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GOVERNMENT OF INDIA
Ministry of Jal Shakti
Department of Water Resources
River Development and Ganga Rejuvenation

REPORT ON WATER QUALITY HOT-SPOTS IN RIVERS OF INDIA (4TH EDITION)

(January-December 2021)

Central Water Commission

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Water, the world's most valuable natural resource, is essential for the survival of all living organisms on the earth. With population growth, industrial development, urbanisation & agricultural activities, the demand & consumption for freshwater is rising. This has caused increased utilisation of water from rivers, lakes and other water sources affecting the diversity of flora and fauna. Further, after utilisation by industries, agriculture, human settlements etc., the effluent/discharge is generally poorer in quality/quantity than the original intake. This necessitates creation of treatment facilities, defining standards of effluent discharge, and foremost continuous monitoring of water quality of rivers and other water sources.

Since 1963, Central Water Commission has been involved in water quality monitoring. Central Water Commission has been monitoring the water quality at 782 (as on January, 2023) stations across various rivers and 88 water bodies (April, 2023) in India.

This report, now in its fourth edition, aims to provide insights into the water quality scenario based on standards set by the Ministry of Environment, Forest and Climate Change (MoEFCC), the Central Pollution Control Board (CPCB) and Bureau of Indian Standards (BIS). Previous editions were published in August 2011, November 2017, and November 2021. This fourth edition is based on the seasonal average values (Pre-monsoon, Monsoon and Post-monsoon) observed during January-December, 2021 at monitoring stations across India. It is our hope that future editions will be expanded to include additional data from more monitoring stations, accompanied by comprehensive maps and graphs.

Shri P. Manroi Scott

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Water in its purest form on Earth, comes from rain and snow. This water is available first in the form of surface water through rivers and Lakes. Thus we can say the journey of water on Earth starts in the shape of surface runoff. This surface water forms the lifeline of almost all the human activities as also most of nature's activities. It is the surface water which percolates down and recharges the aquifers and becomes part of Ground Water. Due to the fast pace of industrialization and urbanization, a lot of effluent and sewage is being generated, for a major portion of which there are no effluent treatments. This has resulted in discharge of this sewage into the rivers untreated or only partially treated. Rivers are our lifeline and we all have the responsibility of preserving it, to make our development and consequently quality of life sustainable. Pollution of rivers does not mean that they are polluted from its source to mouth, but there are stretches in some rivers which are polluted and actions are being taken by the Government to bring these stretches to acceptable conditions.

Central Water Commission has been monitoring the quality of river water at 782 stations on different rivers & 88 water bodies, all over India. It all started with the aim of monitoring the water quality parameters for agricultural purposes, but later on many more parameters were added and at present it covers more or less the entire spectrum of water quality. This is the fourth edition of Hot spots report and it is based on the seasonal average values observed during January-December, 2021 at 772 WQ monitoring stations of CWC.

I would like to place on record my appreciation of Sh Satish Jain, Deputy Director, RDC-II; Dr. Jakir Hussain, Research Officer, RDC-II; Rajesh Kumar, Research Officer, RDC-II; Nitish Kumar Singh, Assistant Research Officer, RDC-II for excellently bringing out fourth edition of this publication. I also appreciate the sampling, testing and compilation work done by scientific officers of CWC.

Shri Davendra Pratap Mathuria

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Water is one of the most important and a basic natural resource on the Earth and it sustain lives of all organism of the Earth. Only 2.5% of surface water is fresh water. The rest is sea water and is undrinkable. Out of the 2.5%, over1.75 % is locked as frozen form and thus remaining 0.75 % of all the water is available for human consumption. Central Water Commission, an apex engineering Organization under the Ministry of Water Resources, River Development and Ganga Rejuvenation is playing an active role in the field not only for water resource development but also in field of water quality.

CWC is monitoring the water quality of rivers since 1960's. Its water quality network consists of 782 water quality stations (as on January, 2023) along with 88 water bodies and a 3-tier laboratory system of 427 Level-I, 18 Level-II and 5 Level-III laboratories across the country. Water quality monitoring in Indian rivers is gaining importance in present day context with increasing urbanization, rapid industrialization and rising standards of living. The present 4th edition of the Report "Water Quality Hot spots in Rivers of India" is based on the seasonal average values observed for 13 parameters (pH, Electrical Conductivity (EC), Fluoride (F-), Ammonia as N (NH3-N), Nitrate as N (NO3-N), Chloride (Cl-), Total Hardness (TH), Boron (B), Sodium Adsorption Ratio (SAR), Dissolved Oxygen (DO), Biochemical Oxygen Demand (BOD), Total Coliform (TC) and Faecal Coliform (FC))during January-December 2021 at monitoring stations across India. The report brings out the identified locations having concentration of these parameters above the acceptable limits.

I appreciate the hard work done by Sh. Rajat Sharma, Senior Research Assistant (Lead Author) of River Data Compilation-2 Directorate & my appreciation to all field Chief Engineers of CWC for collection and submission of water quality data to River Data Compilation-2 Directorate and thus paving way to publish such a useful report.

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All Scientific Staffs & Officers of concerned divisional laboratories of Central Water Commission. Data and results were shared vide email and presented during Technical discussion on 08 February, 2024 with all the staff/ officers of regional CWC offices /labs.

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EXECUTIVE SUMMARY

The assessment of water quality is an essential measure within environmental monitoring. When water quality is poor, it affects not only the aquatic life but also the surrounding ecosystems. Rivers are unquestionably important parts of the hydrological cycle, mainly because they are fluxes of water and not reservoirs of water. Rivers, along with water, drag off sediments and other suspended materials (biotic and abiotic) that ultimately will reach all the other aquatic environments. The present study (4th Edition) based on the data of 13 water quality parameters observed at 772 water quality monitoring stations in 2021. The eight parameters — pH, dissolved oxygen (DO), biochemical oxygen demand (BOD), total coliform bacteria (TC), free ammonia (NH_3-N), electrical conductivity (EC), boron (B), sodium adsorption ratio (SAR) are important for classification based on the uses defined by the Central Pollution Control Board (CPCB). Fluoride (F^-), Chloride (Cl-), Total Hardness (TH) and Nitrate (NO_3^--N) are among the parameters defined by the Bureau of Indian Standards (BIS: 10500:2012) for drinking water. Faecal Coliform (FC) is based on the primary water quality criteria for bathing water listed in the Gazette Notification issued by the Ministry of Environment, Forest and Climate Change (MoEFCC) in 2000. These samples were analyzed at 23 water quality laboratories of CWC. The analysis results are compared with the prescribed limits of CPCB deginated best uses, BIS 10500:2012 and MoEFCC standards to find out the hot spot in Indian Rivers. The parameter-wise summary of the analysis results is given below:

pH

Acceptable Limit of Designated Best Uses of Water by CPCB (Class A, B, D)	pH 6.5 – 8.5
No. of Samples Tested	16185
No. of samples where pH value found beyond acceptable limit	882
No. of Monitoring stations where average (pre-monsoon/, monsoon / post monsoon) pH value found beyond acceptable limit	19
No. of basins/rivers where pH value found beyond acceptable limit	7/17

The recommended acceptable limit of pH for Drinking Water Source without conventional treatment but after disinfection (Class A); Outdoor bathing Organised (Class B), Propagation of wild life and fisheries (Class D). Total of 16185 river water samples were analyzed, out of which 882 samples exceeded the acceptable limit. 19 water quality monitoring stations on 17 rivers exceeded the acceptable limit. The highest pH value (9.7) was observed at the Yazali water quality monitoring station on the Ranganadi River.

Electrical Conductivity (EC)

Acceptable Limit of Designated Best Uses of Water by CPCB (Class E)	**EC < 2250 µS/cm**
No of Samples Tested	16462
No. of samples where electrical conductivity found above acceptable limit	98
No. of Monitoring stations where average (pre-monsoon/monsoon/post-monsoon) electrical conductivity found above acceptable limit	6
No. of basins/rivers **where electrical conductivity found above acceptable limit**	4/6

The recommended acceptable limit of electrical conductivity is 2250 µS/cm for Class E, Irrigation, Industrial Cooling, and Controlled Waste Disposal. Total of 16462 river water samples were analyzed, out of which 98 samples exceeded the acceptable limit. Six (06) water quality monitoring stations on 6 rivers exceeded the acceptable limit. The highest electrical conductivity (33666 µS/cm) was observed at the Durvesh water quality monitoring station on the Vaitarna River.

Ammonia as N (NH_3-N)

Acceptable Limit of Designated Best Uses of Water by CPCB (Class D)	$NH_3 < 1.2$ mg/L
No of Samples Tested	9089
No. of samples where ammonia found above acceptable limit	597
No. of Monitoring stations where average (pre-monsoon/monsoon/post-monsoon) ammonia found above acceptable limit	21
No. of basins/rivers where ammonia found above acceptable limit	5/7

The recommended acceptable limit of ammonia as N (NH_3-N) is 1.2 mg/L for Class D, Propagation of wild life and fisheries. Total of 9089 river water samples were analyzed, out of which 597 samples were found to exceed the acceptable limit. 21 water quality monitoring stations on 7 rivers exceeded the acceptable limit. The highest ammonia concentration 68 mg/L was observed at R.S.P. water quality monitoring station on the Brahmani River.

Boron (B)

Acceptable Limit of Designated Best Uses of Water by CPCB (Class E)	B < 2.0 mg/L
No of Samples Tested	7283
No. of samples where boron found above acceptable limit	0
No. of Monitoring stations where average (pre-monsoon/monsoon/post-monsoon) boron found above acceptable limit	0

The recommended acceptable limit of boron is 2.0 mg/L for Class E, Irrigation, Industrial Cooling, and Controlled Waste Disposal. Total of 7,283 river water samples were analyzed. The average values of water quality monitoring stations during the pre-monsoon/monsoon/post-monsoon seasons have been found to be within the acceptable limit for boron.

