rocks of the state have been divided intotwo broad types (1) hard rocks and (2) soft rocks. Both these types of rocks were further subdividedinto groups to simplify the complex geological classification for the purpose of study of ground water behavior The distribution of hydrogeological units is presented in Table-3 and hydro- geological map of Chhattisgarh is presented in Figure-2.

Table 8 Distribution of Hydrogeological Units in Chhattisgarh

Geological Age		Rock Formations	Districts/ Hydrogeological Characters
Consolidated Formations:			
Upper Cretaceous to Eocene	Deccan traps	Basalts, Dolerites and acidic derivatives of Basaltic magma	Jashpur, Surguja, Kawardha, Bilaspur
Pre Cambrian (Proterozoics)	Chhattisgarh Super Group, Indravati Group, Khariyar Group, Sukma Group and Pakhal Group	❖ Consolidated sandstones ❖ Shales ❖ Limestones and Dolomites	Raipur, Durg, Dhamtari, Janjgir-Champa, Bilaspur, Mahasamund, Rajnandgaon, Raigarh, Kawardha, Korba, Bastar, Dantewada Karstified and Cavernous, Lime-stones, Recrystallised fractured dolomites and fractured Shales forms the unconfined to confined aquifers.
	Dongargarh Supergroup (Abhujmar Group, Chilpi group, Dongargarh and Kanker Granites, Nandgaon Group)	❖ Granites ❖ Schists and Phyllites ❖ Arkose and Conglomerate ❖ Rhyolites and Andesites	Bastar, Kanker, Raipur, Maha-samund, Dhamtari, Rajnandgaon, Kawardha, Durg, Bilaspur, Raigarh, Surguja, Dantewada Unconfined shallow aquifer
Archaeans	Bengpal / Amgaon Group Peninsular Gneiss and unclassified basement	Granites, Gneiss and Metasediment Charnockites and Khondalites	Dantewada, Bastar, Kanker, Raipur, Raigarh, Bilaspur, Mahasamund, Rajnandgaon, Surguja, Jashpur, Kawardha, Champa, Korba, Durg, Koriya Unconfined shallow aquifer
Semi-consolidated formation:			
Carboniferous to Cretaceous	Gondwana Supergroup	Pebbles and boulders Sandstones Shales Coal Seams	Raigarh, Surguja, Koriya, Korba Unconfined to confined aquifers
Unconsolidated formation:			
Quaternary	Alluvium and Laterites	Sand, Silt and Gravels Laterites	All over the State along major drainages. In isolated patches. Unconfined aquifers.

Hard rock

Rocks having secondary porosity- much dominated over primary porosity are grouped under hard rock category. The rock type and their distribution along with their broad characteristicsare

Basement Crystallines, Plutonic-Volcanic and Meta Sedimentary- Precambrian Sedimentaryrocks and Deccan Volcanics.

Soft Rocks

Rocks having primary porosity much dominated over secondary porosity are groupedunder soft rock category. Semi Consolidated Sedimentary and Unconsolidated Sedimentary rocks.

AQUIFER SYSTEMS OF CHHATTISGARH

Alluvial Aquifers

The unconsolidated Quaternary sediments comprising Recent Alluvium and Older Alluvium, forming by and large the major Alluvial Aquifers. These sediments are essentially composed of clays, silts, sands, pebbles, Kanker etc. found around Dhamtari- along Mahanadi, Bilaspur- along Arpa, Gandai- along Surhi, Jagdalpur- along Indravati, Bamnidih- along of Hasdeo, Dongargaon- along Seonath and Khairagarh- along Amner. The maximum thickness of the alluvium is found as 30 m in Bilaspur and 70m in Dhamtari area. In addition to the Annual Replenishable Ground Water Resources in the zone of Water Level Fluctuation (Dynamic GroundWater Resource), a huge ground water reserve occurs below the zone of fluctuation in unconfinedaquifers and as well as in the deeper confined aquifers. This formation consists of sand, silt, clay and pebbles. Ground water occurs in phreatic to semi-confined condition. Water level in this areavaries between 2 and 20 m. Though isolated, shallow and small, these aquifers have good potentialfor ground water yield and development through dug wells, shallow bore wells and filter point wells.

The dug wells in Bilaspur urban area can yield between 4.5 and 19 lps & the safe yield forlarge diameter dug wells in alluvium is between 4 and 6 lps (345 and 518 m^3/day). Laterites also occur in detached patches over various rock types. Ground water occurs in these rocks in phreaticcondition, which is restricted up to the upper level of the lithomargic clays. Ground water in this province is developed mainly through dug wells, where discharge is found up to 2 lps. The depth of dug wells in laterites in Surguja district ranges from 4 to 5 m and yield 0.46 to 0.70 lps (40-60 m^3/day)

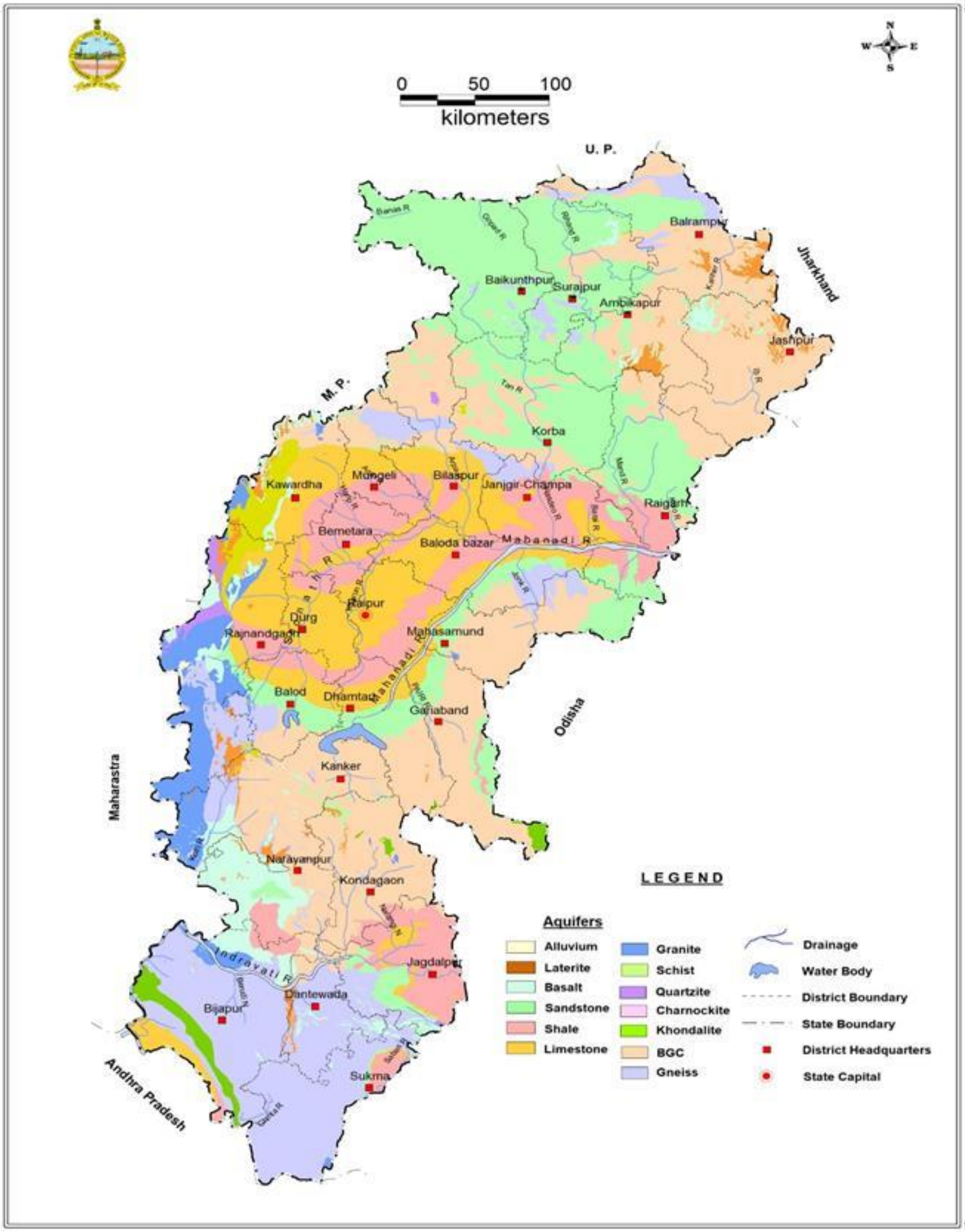

Figure 4 Aquifer system of Chhattisgarh

Table 9 Aquifer System of Chhattisgarh

SlNo	Principal Aquifer Code	Principal Aquifer Name	Major aquifer and Colour Code	Major Aquifer Name	Area Covered(Sq km)	%
1	**AL**	**Alluvium**	AL01	Fluvial Alluvium (Clay/Silt/Sand/ Calcareous concretions)	40.41	0.03
2	**LT**	**Laterite**	LT01	Laterite / Ferruginous concretions	1989.47	1.47
3	**BS**	**Basalt**	BS01	Basic Rocks (Basalt)	875.47	0.65
4			BS02	Ultra-Basic	4514.5	3.33
5	**ST**	**Sandstone**	ST02	Sandstone with Shale	10727.4	7.91
6			ST03	Sandstone with Shale/ Coal beds	9137.84	6.74
7			ST05	Sandstone/Conglomerate	7257.58	5.35
8			ST06	Sandstone with Shale	854.03	0.63
9	**SH**	**Shale**	SH03	Shale, Limestone and Sandstone	860.69	0.63
10			SH05	Shale/Shale with Sandstone	5374.75	3.96
11			SH06	Shale with Limestone	9792.08	7.22
12	**LS**	**Limestone**	LS03	Limestone/Dolomite	13651.1	10.07
13			LS04	Limestone with Shale	2910.47	2.15
14	**GR**	**Granite**	GR02	Acidic Rocks (Pegmatite, Granite, Syenite, Rhyolite, etc.)	4453	3.28
15	**SC**	**Schist**	SC02	Phyllite	1551.04	1.14
16			SC03	Slate	39.55	0.03
17	**QZ**	**Quartzite**	QZ01	Quartzite	569.07	0.42
18	**CK**	**Charnokite**	CK01	Charnockite	1198	0.88
19	**KH**	**Khondalite**	KH01	Khondalite	12	0.01
20	**BG**	**Banded Gneissic Complex(BGC)**	BG01	Banded Gneissic Complex (BGC)	39716.6	29.29
21	**GN**	**Gneiss**	GN01	Undifferentiated metasedimentary/ Undifferentiated metamorphic	6570.55	4.85
22			GN02	Gneiss	13500.4	9.96

Laterite Aquifer

Laterites are formed due to leaching (chemical weathering) of parent sedimentary rocks (sandstones, clays, limestones); metamorphic rocks (schists, gneisses, migmatites) and igneous rocks (granites, basalts, gabbros, peridotites) under hot and humid climatic conditions. Laterites rich in iron and aluminium contents are the most widespread and extensively developed aquifer especially in Jashpur District, Kumhari area in Durg district, Mainpat and Bodal Daldali area of Surguja- Kawardha districts in Chhattisgarh. Laterite forms potential aquifers along valleys and topographic lows where thick saturated zone sustain large diameter open wells for domestic and irrigation use.

Sandstone and Shale Aquifer

The sandstone and shale generally belong to the group of rocks ranging in age from Carboniferous to Mio-Pliocene forms this aquifer. These aquifers are found in Raigarh, Sarguja, Surajpur, Koriya, Janjgir-Champa and Korba. The terrestrial freshwater deposits belonging to Gondwana System and the Tertiary deposits along the west and east coast of the peninsular region are included under this category. The Gondwana sandstones form highly potential aquifers locally. Elsewhere, they have moderate potential and in places they yield meagre supplies. The Gondwana sandstones is the most extensive and productive aquifers.

The Gondwana Super Group and Lameta Group of rocks consist of sandstone, shale, clay, siltstone and coal. They possess both primary and secondary porosity, where primary porosity dominates over secondary porosity. Ground water occurs in both phreatic and semi-confined to confined conditions. Shallow aquifers are phreatic to semi-confined whereas deeper aquifers are generally confined, many time giving rises to flowing artesian wells. These rocks have good potential aquifer system (except the Talchir formation), ground water development in this area is still moderate and exploitation is restricted to the upper aquifers (within 120m). Dug wells tapping the Lametas in Surguja district have yield upto 0.80 lps (70 m3/day). the specific capacity ranges between 50-150 lpm/m of drawdown, hydraulic conductivity varies between 10-25 m/d and specific yield is from 10-15%

Limestone Aquifer

The consolidated sedimentary rocks include carbonate rocks such as limestone, dolomite and marble. Limestone is the dominating rock type among the carbonate rocks, which is widely distributed in Bastar, Raipur, Durg, Dhamtari, Janjgir-Champa, Mahasamund, Rajnandgaon, Raigarh, Kawardha, Bilaspur, Korba and Dantewad. In the carbonate rocks the secondary porosity like fractures and solution cavities form the aquifer. Consolidated sedimentary rocks of Chhattisgarh Supergroup, Indravati, Sukma, Khariar and Pakhal Groups consist of limestone/dolomites apart from other major litho-units such as conglomerates, sandstones, shale, slates and quartzite form this principal aquifer. These are Unconfined to semi-confined aquifer, developed by dug /dug cum bore wells.

The rocks of Chhattisgarh Super Group, which are sedimentary rocks of marine origin consists ofarenaceous-argillaceous-calcareous rocks and are dominated by limestone/ dolomites and calcareous shale and ortho-quartzite. The limestone is more ground water productive. The ortho- quartzites and shale are poor aquifers. The weathered zone is restricted to upper 30 m depth. The ground water in these formations occurs under water table, semi-confined and confined conditions. The weathered and cavernous part of the formation constitutes the good potential aquifers in the area. The transmissivity value of Maniyari formation is varying from 100 to 600 m^2/day. The Charmuria and Chandi formation having Transmissivity value ranging from 5 to 400 m^2/day. TheStorativity is poor to moderate as calculated, ranges from 1.19×10^{-2} to 9.72×10^{-4} , field permeability ranges from 4 to 65 m/day. The specific capacity for the bore wells ranges from 0.0002 to 1.39 m^3/min/m drawdown.

Basalt aquifers

Basalt is the basic volcanic rock which forms alternate layers of compact and vesicular beds of lava flows as seen in isolated patches in Koriya, Surguja, Jashpur, Kawardha and Bilsapur districts, generally occupying the hill tops. The groundwater occurrence in the basalts are controlled by nature and extent of weathering, presence of vesicles and lava tubes, thickness, number of flows and the nature of inter-trappean layers. The basalts have usually medium to low permeability. Groundwater occurrence in the Deccan Traps is controlled by the contrasting water bearing properties of different flow units, thus, resulted in multiple aquifer system, at places. Thewater bearing zones are the weathered and fractured zones.

This consists of basaltic lava flows and each flow is separated from other flow by intertrappean orred boles. The vesicular top parts of various flows and inter flow red boles form the aquifer alongwith weathered and fractured zones. The area is being developed through construction of dug wellsand shallow bore wells fitted with hand pumps and have limited discharge. In general, the weathered part of trap is converted to Laterites and can yield substantial water to the dug wells. The Laterites of Jashpur area can yield up to 2 lps (173 m^3/day) discharge. In some areas the control of dolerite dykes on occurrence of ground water was observed. Wells located on the upstream side of these dykes and also on tectonic lineaments gave better yields.

Crystalline Aquifers

The crystalline hard rock aquifers such as granite, gneisses and high grade metamorphic charnockite and khondalite constitute moderate to good repository of ground water. Hard rocks generally neither receive nor transmit water, due to negligible or limited primary porosity. However, these may form good aquifers if weathered and/or have good secondary porosity in the form of faults, fractures, joints, bedding planes, and solution cavities. The crystalline rocks also form the aquifers with weathered zone or the fracture system. The weathered mantle cover and associated secondary porosity do not occur uniformly but are rather localised phenomena. The weathered zone is underlain by semi-weathered saprolite zone followed by fractured and massive rock. These aquifers distributed in Dantewara, Sukma and Bijapur, Bastar, Narayanpur, Kondagaon, Kanker, Rajnandgaon, Durg, Kawardha, Bilaspur, Janjgir-Champa, Mahasamund, Korba, Jashpur, Balrampur. Surguja, Koriya and parts of Raigarh districts.

In these aquifers, ground water occurs under phreatic condition in the weathered mantle cover and under semi-confined to confined state in underlying fissured, fractured, and jointed hard rock. The volume of ground water stored under semi-confined condition within the body of the hard rock is much lower than the storage in the overlying phreatic aquifer which is often much greater. Hydraulically connected fissures and fractures underlying weathered mantle cover generally serves as a permeable conduit feeding the deeper wells. Ground water flow rarely occurs across the topographical water divides so far as the unconfined aquifer is concerned and each basinor sub-basin can be treated as a separate hydro geological unit for planning the development of ground water resources.

The dug wells in the area have yield in the range of 0.23 to 2.30 lps. The bore wells have drill timedischarge generally below 3 lps & specific capacity ranges from 20-200 lpm/m drawdown. Theseaquifers have low Transmissivity in the range of 1 to 55 m^2/day (having less Storativity). The specific capacity for the open dug wells of BHQ and Gneisses in Durg district varies from 1.37 x 10^{-2} to 7.86 x 10^{-3} m^3/min/m drawdown. Hydraulic conductivity is generally less than 1 m/d and specific yield less than 5%.

Plutonic-Volcanic meta-sedimentary group constitutes of granites, acid and basic volcanics and Proterozoic meta-sedimentaries. Ground water in this rock mainly occurs in phreatic to semiconfined condition. These aquifer groups have better potential than the basement crystallines. Thebore wells in the province can yield upto 5 lps (432 m^3/day) with general discharge up to 3 lps. The Transmissivity ranges between 2 and 150 m^2/day, which is good in comparison with other aquifers of the state.

CHAPTER - 5

5.0 GROUND WATER LEVEL SCENARIO IN CHHATTISGARH

5.1 Groundwater Level Scenario (2023)

Groundwater level data of pre-monsoon 2023

In general, the depth to water level ranges of 0 to 2 m bgl is observed in approximately 2.24 % of the wells, 2 to 5 m bgl is observed in approximately 32.24% of the wells and depth to water level range up to 10 m bgl is observed in 52.44% of the wells in the state. Deeper water levels ranging between 10 - 20 and 20 - 40 m bgl occur respectively in 12.34% and 0.714% of the observation wells only in parts of Bilaspur, Durg, Janjgir Champa Dhamtari, Mahasamund, Raigarh districts. The deepest water level of 25.31m bgl was monitored in Sikharipalli, Pithora observation well of Mahasamund district.

22 numbers of wells (approximately 2.24% of the monitored wells) in the state are showing water levels between 0 - 2 m bgl in almost all the districts of Chhattisgarh State. Water levels in the range of 2 - 5 m bgl are recorded in about 316 of the observation wells monitored. The highest percentages of wells in this range are in Raipur (63.44%), Dhamtari (56.25m bgl) Durg (45.45%), Kanker (57.14%), Mahasamund (25.81%), Rajnandgaon (32.31 %), Bastar (25.93%) and Janjgir champa (29.41%) districts. Nearly, 32.24% of observation wells are exhibiting water level in the range of 2 – 5 m bgl in most of the districts of the state.

Groundwater level data for post-monsoon 2023

The depth to water level range up to 2 m bgl is observed in approximately 17.57% of wells, water level range up to 5 m bgl is observed in approximately 58.30% of the wells and depth to water level range up to 10 m bgl is observed in approximately 22.61% of the wells in the state. Deeper water levels ranging between 10 and 20 m bgl occur only in 1.26% of the observation wells and mostly in parts of Surguja Raigarh, Kanker Durg and Kawardha districts. The deepest water level of 50 mbgl was monitored in Ganiyari new observation well of Bilaspur district.

164 numbers of wells (approximately 17.57% of the monitored wells) in the state are showing water levels between 0-2 m bgl in almost all the districts of Chhattisgarh State. Water levels in the range of 2-5 m bgl are recorded in about 544 (58.30%) of the observation wells monitored. The highest percentages of wells in this range are in Korba (61.11%), Kanker (57.14%), Koriya (70.83%), Jashpur (58.23%), Janjgir-champa (56.25%), and Sarguja (61.11%) districts. Nearly 22.61% of observation wells are exhibiting water level in the range of 5-10 mbgl in most of

the districts of the state.

5.2 Fluctuation of Groundwater Level:

Comparison of Pre-monsoon 2023 to Pre-monsoon 2022

When compared to water level in May 2022, nearly 43.30% of the observation wells are showing rise in water level in May 2023. Rise of water level in the range of 0-2 m is observed in 31.59% of the wells distributed in all the districts. Rise of water level in the range of 2-4 m is observed in 78.89 % of the wells distributed in almost all the districts except Kanker and Jashpur districts. Rise of water level by more than 4 m is also observed in 17.20% of the monitored wells in Bilaspur, Dhamtari, Durg, Janjgir-Champa, Korba, Koriya, Mahasamund, Raigarh, Raipur and Surguja districts. Rise of more than 4 % is observed in 12.01% of wells. Fall of water level is recorded in nearly 51.23% of the monitored wells. Fall of water level in the range of 0-2 m, 2-4 m and more than 4 m are observed in 13.95%, 7.86% and 84.51% of the monitored wells, respectively in the state.