Fluoride (F^-)

Acceptable Limit as BIS 10500: 2012	$F^- < 1.5$ mg/L
No of Samples Tested	11613
No. of samples where fluoride found above acceptable limit	75
No. of Monitoring stations where average (pre-monsoon/monsoon/post-monsoon) fluoride found above acceptable limit	2
No. of basins/rivers where fluoride found above acceptable limit	2/2

Bureau of Indian Standard (10500:2012) has recommended the acceptable limit of 1.5 mg/ for fluoride. Total of 11613 river water samples were analyzed, out of which 75 samples were found to exceed the acceptable limit. 2 water quality monitoring stations on 2 rivers exceeded the acceptable limit. The fluoride concentration range was from BDL to 8.88 mg/L. The highest F concentration (8.88 mg/L) was observed at the Parmanpur water quality monitoring station on the Mahanadi River.

Nitrate as N (NO_3^--N)

Acceptable Limit as BIS 10500: 2012	NO_3^- – N < 10.16 mg/L
No of Samples Tested	10619
No. of samples where nitrate found above acceptable limit	353
No. of Monitoring stations where average (pre-monsoon/monsoon/post-monsoon) nitrate found above acceptable limit	24
No. of basins/rivers where nitrate found above acceptable limit	9/19

Bureau of Indian Standard (10500:2012) has recommended that the acceptable limit for nitrate is 45 mg/L or 10.16 mg/L as NO_3^- – N in drinking water. Total of 10619 river water samples were analyzed, out of which 353 samples exceeded the acceptable limit. 24 water quality monitoring stations on 19 rivers exceeded the acceptable limit. The nitrate concentration range was from BDL to 40.9 mg/L.

Chloride (Cl^-)

BIS (Bureau of Indian Standard) 10500:2012) has recommended an acceptable limit of 1000 mg/L of chloride in drinking water. Total of 16046 river water samples were analyzed, out of which 13 samples exceeded the acceptable limit. 2 water quality monitoring stations on 2 rivers exceeded the acceptable limit. The highest chloride concentration (11792 mg/L) was observed at the Durvesh water quality monitoring station on the Vaitarna River during 2021.

Acceptable Limit as BIS 10500: 2012	**Cl^- < 1000 mg/L**
No of Samples Tested	16046
No. of samples where chloride found above acceptable limit	13
No. of Monitoring stations where average (pre-monsoon/monsoon/post-monsoon) chloride found above acceptable limit	2
No. of basins/rivers **where chloride found above acceptable limit**	2/2

Total Hardness (TH)

BIS (Bureau of Indian Standard) 10500:2012) has recommended an acceptable limit of 600 mg/L of total hardness in drinking water. Total of 15626 river water samples were analyzed, out of which 32 samples exceeded the acceptable limit. 4 water quality monitoring stations on 4 rivers exceeded the acceptable limit. The highest total hardness concentration (4117.08 mg/L) was observed at the Durvesh water quality monitoring station on the Vaitarna River during 2021.

Acceptable Limit as BIS 10500: 2012	**TH < 600 mg/L**
No of Samples Tested	15626
No. of samples where total hardness found above acceptable limit	32
No. of Monitoring stations where **average (pre-monsoon/monsoon/post-monsoon)** total hardness found above acceptable limit	4
No. of basins/rivers where total hardness found above acceptable limit	4/4

Dissolved Oxygen (DO)

The recommended acceptable limit of dissolved oxygen is < 5.0 mg/L for Class B, outdoor bathing (organised). Total of 14973 river water samples were analyzed, out of which 3069 samples exceeded the acceptable limit. 155 water quality monitoring stations on 80 rivers were found to exceed the acceptable limit. The lowest dissolved oxygen (DO) concentration (Zero) was observed at 7 water quality monitoring stations during the pre-monsoon season, four during the monsoon, and five during the post-monsoon season.

Acceptable Limit of Designated Best Uses of Water by CPCB (Class B)	**DO > 5.0 mg/L**
No of Samples Tested	14973
No. of samples where dissolved oxygen found above acceptable limit	3069
No. of Monitoring stations where **average (pre-monsoon/monsoon/post-monsoon)** dissolved oxygen found above acceptable limit	155
No. of basins/rivers where dissolved oxygen found above acceptable limit	13/80

Bio-chemical Oxygen Demand (BOD)

The recommended acceptable limit of biochemical oxygen demand is > 3.0 mg/L for Class B, outdoor bathing (organised). In 2021, a total of 12207 river water samples were analyzed, out of which 2200 samples exceeded the acceptable limit. 123 water quality monitoring stations on 60 rivers exceeded the acceptable limit. The highest biochemical oxygen demand concentration (130 mg/L) was observed at the Satrapur water quality monitoring station on the Kanhan River during 2021.

Acceptable Limit of Designated Best Uses of Water by CPCB (Class B)	**BOD < 3.0 mg/L**
No of Samples Tested	12207
No. of samples where BOD found above acceptable limit	2200
No. of Monitoring stations where **average (pre-monsoon/monsoon/post-monsoon)** BOD found above acceptable limit	123
No. of basins/rivers where BOD found above acceptable limit	9/60

Total Coliform (TC)

The recommended acceptable limit of total coliforms are > 500 MPN/100 ml for Class B, outdoor bathing (organised). Total of 5791 river water samples were analyzed, out of which 5127 samples exceeded the acceptable limit. 312 water quality monitoring stations on 155 rivers exceeded the acceptable limit. The highest total coliform level (16,0000000 MPN/100 ml) was observed at the Delhi Railway bridge water quality monitoring station on the Yamuna River.

Acceptable Limit of Designated Best Uses of Water by CPCB (Class B)	**TC < 500 MPN/ 100ml**
No of Samples Tested	5791
No. of samples where total coliform found above acceptable limit	5127
No. of Monitoring stations where **average (pre-monsoon/monsoon/post-monsoon)** total coliform found above acceptable limit	312
No. of basins/rivers where total coliform found above acceptable limit	11/155

Faecal Coliform (FC)

Primary Water Quality Criteria for Bathing water (MoEF & CC) Gazette Notification, 2000 recommended acceptable limit of faecal coliform is > 500 MPN/100 ml. Total of 5788 river water samples were analyzed, out of which 4124 samples exceeded the acceptable limit. 289 water quality monitoring stations on 141 rivers exceeded the acceptable limit. The highest faecal coliform value (4, 9000000 MPN/100ml) was observed at the Galeta and Noida water quality monitoring station on the Hindon and Yamuna.

Primary Water Quality Criteria for Bathing water (MoEF & CC) Gazette Notification, 2000	**FC < 500 MPN/ 100ml**
No of Samples Tested	5788
No. of samples where faecal coliform found above acceptable limit	4124
No. of Monitoring stations where faecal coliform found above acceptable limit	289
No. of basins/rivers where faecal coliform found above acceptable limit	11/141

Sodium Adsorption Ration (SAR)

The recommended acceptable limit of SAR is 26 for Class E, Irrigation, Industrial Cooling, and Controlled Waste Disposal. Total of 12758 river water samples were analyzed. The average values of water quality monitoring stations during the pre-monsoon/monsoon/post-monsoon seasons have been found to be within the acceptable limit for SAR.

Acceptable Limit of Designated Best Uses of Water by CPCB (Class B)	**SAR < 26**
No of Samples Tested	12758
No. of samples where SAR found above acceptable limit	2
No. of Monitoring stations where average (pre-monsoon/monsoon/post-monsoon) SAR found above acceptable limit	0

CHAPTER – 1

1. Introduction

1.1 Water Quality & its Importance

“Water quality," in general, can be defined as the suitability of water to sustain various uses or processes. Any particular use will have specific requirements for the physical, chemical, or biological characteristics of water. The term is most frequently employed by reference to a set of standards against which compliance, generally achieved through water treatment, can be assessed. The most common standards used to monitor and assess water quality convey the health of ecosystems, the safety of human contact, the extent of water pollution, and the condition of drinking water. Water quality significantly impacts water supply and often determines supply options. The parameters for water quality are determined by the intended use. Work in the area of water quality tends to be focused on water that is treated for potability, industrial/domestic use, or restoration (of an environment/ecosystem, generally for the health of human/aquatic life).

The composition of surface and underground waters depends on natural factors (geological, topographical, meteorological, hydrological, and biological) in the drainage basin and varies with seasonal differences in runoff volumes, weather conditions and water levels. Large natural variations in water quality may, therefore, be observed even when only a single watercourse is involved. Human intervention also has significant effects on water quality. Some of these effects result from hydrological changes, such as the construction of dams, draining of wetlands, and diversion of flow. More obvious are the polluting activities, such as the discharge of domestic, industrial, urban, and other wastewaters into the watercourse (whether intentional or accidental) and the spreading of chemicals on agricultural land in the drainage basin. Water quality is influenced by a wide range of natural factors. The most important of these natural influences are geological, hydrological and climatic, as they affect the quantity and quality of water available.

The water quality of Indian rivers is of considerable importance, as these waters serve various purposes, including drinking for domestic and residential water supplies, agriculture (irrigation), hydroelectric power plants, tourism, recreation, and other human or economic uses of water.

The monitoring of river water quality is a crucial aspect of restoring water quality. One of the primary objectives of river water quality monitoring is to evaluate the suitability of river water for drinking purposes, irrigation, outdoor bathing and the propagation of wildlife and fisheries. The physical and chemical quality of river water plays a key role in determining its fitness for drinking. Therefore, the suitability of river water for potable uses, particularly in terms of its chemical quality, must be assessed based on vital characteristics. The Bureau of Indian Standards (BIS), formerly known as the Indian Standard Institute (ISI), has outlined quality standards for drinking water in its document IS 10500:2012 serving as a reference for determining the suitability of river water.

Monitoring and assessing water quality are essential for comprehending the extent and magnitude of the water quality challenge. Unlike water quantity, monitoring water quality is a complex process. Managing the water quality of rivers is a challenging task, with various manmade and natural factors likely to increase complexity in the future. One significant reason is the introduction and use of numerous new chemicals each year in agriculture, chemical industries, pharmaceutical industries etc. The large quantity of these new chemicals, along with the difficulty in quantifying many of them due to certain limitations, makes it challenging to reliably assess the health and environmental consequences. This complexity is further compounded by the continuous introduction of new chemicals, making it difficult to predict the long-term impact on water quality and associated ecosystems.

1.2 Water Quality Hot Spots

As per the Guidelines for Water Quality Monitoring, 2017, a 'Hotspot' is defined as a location or Monitoring station where the concentration of a particular parameter exceeds the permissible limits prescribed by the water quality standards in the BIS code IS 10500:2012. In this report, a 'Hotspot' is determined based on the location or Monitoring station where the concentration of a specific parameter surpasses the permissible limits set by the drinking water quality standards in the BIS code IS 10500:2012, 'Designated Best Use Water Quality Criteria' established by the Central Pollution Control Board (CPCB) and Primary Water Quality Criteria for Bathing Water mentioned in the Ministry of Environment, Forest and Climate Change (MoEFCC) Gazette Notification, 2000. The report incorporates data from 772 water quality monitoring stations in year 2021 of the Central Water Commission (CWC), covering significant rivers in India.

It is based on the average values observed during Pre-monsoon (January to May), Monsoon (June to October) and Post-monsoon (November to December) seasons for the year 2021. River water quality has been evaluated based on 13 parameters: pH, Electrical Conductivity (EC), Fluoride (F^-), Ammonia as N (NH_3-N), Nitrate as N (NO_3^-N), Chloride (Cl^-), Total Hardness (TH), Boron (B), Sodium Adsorption Ratio (SAR), Dissolved Oxygen (DO), Biochemical Oxygen Demand (BOD), Total Coliform (TC) and Faecal Coliform (FC). These parameters are crucial in defining the quality of surface water in rivers. Therefore, the presence of these parameters in river water beyond the permissible limits is considered as river water quality hotspots.

CHAPTER -2

2. Indian Water Resources Scenario

2.1 River Basins of India

CWC under its publication No. 30/88 “Water Resources of India”, April 1988 has standardized the river basins of India. The country is classified into 20 river basins comprising of 12 major basins and 8 composite river basins.

The 12 major basins are: (1) Indus; (2) Ganga-Brahmaputra-Meghna; (3) Godavari; (4) Krishna; (5) Cauvery; (6) Mahanadi; (7) Pennar; (8) Brahmani-Baitarani; (9) Sabarmati; (10) Mahi; (11) Narmada and (12) Tapi. Each of these basins is having a drainage area exceeding 20000 sq.km.

The 8 composite river basins are:

1) Subarnarekha – combining Subarnarekha and other small rivers between Subarnarekha and Baitarni.
2) East flowing rivers between Mahanadi and Pennar.
3) East flowing rivers between Pennar and Kanyakumari.
4) Area of Inland Drainage in Rajasthan Desert.
5) West flowing rivers of Kutch and Saurashtra including Luni;
6) West flowing rivers from Tapi to Tadri.
7) West flowing rivers from Tadri to Kanyakumari.
8) Minor rivers draining into Myanmar (Burma) and Bangladesh.

2.2 Indian River System

The Indian River Systems can be divided into four categories:- the Himalayan, the Rivers traversing the Deccan Plateau, the Coastal and those in the inland drainage basin (Figure 1).

The Himalayan Rivers are perennial as they are fed by melting glaciers every summer. During the monsoon, these Rivers assume alarming proportions. Swollen with rainwater, they often inundate villages and towns in their path. The Gangetic basin is the largest River system in India, draining almost a quarter of the country.

The Rivers of the Indian peninsular plateau are mainly fed by rain. During summer, their flow is greatly reduced, and some of the tributaries even dry up, only to be revived in the monsoon. The Godavari basin in the peninsula is the largest in the country, spanning an area of almost one-tenth of the country. The Rivers Narmada and Tapi flow almost parallel to each other but empty themselves in opposite directions. The two Rivers make the valley rich in alluvial soil and teak forests cover much of the land. While coastal River’s gush down the peaks of the Western Ghats into the Arabian Sea in torrents during the rains, their flow slow down after the monsoon. Streams like the Sambhar in western Rajasthan are mainly seasonal in character, draining into the inland basins and salt lakes. In the Rann of Kutch, the only River that flows through the salt desert is the Luni.

2.2.1 Indus system

This comprises the river Indus and its tributaries like the Jhelum, Chenab, Ravi, Beas and Sutlej. These originate in the North and generally flow in a West or South-West direction to eventually flow into Arabian Sea through Pakistan.

2.2.2 Ganga-Brahmaputra-Meghna system

The main river Ganga and its tributaries like the Yamuna, Sone, Gandak, Kosi and many others; similarly, main rivers Brahmaputra, Meghna and their tributaries. All these eventually flow into Bay of Bengal, through Bangladesh. Some of the tributaries of these rivers are larger than other independent rivers. e.g. Yamuna, a tributary of Ganga, has a larger catchment area than the Tapi, a small peninsula river.

2.2.3 Rivers of Rajasthan and Gujarat

Mahi, Sabarmati, Luni etc. These are rivers of arid regions, they carry relatively little flow, some of them flow to Arabian Sea through Gujarat while some are land-locked and their flow is lost through percolation and evaporation in the vast arid regions.

2.2.4 East Flowing Peninsular Rivers

The important members of this group are: Damodar, Mahanadi, Brahmani, Baitarani, Subarnarekha, Krishna, Godavari and Cauvery. They all flow into Bay of Bengal at various places along the Eastern Coast of India.

2.2.5 West Flowing Peninsular Rivers

Narmada and Tapi rivers originate in Central India and flow in a western direction to meet Arabian Sea south of Gujarat.

2.2.6 Western Coast Rivers

There are large number of rivers in the Western Coast - i.e. coastal Maharashtra and Karnataka, and entire Kerala. These rivers are small in length but carry a significant amount of water due to very high rainfall in Western Ghats. They drain only 3% of the India's land area but carry 11% of India's water resources.

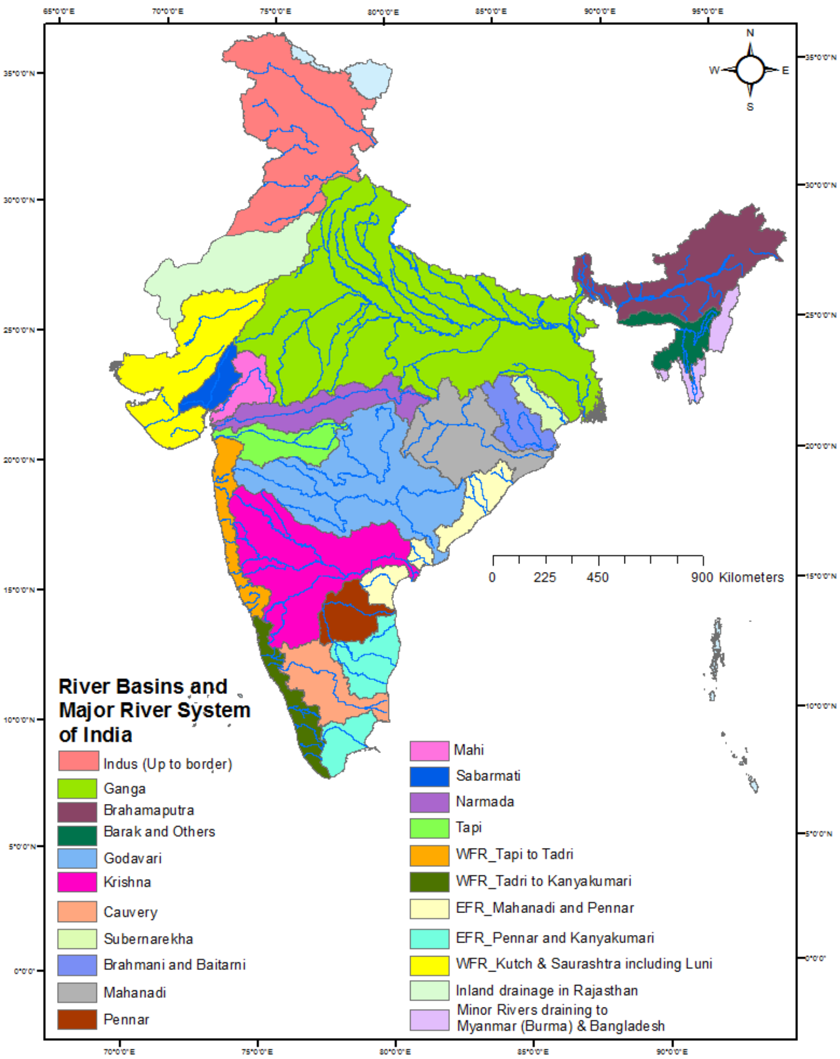


Figure.2 River Basins and Major River Systems of India

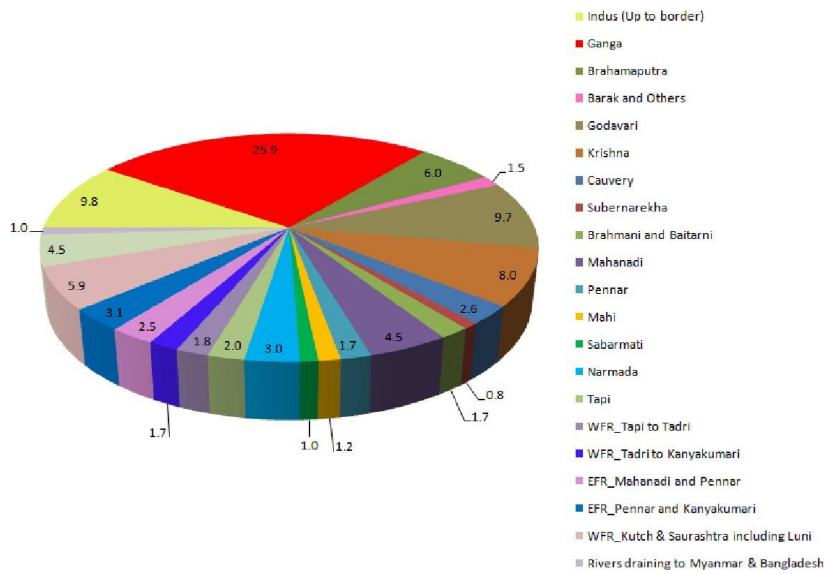


Figure.3 Percentage of geographical area in each basin

Sources:

1. CWC publication "Reassessment of Water Availability in India using Space inputs" June 2019 from Basin Planning & Management Organization, CWC, New Delhi. India WRIS:
2. India Water Resources Information System

The more details may be assessed by clicking the links given below: (http://old.cwc.gov.in/main/downloads/ReassessmentMainReport.pdf)&(https://indiawris.gov.in/wris)

CHAPTER – 3

3. Hydrochemistry

Hydrochemistry is an interdisciplinary science that deals with the chemistry of water in the natural environment. Professional fields such as chemical hydrology, aqueous chemistry, hydrochemistry, water chemistry and hydro-geochemistry are all more or less synonyms. The classical use of chemical characteristics in chemical hydrology is to provide information about the regional distribution of water qualities.