Comparison of November 2023 to November 2022

When compared to water level in November 2022, nearly 31.64% of the observation wells are showing rise in water level in November 2023. Rise of water level in the range of 0-2 m is observed in 88.64% of the wells distributed in almost all the districts. Rise of water level in the range of 2-4 m is observed in 8.42% distributed in almost all the districts except in Bastar, Kanker, Kawardha, Koriya and Raipur. Rise of water level by more than 4 m is observed 2.93 % of the monitored wells except in Bastar, Bilaspur, Dhamtari, Janjgir – champa, Jashpur, Kanker, Kawardhaand Rajnandgaon. Fall of water level is recorded in nearly 66.43% of the monitored wells. Fall of water level in the range of 0-2 m, 2-4 m and more than 4 m are observed in 82.30%, 12.02% and 5.67% of the monitored wells, respectively in the State.

Comparison of Pre-Monsoon 2023 with decadal mean of Pre-Monsoon (2013 to 2022)

When compared to the decadal mean water level (May 2013 to May 2022), 52.54% of observation wells are showing a fall in water level in May 2023. Out of the wells monitored, 72.40% of the wells are showing a fall up to 2 m and 21.412% between 2 to 4 m except in Kanker and Kawardha districts. 6.181% of the monitored wells are showing a fall in water level of more than 4 m. Fall of water level as compared to the decadal mean by more than 4m is observed in all districts except Kanker, Kawardha and Koriya districts. Nearly, 67.35% of monitored wells are showing a rise in the water level, mostly in the range of 0-2 meters (About 23.74% of the monitored wells are showing a rise in the range of 2-4 meter whereas 7.762% of the monitored wells are showing a rise of > 4 m in all districts except in Bastar and Mahasamund districts.

Comparison of Post-Monsoon 2023 with decadal mean of Post-Monsoon (2013 to 2022)

When compared to the decadal mean water level (November 2013 to November 2022), 67.35% of monitored wells are showing a rise in the water level, mostly in the range of 0-2. About 23.744% of the monitored wells are showing a rise in the range of 2-4 meters except in Bastar and Kanker districts, whereas 8.9% of the monitored wells are showing a rise of more than 4 m in Bastar, Bilaspur, Dhamtari, Janjgir – Champa, Jashpur, Kanker, Kawardha Koriya, Mahasamund, Raigarh, Raipur and Rajnandgaon districts. Out of 444 wells showing fall in water level nearly 51.62% of observation wells are showing a fall in water level in November 2023. Out of the wells monitored, out of no of wells showing falling water level 83.11% of the wells are showing a fall up to 2 m. About 12.83% between 2 to 4 meters except in Kawardha districts and 4.054% of the monitored wells are showing a fall in water level of more than 4 m restricted only in Janjgir – champa, Jashpur, Koriya, Rajnandgaon and Raigarh districts.

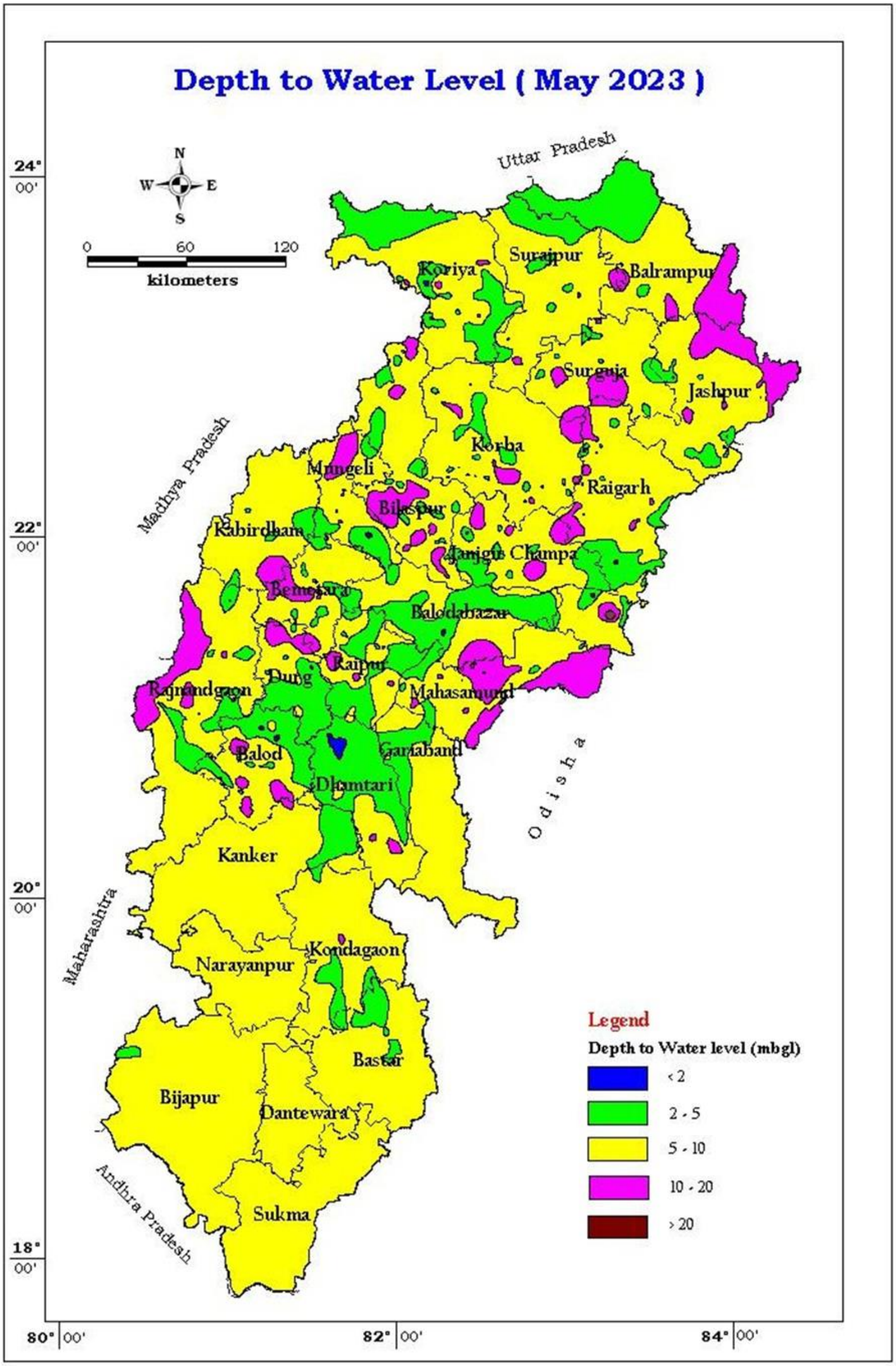

Figure 5 Depth to Water Level Map of the State/UT Pre-Monsoon 2023

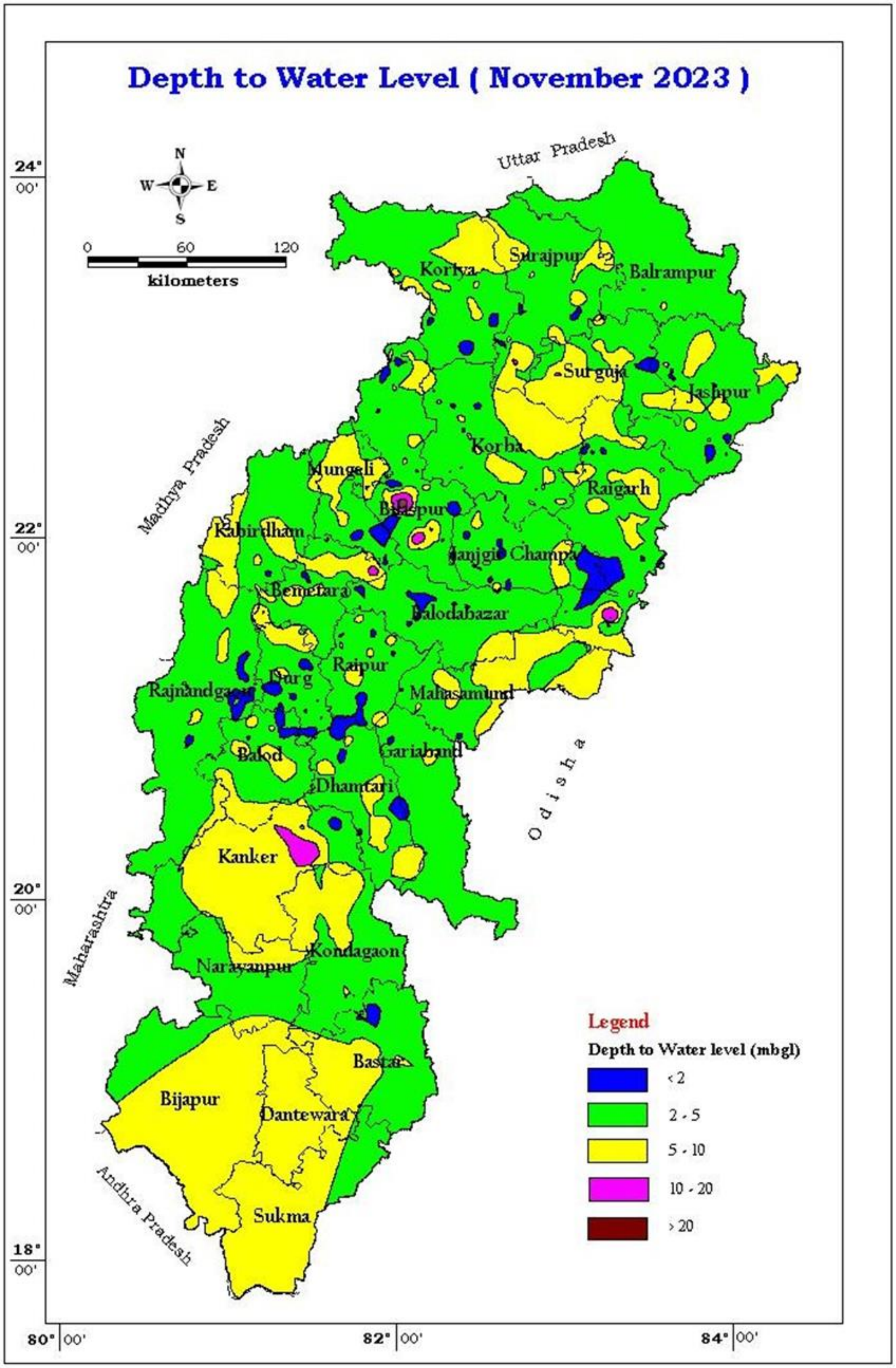

Figure 6 Depth to Water Level Map of the State/UT Post-Monsoon 2023

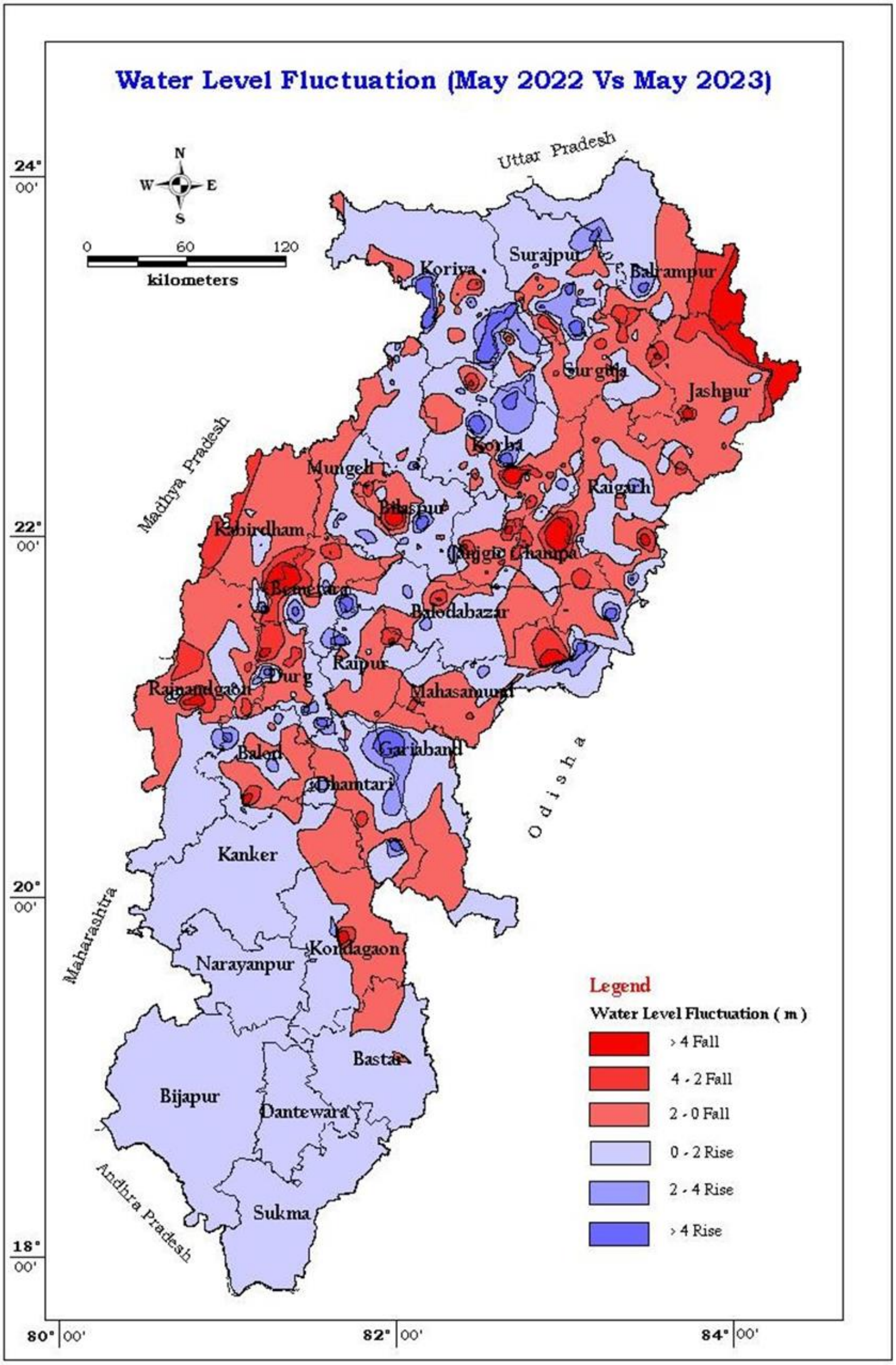

Figure 7 Groundwater Level Fluctuation: Pre-monsoon 2022 compared to Pre-monsoon 2023

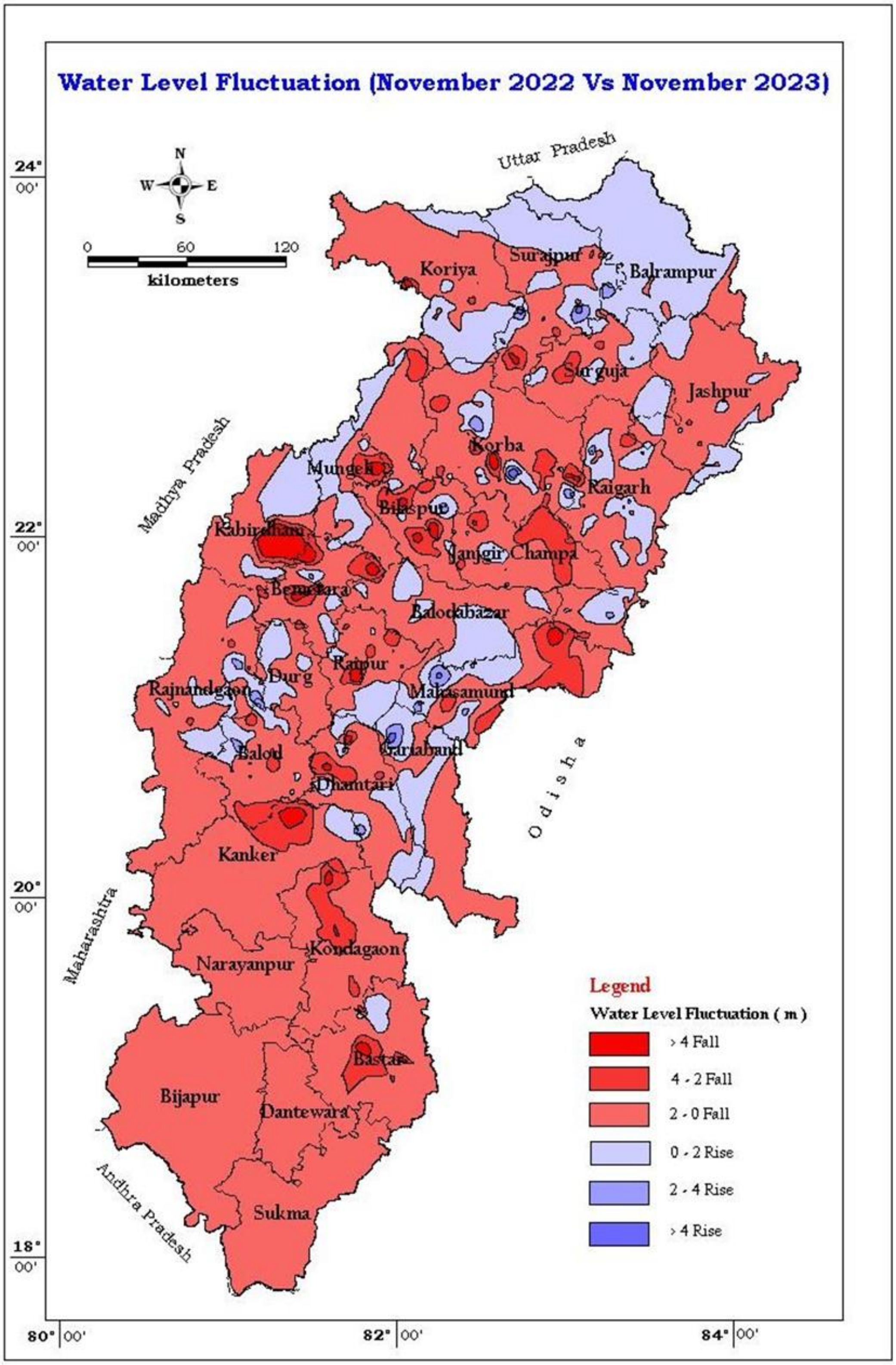

Figure 8 Groundwater Level Fluctuation: November 2022 compared to November 2023

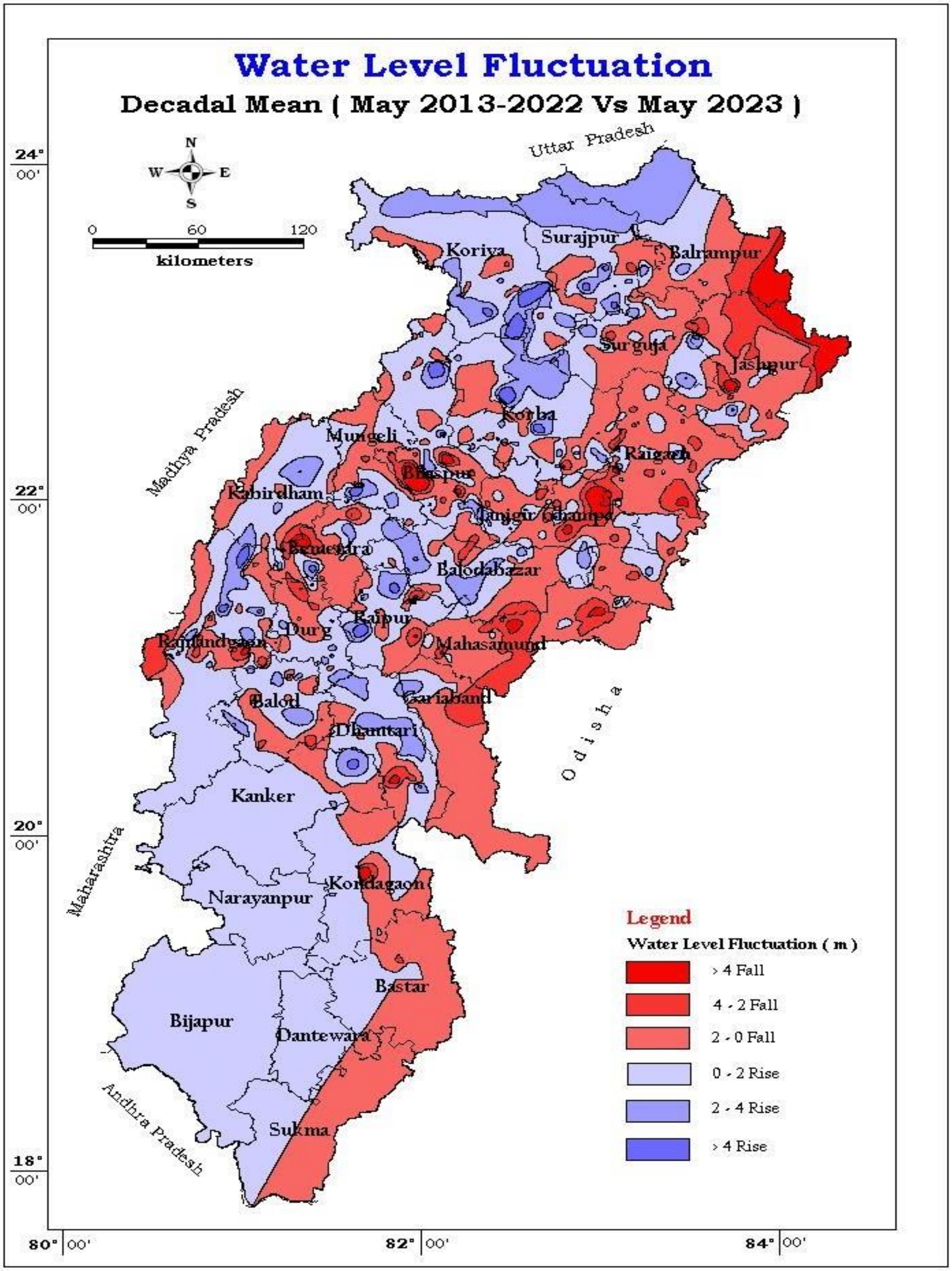

Figure 9 Decadal water level fluctuation with mean Pre-Monsoon (2013 to 2022) and Pre-Monsoon 2023

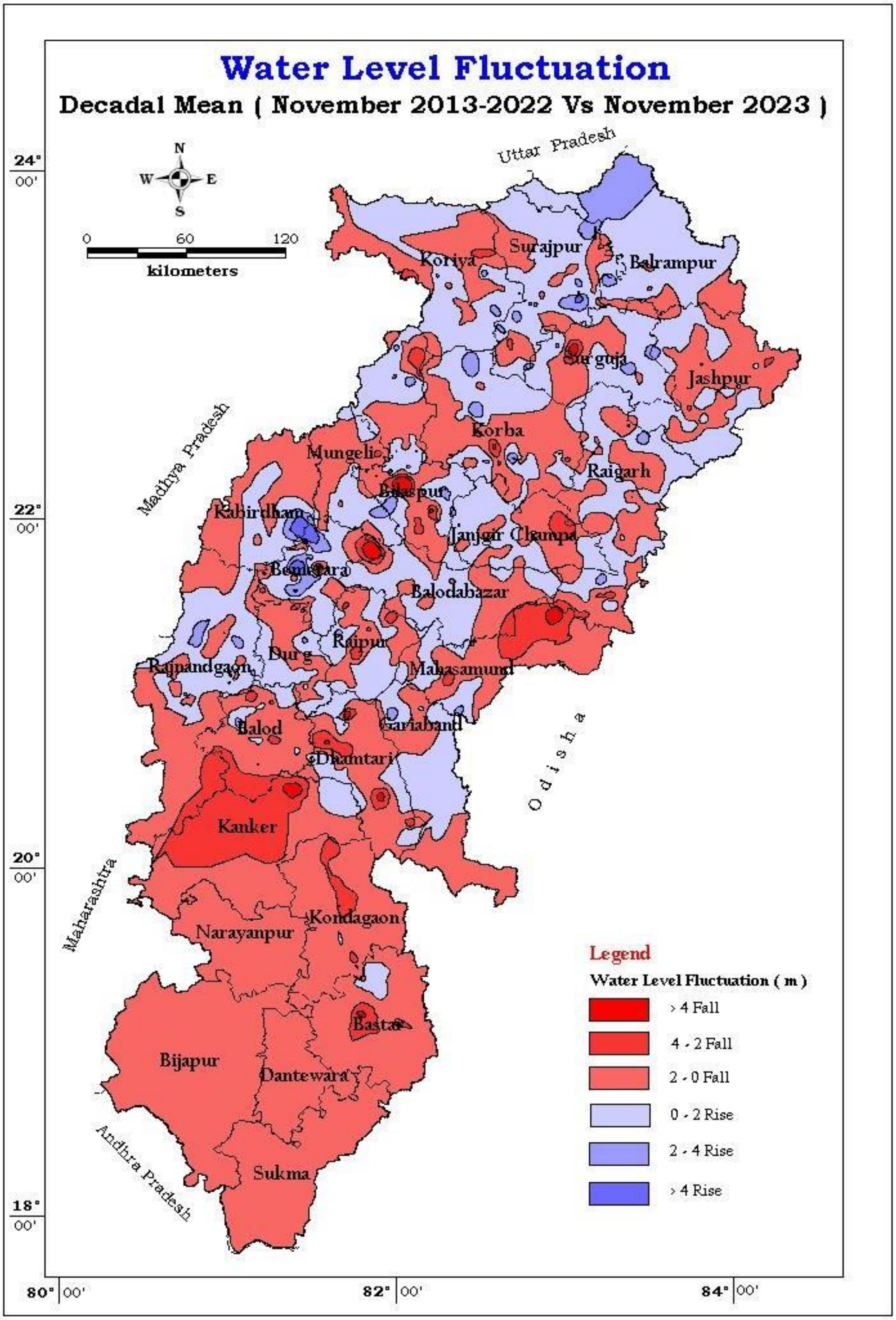

Figure 10 Decadal water level fluctuation with mean Post-Monsoon (2013 to 2022) and Post-Monsoon 2023

CHAPTER 6

6.0 GROUND WATER RESOURCES OF THE STATE/UT

6.1.ANNUAL GROUND WATER RECHARGE

Total Annual Ground Water Recharge is 14.18 bcm and Natural Discharge during Non-Monsoon Period is 1.25 bcm.

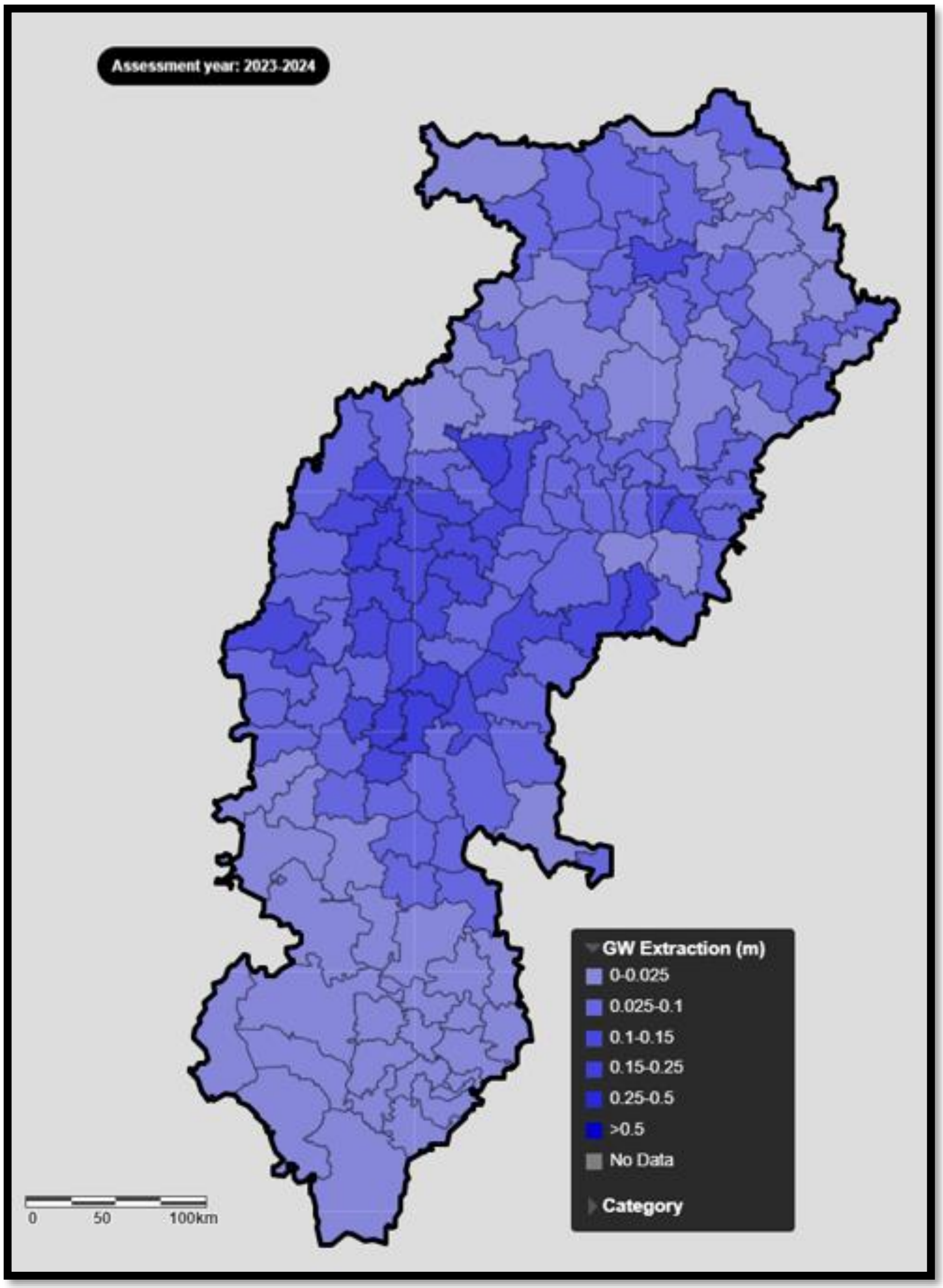

Figure 11 Annual Groundwater Recharge Unit Map

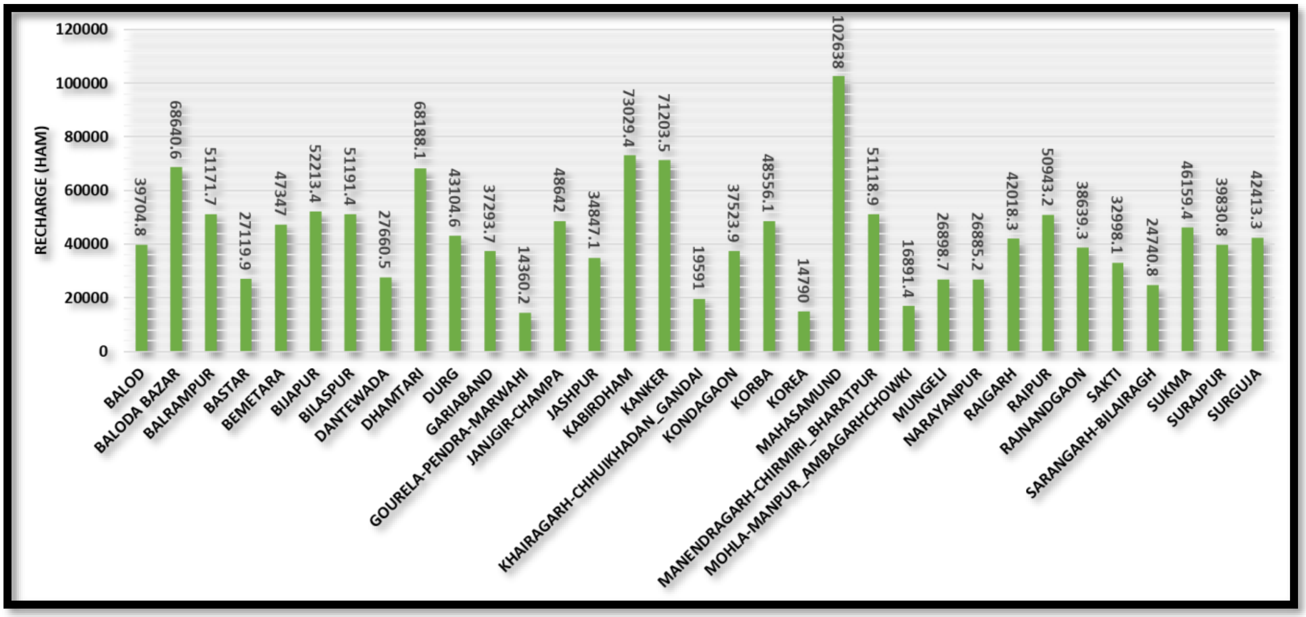

Figure 12 District wise Total Annual ground Water Recharge 2024

6.2.ANNUAL EXTRACTABLE GROUND WATER RESOURCES

The Annual Extractable GroundWater Resource of the state is 12.92 bcm.

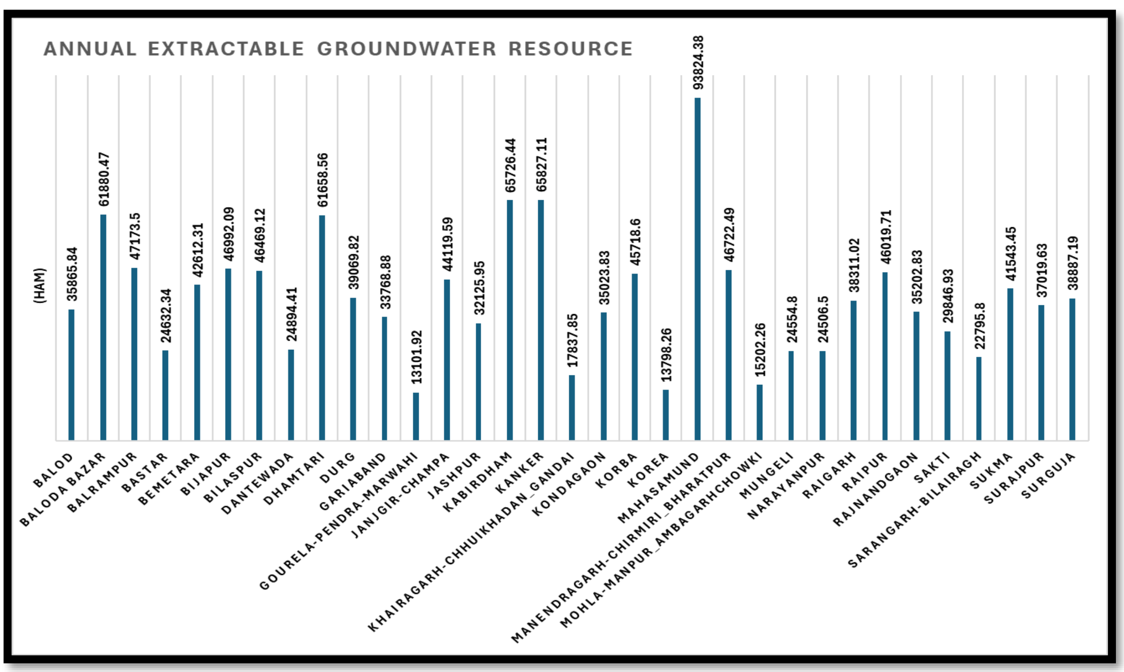

Figure 13 Annual Extractable Ground Water Resource.

6.3.ANNUAL TOTAL GROUND WATER EXTRACTION

The existing groundwater extraction for all uses in the state is 6.11 bcm with Mahasamund district having the highest extraction of ground water (56616.87 Ham) and Narayanpur district having the lowest (1797.25 Ham) ground water extraction. Mahasamund is one of the most developed district in the state in terms of Agricultural production and dependence on ground water is very high in the district. Comparison of ground water extraction for various uses reveals that extraction for irrigation accounts for morethan 86 % of the total ground water extraction, whereas extraction for domestic purposes accountsfor 12 % and for Industrial purposes is 2 % of the total ground water extraction in the state.

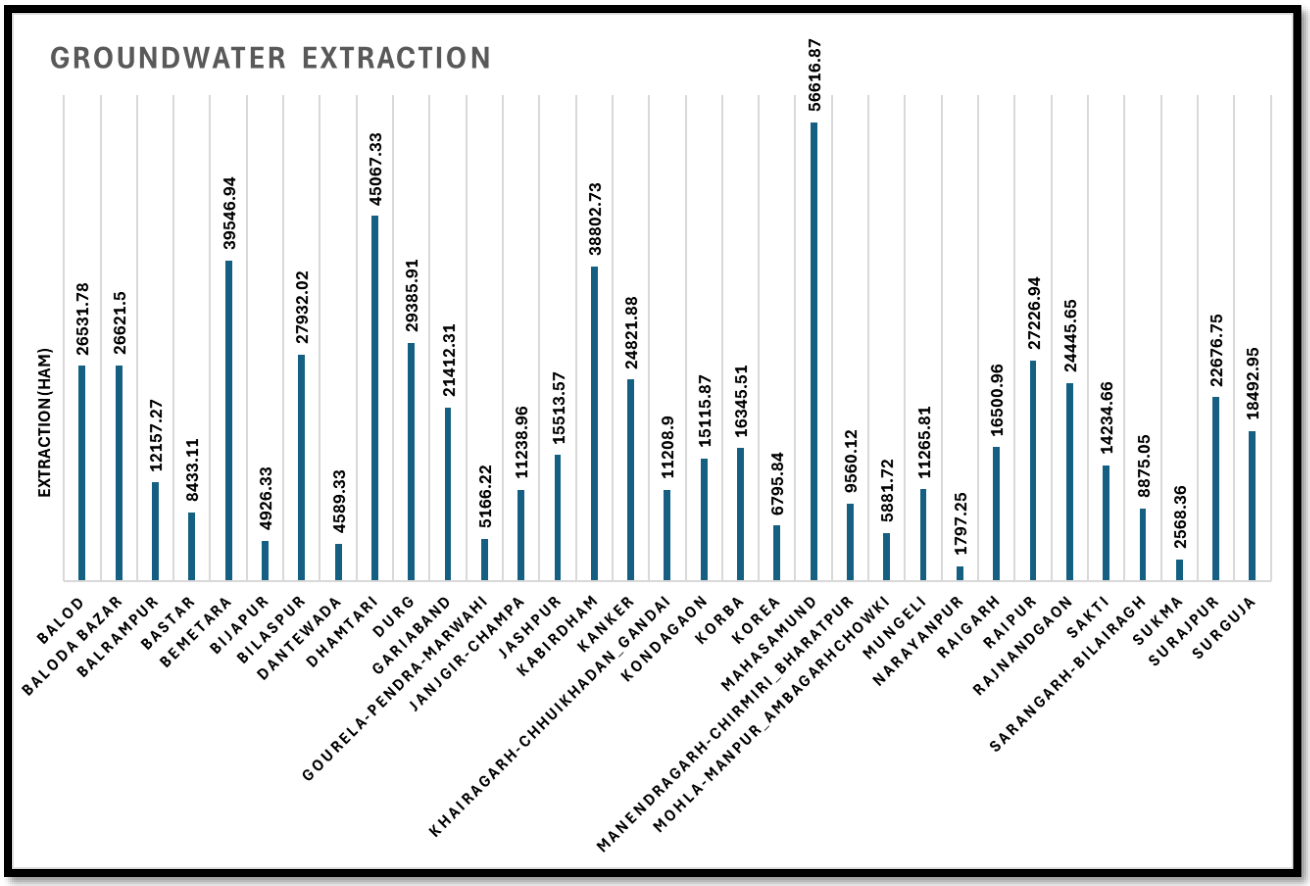

Figure 14 District wise Groundwater Extraction

6.4. STAGE OF GROUND WATER EXTRACTION

Stage of groundwater extraction of Chhattisgarh state as on March-2024 is 47.32%, which is low as compared to the national extraction of 59.26% (as on March-2023). Four districts in the state namely Balod, Bametra, Dhamtari, Durg, have stage of development more than 70% i.e. 73.98%, 92.81%, 73.09%, 75.21% respectively. The Nawagarh block of Bemetara district reached at highest ground water extraction of 97.03% and Bemetara district shows highest ground water extracted district i.e. 92.81 % in state. Sukma districthas lowest stage of ground development of less than 6.18%. Out of 146 blocks, 120 blocks are safe and only 26 blocks have attained stages of development more than 70%. The state as a whole has a stage of extraction of 47.32 % only.

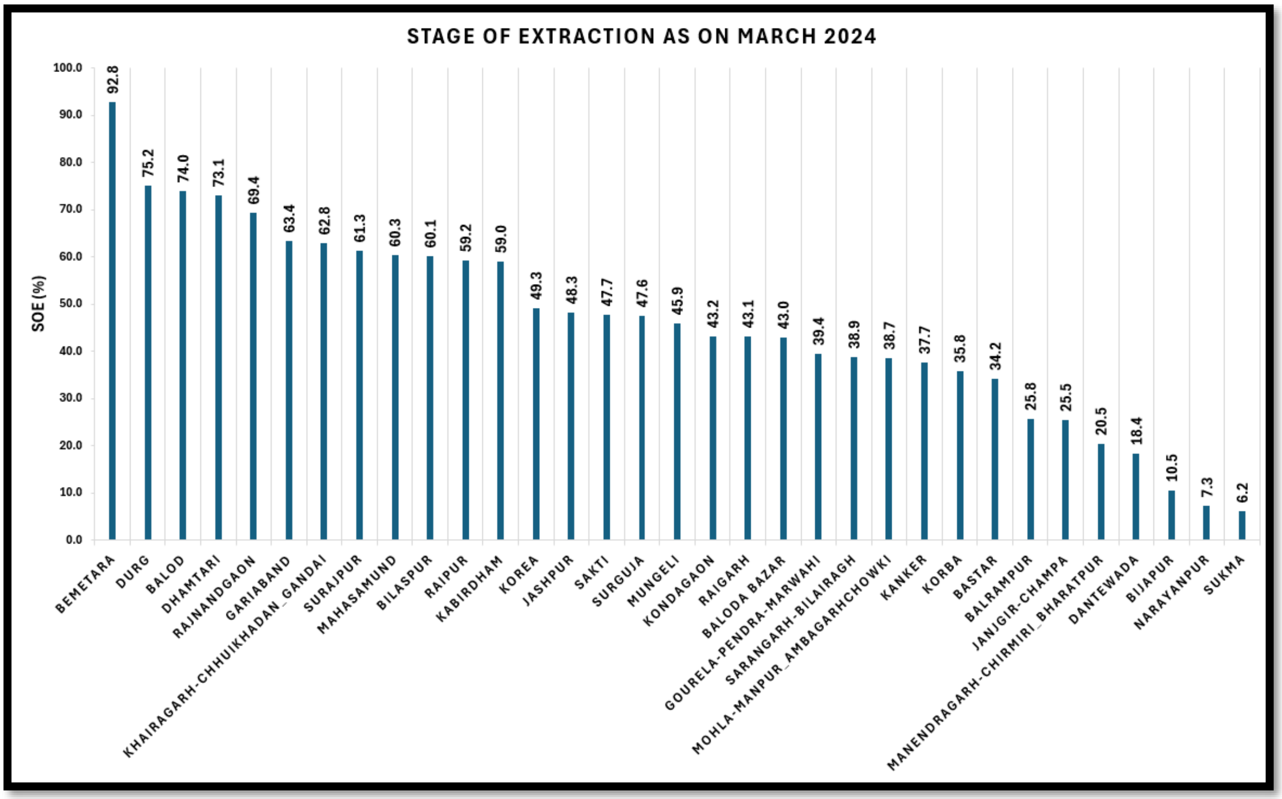

Figure 15 Graph depicting district wise stage of extraction.