Main areas of work are the chemical characterization of the water (which is highly dependent on the regional and geochemical event units), the determination of water-chemical parameters and the assessment of anthropogenic and other influences on the water quality.

At the same time, hydrochemistry can also be of immense help in yielding information about the environment through which water has circulated. It is essential to study the entire system like atmospheric water (rainwater), surface water and ground water simultaneously in evaluating their hydrochemistry and pollution effect.

3.1 Chemistry of Rainwater

The atmosphere is composed of water vapors, dust particles and various gaseous components such as N_2, O_2, CO_2, CH_4, CO, SO_2, NO_2 etc. Pollutants in the atmosphere can be transported through long distances by the wind. These pollutants are mostly washed down by precipitation and partly as dry fall out. Composition of rainwater is determined by the source of water vapors and by the ion, which are taken up during transport through the atmosphere. In general, chemical composition of rainwater shows that rainwater is slightly mineralized with specific electrical conductance (EC) generally below 50 µS/cm, chloride (Cl^-) below 5 mg/l and HCO_3 below 10 mg/l. Among the cations, concentration of Ca, Mg, Na & K vary considerably but the total cations content is generally below 15 mg/l except in samples contaminated with dust. The concentration of sulphates and nitrates in rainwater may be high in areas near industrial hubs.

3.2 Chemistry of Surface Water

Surface water is found extremely variable in its chemical composition due to variations in relative contributions of ground water and surface water sources. The possible causes and consequences of changes in climate, land use and industrial, urban and agricultural pollution can be expected to be indicated by changes in the physical and chemical composition of water in rivers and streams. The mineral content in river water usually bears an inverse relationship to discharge. The mineral content of river water tends to increase from source to mouth, although the increase may not be continuous or uniform. Other factors like discharge of city wastewater, industrial waste and mixing of waters can also affect the nature and concentration of minerals in surface water. Among anions, bicarbonates are the most important and constitute over 50% of the total anions in terms of milli equivalent per litre (meq/l). In case of cations, alkaline earths or normally calcium predominates but with increasing salinity the hydro chemical facies tend to change to mixed cations or even to Na- HCO_3 type.

3.3 Chemistry of Ground Water

The downward percolating water is not inactive, and it is enriched in CO_2. It can also act as a strong weathering agent apart from general solution effect. Consequently, the chemical composition of ground water will vary depending upon several factors like frequency of rain, which will leach out the salts, time of stay of rain water in the root-zone and intermediate zone, presence of organic matter etc. It may also be pointed out that the water front does not move in a uniform manner as the soil strata are generally quite heterogeneous. The movement of percolating water through larger pores is much more rapid than through the finer pores. The overall effect of all these factors is that the composition of ground water varies from time to time and from place to place.

Before reaching the saturated zone, percolating water is charged with oxygen and carbon dioxide and is most aggressive in the initial stages. This water gradually loses its aggressiveness, as free CO_2 associated with the percolating water gets gradually exhausted through interaction of water with minerals.

The oxygen present in this water is used for the oxidation of organic matter that subsequently generates CO_2 to form H_2CO_3. This process goes on until oxygen is fully consumed.

Apart from these reactions, there are several other reactions including microbiological mediated reactions, which tend to alter the chemical composition of the percolating water. For example, the bicarbonate present in most waters is derived mostly from CO_2 that has been extracted from the air and liberated in the soil through biochemical activity.

Some rocks serve as sources of chloride and sulphate through direct solution. The circulation of sulphur, however, may be greatly influenced by biologically mediated oxidation and reduction reactions. Chloride circulation may be a significant factor influencing the anion content in natural water.

CHAPTER - 4

4. River Water Pollution

The World Health Organisation (WHO) says that polluted water is water whose composition has been changed to the extent that it is unusable. In other words, it is toxic water that cannot be drunk or used for essential purposes like agriculture and which also causes diseases like diarrhoea, cholera, dysentery, typhoid and many more.

River Water pollution occurs when pollutants are discharged directly or indirectly into rivers without adequate treatment of harmful compounds. River Water pollution affects humans, plants and organisms living in these rivers. Water pollutants are damaging not only the individual species and populations, but also the natural biological communities. Moving water dilutes and decomposes pollutants more rapidly than standing water.

The primary reasons for river water pollution are because of three major sources of pollution i.e. industry, agriculture and domestic situated along the rivers. Industries and cities have been located along rivers historically, because rivers provide transportation and have traditionally been a convenient place to discharge waste. Agricultural activities have tended to be concentrated near rivers, because river floodplains are exceptionally fertile due to the many nutrients that are deposited in the soil when the river overflows.

4.1 Sources of Pollution

4.1.1. Point source pollution

Point source pollution refers to the pollution entering the water way through a discrete conveyance like pipes, channels etc., from source such as industry.

4.1.2 Non- point source pollution

Non-point source pollution refers to the pollution that does not enter the water way through a discrete source but accumulative in nature. The pollutants are collected in small amounts from over a large area. These pollutants are:

- Natural contaminants such as dry leaves, dead insects and animals, bird droppings etc.
- Agricultural contaminants such as agricultural runoff containing fertilizers, pesticides etc. The fertilizers and pesticides can be washed through the soil by rain, to end up in rivers.
- Industrial contaminants such as industrial runoff containing industrial wastes.
- Microbial contaminants such as faecal & Total Coliform.
- Human added contaminants such as organic matter through domestic discharges.

If large amounts of fertilizers or farm waste drain into a river the concentration of nitrate and phosphate in the water increases considerably. Algae use these substances to grow and multiply rapidly turning the water green. This massive growth of algae, called eutrophication, leads to pollution. When the algae die they are broken down by the action of the bacteria which quickly multiply, using up all the oxygen in the water which leads to the death of many animals.

Chemical waste products from industries are discharged in to rivers. Such pollutants include cyanide, zinc, lead, copper, cadmium and mercury. These substances may enter the water in such high concentrations that fish and other animals are killed immediately. Sometimes the pollutants enter a food chain and accumulate until they reach toxic levels, eventually killing birds, fish and mammals.

Factories use water from rivers to power machinery or to cool down machinery. Dirty water containing chemicals is put back in to the rivers. Water used for cooling is warmer than the river itself. Raising the temperature of the water, lowers the level of dissolved oxygen and upsets the balance of life in the water. People sometimes carelessly throw rubbish directly into rivers.

4.2 Effects of Environmental factors on River water quality

River water quality is highly variable by nature due to environmental conditions such as basin lithology, vegetation and climate. In small watersheds spatial variations extend over orders of magnitude for most major elements and nutrients, while this variability is an order of magnitude lower for major basins. Standard river water for use as reference is therefore not applicable. As a consequence, natural waters can possibly be unfit for various human uses, even including drinking.

There are three major natural sources of dissolved and soluble matter carried by rivers: the atmospheric inputs of material, the degradation of terrestrial organic matter and the weathering of surface rocks. These substances generally transit through soil and porous rocks and finally reach the rivers. On their way, they are affected by numerous processes such as recycling in terrestrial biota, recycling and storage in soils, exchange between dissolved and particulate matter, loss of volatile substances to the atmosphere, production and degradation of aquatic plants within rivers and lakes etc. As a result of these multiple sources and pathways, the concentrations of elements and compounds found in rivers depend on physical factors (climate, relief), chemical factors (solubility of minerals) and biological factors (uptake by vegetation, degradation by bacteria). The most important environmental factors controlling river chemistry are:

- Occurrence of highly soluble (halite, gypsum) or easily weathered (calcite, dolomite, pyrite, olivine) minerals.
- Distance to the marine environment which controls the exponential decrease of ocean aerosols input to land (Na^+, Cl^-, SO_4^{2-}, and Mg^{2+}).

- Aridity (precipitation/runoff ratio) which determines the concentration of dissolved substances resulting from the two previous processes.
- Terrestrial primary productivity which governs the release of nutrients (C, N, Si, K).
- Ambient temperature which controls, together with biological soil activity, the weathering reaction kinetics.

5. Water Quality Monitoring by CWC

Central Water Commission (CWC) is playing an important role in the field of water quality monitoring of river water and is observing water quality at various rivers since 1960's. As on January, 2023, CWC is observing water quality at 782 key locations in different rivers across the country: 657 on Hydrological Observation network and 125 Water Quality Sampling stations (WQSS). In addition, CWC has started monitoring of water quality of water bodies across India since 01.03.2023. Till date, 88 water bodies have been identified for water quality monitoring purpose across various states of the country (Figure 4).

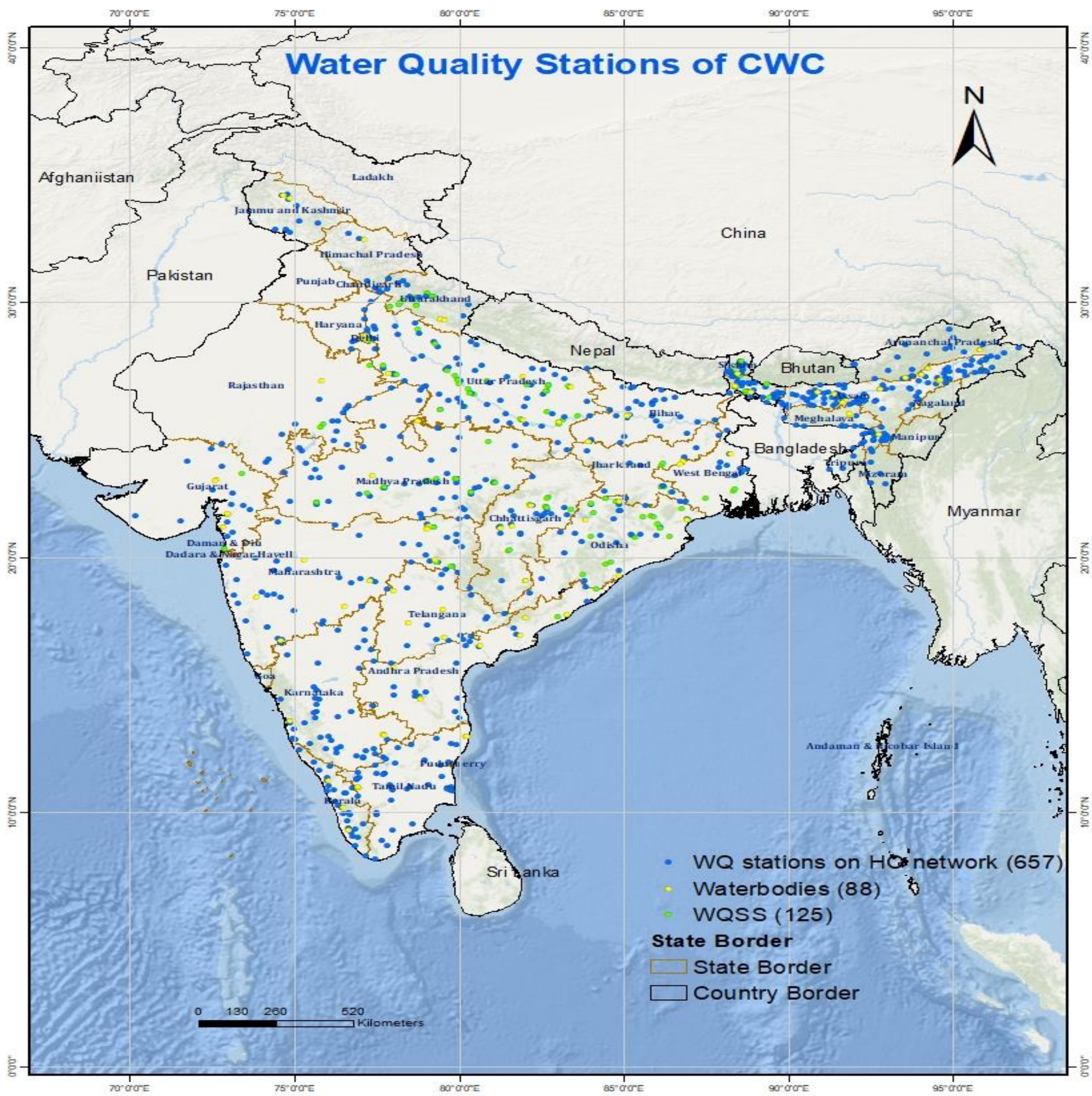


Figure 4: Water quality network of CWC

The details of distribution of WQ monitoring stations among different states and organisations/basins of CWC are given in the tables and figures given below.

Table 1: State–wise distribution of Water Quality Monitoring stations of CWC

S.No.	State	GDQ	GDSQ	GQ	WQSS	Water Bodies	Total
1	Andhra Pradesh	4	14	1	2	7	28
2	Arunachal Pradesh	9	9	10	-	2	30
3	Assam	21	26	53	-	11	111
4	Bihar	6	22	1	-	2	31
5	Chhattisgarh	2	18	-	12	4	36
6	Delhi	1	2	-	3	3	9
7	Gujarat	4	9	-	2	6	21
8	Haryana	3	1	-	-	-	4
9	Himachal Pradesh	-	6	-	-	1	7
10	Jammu & Kashmir	3	6	-	-	2	11
11	Jharkhand	4	6	1	6	2	19
12	Karnataka	17	23	2	-	4	46
13	Kerala	2	24		-	3	29
14	Madhya Pradesh	20	24	4	12	2	62
15	Maharashtra	17	25	4	6	10	62
16	Manipur	-	-	1	-	-	1
17	Meghalaya	5	3	1	-	2	11
18	Mizoram	-	5	-	-	-	5
19	Odisha	2	22	1	25	4	54
20	Puducherry	3	-	-	-	-	3
21	Rajasthan	8	8		2	1	19
22	Sikkim	-	11	6	5	1	23
23	Tamil Nadu	21	21	-	-	5	47
24	Telangana	4	8	1	-	4	17
25	Tripura	-	3	2	-	-	5
26	Uttar Pradesh	14	47	4	28	6	99
27	Uttarakhand	5	9		15	3	32
28	West Bengal	7	21	10	7	3	48
	Grand Total	**182**	**373**	**102**	**125**	**88**	**870**

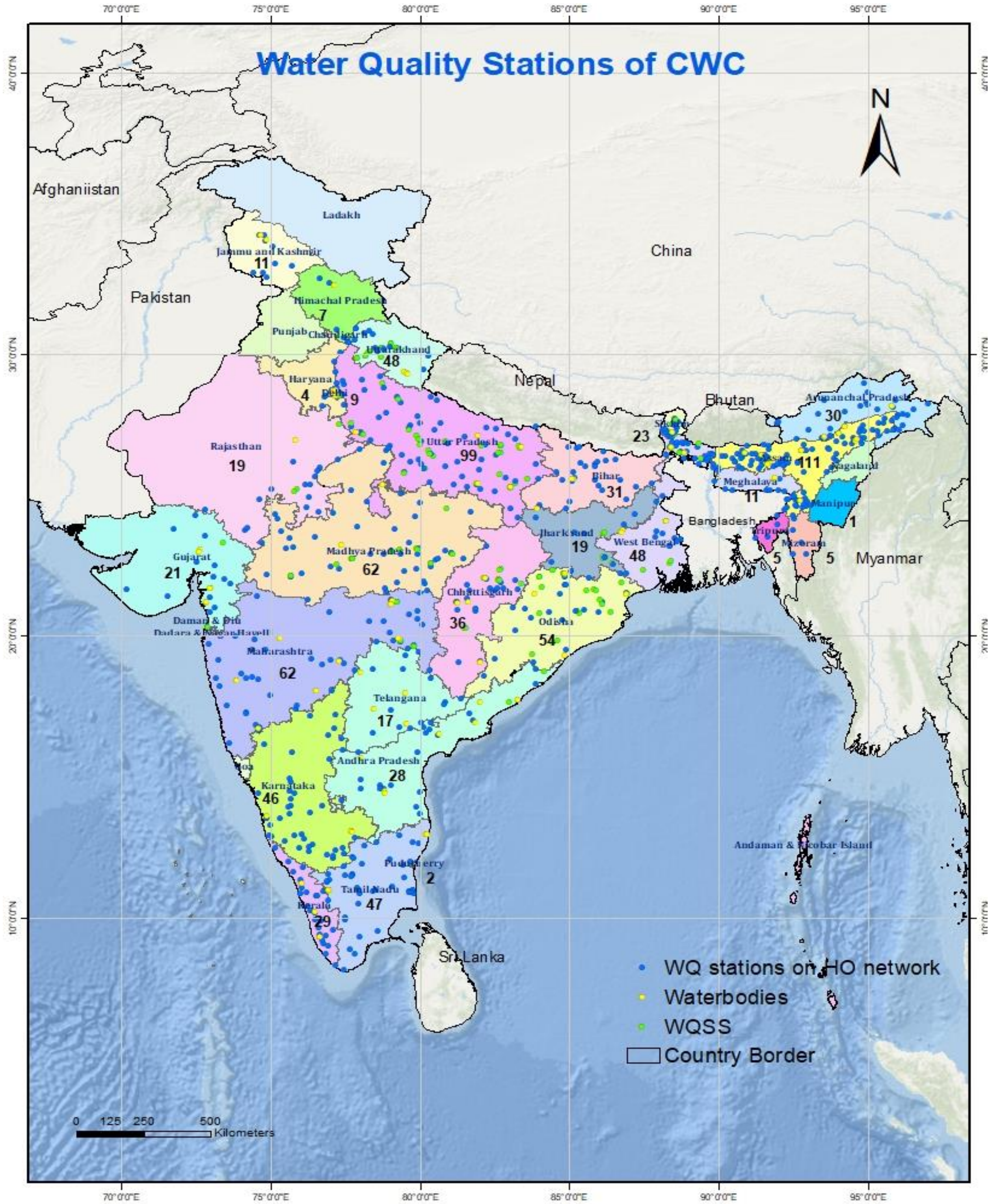


Figure 5: State-wise distribution of Water Quality Monitoring stations monitored by CWC

Table 2: Organisation–wise distribution of Water Quality Monitoring stations of CWC

S.No.	Organization	GDQ	GDSQ	GQ	WQSS	Water Bodies	Total
1	Barak and Other Basins Organisation, Shillong	7	22	8	-	3	40
2	Brahmaputra Basin Organisation, Guwahati	27	24	58	-	12	121
3	Cauvery and southern rivers Organisation, Coimbatore	35	53	-	-	11	99
4	Indus Basin Organisation, Chandigarh	3	8	-	-	3	14
5	Krishna & Godavari Basin Organisation, Hyderabad	19	34	7	-	15	75
6	Lower Ganga Basin Organisation, Patna	9	33	1	6	5	54
7	Mahanadi and Eastern Rivers Organisation, Bhubaneswar	2	43	1	43	7	96
8	Mahi & Tapi Basin Organisation, Gandhinagar	6	15		2	6	29
9	Monitoring Central Organisation, Nagpur	10	14	1	6	5	36
10	Monitoring South Organisation, Bengaluru	11	17	-	-	3	31
11	Narmada Basin Organisation, Bhopal	8	9	4	11	1	33
12	Teesta & Bhagirathi Damodar Basin Organisation, Kolkata	11	32	18	14	6	81
13	Upper Ganga Basin Organisation, Lucknow	6	32	1	33	5	77
14	Yamuna Basin Organisation, New Delhi	28	37	3	10	6	84
	Grand Total	**182**	**373**	**102**	**125**	**88**	**870**

Figure 6: Organisation-wise distribution of water quality Monitoring stations monitored by CWC.