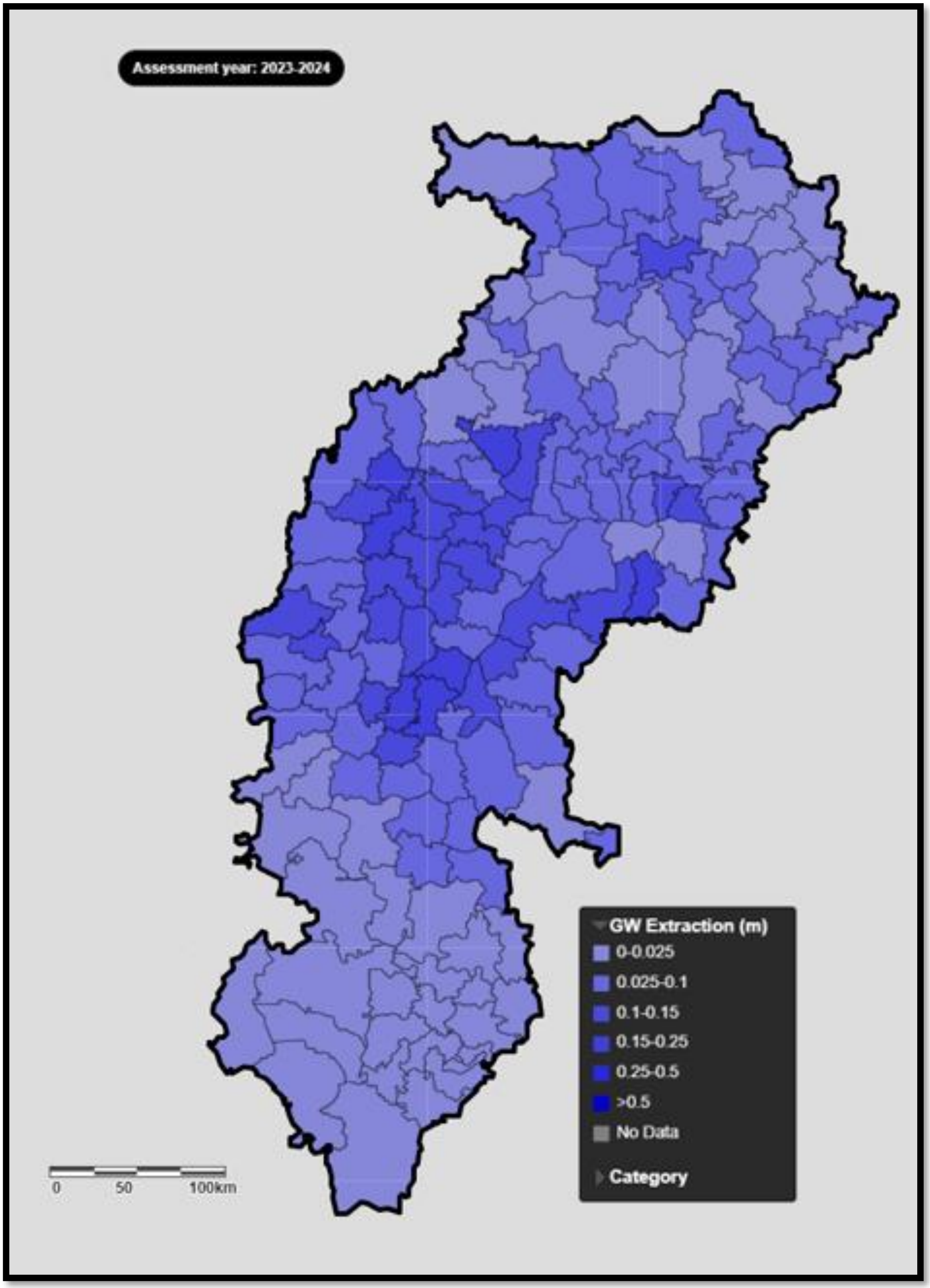

Figure 16 Annual Groundwater Extraction Unit Map

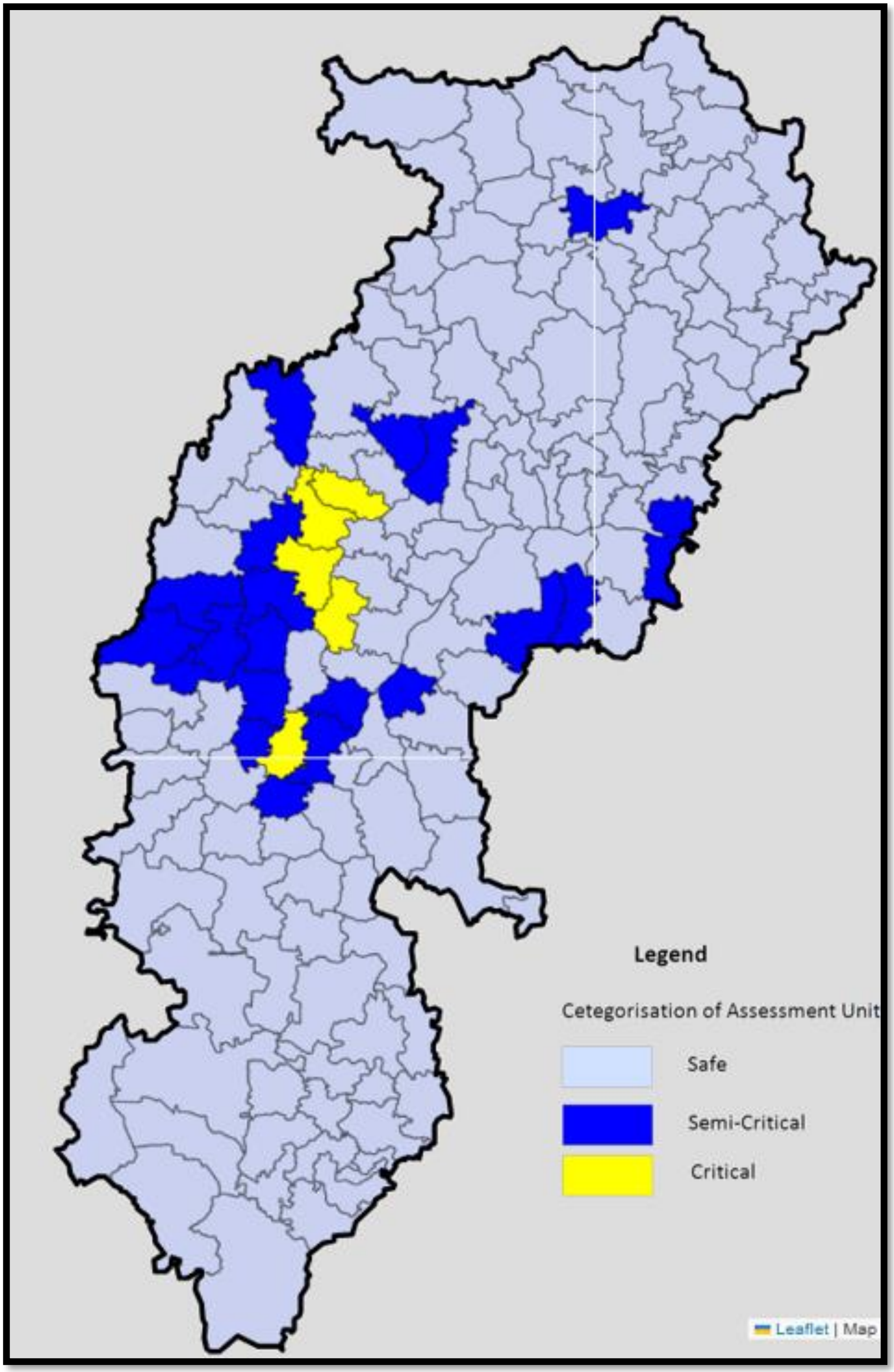

Figure 17 Categorization of assessment unit as on March, 2024

6.5. CATEGORIZATION OF ASSESSMENT UNITS

Out of 146 assessment units (blocks), 5 units (3.42 %) as ‘Critical’, 22 units (14.38 %) have been categorized as ‘Semi-critical’ and 120 units (82.19 %) as ‘Safe’ categories of assessment units. There are no ‘Over-exploited’ and ‘Saline’ categories of assessment units. Out of 106078.71 sq km recharge worthy area of the State, 3119.06 sq km (2.94 %) area are under ‘Critical’, 14090.19 sq km (13.28 %) under ‘Semi- critical’, 88869.46 sq km (83.78 %) under ‘Safe’ categories of assessment units. Out of total 13186.48 mcm annual extractable ground water resources of the State, 464.26 mcm (3.52 %) under ‘Critical’, 2413.61 mcm (18.3 %) under ‘Semi-critical’ and 10308.62 mcm (78.18 %) are under ‘Safe’ categories of assessment units. (Annexure 3, Figure-7). There are no ‘Over-exploited’ and ‘Saline’ categories of assessment units. Critical and Semi-critical blocks are distributed in Balod, Bemetara, Bilaspur, Dhamtari, Durg, Gariaband, Kabirdham, Kanker, Mahasamund, Raigarh, Raipur, Rajnandgaon, Sarangarh-Bilaigarh and Surajpur districts. Rest all subunits have been categorized as safe from groundwater extraction point of view.

6.6. COMPARIOSN WITH PREVIOUS ASSESSMENT

The comparison with the previous assessment year reveals some changes in the categorization of assessment units. In the previous year, out of 146 blocks, 120 blocks were categorized as 'Safe', 21 blocks as 'Semi-critical', and 5 blocks as 'Critical'. In the current assessment year, out of 146 blocks, 121 blocks are categorized as 'Safe', 20 blocks as 'Semi-critical', and 5 blocks as 'Critical'.

CHAPTER - 7

7.0 CONCLUSIONS

The report on Dynamic Groundwater Resources of Chhattisgarh, 2024, signifies a critical milestone in understanding and managing the state's water resources amidst rising pressures from agricultural, industrial, and domestic needs. This comprehensive assessment, collaboratively executed by the State Groundwater Survey and the Central Ground Water Board, underscores the vital importance of sustainable water management practices in addressing the challenges posed by overexploitation and variable monsoon patterns.

Notably, the analysis highlights a mix of critical, semi-critical, and safe blocks, indicating a complex and varied groundwater scenario across Chhattisgarh. This nuanced understanding is crucial for crafting targeted policies that not only address areas of acute shortage but also prevent future overexploitation in currently safe zones. Furthermore, the report's recommendations for enhancing groundwater recharge, such as the implementation of artificial recharge structures and the promotion of water conservation practices, reflect a proactive approach to resource management. This strategic direction, coupled with the continued monitoring and assessment of groundwater levels, will provide a robust framework for ensuring the long-term sustainability of Chhattisgarh's groundwater resources.

Annexure 1 Ground water resources availability, utilization and stage of extraction (as in 2024)

DYNAMIC GROUND WATER RESOURCES OF INDIA, 2024															
INDIA															
S.NO	States / Union Territories	Ground Water Recharge					Total Natural Discharges	Annual Extractable Ground Water Resource	Current Annual Ground Water Extraction				Annual GW Allocation for Domestic use as on 2025	Net Ground Water Availability for future use	Stage of Ground Water Extraction(%)
		Monsoon Season		Non-Monsoon Season		Total Annual Ground Water Recharge			Irrigation	Industrial	Domestic	Total			
		Recharge from rainfall	Recharge from other Sources	Recharge from Rainfall	Recharge from other Sources										
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1	CHHATTISGARH	8.57	3.43	0.15	2.03	14.18	1.26	12.93	5.21	0.14	0.77	6.12	0.84	6.82	47.32
	Total(bcm)	8.57	3.43	0.15	2.03	14.18	1.26	12.93	5.21	0.14	0.77	6.12	0.84	6.82	47.32

Annexure 2 District-wise ground water resources availability, utilization and stage of extraction (as in 2024)

DYNAMIC GROUND WATER RESOURCES OF INDIA, 2024															
CHHATTISGARH															
S. NO	Name of District	Ground Water Recharge					Total Natural Discharges	Annual Extractable Ground Water Resource	Current Annual Ground Water Extraction				Annual GW Allocation for Domestic use as on 2025	Net Ground Water Availability for future use	Stage of Ground Water Extraction(%)
		Monsoon Season		Non-Monsoon Season		Total Annual Ground Water Recharge			Irrigation	Industrial	Domestic	Total			
		Recharge from rainfall	Recharge from other Sources	Recharge from Rainfall	Recharge from other Sources										
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1	BALOD	16827.95	15473.6	0	7403.29	39704.84	3839.01	35865.84	24199.76	72.58	2259.42	26531.78	2356.22	9598.22	73.98
2	BALODA BAZAR	25659.93	36010.49	412.24	6557.98	68640.64	6760.17	61880.47	20954.05	1145.11	4522.3	26621.5	5644.19	34581	43.02
3	BALRAMPUR	46086.19	2343.06	309.07	2433.36	51171.68	3998.17	47173.5	10072.29	9.99	2074.99	12157.27	2200.65	34890.56	25.77
4	BASTAR	22040.82	1313.81	1758.77	2006.53	27119.93	2487.59	24632.34	6061.61	72.29	2299.22	8433.11	2400.33	16098.12	34.24
5	BEMETARA	18175.02	16782.78	0	12389.23	47347.03	4734.72	42612.31	36869.55	212.3	2465.12	39546.94	2889.52	4366.86	92.81
6	BIJAPUR	49859.36	762.77	214.88	1376.43	52213.44	5221.35	46992.09	4243.84	1.91	680.59	4926.33	711.88	42034.47	10.48
7	BILASPUR	21989.71	16860.67	426.62	11914.36	51191.36	4722.24	46469.12	21566.19	664.59	5701.27	27932.02	6529.12	19980.2	60.11
8	DANTEWADA	25283.02	630.44	342.85	1404.15	27660.46	2766.05	24894.41	3652.09	158.45	778.79	4589.33	820	20263.87	18.44
9	DHAMTARI	20986.49	28926.68	0	18274.95	68188.12	6529.57	61658.56	42872.68	78.99	2115.66	45067.33	2180.05	16526.84	73.09
10	DURG	14510.5	19764.1	0	8830.02	43104.62	4034.8	39069.82	24015.02	408.38	4962.51	29385.91	5135.19	10672.78	75.21
11	GARIABAND	22766.79	8496.39	0	6030.52	37293.7	3524.82	33768.88	19665.59	17.24	1729.48	21412.31	1877.55	12208.5	63.41
12	GOURELA-PENDRA-MARWAHI	11297.19	1275.67	545.15	1242.23	14360.24	1258.33	13101.92	4016.68	1.62	1147.91	5166.22	1324.53	7759.07	39.43
13	JANJGIR-CHAMPA	12350.45	20831.76	153.04	15306.79	48642.04	4522.44	44119.59	8143.85	231.79	2863.32	11238.96	3060.17	32683.76	25.47
14	JASHPUR	27453.62	2804.53	873.11	3715.88	34847.14	2721.18	32125.95	13239.81	29.64	2244.1	15513.57	2320.47	16536.99	48.29
15	KABIRDHAM	32690.31	29684.9	1408.77	9245.4	73029.38	7302.94	65726.44	36151.32	75.18	2576.21	38802.73	2837.22	27631.68	59.04

16	KANKER	55430.65	4915.27	2224.16	8633.41	71203.49	5376.38	65827.11	22734.24	30.55	2057.07	24821.88	2150.07	40912.25	37.71
17	KHAIRAGARH-CHHUIKHADAN_GANDAI	9010.98	7608.23	98.12	2873.7	19591.03	1753.18	17837.85	10111.42	11.82	1085.67	11208.9	1161.58	6553.04	62.84
18	KONDAGAON	30505.36	2723.03	2064.15	2231.35	37523.89	2500.06	35023.83	13506.65	21.75	1587.46	15115.87	1658.78	20053.25	43.16
19	KORBA	37675.69	4693.11	676.81	5510.46	48556.07	2837.47	45718.6	10260.7	2438.78	3646.02	16345.51	3879.21	29139.9	35.75
20	KOREA	9543.17	3323.71	53.15	1869.95	14789.98	991.72	13798.26	5742.25	390.63	662.96	6795.84	683.63	6981.76	49.25
21	MAHASAMUND	47011.09	38521.02	325.68	16779.85	102637.64	8813.26	93824.38	53575.12	124.18	2917.58	56616.87	3077.95	37047.14	60.34
22	MANENDRAGARH-CHIRMIRI_BHARATPUR	47273.19	1891.66	244.3	1709.74	51118.89	4396.4	46722.49	7737.71	720.69	1101.72	9560.12	1136.16	37127.94	20.46
23	MOHLA-MANPUR_AMBAGARHCHOWKI	12357.67	1879.34	144.29	2510.11	16891.41	1689.15	15202.26	5107.48	31.5	742.76	5881.72	767.82	9295.49	38.69
24	MUNGELI	9680.27	12373.58	0	4844.83	26898.68	2343.88	24554.8	9315.57	30.68	1919.55	11265.81	2236.98	12971.56	45.88
25	NARAYANPUR	25101.06	457.92	772.79	553.46	26885.23	2378.73	24506.5	1393.87	10.65	392.72	1797.25	412.02	22689.96	7.33
26	RAIGARH	35392.31	2788.33	408.53	3429.14	42018.31	3707.28	38311.02	10689.7	2666.41	3144.87	16500.96	3302.28	21652.65	43.07
27	RAIPUR	19715.92	23406.18	42.18	7778.94	50943.22	4923.51	46019.71	17943.08	1896.52	7387.33	27226.94	8179.69	19060.3	59.16
28	RAJNANDGAON	20156.4	9704.94	236.55	8541.37	38639.26	3436.43	35202.83	20995.43	228.59	3221.6	24445.65	4080.63	9898.15	69.44
29	SAKTI	9148.9	10717.41	101.69	13030.06	32998.06	3151.13	29846.93	12286.55	8.87	1939.26	14234.66	2086.47	15465.06	47.69
30	SARANGARH-BILAIRAGH	14175.82	6923.33	361.15	3280.46	24740.76	1944.96	22795.8	6980.99	45.46	1848.62	8875.05	2028	13741.37	38.93
31	SUKMA	44267.11	915.59	0	976.69	46159.39	4615.94	41543.45	1945.34	1.6	621.41	2568.36	636.6	38959.89	6.18
32	SURAJPUR	28568.63	4629.44	217.28	6415.47	39830.82	2811.19	37019.63	19533.56	955.05	2188.08	22676.75	2298.05	14232.91	61.26
33	SURGUJA	34167.83	3443.26	885.79	3916.43	42413.31	3526.12	38887.19	15102.93	1059.23	2330.79	18492.95	2436.01	20303.64	47.56
	Total(Ham)	857159.4	342877	15301.12	203016.54	1418354.06	125620.17	1292733.88	520686.92	13853.01	77216.35	611756.4	84499.02	681919.18	47.32
	Total(Bcm)	8.57	3.43	0.15	2.03	14.18	1.26	12.93	5.21	0.14	0.77	6.12	0.84	6.82	47.32

Annexure III (A)

Annexure 3 Categorization of blocks/ mandals/ taluks in India (as in 2024) for Chhattisgarh.