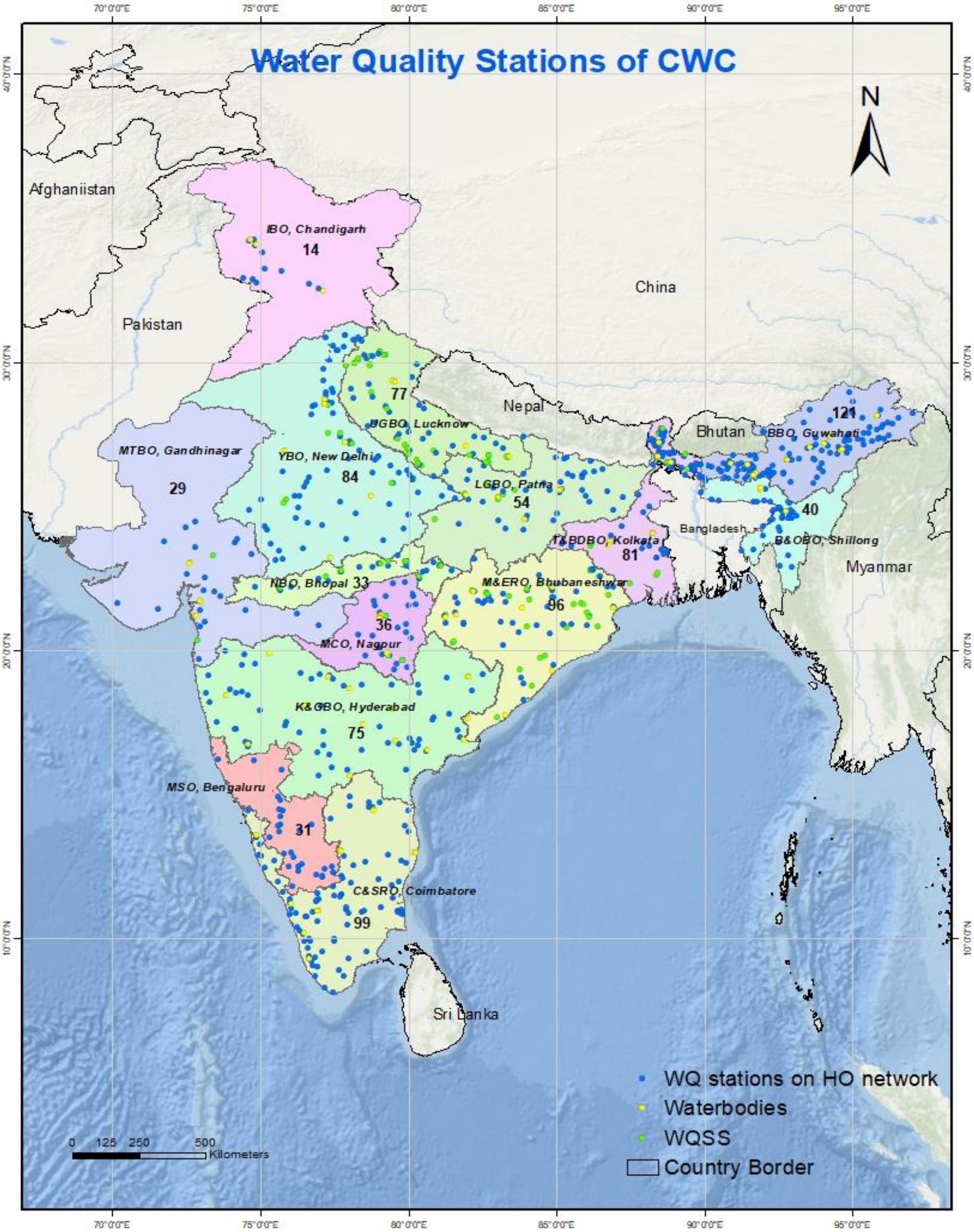
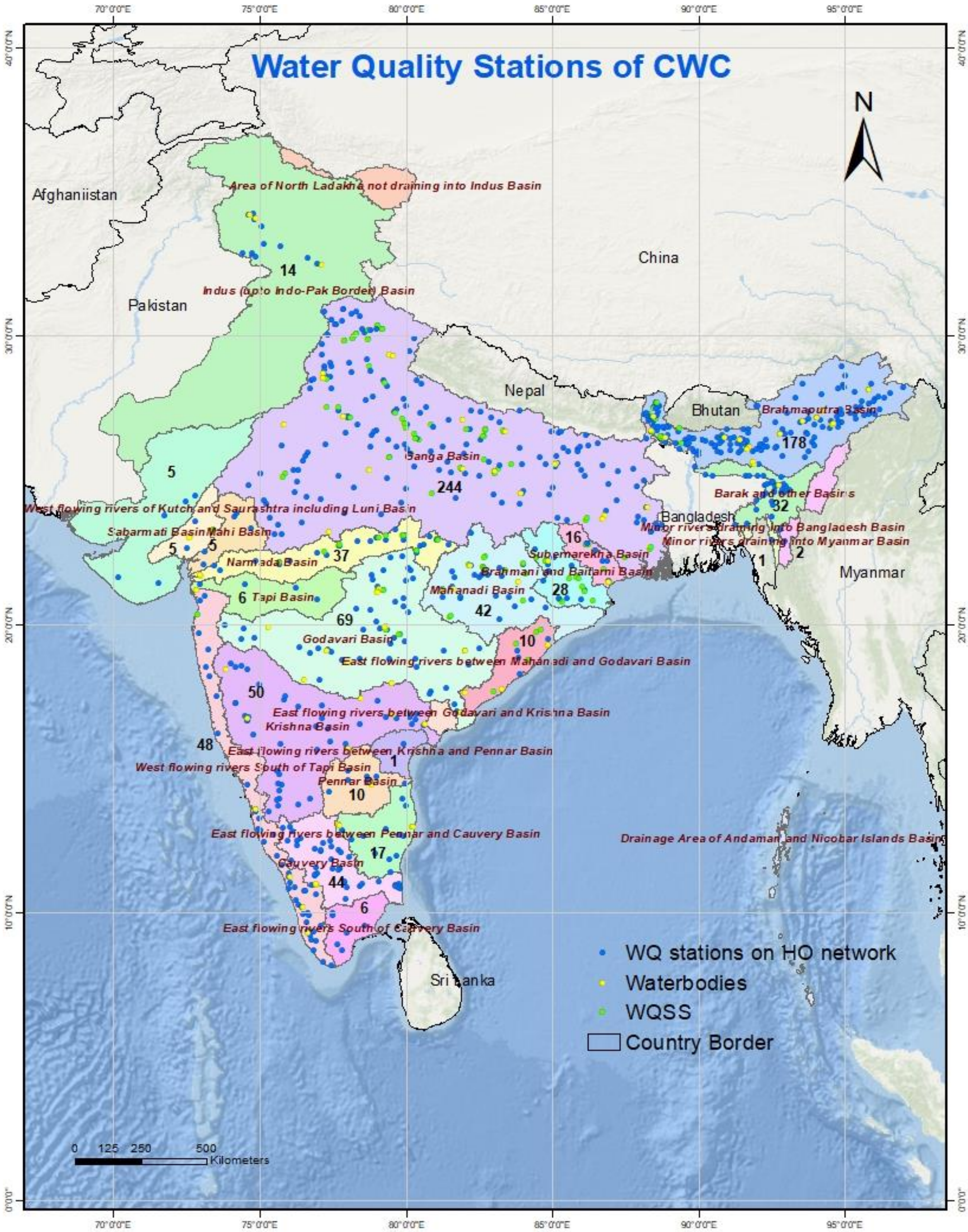


Table 3: Basin-wise water-quality Monitoring stations monitored by CWC

S.No.	Basin	GDQ	GDSQ	GQ	WQSS	Water Bodies	Total
1	Barak and Others Basin	6	18	7	-	1	32
2	Brahmani and Baitarni Basin	-	11	1	15	1	28
3	Brahmaputra Basin	34	44	76	7	17	178
4	Cauvery Basin	17	24	-	-	3	44
5	EFR bertween Pennar and Cauvery	8	4	-	-	5	17
6	EFR between Krishna and Pennar	-	1	-	-	-	1
7	EFR between Mahanadi and Godavari	-	4	-	5	1	10
8	EFR South of Cauvery	2	4	-	-	-	6
9	Ganga Basin	48	115	6	56	19	244
10	Godavari Basin	19	26	4	6	14	69
11	Indus (Up to border) Basin	3	8	-	-	3	14
12	Krishna Basin	14	27	3	-	6	50
13	Mahanadi Basin	1	22	-	15	4	42
14	Mahi Basin	2	3	-	-	-	5
15	Narmada Basin	8	11	4	11	3	37
16	Pennar Basin	4	4		-	2	10
17	River draining into Bangladesh Basin	-	1	-	-	-	1
18	River draining into Myanmar Basin	-	2	-	-	-	2
19	Sabarmati Basin	1	1	-	1	2	5
20	Subarnarekha Basin	1	6	-	8	1	16
21	Tapi Basin	1	3	-	-	2	6
22	WFR of Kutch and Saurashtra including Luni Basin	2	3	-	-	-	5
23	WFR South of Tapi	11	31	1	1	4	48
	Grand Total	**182**	**373**	**102**	**125**	**88**	**870**

Figure 7: Map showing the basin-wise distribution of water quality Monitoring stations monitored by CWC.



The water quality samples collected at these monitoring stations are analysed at laboratories of CWC. At present, CWC follows a three-tier laboratory system which consists of Level I, II and III types of laboratories for providing analytical facilities for the analysis of river water samples collected from water quality monitoring Monitoring stations covering all the important river basins of India.

The three-tier laboratory system consists of:

1. **Level-I Laboratories:** 427 level-I laboratories located at field water quality monitoring monitoring stations on various rivers of India for monitoring of 6 in-situ parameters: Colour, Odour, Temperature pH, Electrical Conductivity and Dissolved Oxygen (a map showing 427 Level-I labs can be seen at figure-5).
2. **Level-II Laboratories:** 18 level-II laboratories located at division offices to analyse 25 physico-chemical and bacteriological parameters of river water.
3. **Level-III Laboratories:** 5 regional labs located at New Delhi, Varanasi, Hyderabad, Coimbatore and Guwahati for analysis of 41 parameters including trace & toxic metals and pesticides.

Out of 23 level-II/III laboratories of CWC, 22 laboratories of CWC have got accreditation by National Accreditation Board for Testing and Calibration Laboratories (NABL) in the field of testing in accordance with Standard ISO/IEC 17025:2017. A map showing level-II/III labs can be seen at figure-6. The details of monitoring parameters in each level labs are depicted in table-10.