CATEGORIZATION OF BLOCKS/ MANDALS/ TALUKAS IN INDIA (2024)												
S.No	**States / Union Territories**	**Total No. of Assessed Units**	**Safe**		**Semi-Critical**		**Critical**		**Over-Exploited**		**Saline**	
			Nos.	**%**	**Nos.**	**%**	**Nos.**	**%**	**Nos.**	**%**	**Nos.**	**%**
1	CHHATTISGARH	146	120	82.19	21	14.38	5	3.42	-	-	-	-
	Total	146	120	82.19	21	14.38	5	3.42	-	-	-	-
	Grand Total	146	120	82.19	21	14.38	5	3.42	-	-	-	-

Annexure 4 District Wise Categorization of blocks/ mandals/ taluks for Chhattisgarh. (as in 2024)

DYNAMIC GROUND WATER RESOURCES OF INDIA, 2024												
CHHATTISGARH												
S.No	**Name of District**	**Total No. of Assessed Units**	**Safe**		**Semi-Critical**		**Critical**		**Over-Exploited**		**Saline**	
			No	**%**	**No.**	**%**	**No.**	**%**	**No.**	**%**	**No.**	**%**
1	KANKER	7	6	85.71	1	14.29	-	-	-	-	-	-
2	DANTEWADA	4	4	100.0	-	-	-	-	-	-	-	-
3	BALRAMPUR	6	6	100.0	-	-	-	-	-	-	-	-
4	SURAJPUR	6	5	83.33	1	16.67	-	-	-	-	-	-
5	KHAIRAGARH-CHHUIKHADAN_GANDAI	2	1	50.0	1	50.0	-	-	-	-	-	-
6	BILASPUR	4	2	50.0	2	50.0	-	-	-	-	-	-
7	GARIABAND	5	4	80.0	1	20.0	-	-	-	-	-	-
8	BIJAPUR	4	4	100.0	-	-	-	-	-	-	-	-
9	BASTAR	7	7	100.0	-	-	-	-	-	-	-	-
10	BALODA BAZAR	5	5	100.0	-	-	-	-	-	-	-	-
11	SUKMA	3	3	100.0	-	-	-	-	-	-	-	-
12	KOREA	2	2	100.0	-	-	-	-	-	-	-	-

13	GOURELA-PENDRA-MARWAHI	3	3	100.0	-	-	-	-	-	-	-	-
14	KONDAGAON	5	5	100.0	-	-	-	-	-	-	-	-
15	DURG	3	1	33.33	2	66.67	-	-	-	-	-	-
16	JANJGIR-CHAMPA	5	5	100.0	-	-	-	-	-	-	-	-
17	MAHASAMUND	5	3	60.0	2	40.0	-	-	-	-	-	-
18	NARAYANPUR	2	2	100.0	-	-	-	-	-	-	-	-
19	BEMETARA	4	-	-	1	25.0	3	75.0	-	-	-	-
20	DHAMTARI	4	2	50.0	2	50.0	-	-	-	-	-	-
21	JASHPUR	8	8	100.0	-	-	-	-	-	-	-	-
22	KABIRDHAM	4	3	75.0	1	25.0	-	-	-	-	-	-
23	KORBA	5	5	100.0	-	-	-	-	-	-	-	-
24	BALOD	5	2	40.0	2	40.0	1	20.0	-	-	-	-
25	MUNGELI	3	3	100.0	-	-	-	-	-	-	-	-
26	RAIGARH	7	6	85.71	1	14.29	-	-	-	-	-	-
27	RAIPUR	4	3	75.0	-	-	1	25.0	-	-	-	-
28	RAJNANDGAON	4	1	25.0	3	75.0	-	-	-	-	-	-
29	SURGUJA	7	7	100.0	-	-	-	-	-	-	-	-
30	MANENDRAGARH-CHIRMIRI_BHARATPUR	3	3	100.0	-	-	-	-	-	-	-	-
31	MOHLA-MANPUR_AMBAGARHCHOWKI	3	3	100.0	-	-	-	-	-	-	-	-
32	SAKTI	4	4	100.0	-	-	-	-	-	-	-	-
33	SARANGARH-BILAIRAGH	3	2	66.67	1	33.33	-	-	-	-	-	-
	Total	146	120	82.19	21	14.38	5	3.42	-	-	-	-

Annexure III (C)

Annexure 5 Annual Extractable Ground Water Resource of Assessment Units under Different Category for Chhattisgarh.

(as in 2024)

ANNUAL EXTRACTABLE RESOURCE OF ASSESSMENT UNITS UNDER DIFFERENT CATEGORIES, 2024												
S.No	**State/Union Territories**	**Total Annual Extractable Resource of Assessed Units (in mcm)**	**Safe**		**Semi-Critical**		**Critical**		**Over-Exploited**		**Saline**	
			Total Annual Extractable Resource (in mcm)	**%**	**Total Annual Extractable Resource (in mcm)**	**%**	**Total Annual Extractable Resource (in mcm)**	**%**	**Total Annual Extractable Resource (in mcm)**	**%**	**Total Annual Extractable Resource (in mcm)**	**%**
1	CHHATTISGARH	12927.34	10132.06	78.38	2334.88	18.06	460.4	3.56	-	-	-	-
	Total	12927.34	10132.06	78.38	2334.88	18.06	460.4	3.56	-	-	-	-
	Grand Total	12927.34	10132.06	78.38	2334.88	18.06	460.4	3.56	-	-	-	-

Annexure- III (D)

Annexure 6 District Wise Annual Extractable Ground Water Resource of Assessment Units under Different Category for Chhattisgarh. (as in 2024)

DYNAMIC GROUND WATER RESOURCES OF INDIA, 2024												
CHHATTISGARH												
S.No	**Name of District**	**Total Annual Extractable Resource of Assessed Units (in mcm)**	**Safe**		**Semi-Critical**		**Critical**		**Over-Exploited**		**Saline**	
			Total Annual Extractable Resource (in mcm)	**%**	**Total Annual Extractable Resource (in mcm)**	**%**	**Total Annual Extractable Resource (in mcm)**	**%**	**Total Annual Extractable Resource (in mcm)**	**%**	**Total Annual Extractable Resource (in mcm)**	**%**
1	KANKER	658.27	573.2	87.08	85.07	12.92	-	-	-	-	-	-
2	DANTEWADA	248.94	248.94	100	-	-	-	-	-	-	-	-
3	BALRAMPUR	471.74	471.74	100	-	-	-	-	-	-	-	-
4	SURAJPUR	370.2	275.32	74.37	94.88	25.63	-	-	-	-	-	-
5	KHAIRAGARH-CHHUIKHADAN_GANDAI	178.38	84.76	47.52	93.62	52.48	-	-	-	-	-	-
6	BILASPUR	464.69	173.96	37.44	290.73	62.56	-	-	-	-	-	-
7	GARIABAND	337.69	251.8	74.56	85.89	25.44	-	-	-	-	-	-
8	BIJAPUR	469.92	469.92	100	-	-	-	-	-	-	-	-
9	BASTAR	246.32	246.32	100	-	-	-	-	-	-	-	-
10	BALODA BAZAR	618.8	618.8	100	-	-	-	-	-	-	-	-
11	SUKMA	415.43	415.43	100	-	-	-	-	-	-	-	-
12	KOREA	137.98	137.98	100	-	-	-	-	-	-	-	-
13	GOURELA-PENDRA-MARWAHI	131.02	131.02	100	-	-	-	-	-	-	-	-
14	KONDAGAON	350.24	350.24	100	-	-	-	-	-	-	-	-
15	DURG	390.7	135.23	34.61	255.47	65.39	-	-	-	-	-	-
16	JANJGIR-CHAMPA	441.2	441.2	100	-	-	-	-	-	-	-	-

17	MAHASAMUND	938.24	619.2	66	319.04	34	-	-	-	-	-	-
18	NARAYANPUR	245.06	245.06	100	-	-	-	-	-	-	-	-
19	BEMETARA	426.12	-	-	124.29	29.17	301.83	70.83	-	-	-	-
20	DHAMTARI	616.59	231.91	37.61	384.68	62.39	-	-	-	-	-	-
21	JASHPUR	321.26	321.26	100	-	-	-	-	-	-	-	-
22	KABIRDHAM	657.26	550.65	83.78	106.61	16.22	-	-	-	-	-	-
23	KORBA	457.19	457.19	100	-	-	-	-	-	-	-	-
24	BALOD	358.66	150.06	41.84	134.6	37.53	74	20.63	-	-	-	-
25	MUNGELI	245.55	245.55	100	-	-	-	-	-	-	-	-
26	RAIGARH	383.11	341.47	89.13	41.64	10.87	-	-	-	-	-	-
27	RAIPUR	460.2	375.63	81.62	-	-	84.57	18.38	-	-	-	-
28	RAJNANDGAON	352.03	101.09	28.72	250.94	71.28	-	-	-	-	-	-
29	SURGUJA	388.87	388.87	100	-	-	-	-	-	-	-	-
30	MANENDRAGARH-CHIRMIRI_BHARATPUR	467.22	467.22	100	-	-	-	-	-	-	-	-
31	MOHLA-MANPUR_AMBAGARHCHOWKI	152.02	152.02	100	-	-	-	-	-	-	-	-
32	SAKTI	298.47	298.47	100	-	-	-	-	-	-	-	-
33	SARANGARH-BILAIRAGH	227.96	160.55	70.43	67.41	29.57	-	-	-	-	-	-
	Total	12927.34	10132.06	78.38	2334.88	18.06	460.4	3.56	-	-		
	Grand Total	12927.34	10132.06	78.38	2334.88	18.06	460.4	3.56	-	-		

Annexure- III (E)

Annexure 7 Recharge Worthy Area of Assessment unit under Different Category for Chhattisgarh. (as in 2024)

AREA OF ASSESSMENT UNITS UNDER DIFFERENT CATEGORIES IN INDIA (2024)														
S.No	**States / Union Territories**	**Total Geographical Area of Assessed Units (in sq km)**	**Recharge Worthy Area (in sq km)**	**Safe**		**Semi-Critical**		**Critical**		**Over-Exploited**		**Saline**	
				Recharge Worthy Area in sq km	**%**	**Recharge Worthy Area in sq km**	**%**	**Recharge Worthy Area in sq km**	**%**	**Recharge Worthy Area in sq km**	**%**	**Recharge Worthy Area in sq km**	**%**
1	CHHATTISGARH	135191.53	106078.71	88869.46	83.78	14090.19	13.28	3119.06	2.94	-	-	-	-
	Total	135191.53	106078.71	88869.46	83.78	14090.19	13.28	3119.06	2.94	-	-	-	-
	Grand Total	135191.53	106078.71	88869.46	83.78	14090.19	13.28	3119.06	2.94	-	-	-	-

Annexure III (F)

Annexure 8 District Wise Recharge Worthy Area of Assessment unit under Different Category for Chhattisgarh. (as in 2024)

DYNAMIC GROUND WATER RESOURCES OF INDIA, 2024												
CHHATTISGARH												
S.No	**Name of District**	**Total Recharge Worthy Area of Assessed Units (in sq.km)**	**Safe**		**Semi-Critical**		**Critical**		**Over-Exploited**		**Saline**	
			Recharge Worthy Area of Assessed Units (in sq.km)	**%**	**Recharg e Worthy Area of Assessed Units (in sq.km)**	**%**	**Recharge Worthy Area of Assessed Units (in sq.km)**	**%**	**Recharg e Worthy Area of Assessed Units (in sq.km)**	**%**	**Recharg e Worthy Area of Assessed Units (in sq.km)**	**%**
1	KANKER	6260.36	5805.01	92.73	455.35	7.27	-	-	-	-	-	-
2	DANTEWADA	3118.66	3118.66	100.0	-	-	-	-	-	-	-	-
3	BALRAMPUR	5661.31	5661.31	100.0	-	-	-	-	-	-	-	-
4	SURAJPUR	2637.88	2073.14	78.59	564.74	21.41	-	-	-	-	-	-
5	KHAIRAGARH-CHHUIKHADAN_ GANDAI	1490.38	689.15	46.24	801.23	53.76	-	-	-	-	-	-
6	BILASPUR	3175.95	1572.65	49.52	1603.3	50.48	-	-	-	-	-	-
7	GARIABAND	2631.4	2036.1	77.38	595.3	22.62	-	-	-	-	-	-
8	BIJAPUR	4377.29	4377.29	100.0	-	-	-	-	-	-	-	-
9	BASTAR	3835.33	3835.33	100.0	-	-	-	-	-	-	-	-
10	BALODA BAZAR	4067.48	4067.48	100.0	-	-	-	-	-	-	-	-
11	SUKMA	5211.99	5211.99	100.0	-	-	-	-	-	-	-	-
12	KOREA	726.47	726.47	100.0	-	-	-	-	-	-	-	-
13	GOURELA-PENDRA-MARWAHI	1651.23	1651.23	100.0	-	-	-	-	-	-	-	-
14	KONDAGAON	3722.41	3722.41	100.0	-	-	-	-	-	-	-	-
15	DURG	2319.99	762.33	32.86	1557.66	67.14	-	-	-	-	-	-
16	JANJGIR-CHAMPA	2152.58	2152.58	100.0	-	-	-	-	-	-	-	-
17	MAHASAMUND	4597.2	3142.2	68.35	1455.0	31.65	-	-	-	-	-	-
18	NARAYANPUR	3510.43	3510.43	100.0	-	-	-	-	-	-	-	-

19	BEMETARA	2854.81	-	-	724.86	25.39	2129.95	74.61	-	-	-	-
20	DHAMTARI	2487.06	1215.81	48.89	1271.25	51.11	-	-	-	-	-	-
21	JASHPUR	4510.05	4510.05	100.0	-	-	-	-	-	-	-	-
22	KABIRDHAM	4239.63	3123.17	73.67	1116.46	26.33	-	-	-	-	-	-
23	KORBA	4314.3	4314.3	100.0	-	-	-	-	-	-	-	-
24	BALOD	2614.7	1292.95	49.45	984.95	37.67	336.8	12.88	-	-	-	-
25	MUNGELI	1639.42	1639.42	100.0	-	-	-	-	-	-	-	-
26	RAIGARH	3859.19	3348.89	86.78	510.3	13.22	-	-	-	-	-	-
27	RAIPUR	2891.98	2239.67	77.44	-	-	652.31	22.56	-	-	-	-
28	RAJNANDGAON	2597.32	747.87	28.79	1849.45	71.21	-	-	-	-	-	-
29	SURGUJA	4254.42	4254.42	100.0	-	-	-	-	-	-	-	-
30	MANENDRAGARH-CHIRMIRI_ BHARATPUR	3298.4	3298.4	100.0	-	-	-	-	-	-	-	-
31	MOHLA-MANPUR_AMBAGARH CHOWKI	1548.82	1548.82	100.0	-	-	-	-	-	-	-	-
32	SAKTI	1543.89	1543.89	100.0	-	-	-	-	-	-	-	-
33	SARANGARH-BILAIRAGH	2276.38	1676.04	73.63	600.34	26.37	-	-	-	-	-	-
	Total	106078.71	88869.46	83.78	14090.19	13.28	3119.06	2.94	-	-	-	-

Annexure IV (A)

Annexure 9 Categorization of Over Exploited, Critical and Semi Critical blocks/ mandals/ taluks (as in 2024)

CATEGORISATION OF ASSESSMENT UNIT, 2024							
CHHATTISGARH							
S.NO	**Name of District**	**S.NO**	**Name of Semi-Critical Assessment Units**	**S.NO**	**Name of Critical Assessment Units**	**S.NO**	**Name of Over-Exploited Assessment Units**
1	BALOD	1	BALOD	1	GURUR		
		2	GUNDERDEHI				
2	BEMETARA	1	SAJA	1	NAWAGARH		
				2	BEMETARA		
				3	BERLA		
3	BILASPUR	1	TAKHATPUR				
		2	BELHA				
4	DHAMTARI	1	DHAMTARI				
		2	KURUD				
5	DURG	1	DURG				
		2	DHAMDHA				
6	GARIABAND	1	RAJIM/FINGESHWAR				
7	KABIRDHAM	1	PANDARIYA				
8	KANKER	1	CHARAMA				

9	KHAIRAGARH-CHHUIKHADAN_GANDAI	1	KHAIRAGARH				
10	MAHASAMUND	1	BASNA				
		2	PITHORA				
11	RAIGARH	1	PUSAUR				
12	RAIPUR			1	DHARSIWA		
13	RAJNANDGAON	1	RAJNANDGAON				
		2	DONGARGAON				
		3	DONGARGARH				
14	SARANGARH-BILAIRAGH	1	BARAMKELA				
15	SURAJPUR	1	SURAJPUR				

Annexure IV (B)

Annexure 10 Quality problems in Assessment units (as in 2024)

QUALITY PROBLEMS IN ASSESSMENT UNITS, 2024							
CHHATISGARH							
S. No	**Name of District**	**S. No**	**Name of Assessment Units affected by Fluoride**	**S. No**	**Name of Assessment Units affected by Arsenic**	**S. No**	**Name of Assessment Units affected by Salinity**
1	Balrampur	1	Balrampur				
2	Gariaband	1	Chhura				
		2	Deobhog				
		3	Gariaband				
3	Gourela-Pendra-Marwahi	1	Marwahi				
4	Jashpur	1	Bagicha				
		2	Kunkuri				
		3	Pharsabahar				
5	Korea	1	Kartala				
		2	Katghora				
		3	Korba				
		4	Pali				
6	Mahasamund	1	Bagbahara				
7	Mohla-Manpur-Ambagarhchowki			1	Ambagarh Chowki		

8	Raigarh	1	Dharamjaigarh				
		2	Lailunga				
		3	Tamnar				
9	Sarangarh-Bilairagh	1	Sarangarh				
10	Surajpur	1	Pratappur				
		2	Premnagar				
		3	Ramanujnagar				

ABSTRACT

Total No. of Assessed Units	Number of Assessment Unit affected by Fluoride	Number of Assessment Unit affected by Arsenic	Number of Assessment Unit affected by Salinity
146	**20**	**1**	**0**

Annexure V (A)

Annexure 11 Summary of Assessment units improved or deteriorated from 2023 to 2024 assessment

State-Wise Summary of Assessment Units Improved Or Deteriorated From 2023 To 2024 Assessment				
S.No	**Name of States / Union Territories**	**Number of Assessment Units Improved**	**Number of Assessment Units Deteriorated**	**Number of Assessment Units With No Change**
1	**CHHATTISGARH**	**2**	**1**	**143**

Annexure V (B)

Annexure 12 Comparison of categorization of assessment units (2023 to 2024)

COMPARISON OF CATEGORIZATION OF ASSESSMENT UNITS (2023 AND 2024)									
CHHATTISGARH									
S.No	**Name of District**	**Name of Assessment Unit**	**Stage of Ground Water Extraction (%)2023**	**Categorization in2023**	**Name of District**	**Name of Assessment Unit**	**Stage of Ground Water Extraction (%)2024**	**Categorization in2024**	**Remark**
1	**MAHASAMUND**	**PITHORA**	**62.58**	**safe**	**MAHASAMUND**	**PITHORA**	**74.80**	**semi critical**	**Deteriorated**
2	**KORBA**	**KATGHORA**	**74.48**	**semi critical**	**KORBA**	**KATGHORA**	**63.55**	**safe**	**Improved**
3	**RAIGARH**	**TAMNAR**	**71.72**	**semi critical**	**RAIGARH**	**TAMNAR**	**61.58**	**safe**	**Improved**

Annexure VI

Annexure 13 Assessment Unit Wise Report (Attribute Table Recharge)

S. No	District	Assessment Unit Name	Total Geographical Area	Recharge Worthy Area	Recharge from Rainfall-MON	Recharge from Other Sources-MON	Recharge from Rainfall-NM	Recharge from Other Sources-NM	Total Annual Ground Water (Ham) Recharge	Total Natural Discharges (Ham)	Annual Extractable Ground Water Resource (Ham)	Total Extraction (Ham)	Annual GW Allocation for for Domestic Use as on 2025 (Ham)	Net Ground Water Availability for future use (Ham)	Stage of Ground Water Extraction (%)	Categorization (OE/Critical/Semicritical/Safe)
1.	KANKER	ANTAGARH	79632	78039	6164.85	266.49	133.31	256.06	6820.71	682.07	6138.64	1456.19	226.70	4672.04	23.72	safe
2.	KANKER	CHARAMA	50595	45535	5359.45	1531.22	77.78	2484.30	9452.75	945.27	8507.48	6172.68	289.34	2325.62	72.56	semi critical
3.	KANKER	BHANUPRATAPUR	91366	89539	8948.21	258.51	152.95	569.34	9929.01	510.06	9418.95	2624.37	265.36	6784.56	27.86	safe
4.	KANKER	NARHARPUR	73758	73020	5796.04	1019.76	521.80	2031.33	9368.93	522.74	8846.19	5269.67	317.63	3561.99	59.57	safe
5.	KANKER	KOYALIBEDA	204312	198183	15562.38	1303.9	1096.23	1339.45	19301.96	1083.23	18218.73	3790.52	502.77	14403.02	20.81	safe
6.	KANKER	KANKER	81071	80260	6340.29	336.59	137.10	1496.17	8310.15	831.01	7479.14	4109.27	371.09	3352.91	54.94	safe
7.	KANKER	DURGUKONDAL	62714	61460	7259.43	198.8	104.99	456.76	8019.98	802.00	7217.98	1399.18	177.18	5812.11	19.38	safe
8.	DANTEWADA	DANTEWADA	177296	160453	12313.31	203.65	166.98	563.67	13247.61	1324.77	11922.84	1834.35	238.99	10085.45	15.39	safe
9.	DANTEWADA	GEEDAM	58628	55110	4262.33	222.33	57.80	424.36	4966.82	496.68	4470.14	1402.42	296.53	3036.12	31.37	safe
10.	DANTEWADA	KATEKALYAN	48800	43920	4764.91	70.48	64.61	161.33	5061.33	506.13	4555.20	529.02	115.60	4022.58	11.61	safe
11.	DANTEWADA	KUAKONDA	56326	52383	3942.47	133.98	53.46	254.79	4384.70	438.47	3946.23	823.54	168.88	3119.72	20.87	safe
12.	BALRAMPUR	WADRAFNAGAR	136594	105098	12924.16	407.4	67.79	329.53	13728.88	705.78	13023.10	2126.86	491.96	10866.47	16.33	safe
13.	BALRAMPUR	SHANKARGARH	90038	63645	4631.11	216.76	34.58	240.63	5123.08	512.32	4610.76	1230.07	199.35	3373.01	26.68	safe
14.	BALRAMPUR	BALRAMPUR	108416	82416	4811.12	421.39	35.89	354.85	5623.25	562.33	5060.91	1880.12	337.68	3160.32	37.15	safe