Table 4: List of Water Quality Parameters monitored by CWC

Sl. No.	Level-I	Level-II	Level-III
1	Temperature	Temperature	Temperature
2	Colour	pH	pH
3	Odour	Electrical Conductivity	Electrical Conductivity
4	pH	Dissolved Oxygen	Dissolved Oxygen
5	Electrical Conductivity	Turbidity	Turbidity
6	Dissolved Oxygen	Biochemical Oxygen Demand	Biochemical Oxygen Demand
7		Chemical Oxygen Demand	Chemical Oxygen Demand
8		Total Dissolved Solids)	Total Dissolved Solids
9		Sodium	Sodium
10		Calcium	Calcium
11		Magnesium	Magnesium
12		Potassium	Potassium
13		Carbonate	Carbonate
14		Bicarbonate	Bicarbonate
15		Chloride	Chloride
16		Sulphate	Sulphate
17		Fluoride	Fluoride
18		Boron	Boron
19		Ammoniacal Nitrogen	Ammoniacal Nitrogen
20		Nitrate	Nitrate
21		Nitrite	Nitrite
22		Phosphate	Phosphate
23		Silicate	Silicate
24		Total Coliform	Total Coliform
25		Faecal Coliform	Faecal Coliform
26			Arsenic
27			Cadmium
28			Chromium
29			Copper
30			Iron
31			Lead
32			Nickel
33			Mercury
34			Zinc
35			Alpha Benzenehexachloride (BHC), Beta BHC, Gama BHC (Lindane)
36			OP-Dichlorodiphenyltrichloroethane (OP DDT), PP-DDT
37			Alpha Endosulphan, Beta Endosulphan
38			Aldrin, Dieldrin
39			Carbaryl (Carbamate)
40			Malathion, Methyl Parathion
41			Anilophos, Chloropyriphos

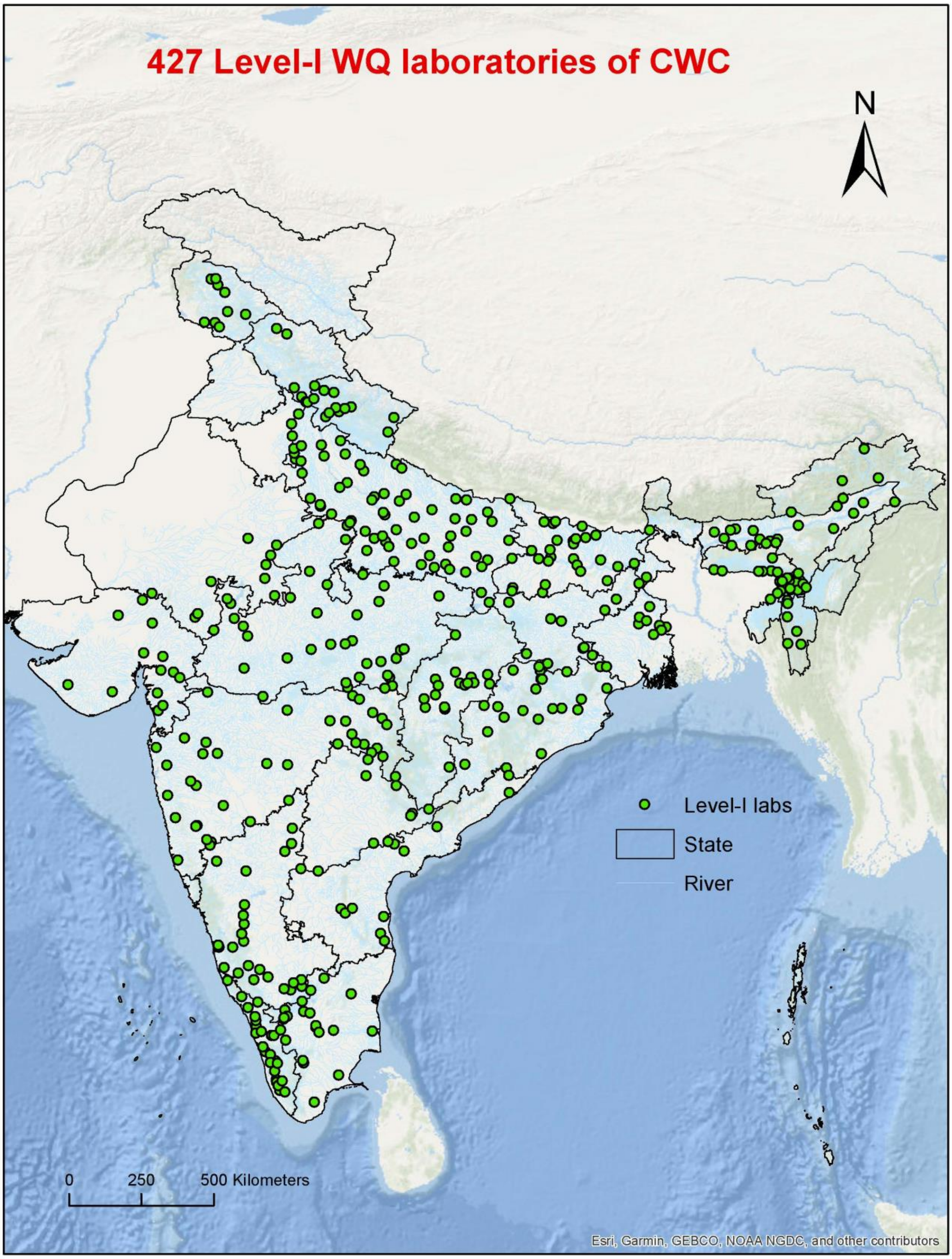


Figure 8: Level-I Water quality laboratories of CWC

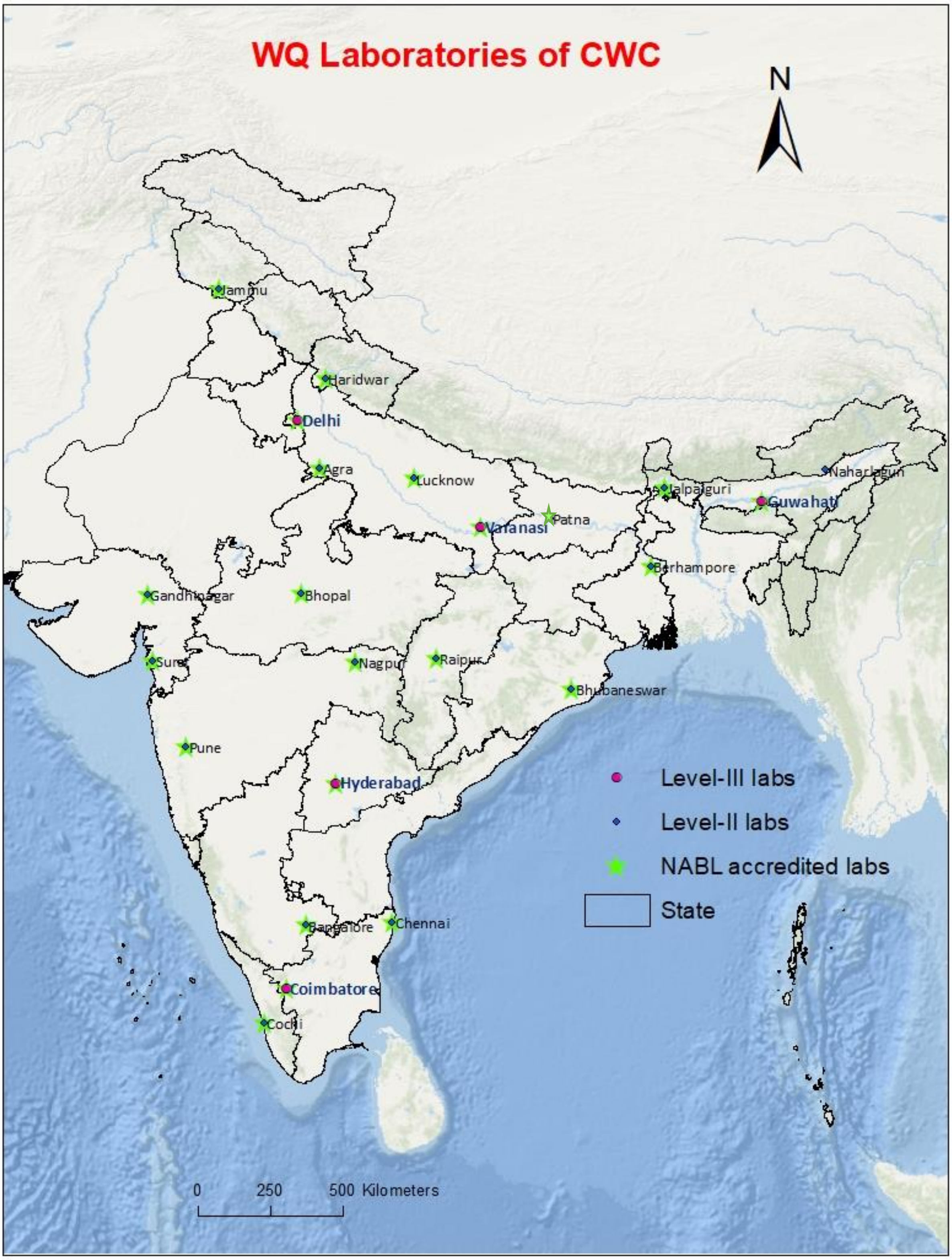


Figure 9: Level-II/III Water quality laboratories of CWC

CHAPTER – 6

6.1 River Water Quality Hot Spots in India

Monitoring of river water quality is the most essential aspect of restoring water quality. One of the main objectives of monitoring river water quality is to assess the suitability of river water for drinking purposes, irrigation, outdoor bathing and propagation of wildlife, fisheries. The physical and chemical qualities of river water are important in deciding its suitability as a source of drinking water after treatment/bathing etc. As such the suitability of river water for potable uses with regard to its chemical quality has to be determined and defined on the basis of some vital characteristics of the water. River water quality is very important for aspect in India. The physico-chemical parameters such as pH, Electrical Conductivity (EC), Fluoride (F^-), Ammonia as N (NH_3-N), Nitrate as N (NO_3^--N), Chloride (Cl^-), Total Hardness (TH), Boron (B), Sodium Adsorption Ratio (SAR), Dissolved Oxygen (DO), Biochemical Oxygen Demand (BOD), Total Coliform (TC) and Faecal Coliform (FC) are important constituents defining the quality of river water in surface water. Therefore, presence of these parameters in river water beyond the value for permissible limit has been considered as river water quality hot spots. The best use classification is essential, for maintaining the quality of river water of the particular stretch. The study is based on average values of 13 parameters observed during Pre-monsoon (January to May), Monsoon (June to October) and Post-monsoon (November to December) seasons for the year 2021.