15.	BALRAMPUR	RAJPUR	100066	89540	7517.03	432.47	56.52	509.28	8515.30	851.53	7663.77	2136.15	330.47	5508.40	27.87	safe
16.	BALRAMPUR	RAMCHANDRAPUR	127833	105873	7397.96	584.34	55.63	711.66	8749.59	874.96	7874.63	3427.95	531.43	4410.57	43.53	safe
17.	BALRAMPUR	KUSMI	150973	119559	8804.81	280.7	58.66	287.41	9431.58	491.25	8940.33	1356.12	309.76	7571.79	15.17	safe
18.	SURAJPUR	PREMNAGAR	29198	27892	2490.86	528.69	0.00	667.38	3686.93	190.67	3496.26	1685.34	196.27	1799.80	48.20	safe
19.	SURAJPUR	ODGI	47104	37389	3591.69	564.35	0.00	724.14	4880.18	267.45	4612.73	2484.89	267.05	2111.42	53.87	safe
20.	SURAJPUR	BHAIYATHAN	43360	42608	5342.21	844.24	0.00	1005.95	7192.40	406.11	6786.29	3183.43	369.94	3588.21	46.91	safe
21.	SURAJPUR	PRATAPPUR	60461	60013	6061.49	855.64	0.00	913.05	7830.18	783.03	7047.15	4205.21	456.08	2814.93	59.67	safe
22.	SURAJPUR	RAMANUJNAGAR	41063	39412	4262.8	1031.18	217.28	698.84	6210.10	621.01	5589.09	3641.03	349.25	1932.07	65.15	safe
23.	SURAJPUR	SURAJPUR	57534	56474	6819.58	805.34	0.00	2406.11	10031.03	542.92	9488.11	7476.85	659.46	1986.48	78.80	semi_critical
24.	KHAIRAGARH-CHHUIKHADAN_GANDAI	CHHUIKHADAN	75464	68915	3588.55	4150.11	41.25	1408.82	9188.73	712.96	8475.77	3998.77	569.12	4436.24	47.18	safe
25.	KHAIRAGARH-CHHUIKHADAN_GANDAI	KHAIRAGARH	81095	80123	5422.43	3458.12	56.87	1464.88	10402.30	1040.22	9362.08	7210.13	592.46	2116.80	77.01	semi_critical
26.	BILASPUR	MASTURI	73920	73920	3923.79	1114.48	250.01	797.78	6086.06	608.60	5477.46	2604.67	1291.43	2656.61	47.55	safe
27.	BILASPUR	TAKHATPUR	72440	72440	4574.6	8204.58	0.00	6290.39	19069.57	1906.96	17162.61	12651.73	1115.41	6656.43	73.72	semi_critical
28.	BILASPUR	KOTA	116598	83345	6844.85	3700.91	0.00	2255.98	12801.74	883.27	11918.47	2842.16	732.96	9027.34	23.85	safe
29.	BILASPUR	BELHA	87890	87890	6646.47	3840.7	176.61	2570.21	13233.99	1323.41	11910.58	9833.46	3389.32	1639.82	82.56	semi_critical
30.	GARIABAND	CHHURA	111127	44880	3102.5	1619.9	0.00	1278.70	6001.10	417.96	5583.14	3584.72	325.31	1985.72	64.21	safe
31.	GARIABAND	DEOBHOG	39129	30000	2401.57	773.19	0.00	703.84	3878.60	365.44	3513.16	1898.53	283.29	1598.20	54.04	safe
32.	GARIABAND	GARIABAND	154517	80280	6885.33	2163.37	0.00	1366.45	10415.15	1041.52	9373.63	5676.64	258.05	3687.99	60.56	safe
33.	GARIABAND	RAJIM/FINGESHWAR	59530	59530	4921.24	2510.94	0.00	2111.49	9543.67	954.37	8589.30	6891.90	466.50	1681.13	80.24	semi_critical
34.	GARIABAND	MAINPUR	217963	48450	5456.15	1428.99	0.00	570.04	7455.18	745.53	6709.65	3360.52	544.40	3255.46	50.08	safe
35.	BIJAPUR	USOOR	174535	111983	13703.7	154.98	59.06	189.71	14107.45	1410.75	12696.70	633.20	136.07	12061.77	4.99	safe
36.	BIJAPUR	BIJAPUR	114011	86778	10515.44	166.26	45.32	386.65	11113.67	1111.37	10002.30	2045.81	165.11	7954.36	20.45	safe

37.	BIJAPUR	BHOPALPATTNAM	144418	92598	9042.22	252.95	38.97	449.50	9783.64	978.37	8805.27	1248.38	136.84	7551.56	14.18	safe
38.	BIJAPUR	BHAIRAMGARH	228284	146370	16598	188.58	71.53	350.57	17208.68	1720.86	15487.82	998.94	273.86	14466.78	6.45	safe
39.	BASTAR	BASTANAR	59987	47888	3108.9	81.37	275.40	77.69	3543.36	354.34	3189.02	322.61	123.00	2863.44	10.12	safe
40.	BASTAR	BAKAWAND	106455	68134	3619.89	261.27	302.09	558.38	4741.63	249.75	4491.88	2318.08	426.04	2154.68	51.61	safe
41.	BASTAR	BASTAR	125149	89027	4120.23	419.11	363.51	741.65	5644.50	564.45	5080.05	2485.56	468.32	2573.03	48.93	safe
42.	BASTAR	DARBHA	98449	34077	2109.05	58.11	186.84	39.55	2393.55	239.35	2154.20	389.28	215.43	1757.40	18.07	safe
43.	BASTAR	JAGDALPUR	101017	50170	3672.46	208.32	217.08	235.57	4333.43	433.35	3900.08	1585.76	737.43	2282.22	40.66	safe
44.	BASTAR	LOHANDIGUDA	79793	57951	3068.21	107.42	271.03	100.29	3546.95	354.70	3192.25	526.25	211.97	2657.34	16.49	safe
45.	BASTAR	TOKAPAL	42148	36286	2342.08	178.21	142.82	253.40	2916.51	291.65	2624.86	805.57	218.14	1810.01	30.69	safe
46.	BALODA BAZAR	SIMGA	61506	61506	5136.58	8828.6	37.57	1840.28	15843.03	1584.29	14258.74	7927.39	1360.26	6323.60	55.60	safe
47.	BALODA BAZAR	BALODA BAZAR	62320	62320	3771.66	8304.68	188.25	1054.39	13318.98	1331.89	11987.09	5262.47	1407.89	6587.07	43.90	safe
48.	BALODA BAZAR	BHATAPARA	47115	47115	3230.53	7974.79	156.90	1645.64	13007.86	1300.80	11707.06	5270.96	868.04	6307.38	45.02	safe
49.	BALODA BAZAR	KASDOL	176339	176339	9774.11	3461.81	0.00	1163.06	14398.98	1439.89	12959.09	5779.38	768.05	7095.79	44.60	safe
50.	BALODA BAZAR	PALARI	59468	59468	3747.05	7440.61	29.52	854.61	12071.79	1103.30	10968.49	2381.30	1239.95	8267.16	21.71	safe
51.	SUKMA	CHHINDGARH	84871	79921	8357.99	303.12	0.00	335.98	8997.09	899.72	8097.37	1216.85	212.94	6873.81	15.03	safe
52.	SUKMA	KONTA	382059	350479	28530.11	400.23	0.00	352.15	29282.49	2928.25	26354.24	616.46	236.52	25736.77	2.34	safe
53.	SUKMA	SUKMA	96649	90799	7379.01	212.24	0.00	288.56	7879.81	787.97	7091.84	735.05	187.14	6349.31	10.36	safe
54.	KOREA	BAIKUNTHPUR	56221	43547	5401.34	1659.49	31.24	1185.15	8277.22	545.17	7732.05	4679.36	538.44	3040.30	60.52	safe
55.	KOREA	SONHAT	35471	29100	4141.83	1664.22	21.91	684.80	6512.76	446.55	6066.21	2116.48	145.19	3941.46	34.89	safe
56.	GOURELA-PENDRA-MARWAHI	PENDRA	34921	34921	3024.3	399.97	122.64	520.47	4067.38	229.02	3838.36	2287.06	320.23	1515.30	59.58	safe
57.	GOURELA-PENDRA-MARWAHI	MARWAHI	100972	79547	4738.54	361.59	244.62	368.58	5713.33	571.35	5141.99	1648.54	504.23	3409.04	32.06	safe

58.	GOURELA-PENDRA-MARWAHI	GAURELA	94846	50655	3534.35	514.11	177.89	353.18	4579.53	457.96	4121.57	1230.62	500.07	2834.73	29.86	safe
59.	BALOD	GURUR	41128	33680	2391.07	4269.41	0.00	1561.94	8222.42	822.25	7400.17	6931.07	388.90	816.94	93.66	critical
60.	BALOD	GUNDERDEHI	68070	68070	4165.75	3999.93	0.00	1918.68	10084.36	1008.44	9075.93	6482.95	603.03	2562.66	71.43	semi_critical
61.	BALOD	DOUNDI	52919	40963	2384.28	1538.34	0.00	720.83	4643.45	332.85	4310.60	2795.27	436.26	1502.57	64.85	safe
62.	BALOD	DOUNDI LOHARA	88332	88332	5661.3	4006.19	0.00	2216.45	11883.94	1188.40	10695.54	6620.70	554.61	4052.21	61.90	safe
63.	BALOD	BALOD	30425	30425	2225.55	1659.73	0.00	985.39	4870.67	487.07	4383.60	3701.79	373.42	663.84	84.45	semi_critical
64.	MOHLA-MANPUR_AMBAGARHCHOWKI	MOHLA	70301	50408	3237.1	514.97	49.80	773.70	4575.57	457.56	4118.01	1842.87	233.60	2267.57	44.75	safe
65.	MOHLA-MANPUR_AMBAGARHCHOWKI	MANPUR	113950	57041	5805.56	473.97	59.92	577.74	6917.19	691.72	6225.47	1463.66	239.55	4753.74	23.51	safe
66.	MOHLA-MANPUR_AMBAGARHCHOWKI	AMBAGARH CHOWKI	54747	47433	3315.01	890.4	34.57	1158.67	5398.65	539.87	4858.78	2575.19	294.67	2274.18	53.00	safe
67.	SURGUJA	UDAIPUR	141730	125630	10032.15	393.81	423.10	498.56	11347.62	583.09	10764.53	3529.42	226.37	7224.55	32.79	safe
68.	SURGUJA	SITAPUR	50099	48167	3810.58	429.46	22.16	454.27	4716.47	471.65	4244.82	2444.31	258.76	1792.82	57.58	safe
69.	SURGUJA	MAINPAT	67179	35076	2575.97	180.52	10.16	113.95	2880.60	288.06	2592.54	897.12	211.78	1687.26	34.60	safe
70.	SURGUJA	AMBIKAPUR	67632	57665	4494.08	1018.31	194.21	1121.17	6827.77	682.78	6144.99	3913.36	862.94	2190.75	63.68	safe
71.	SURGUJA	BATAULI	40173	32460	2558.91	327.41	0.00	606.66	3492.98	185.76	3307.22	2142.39	194.06	1172.02	64.78	safe
72.	SURGUJA	LAKHANPUR	78008	64699	5912.72	487.66	236.16	745.87	7382.41	738.23	6644.18	2887.55	342.55	3741.04	43.46	safe
73.	SURGUJA	LUNDRA	74294	61745	4783.42	606.09	0.00	375.95	5765.46	576.55	5188.91	2678.80	339.55	2495.20	51.63	safe
74.	MAHASAMUND	BAGBAHARA	117600	96920	11776.5	11783.82	0.00	4049.58	27609.90	2760.98	24848.92	10882.22	602.72	13928.79	43.79	safe
75.	MAHASAMUND	BASNA	64300	64300	6508.62	4294.99	0.00	3229.06	14032.67	924.74	13107.93	11538.42	475.16	1554.32	88.03	semi_critical
76.	MAHASAMUND	MAHASAMUND	116700	116700	12967.69	9852	0.00	3766.25	26585.94	2054.83	24531.11	13013.31	799.43	11477.62	53.05	safe
77.	MAHASAMUND	PITHORA	97100	81200	9876.33	6969.66	0.00	4038.79	20884.78	2088.48	18796.30	14059.32	577.67	4713.04	74.80	semi_critical
78.	MAHASAMUND	SARAIPALI	100600	100600	5881.95	5620.55	325.68	1696.17	13524.35	984.23	12540.12	7123.60	622.97	5373.37	56.81	safe

79.	SAKTI	SAKTI	65230	34231	2002.19	1341.07	22.11	1723.09	5088.46	508.85	4579.61	2227.59	557.62	2316.70	48.64	safe
80.	SAKTI	DABHARA	42064	42064	2501.54	2049.83	27.73	2865.25	7444.35	595.75	6848.60	4277.31	488.76	2546.51	62.46	safe
81.	SAKTI	JAIJAIPUR	44026	44026	2581.37	4947.06	28.89	5452.31	13009.63	1300.96	11708.67	4250.64	554.73	7409.68	36.30	safe
82.	SAKTI	MALKHARODA	34068	34068	2063.8	2379.45	22.96	2989.41	7455.62	745.57	6710.05	3479.12	485.36	3192.17	51.85	safe
83.	DHAMTARI	DHAMTARI	67883	67883	5927.83	9043.84	0.00	7296.28	22267.95	2226.80	20041.15	15359.23	774.76	4661.53	76.64	semi_critical
84.	DHAMTARI	KURUD	59242	59242	4535.62	9974.48	0.00	5963.79	20473.89	2047.39	18426.50	14321.29	598.16	4085.72	77.72	semi_critical
85.	DHAMTARI	MAGARLOD	88191	88191	7101.72	5857.44	0.00	2488.73	15447.89	1255.54	14192.35	9358.85	336.50	4821.01	65.94	safe
86.	DHAMTARI	NAGRI	192877	33390	3421.32	4050.92	0.00	2526.15	9998.39	999.84	8998.56	6027.96	470.63	2958.58	66.99	safe
87.	NARAYANPUR	ORCHHA	497551	248611	19449.95	22.82	547.29	21.64	20041.70	2004.17	18037.53	297.47	100.35	17735.36	1.65	safe
88.	NARAYANPUR	NARAYANPUR	193765	102432	5651.11	435.1	225.50	531.82	6843.53	374.56	6468.97	1499.78	311.67	4954.60	23.18	safe
89.	KABIRDHAM	SAHASPUR LOHARA	97520	96282	8289.08	10850.25	356.70	1816.78	21312.81	2131.28	19181.53	11478.82	596.18	7623.65	59.84	safe
90.	KABIRDHAM	PANDARIYA	121778	111646	8085.98	1783.66	343.14	1633.22	11846.00	1184.60	10661.40	9282.64	852.50	1309.49	87.07	semi_critical
91.	KABIRDHAM	KAWARDHA	53143	53143	5768.87	9073.16	250.54	3306.22	18398.79	1839.88	16558.91	11047.07	797.18	6409.27	66.71	safe
92.	KABIRDHAM	BODLA	172264	162892	10546.38	7977.83	458.39	2489.18	21471.78	2147.18	19324.60	6994.20	591.36	12289.27	36.19	safe
93.	MANENDRAGARH-CHIRMIRI_BHARATPUR	MANENDRAGARH	46383	31914	4354.97	575.51	22.81	427.09	5380.38	322.32	5058.06	2129.63	419.48	2916.57	42.10	safe
94.	MANENDRAGARH-CHIRMIRI_BHARATPUR	KHADGAWAN	229601	71739	9226.44	901.04	52.60	792.46	10972.54	597.48	10375.06	4455.98	447.91	5912.58	42.95	safe
95.	MANENDRAGARH-CHIRMIRI_BHARATPUR	BHARATPUR	230094	226187	33691.78	415.11	168.89	490.19	34765.97	3476.60	31289.37	2974.51	268.77	28298.79	9.51	safe
96.	RAIGARH	TAMNAR	46900	23800	3877.5	370.96	34.53	370.34	4653.33	465.32	4188.00	2578.99	281.06	1595.90	61.58	safe
97.	RAIGARH	RAIGARH	94272	78841	6292.04	484.59	83.20	481.06	7340.89	734.09	6606.80	2890.49	1009.45	3657.01	43.75	safe
98.	RAIGARH	PUSAUR	51030	51030	3188.67	547.67	28.60	861.50	4626.44	462.64	4163.80	3609.99	424.02	528.90	86.70	semi_critical

99.	RAIGARH	LAILUNGA	91035	75115	6651.9	374.57	69.30	344.00	7439.77	406.09	7033.68	1097.01	357.90	5924.36	15.60	safe
100	RAIGARH	KHARSIYA	40079	31449	2988.69	313.85	28.39	447.87	3778.80	221.23	3557.57	1795.56	426.13	1745.43	50.47	safe
101	RAIGARH	DHARAMJAIGARH	153769	95749	9177.59	463.34	121.81	588.48	10351.22	1035.12	9316.10	2916.81	571.35	6378.93	31.31	safe
102	RAIGARH	GHARGHODA	43304	29935	3215.92	233.35	42.70	335.89	3827.86	382.79	3445.07	1612.11	232.37	1822.12	46.79	safe
103	RAIPUR	ABHANPUR	60398	60398	2990.74	6608.08	0.00	2036.44	11635.26	1163.53	10471.73	4609.10	903.99	5762.58	44.01	safe
104	RAIPUR	ARANG	90039	90039	4684.63	5846.75	0.00	1556.11	12087.49	1037.94	11049.55	5713.36	1055.17	5248.79	51.71	safe
105	RAIPUR	DHARSIWA	65231	65231	5851.91	2826.65	0.00	717.57	9396.13	939.61	8456.52	7907.67	5524.03	1034.34	93.51	critical
106	RAIPUR	TILDA	73530	73530	6188.64	8124.7	42.18	3468.82	17824.34	1782.43	16041.91	8996.81	696.50	7014.59	56.08	safe
107	KORBA	KORBA	204001	88256	7933.91	559.42	142.03	449.66	9085.02	474.54	8610.48	3110.36	1218.49	5432.00	36.12	safe
108	KORBA	KATGHORA	47181	47116	5287.21	708.52	75.73	607.81	6679.27	667.93	6011.34	3820.19	1066.77	2116.00	63.55	safe
109	KORBA	PODI UPRORA	234881	131634	10526.13	2325.76	212.83	2768.88	15833.60	798.82	15034.78	2153.87	548.67	12853.60	14.33	safe
110	KORBA	PALI	150482	99201	7284.65	628.07	133.53	1021.60	9067.85	472.65	8595.20	4379.50	620.66	4174.41	50.95	safe
111	KORBA	KARTALA	77999	65223	6643.79	471.34	112.69	662.51	7890.33	423.53	7466.80	2881.59	424.62	4563.89	38.59	safe
112	MUNGELI	LORMI	162240	51146	4315.97	6391.92	0.00	1952.46	12660.35	1148.08	11512.27	3758.93	457.89	7712.55	32.65	safe
113	MUNGELI	PATHARIA	51464	51464	2336.25	3291.27	0.00	1570.51	7198.03	491.77	6706.26	3957.39	879.46	2564.02	59.01	safe
114	MUNGELI	MUNGELI	61332	61332	3028.05	2690.39	0.00	1321.86	7040.30	704.03	6336.27	3549.49	899.63	2694.99	56.02	safe
115	SARANGARH-BILAIRAGH	BILAIGARH	92692	92692	5940.81	5289.73	54.08	658.38	11943.00	1194.31	10748.69	1786.31	838.37	8867.15	16.62	safe
116	SARANGARH-BILAIRAGH	BARAMKELA	78134	60034	4337.27	670.38	49.72	2080.33	7137.70	396.88	6740.82	5183.88	556.42	1495.36	76.90	semi_critical
117	SARANGARH-BILAIRAGH	SARANGARH	85112	74912	3897.74	963.22	257.35	541.75	5660.06	353.77	5306.29	1904.86	633.21	3378.86	35.90	safe
118	RAJNANDGAON	DONGARGAON	41249	40736	2915.77	2138.6	30.94	1221.44	6306.75	630.67	5676.08	4853.97	407.98	799.60	85.52	semi_critical
119	RAJNANDGAON	CHHURIYA	80214	74787	5260.75	3316.36	78.38	2576.95	11232.44	1123.24	10109.20	4178.17	532.99	5901.61	41.33	safe
120	RAJNANDGAON	DONGARGARH	76732	69964	6083.22	2810.86	65.30	2733.69	11693.07	741.82	10951.25	8162.70	618.04	2758.98	74.54	semi_critical

121	RAJNANDGAON	RAJNANDGAON	74265	74245	5896.66	1439.12	61.93	2009.29	9407.00	940.70	8466.30	7250.81	2521.62	437.96	85.64	semi_critical
122	KONDAGAON	BADERAJPUR	47376	46676	3148.07	493.82	235.77	279.61	4157.27	207.87	3949.40	2336.43	234.17	1821.95	59.16	safe
123	KONDAGAON	KESHKAL	74916	73004	5827.45	522.04	474.12	512.64	7336.25	392.07	6944.18	3207.51	258.86	3727.43	46.19	safe
124	KONDAGAON	KONDAGAON	139297	132097	9645.34	402.23	571.93	416.38	11035.88	1103.58	9932.30	2378.13	601.97	7524.13	23.94	safe
125	KONDAGAON	PHARASGAON	67581	65881	6322.68	736.32	427.85	510.85	7997.70	446.70	7551.00	3389.52	277.17	4150.57	44.89	safe
126	KONDAGAON	MAKDI	56857	54583	5561.82	568.62	354.48	511.87	6996.79	349.84	6646.95	3804.28	286.61	2829.17	57.23	safe
127	JANJGIR-CHAMPA	AKALTARA	39699	39699	2652.68	3351.8	31.86	2265.29	8301.63	722.13	7579.50	2074.03	538.11	5474.94	27.36	safe
128	JANJGIR-CHAMPA	BAMHANIDIH	34334	34334	1966.09	4092.39	22.48	4092.11	10173.07	1017.31	9155.76	2435.39	678.09	6676.71	26.60	safe
129	JANJGIR-CHAMPA	JANJGIR (NAWAGARH)	60361	60361	2700.69	7253.7	34.99	4334.37	14323.75	1432.38	12891.37	2664.38	1008.27	10156.07	20.67	safe
130	JANJGIR-CHAMPA	PAMGARH	44533	44533	2332.26	4894.68	28.91	2934.02	10189.87	957.81	9232.05	2013.07	495.02	7193.39	21.81	safe
131	JANJGIR-CHAMPA	BALODA	58631	36331	2698.73	1239.19	34.80	1681.00	5653.72	392.81	5260.91	2052.09	340.68	3182.65	39.01	safe
132	JASHPUR	MANORA	89049	56129	3252.52	212.22	109.54	325.48	3899.76	389.97	3509.79	1087.79	159.92	2417.41	30.99	safe
133	JASHPUR	JASHPUR	58986	44936	2693.43	179.52	70.40	445.75	3389.10	172.41	3216.69	2131.38	287.82	1073.34	66.26	safe
134	JASHPUR	KANSABEL	50715	39155	2606.54	258.43	85.79	400.87	3351.63	173.30	3178.33	1792.07	196.41	1381.64	56.38	safe
135	JASHPUR	KUNKURI	55737	47537	2232.02	371.25	74.39	468.18	3145.84	314.58	2831.25	1624.67	253.06	1200.07	57.38	safe
136	JASHPUR	PATHALGAON	79200	57040	3725.51	697.24	124.97	847.23	5394.95	539.50	4855.45	2922.31	538.65	1912.79	60.19	safe
137	JASHPUR	PHARSABAHAR	79650	63350	5559.99	386.49	142.54	533.72	6622.74	662.27	5960.47	2167.58	275.59	3786.79	36.37	safe
138	JASHPUR	DULDULA	51364	31968	1616.08	101.07	39.47	219.15	1975.77	100.66	1875.11	985.32	131.81	886.40	52.55	safe
139	JASHPUR	BAGICHA	181040	110890	5767.53	598.31	226.01	475.50	7067.35	368.49	6698.86	2802.45	477.21	3878.55	41.83	safe
140	DURG	DHAMDHA	88249	88249	6137.39	5892.88	0.00	4114.04	16144.31	1614.43	14529.88	12202.54	826.91	2283.72	83.98	semi_critical
141	DURG	DURG	67517	67517	4226.1	5141.42	0.00	2567.66	11935.18	917.86	11017.32	9374.99	3372.77	2707.50	85.09	semi_critical
142	DURG	PATAN	76233	76233	4147.01	8729.8	0.00	2148.32	15025.13	1502.51	13522.62	7808.38	935.51	5681.56	57.74	safe

143	BEMETARA	BEMETARA	72779	72779	4293.25	5177.62	0.00	3709.41	13180.28	1318.03	11862.25	10772.75	883.09	2242.18	90.82	critical
144	BEMETARA	BERLA	77718	77718	5870.52	3506.5	0.00	3261.65	12638.67	1263.87	11374.80	10999.28	674.75	657.44	96.70	critical
145	BEMETARA	NAWAGARH	62498	62498	3430.05	2305.87	0.00	1982.02	7717.94	771.80	6946.14	6739.67	907.10	34.69	97.03	critical
146	BEMETARA	SAJA	72486	72486	4581.2	5792.79	0.00	3436.15	13810.14	1381.02	12429.12	11035.24	424.58	1432.55	88.79	semi_critical
									1418354.06	125620.17	1292733.88	611756.40	84499.02	681919.18	47.32	

Annexure 14 Assessment Unit wise Extraction

S.No	District	Assessment Unit Name	Irrigation Use (Ham)	Industrial Use (Ham)	Domestic Use (Ham)	Total Extraction (Ham)	Stage of Ground Water Extraction (%)	Categorization (OE/Critical/Semicritical/Safe)
1.	KANKER	ANTAGARH	1239.75	0.15	216.30	1456.19	23.72	safe
2.	KANKER	CHARAMA	5889.38	3.15	280.14	6172.68	72.56	semi_critical
3.	KANKER	BHANUPRATAPUR	2357.16	11.87	255.34	2624.37	27.86	safe
4.	KANKER	NARHARPUR	4964.35	2.22	303.10	5269.67	59.57	safe
5.	KANKER	KOYALIBEDA	3309.92	3.02	477.58	3790.52	20.81	safe
6.	KANKER	KANKER	3751.05	4.09	354.13	4109.27	54.94	safe
7.	KANKER	DURGUKONDAL	1222.63	6.06	170.49	1399.18	19.38	safe
8.	DANTEWADA	DANTEWADA	1443.57	154.83	235.95	1834.35	15.39	safe
9.	DANTEWADA	GEEDAM	1135.43	2.06	264.93	1402.42	31.37	safe
10.	DANTEWADA	KATEKALYAN	416.86	0.15	112.00	529.02	11.61	safe
11.	DANTEWADA	KUAKONDA	656.23	1.41	165.91	823.54	20.87	safe
12.	BALRAMPUR	WADRAFNAGAR	1663.27	1.40	462.19	2126.86	16.33	safe
13.	BALRAMPUR	SHANKARGARH	1038.21	0.18	191.67	1230.07	26.68	safe
14.	BALRAMPUR	BALRAMPUR	1562.40	0.51	317.21	1880.12	37.15	safe
15.	BALRAMPUR	RAJPUR	1820.03	4.87	311.25	2136.15	27.87	safe
16.	BALRAMPUR	RAMCHANDRAPUR	2930.53	2.10	495.32	3427.95	43.53	safe
17.	BALRAMPUR	KUSMI	1057.85	0.92	297.34	1356.12	15.17	safe
18.	SURAJPUR	PREMNAGAR	1499.89	0.29	185.15	1685.34	48.20	safe
19.	SURAJPUR	ODGI	2233.84	0.41	250.63	2484.89	53.87	safe

20.	SURAJPUR	BHAIYATHAN	2659.06	169.07	355.29	3183.43	46.91	safe
21.	SURAJPUR	PRATAPPUR	3549.23	226.88	429.07	4205.21	59.67	safe
22.	SURAJPUR	RAMANUJNAGAR	3206.91	100.85	333.26	3641.03	65.15	safe
23.	SURAJPUR	SURAJPUR	6384.63	457.54	634.68	7476.85	78.80	semi_critical
24.	KHAIRAGARH-CHHUIKHADAN_GANDAI	CHHUIKHADAN	3467.68	2.75	528.36	3998.77	47.18	safe
25.	KHAIRAGARH-CHHUIKHADAN_GANDAI	KHAIRAGARH	6643.75	9.07	557.31	7210.13	77.01	semi_critical
26.	BILASPUR	MASTURI	1277.12	252.30	1075.25	2604.67	47.55	safe
27.	BILASPUR	TAKHATPUR	11526.82	134.91	990.02	12651.73	73.72	semi_critical
28.	BILASPUR	KOTA	2120.36	37.82	683.99	2842.16	23.85	safe
29.	BILASPUR	BELHA	6641.88	239.56	2952.02	9833.46	82.56	semi_critical
30.	GARIABAND	CHHURA	3269.65	2.46	312.61	3584.72	64.21	safe
31.	GARIABAND	DEOBHOG	1630.67	1.01	266.86	1898.53	54.04	safe
32.	GARIABAND	GARIABAND	5422.96	4.64	249.05	5676.64	60.56	safe
33.	GARIABAND	RAJIM/FINGESHWAR	6432.63	9.03	450.23	6891.90	80.24	semi_critical
34.	GARIABAND	MAINPUR	2909.68	0.12	450.73	3360.52	50.08	safe
35.	BIJAPUR	USOOR	498.09	0.77	134.34	633.20	4.99	safe
36.	BIJAPUR	BIJAPUR	1882.49	0.33	162.98	2045.81	20.45	safe
37.	BIJAPUR	BHOPALPATTNAM	1116.75	0.14	131.51	1248.38	14.18	safe
38.	BIJAPUR	BHAIRAMGARH	746.51	0.68	251.76	998.94	6.45	safe
39.	BASTAR	BASTANAR	202.10	0.48	120.03	322.61	10.12	safe
40.	BASTAR	BAKAWAND	1905.70	5.48	406.92	2318.08	51.61	safe
41.	BASTAR	BASTAR	2031.27	7.44	446.86	2485.56	48.93	safe
42.	BASTAR	DARBHA	179.17	2.19	207.91	389.28	18.07	safe
43.	BASTAR	JAGDALPUR	831.97	48.46	705.33	1585.76	40.66	safe
44.	BASTAR	LOHANDIGUDA	320.76	2.19	203.31	526.25	16.49	safe
45.	BASTAR	TOKAPAL	590.66	6.05	208.86	805.57	30.69	safe
46.	BALODA BAZAR	SIMGA	6079.87	723.14	1124.37	7927.39	55.60	safe
47.	BALODA BAZAR	BALODA BAZAR	3850.72	357.19	1054.57	5262.47	43.90	safe
48.	BALODA BAZAR	BHATAPARA	4498.14	33.49	739.32	5270.96	45.02	safe
49.	BALODA BAZAR	KASDOL	5089.58	5.66	684.13	5779.38	44.60	safe
50.	BALODA BAZAR	PALARI	1435.74	25.64	919.92	2381.30	21.71	safe
51.	SUKMA	CHHINDGARH	1010.39	0.23	206.23	1216.85	15.03	safe
52.	SUKMA	KONTA	380.62	0.33	235.51	616.46	2.34	safe
53.	SUKMA	SUKMA	554.33	1.05	179.66	735.05	10.36	safe

54.	KOREA	BAIKUNTHPUR	3762.68	390.63	526.05	4679.36	60.52	safe
55.	KOREA	SONHAT	1979.57	0.00	136.92	2116.48	34.89	safe
56.	GOURELA-PENDRA-MARWAHI	PENDRA	2002.82	0.00	284.23	2287.06	59.58	safe
57.	GOURELA-PENDRA-MARWAHI	MARWAHI	1228.17	0.54	419.82	1648.54	32.06	safe
58.	GOURELA-PENDRA-MARWAHI	GAURELA	785.69	1.08	443.85	1230.62	29.86	safe
59.	BALOD	GURUR	6536.81	18.48	375.77	6931.07	93.66	critical
60.	BALOD	GUNDERDEHI	5890.33	19.90	572.71	6482.95	71.43	semi_critical
61.	BALOD	DOUNDI	2352.71	19.05	423.50	2795.27	64.85	safe
62.	BALOD	DOUNDI LOHARA	6081.40	7.32	531.98	6620.70	61.90	safe
63.	BALOD	BALOD	3338.50	7.83	355.45	3701.79	84.45	semi_critical
64.	MOHLA-MANPUR_AMBAGARHCHOWKI	MOHLA	1607.57	9.27	226.03	1842.87	44.75	safe
65.	MOHLA-MANPUR_AMBAGARHCHOWKI	MANPUR	1211.71	20.49	231.47	1463.66	23.51	safe
66.	MOHLA-MANPUR_AMBAGARHCHOWKI	AMBAGARH CHOWKI	2288.20	1.74	285.26	2575.19	53.00	safe
67.	SURGUJA	UDAIPUR	2505.14	808.47	215.81	3529.42	32.79	safe
68.	SURGUJA	SITAPUR	2191.98	1.26	251.07	2444.31	57.58	safe
69.	SURGUJA	MAINPAT	686.00	7.50	203.62	897.12	34.60	safe
70.	SURGUJA	AMBIKAPUR	3069.85	21.44	822.06	3913.36	63.68	safe
71.	SURGUJA	BATAULI	1955.22	0.54	186.63	2142.39	64.78	safe
72.	SURGUJA	LAKHANPUR	2351.47	209.12	326.96	2887.55	43.46	safe
73.	SURGUJA	LUNDRA	2343.27	10.89	324.64	2678.80	51.63	safe
74.	MAHASAMUND	BAGBAHARA	10301.32	16.08	564.81	10882.22	43.79	safe
75.	MAHASAMUND	BASNA	11070.02	8.42	459.97	11538.42	88.03	semi_critical
76.	MAHASAMUND	MAHASAMUND	12165.44	88.62	759.25	13013.31	53.05	safe
77.	MAHASAMUND	PITHORA	13499.49	6.11	553.73	14059.32	74.80	semi_critical
78.	MAHASAMUND	SARAIPALI	6538.85	4.94	579.82	7123.60	56.81	safe
79.	SAKTI	SAKTI	1703.94	1.36	522.30	2227.59	48.64	safe
80.	SAKTI	DABHARA	3812.30	1.03	463.98	4277.31	62.46	safe
81.	SAKTI	JAIJAIPUR	3738.53	5.73	506.38	4250.64	36.30	safe
82.	SAKTI	MALKHARODA	3031.78	0.75	446.60	3479.12	51.85	safe
83.	DHAMTARI	DHAMTARI	14567.42	37.43	754.37	15359.23	76.64	semi_critical
84.	DHAMTARI	KURUD	13710.62	32.00	578.67	14321.29	77.72	semi_critical
85.	DHAMTARI	MAGARLOD	9029.97	4.87	324.01	9358.85	65.94	safe

86.	DHAMTARI	NAGRI	5564.67	4.69	458.61	6027.96	66.99	safe
87.	NARAYANPUR	ORCHHA	201.82	0.00	95.65	297.47	1.65	safe
88.	NARAYANPUR	NARAYANPUR	1192.05	10.65	297.07	1499.78	23.18	safe
89.	KABIRDHAM	SAHASPUR LOHARA	10955.80	5.89	517.12	11478.82	59.84	safe
90.	KABIRDHAM	PANDARIYA	8492.96	6.46	783.23	9282.64	87.07	semi_critical
91.	KABIRDHAM	KAWARDHA	10310.14	11.30	725.63	11047.07	66.71	safe
92.	KABIRDHAM	BODLA	6392.42	51.54	550.23	6994.20	36.19	safe
93.	MANENDRAGARH-CHIRMIRI_BHARATPUR	MANENDRAGARH	1435.29	286.73	407.62	2129.63	42.10	safe
94.	MANENDRAGARH-CHIRMIRI_BHARATPUR	KHADGAWAN	3580.67	433.90	441.41	4455.98	42.95	safe
95.	MANENDRAGARH-CHIRMIRI_BHARATPUR	BHARATPUR	2721.75	0.06	252.70	2974.51	9.51	safe
96.	RAIGARH	TAMNAR	644.43	1666.61	267.95	2578.99	61.58	safe
97.	RAIGARH	RAIGARH	1755.67	184.66	950.15	2890.49	43.75	safe
98.	RAIGARH	PUSAUR	3160.48	50.41	399.11	3609.99	86.70	semi_critical
99.	RAIGARH	LAILUNGA	748.43	3.00	345.59	1097.01	15.60	safe
100.	RAIGARH	KHARSIYA	1234.20	151.81	409.55	1795.56	50.47	safe
101.	RAIGARH	DHARAMJAIGARH	2139.77	226.06	550.99	2916.81	31.31	safe
102.	RAIGARH	GHARGHODA	1006.71	383.87	221.53	1612.11	46.79	safe
103.	RAIPUR	ABHANPUR	3705.09	100.07	803.94	4609.10	44.01	safe
104.	RAIPUR	ARANG	4304.66	440.93	967.77	5713.36	51.71	safe
105.	RAIPUR	DHARSIWA	2365.13	592.92	4949.63	7907.67	93.51	critical
106.	RAIPUR	TILDA	7568.20	762.61	665.99	8996.81	56.08	safe
107.	KORBA	KORBA	1571.71	388.29	1150.37	3110.36	36.12	safe
108.	KORBA	KATGHORA	1217.38	1611.20	991.62	3820.19	63.55	safe
109.	KORBA	PODI UPRORA	1307.07	325.44	521.36	2153.87	14.33	safe
110.	KORBA	PALI	3708.12	92.00	579.37	4379.50	50.95	safe
111.	KORBA	KARTALA	2456.43	21.86	403.30	2881.59	38.59	safe
112.	MUNGELI	LORMI	3341.48	0.35	417.10	3758.93	32.65	safe
113.	MUNGELI	PATHARIA	3236.64	26.13	694.61	3957.39	59.01	safe
114.	MUNGELI	MUNGELI	2737.45	4.20	807.84	3549.49	56.02	safe
115.	SARANGARH-BILAIRAGH	BILAIGARH	1034.85	8.33	743.14	1786.31	16.62	safe
116.	SARANGARH-BILAIRAGH	BARAMKELA	4678.28	10.76	494.84	5183.88	76.90	semi_critical
117.	SARANGARH-BILAIRAGH	SARANGARH	1267.86	26.36	610.64	1904.86	35.90	safe
118.	RAJNANDGAON	DONGARGAON	4422.17	46.32	385.47	4853.97	85.52	semi_critical
119.	RAJNANDGAON	CHHURIYA	3666.43	8.16	503.57	4178.17	41.33	safe

120.	RAJNANDGAON	DONGARGARH	7566.20	8.01	588.47	8162.70	74.54	semi_critical
121.	RAJNANDGAON	RAJNANDGAON	5340.63	166.09	1744.09	7250.81	85.64	semi_critical
122.	KONDAGAON	BADERAJPUR	2109.03	0.84	226.55	2336.43	59.16	safe
123.	KONDAGAON	KESHKAL	2955.57	2.33	249.62	3207.51	46.19	safe
124.	KONDAGAON	KONDAGAON	1788.36	17.84	571.93	2378.13	23.94	safe
125.	KONDAGAON	PHARASGAON	3122.55	0.72	266.25	3389.52	44.89	safe
126.	KONDAGAON	MAKDI	3531.14	0.03	273.11	3804.28	57.23	safe
127.	JANJGIR-CHAMPA	AKALTARA	1431.27	135.17	507.58	2074.03	27.36	safe
128.	JANJGIR-CHAMPA	BAMHANIDIH	1785.38	15.58	634.43	2435.39	26.60	safe
129.	JANJGIR-CHAMPA	JANJGIR (NAWAGARH)	1726.89	0.15	937.35	2664.38	20.67	safe
130.	JANJGIR-CHAMPA	PAMGARH	1541.67	1.97	469.43	2013.07	21.81	safe
131.	JANJGIR-CHAMPA	BALODA	1658.63	78.93	314.51	2052.09	39.01	safe
132.	JASHPUR	MANORA	932.32	0.15	155.33	1087.79	30.99	safe
133.	JASHPUR	JASHPUR	1853.60	2.90	274.88	2131.38	66.26	safe
134.	JASHPUR	KANSABEL	1598.31	1.95	191.79	1792.07	56.38	safe
135.	JASHPUR	KUNKURI	1374.40	3.71	246.55	1624.67	57.38	safe
136.	JASHPUR	PATHALGAON	2388.71	15.29	518.30	2922.31	60.19	safe
137.	JASHPUR	PHARSABAHAR	1895.39	2.70	269.49	2167.58	36.37	safe
138.	JASHPUR	DULDULA	855.54	1.38	128.42	985.32	52.55	safe
139.	JASHPUR	BAGICHA	2341.53	1.56	459.35	2802.45	41.83	safe
140.	DURG	DHAMDHA	11264.45	154.80	783.29	12202.54	83.98	semi_critical
141.	DURG	DURG	5879.63	218.95	3276.39	9374.99	85.09	semi_critical
142.	DURG	PATAN	6870.93	34.63	902.83	7808.38	57.74	safe
143.	BEMETARA	BEMETARA	10000.38	21.97	750.41	10772.75	90.82	critical
144.	BEMETARA	BERLA	10263.25	134.60	601.44	10999.28	96.70	critical
145.	BEMETARA	NAWAGARH	5955.68	48.67	735.32	6739.67	97.03	critical
146.	BEMETARA	SAJA	10650.25	7.06	377.95	11035.24	88.79	semi_critical
			520686.92	13853.01	77216.35	611756.40	47.32	

Annexure 15 SLC Approval and Minutes of meetings

छत्तीसगढ़ शासन
जल संसाधन विभाग
"मंत्रालय"
महानदी भवन, नवा रायपुर अटल नगर,
जिला–रायपुर (छ.ग.)

क्र. 1704 / एफ–1–66 / 31 / एस–2 / GW / 2010, अटल नगर, दिनांक 29 / 04 / 2024

प्रति,

सदस्य सचिव (SLC)
सह क्षेत्रीय निदेशक,
केन्द्रीय भूमि जल बोर्ड,
भारत सरकार, जल शक्ति मंत्रालय,
उत्तर मध्य छत्तीसगढ़ क्षेत्र,
द्वितीय तल, एल.के.कॉर्पोरेट एवं
लौजिस्टिक पार्क, धमतरी रोड,
डूमरतराई, रायपुर–492015

विषय :– **अध्यक्ष (SLC) सह सचिव महोदय जल संसाधन विभाग की अध्यक्षता में दिनांक 19 अप्रैल, 2024 को सम्पन्न Ground Water Resources Assessment for Chhattisgarh State-2024 की बैठक का कार्यवाही विवरण।**

संदर्भ:– आपका ई–मेल दिनांक 24.04.2024.

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विषयांतर्गत संदर्भित ई–मेल के द्वारा प्राप्त अध्यक्ष (SLC) सह सचिव महोदय जल संसाधन विभाग की अध्यक्षता में दिनांक 19 अप्रैल, 2024 को सम्पन्न Ground Water Resources Assessment for Chhattisgarh State-2024 की बैठक का सचिव द्वारा अनुमोदित कार्यवाही विवरण आवश्यक कार्यवाही हेतु प्रेषित है। कृपया उक्त विवरण आपके कार्यालय से जारी करते हुए समिति के सभी सम्मानीय सदस्यों को उपलब्ध कराने का अनुरोध है।

सहपत्र :–उपरोक्तानुसार।

विशेष कर्तव्यस्थ अधिकारी
जल संसाधन विभाग
मंत्रालय, अटल नगर

MINUTES OF THE MEETING OF THE STATE LEVEL COMMITTEE FOR GROUND WATER RESOURCE ASSESSMENT 2024.

Held on 19. 04. 2024.

A meeting of the State Level Committee (SLC) for Ground Water Resources Assessment 'Dynamic Ground Water Resources of Chhattisgarh, 2024' was held in the office of the Secretary, Water Resources Department, Government of Chhattisgarh on 19th April, 2024 at 1:00 pm. The meeting was chaired by Secretary, Water Resources Department, Government of Chhattisgarh. The meeting was attended by representatives from Central Ground Water Board (CGWB), Water Resources Department, Department of Agriculture, Directorate of Industries, National Bank for Agriculture and Rural Development (NABARD), Public Health Engineering Department and Directorate of Economics and Statistics. The list of members who attended the meeting is appended in Annexure-I. The major outcomes of the meeting are given below.

At the outset, Secretary, Water Resources and the Chairman of the State Level Committee for estimation of Ground Water Resources, welcomed all the members and requested the Regional Director, CGWB to give a brief introduction and objectives of the meeting for the assessment of ground water resources of Chhattisgarh state.

1. Dr. Prabir K. Naik, Regional Director, Central Ground Water Board, NCCR, Raipur as the member secretary for the committee gave a brief introduction with importance of the ground water resource estimation and objectives of the meeting for the assessment of ground water resources of Chhattisgarh state followed by the release of the GWRA report for the year 2023 by the SLC members. Subsequently, with the permission of Chair, he handed over the session to Shri Uddeshya Kumar, Scientist C, CGWB for presenting the timeline for the Ground Water Resources Assessment in Chhattisgarh state for the year 2024.

2. Shri Uddeshya Kumar presented the timeline and major activities to be carried out by the members of Ground Water Resource Assessment Cell (GWRAC) for the year 2024. Given the timeline stipulating the SLC approval of the Ground Water Resources by 15th August, 2024, it is essential to conduct data collection preferably by June, 2024 to facilitate sufficient time for thorough data validation. A brief discussion was held on the draft pattern of the state. He further emphasized on the availability and refinement of data. The committee collectively decided to estimate the actual number of borewells in urban and rural areas. The household consumers may also be considered for draft estimation in urban areas.

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3. A detailed discussion was held on the availability of shapefiles of command and non-command areas. It was decided that a shapefile and the list of villages in the command area should be provided for actual comparison of irrigation wells between command and non-command areas. WRD, Chhattisgarh has the data of the major and medium canal command areas and the Secretary, WRD advised to share the data with CGWB. The committee also advised to collect the number of irrigation wells village wise from Zila Panchayat/ Janpad Panchayat.

4. Secretary, WRD further emphasized on data collection of the actual number of borewells from CSPDCL and CREDA for resource estimation. Data from CSPDCL related to energy consumption of irrigation wells may also be collected. Further, it was suggested to collect the block – wise data of the water conservation structures along with their dimensions from the respective departments/ Jal Shakti Kendras.

5. Dr. M. L. Agrawal, EnC, PHED emphasized on the drinking water source sustainability due to decline in the depth to ground water level. He advised for the mapping of command and non – command areas in 1:10000 scale for proper land and water resources management.

6. Regional Director, CGWB discussed the composition of GWRAC with the committee members constituting officers from CGWB and State Ground Water department. It was decided that Superintending Engineer, Water Resources & Ground Water Circle will be the state level Nodal Officer supported by SGH, WRD. Further, it was discussed to constitute a district level Ground Water Resource Assessment cell. SE, Water Survey Circle highlighted the shortage of officers/ geo hydrologists in the state department.

Chairman of the committee directed all the members to take necessary measures for timely completion of Ground Water Resources Assessment 2024.

The meeting ended with thanks to the chair.

(Approved by Chairman-SLC cum Secretary, WRD), GoCG)

Officer on Special Duty
Water Resources Department,
Mantralaya, Naya Raipur

Annexure - 1

List of Members participated in the first meeting of the State Level Committee for Ground Water Resources Assessment for Chhattisgarh, held on 19/04/2024.		
Sl. No.	**Name**	**Designation and department**
1.	Shri Rajesh Sukumar Toppo	IAS, Special Secretary, Water Resources Department, Govt. of Chhattisgarh & Chairman of the Committee
2.	Shri Indrajeet Uikey	Engineer-In-Chief, Water Resources Department, Govt. of Chhattisgarh
3.	Dr. Prabir K. Naik	Regional Director, North Central Chhattisgarh Region, Raipur
4.	Dr. M. L. Agrawal	Engineer-In-Chief, Public Health Engineering Department
5.	Shri K. S. Guroower	Chief Engineer, Water Resources Department
6.	Shri Mukesh Santoshi	Chief Engineer, MGB, Water Resources Department
7.	Shri N. Buliwal	Joint Director, Directorate of Economics and Statistics
8.	Shri S. K. Tikam	Superintending Engineer, Water Resources & Ground Water Circle
9.	Dr. Satish Goswami	Statistical Officer, Directorate of Economics and Statistics
10.	Shri Saurabh Singh	Assistant Manager, NABARD
11.	Shri Satram S. Paikra	Assistant Director, Department of Agriculture
12.	Shri Lokpal Khandekar	Assistant Director, Directorate of Industries
13.	Shri Mitesh Dage	Assistant Director, Directorate of Industries
14.	Shri Champat Dewangan	EE, Water Resources Department, Govt. of Chhattisgarh
15.	Shri Uddeshya Kumar	Scientists-C, NCCR
16.	Shri B. Abhishek	Scientists-C, NCCR
17.	Shri Lokesh Manhar	AGH, Water Resources Department, Govt. of Chhattisgarh
18.	Ms. Sweta Mohanty	AHG, NCCR

भारत सरकार
जल शक्ति मंत्रालय
जल संसाधन, नदी विकास और
गंगा संरक्षण विभाग
केंद्रीय भूमि जल बोर्ड
उत्तर मध्य छत्तीसगढ़ क्षेत्र
दूसरी मंजिल, एल के कॉर्पोरेट्स
और लॉजिस्टिक पार्क,
धमतरी रोड, डुमरतराई
रायपुर - 492015

महत्वपूर्ण (Email/ Speed Post)

Govt. of India
Ministry Jal Shakti
Department of Water Resources,
River Development and Ganga Rejuvenation
Central Ground Water Board,
North Central Chhattisgarh Region,
2nd Floor, L K Towers
Dhamtari Road, Dumartarai
Raipur – 492015
Email: rdnccr-cgwb@nic.in

No. 82/CGWB/NCCR/21-22/ – 35

30 APR 2024

प्रति,

1. प्रमुख अभियंता, जल संसाधन विभाग, शिवनाथ भवन, सेक्टर-19, अटल नगर-नवा रायपुर
2. प्रमुख अभियंता, लोक स्वास्थ्य यांत्रिकी विभाग, मंत्रालय, महानदी भवन, नवा रायपुर- अटल नगर
3. संचालक, कृषि विभाग, कृषक भवन, सेक्टर-19, नॉर्थ ब्लॉक, नवा रायपुर- अटल नगर
4. मुख्य अभियंता, महानदी गोदावरी कछार, जल संसाधन विभाग, रायपुर
5. संचालक, उद्योग विभाग, प्रथम तल, उद्योग भवन, रिंग रोड नं.-1 के पीछे, तेलीबांधा, रायपुर
6. मुख्य महाप्रबंधक नाबार्ड, छत्तीसगढ़ क्षेत्रीय कार्यालय, अनन्य भवन, प्लॉट -01, सेक्टर-24, सेन्ट्रल बैंक के पीछे, नवा रायपुर-अटल नगर
7. संचालक, योजना एवं आर्थिक सांख्यिकी विभाग, इन्द्रावती भवन, नवा रायपुर- अटल नगर

विषय:- **STATE LEVEL COMMITTEE (SLC) FOR GROUND WATER RESOURCES ASSESSMENT (GWRA) 2024 की आयोजित बैठक दिनांक 19.04.2024 का कार्यवाही विवरण।**

उपरोक्त विषयांतर्गत STATE LEVEL COMMITTEE (SLC) FOR GROUND WATER RESOURCES ASSESSMENT (GWRA) 2024 की आयोजित बैठक दिनांक 19.04.2024 का अध्यक्ष -SLC सह सचिव, छत्तीसगढ़ शासन, जल संसाधन विभाग महोदय द्वारा अनुमोदित कार्यवाही विवरण जानकारी एवं आवश्यक कार्यवाही हेतु संलग्न प्रेषित है।

सहपत्र उपरोक्तानुसार। -:

प्रबीर 30/04/24

(डा. प्रबीर कु. नायक)
सदस्य सचिव (SLC)
सह क्षेत्रीय निदेशक, केंद्रीय भूमि जल बोर्ड

प्रतिलिपि:

1. विशेष कर्त्तव्यस्थ अधिकारी, जल संसाधन विभाग, छ.ग. शासन मंत्रालय, महानदी भवन, नवा रायपुर–अटल नगर को पत्र संख्या 1704/एफ-1-66/31/ एस-2/GW/2010 दिनांक 29.04.2024 के सन्दर्भ में सादर सूचनार्थ प्रेषित।

प्रबीर 30/04/24

(डा. प्रबीर कु. नायक)
सदस्य सचिव (SLC)
सह क्षेत्रीय निदेशक, केंद्रीय भूमि जल बोर्ड

महत्वपूर्ण

छत्तीसगढ़ शासन
जल संसाधन विभाग
मंत्रालय
महानदी भवन, नवा रायपुर–अटल नगर

क्र.–एफ–1–66/31/एस–2/GW/2010/3912 नवा रायपुर, दिनांक 04/~~09~~ 10/2024

प्रति,

सदस्य सचिव (SLC),
सह क्षेत्रीय निदेशक, केन्द्रीय भूमिजल बोर्ड,
भारत सरकार, जल शक्ति मंत्रालय,
उत्त मध्य छत्तीसगढ़ क्षेत्र,
द्वितीय तल, एल.के. कॉर्पोरेट एवं
लॉजिस्टिक पार्क, धमतरी रोड,
डुमरतराई, रायपुर–492015

विषयः– **Minutes of the Meeting of the State Level Committee for Approval of Ground Water Resources as on March-2024 Held on 11-09-2024.**

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उपरोक्त विषयांतर्गत STATE LEVEL COMMITTEE (SLC) FOR GROUND WATER RESOURCES ASSESSMENT (GWRA) 2024 की आयोजित बैठक दिनांक 11.09.2024 का अध्यक्ष–SLC सह सचिव, छत्तीसगढ़ शासन, जल संसाधन विभाग महोदय द्वारा अनुमोदित कार्यवाही विवरण आवश्यक कार्यवाही हेतु संलग्न प्रेषित है।

कृपया उक्त कार्यवाही विवरण समिति के सभी सदस्यों को प्रेषित करने का कष्ट करेंगे।

सहपत्र :– उपरोक्तानुसार।
(मूलतः)

O/C

विशेष कर्तव्यस्थ अधिकारी
जल संसाधन विभाग
मंत्रालय, अटल नगर

MINUTES OF THE MEETING OF THE STATE LEVEL COMMITTEE FOR APPROVAL OF GROUND WATER RESOURCES AS ON MARCH-2024.

Held on 11/09/2024

A meeting of the State Level Committee for re-estimation of Ground Water Resources (SLC) for approval of 'Dynamic Ground Water Resources of Chhattisgarh as on March 2024' was held in the office of the Secretary, Water Resources Department, Govt of Chhattisgarh, Mantralaya, Mahanadi Bhawan, Naya Raipur on 11th September 2024 at 12:30 hours. The meeting was chaired by Secretary, Water Resources, Govt. of Chhattisgarh. The meeting was attended by representatives from Central Ground Water Board (CGWB), Water Resources Department, Ground Water Survey, Department of Agriculture and National Bank for Agriculture and Rural Development (NABARD), Public Health Engineering Department, Panchayat and Rural Development Department, Directorate of Economics and Statistics, MGNREGAS, Department of Industries and State Watershed Management Agency. The list of members attended the meeting is appended in Annexure-I. The major outcomes of the meeting are given below.

At the outset, Ms. Sweta Mohanty welcomed the Chairman and all the members of the State Level Committee for re-estimation of Ground Water Resources and requested Dr. Prabir. K Naik Regional Director, CGWB to give welcome address and a brief introduction on objectives of the meeting for the re-assessment of ground water resources of Chhattisgarh state.

1. Dr. Prabir K. Naik, Regional Director of Central Ground Water Board (CGWB), North Central Chhattisgarh Region, Raipur, being the Member Secretary of the committee, provided a concise introduction emphasizing the significance of ground water resource estimation. He also outlined the objectives of the meeting, which focused on the assessment of ground water resources in Chhattisgarh state. Following the directive of the Secretary and Chairman of CGWB from a previous meeting, the District Ground water Information Booklet for Dhamtari was formally released. The Secretary of Water Resources commended CGWB for their expeditious efforts in producing the booklet in Hindi. Subsequently, with the Chair's approval, the session was handed over to Shri. B. Abhishek, Scientist C, CGWB.

2. Shri. B. Abhishek presented an overview of the current ground water scenario in Chhattisgarh state, based on the data compiled up to March 2024. Shri B. Abhishek informed that every year the ground water resources of Chhattisgarh state are re-estimated as per methodology suggested. The recent estimations have been carried out by CGWB and State Ground Water Survey taking 2023-24 as the base year and the new methodology adopted is GEC '2015'. In the assessments, the administrative block was taken as unit of assessment and command & non-command area in block was taken as subunit. The Total Annual Ground Water Recharge of the State has been assessed as 14.18 BCM and Annual Extractable Ground Water Resource is 12.93 BCM. The Total Current Annual Ground Water Extraction is 6.12 BCM and Stage of Ground Water Extraction is 47.32 % with 21 blocks falling under Semi-Critical and 5 blocks under Critical category in Chhattisgarh. He also explained the comparative scenario of Dynamic Ground Resources of Chhattisgarh from 2017 to 2024.

3. Secretary, Water Resources & the Chairman of the Committee enquired about the comparison of results of GWRA-2024 with the nation average in 2023. The total Stage of Ground water Extraction in the country as on March 2023 was 59.26%. As per GWRA - 2023, the groundwater draft at National level was 87% for agriculture, 11% for domestic and 2% for industrial use.When compared to the GWRA -2024 of Chhattisgarh state it approximately shows similar results where agriculture sector accounts for 86%, domestic use accounts for 12% and while industrial use represents 2%. Whereas Rainfall recharge was 60% of the total recharge (Monsoon season: 54%, Non-monsoon season: 6%) at National level in 2023 agriculture sector accounts for 87%, domestic use accounts for 11% and while industrial use represents 2%. and the remaining 40% (Monsoon season: 19%, Non-monsoon season: 21%) is from 'Other sources' viz. canal seepage, return flow from irrigation, recharge from tanks, ponds and water conservation structures taken together. While at state level in 2024, the rainfall recharge is 61.51% and recharge from other sources is 38,49%.

4. The Chairman, also disused about the number of irrigation abstraction structures in the state as per available data which is 4,79,000 which also includes 1,16,638 Solar Pumps issued under Sourya Sujla Yojna. Later the Secretary, Water Resources invited opinion

from all members of the committee on estimation carried out. In response, Dr M. L. Agarwal, ENC PHED informed that the PHED experienced with sustainability and scarcity of ground water in rural water supply for domestic uses and tube wells are getting dry during the lean/Summer period due to enormous ground water with drawal for irrigation purposes near the same tubewells. A brief discussion was held on the drying up of well despite increase in total annual ground water recharge from 13.34 BCM in 2023 to 14.18 BCM in 2024. The additional increase in the recharge was attributed to an increase in the number of irrigation wells resulted in the increase of total extraction. The increase in return flow thus generated by increase in ground water irrigation area is responsible for the comparative increased ground water recharge.The monsoon and non-monsoon ground water utilized in irrigation in the problematic area is approximately 42 % and 58 %. However, in the monsoon this 42% draft is compensated through recharges from rainfall and other sources which accounts for 85% of the total recharge. In the non-monsoon during the Rabi Season the scenario reverses with draft being 58% and recharges accounts for 15% resulting into deepening and drying up of borewells located at the top of the watershed during the period of March to June. This issue can only be managed through developing canal networks in rabi cropped areas near the river where the same cropping pattern has been practiced from a prolonged duration. While in districts like Mahasamund and Bemetara where the copping is uniform along the whole district farm ponds and surface water irrigation can be developed.

5. Later Shri B. Abhishek, through Land-Sat imageries displayed the spatial distribution of Rabi Paddy area within the state. The electricity consumption pattern for Rabi, Kharif and Zaid cropping season for the year 2023-2024 was also discussed to understand the agriculture draft pattern of all the districts. Then a brief discussion was carried out for efficient use of water in agriculture. The Secretary, Water Resources insisted CGWB to carry out the analysis for per hectare crop water requirement for Paddy. The interim findings of the NAQUIM 2.0 studies carried out at Kunkuri block of Jashpur district were also shared with the committee.

6. **All the members of State Level Committee for Re-estimation of Ground Water Resources of Chhattisgarh as on March 2024 has appreciated the work carried out by State Ground Water Department, Govt. of Chhattisgarh & Central Ground Water Board, Govt. of India for bringing out there port on "*Dynamic Ground Water Resources of Chhattisgarh as on March 2024*" which will be helpful for proper development and management of ground water resources in the state of Chhattisgarh and finally GWRA-2024 was approved by the State Level Committee.**

The meeting ended with thanks to the chair.

Sh. Rajesh Sukumar Toppo
Secretary, Water Resources, Govt. of CG
& Chairman of the Committee

Annexure-1

List of Members participated in the meeting of the State Level Committee for Approval of Ground Water Resources Assessment (as on March 2023) for Chhattisgarh, held on 18/01/2024.		
Sl. No.	**Name**	**Designation and department**
1	Sh. Rajesh Sukumar Toppo	IAS, Secretary, Water Resources Department, Govt. of Chhattisgarh & Chairman of the Committee
2	Dr. Prabir K. Naik	Regional Director (CHWB, North Central Chhattisgarh Region, Raipur) & Member Secretary, SLC
3	Sh. Indrajeet Uikey	Engineer-In-Chief, Water Resources Department, Govt. of Chhattisgarh
4	Dr. M. L. Agarwal	Engineer-In-Chief, Public Health Engineering Department Chhattisgarh.
5	S. Jegadasan	IFS, CEO, Chhattisgarh State Watershed Management Agency.
6	Sh. Ram Sagar	Chief Engineer, RES Panchayat and Rural Development.
7	Sh. S. K. Tikam	Chief Engineer, Water Resources Department.
8	Sh. Vinay Gupta	S.E., MGNREGS.
9	Sh. I. A. Siddiqi	S.E, Water Resources Department, Chhattisgarh.
10	Dr. Satish Goswami	Directorate of Economics and Statistics
11	Sh. Lokpal Khandekar	Assistant Director, Department of Commerce and Industries.
12	Sh. Saurabh Singh	Assistant Manager, NABARD
13	Sh. R.L. Dhurandhar	Joint Director, Department of Agriculture
14	Sh. D. N. Gidronia	OSD, Water Resource Department
15	Sh. A.K. Shukla	Senior Hydrogeologist, Water Resources Department,
16	Sh. B. Abhishek	Scientist-C, CGWB, NCCR
17	Sh. Pramod Kumar Sahu	Scientist-B, CGWB, NCCR
18	Sh. Suvam P dash	AHG, CGWB, NCCR
19	Ms. Sweta Mohanty	AHG, CGWB, NCCR
20	Sh. Sarboday Barik	AHG, CGWB, NCCR

“ मायो मौष घीहि ऊं सीर्घाम्नो: घाम्नो राजस्तो वरुण नो मुंच। ”

(अर्थात् हे राजन, आप अपने राज्य के स्थानों में जल और वनस्पतियों को हानि न पहुँचाओ, ऐसा उद्यम करो जिससे हम सभी को जल एवं वनस्पतियाँ सत्त रूप से प्राप्त होती रहे।)

– यजुर्वेद 6/22

क्षेत्रीय निदेशक
केंद्रीय भूमि जल बोर्ड,उत्तर मध्य छत्तीसगढ़ क्षेत्र,
द्वितीय तल, एल. के. कॉर्पोरेट टावर्स,
धमतरी रोड, डूमरतराई, रायपुर (छत्तीसगढ़)- 492015
मेल: rdnccr-cgwb@nic.in