In this study identification of hot spots in Indian rivers wrt pH, Electrical Conductivity (EC), Ammonia as N (NH3-N), Boron (B), Sodium Adsorption Ratio (SAR), Dissolved Oxygen (DO), Biochemical Oxygen Demand (BOD) and Total Coliform (TC) parameters are done based on Class B, D & E of Designated best uses of water by Central Pollution Control Board (CPCB) (Table.4). In addition to the above parameters, hotspots identification in Indian Rivers w.r.t. Fluoride (F^-), Nitrate as N (NO_3^--N) , Chloride (Cl^-), Total Hardness (TH) parameters are done based on BIS (Bureau of Indian Standards) IS 10500: 2012(Table.5) for drinking water as a benchmark in absence of any standard for these parameters for drinking water.Faecal Coliform (FC) is based on the Primary Water Quality Criteria for Bathing Water mentioned in the Ministry of Environment, Forest and Climate Change (MoEFCC) Gazette Notification, 2000.

Study Area

A total of 772 water quality monitoring stations in year 2021 covering all the important rivers of country were studied for water quality hotspots in rivers of India. The details of these monitoring stations are shown in map in Figure 10 respectively.

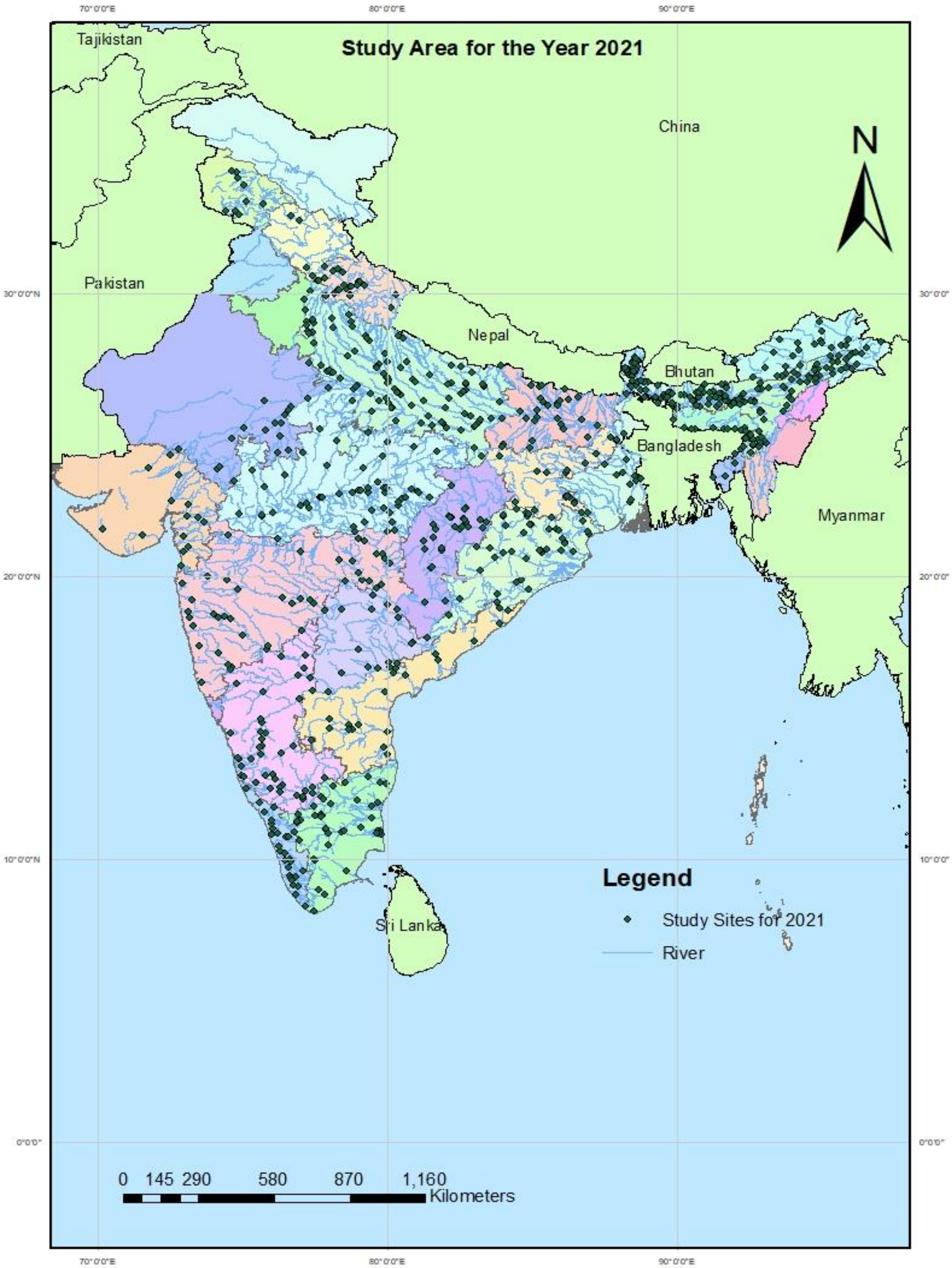


Fig 10: Study area of 772 Water Quality (WQ) Monitoring stations on important rivers of India in year 2021.

6.2 Water Quality Standard in India

Central Pollution Control Board (CPCB) has identified water quality requirements in terms of certain chemical characteristics, known as primary water quality criteria (Table 5). Based on this classification, the natural water has been categorized as Class-A Drinking Water Source without conventional treatment but after disinfection; Class-B Outdoor bathing (Organized); Class-C Drinking water source after conventional treatment and disinfection; Class-D Propagation of Wild life and Fisheries; Class-E Irrigation, Industrial Cooling, Controlled Waste disposal. Further BIS vide its document BIS 10500:2012 has recommended water quality standards for drinking water (Table 6).

Table 5: Designated Best Uses of Water by CPCB

Designated Best Use	Class	Criteria
Drinking Water Source without conventional treatment but after disinfection	A	1. Total Coliforms Organism MPN/100 ml shall be 50 or less 2. pH between 6.5 and 8.5 3. Dissolved Oxygen 6 mg/L or more 4. Biochemical Oxygen Demand 5 days 20 °C, 2 mg/L or less
Outdoor bathing (Organised)	B	1. Total Coliforms Organism MPN/100 ml shall be 500 or less 2. pH between 6.5 and 8.5 3. Dissolved Oxygen 5 mg/l or more 4. Biochemical Oxygen Demand 5 days 20 °C, 3 mg/L or less
Drinking water source after conventional treatment and disinfection	C	1. Total Coliforms Organism MPN/100ml shall be 5000 or less 2. pH between 6 and 9 3. Dissolved Oxygen 4 mg/L or more 4. Biochemical Oxygen Demand 5 days 20 °C, 3mg/Lor less
Propagation of Wild life and Fisheries	D	1. pH between 6.5 and 8.5 2. Dissolved Oxygen 4 mg/l or more 3. Free Ammonia (as N) 1.2 mg/L or less
Irrigation, Industrial Cooling, Controlled Waste disposal	E	1. pH between 6.0 and 8.5 2. Electrical Conductivity at 25 °C micro mhos/cm, maximum 2250 3. Sodium absorption Ratio Max. 26 4. Boron Max. 2 mg/L
	Below -E	Not meeting any of the A, B, C, D & E criteria

Table 6: Drinking Water Quality Standards, BIS: 10500, 2012

S. No.	Characteristic	Requirement (Acceptable Limit)	Permissible limit in the absence of Alternate source
Essential Characteristics			
1	Colour, Hazen units, Max	5	15
2	Odour	Agreeable	Agreeable
3	Taste	Agreeable	Agreeable
4	Turbidity NTU, Max	1	5
5	pH Value	6.5 -8.5	No relaxation
6	Total Hardness (as $CaCO_3$) mg/L, Max.	200	600
7	Iron (as Fe), mg/L, Max	1.0	No relaxation
8	Chlorides (as Cl), mg/L, Max	250	1000
9	Residual free chlorine, mg/L, Minimum	0.2	1.0
Desirable Characteristics			
10	Total Dissolved solids, mg/L, Max	500	2000
11	Calcium (as Ca) mg/L, Max.	75	200
12	Magnesium (as Mg) mg/L, Max	30	100
13	Copper (as Cu), mg/L, Max	0.05	1.5
14	Manganese (as Mn) mg/L, Max	0.1	0.3
15	Sulphates (as SO_4), mg/L, Max	200	400
16	Nitrate (as NO_3) mg/L, Max.	45	No relaxation
17	Fluorides (as F), mg/L, Max	1.0	1.5
18	Ammonia (as total ammonia-N) mg/L	0.5	No relaxation
19	Mercury (as Hg), mg/L, Max	0.001	No relaxation
20	Cadmium (as Cd), mg/L, Max	0.003	No relaxation
21	Selenium (as Se), mg/L, Max	0.01	No relaxation
22	Total Arsenic (as As), mg/L, Max	0.01	No relaxation
23	Cyanides (as CN), mg/L, Max	0.05	No relaxation
24	Lead (as Pb), mg/L, Max	0.01	No relaxation
25	Zinc (as Zn), mg/L, Max	5	15
26	Anionic detergents (as MBAS), mg/L, Max	0.2	1
27	Total Chromium (as Cr), mg/L, Max	0.05	No relaxation
28	Polynuclear aromatic hydrocarbons (as PAH), mg/L, Max	-	-
29	Mineral oil, mg/L, Max	0.5	No relaxation
30	Pesticides mg/L, Max	Absent	0.001
33	Alkalinity mg/L, Max	200	600
34	Aluminum (as Al) mg/L, Max	0.03	0.2
35	Boron mg/L, Max	0.5	1.0

MINISTRY OF ENVIRONMENT AND FORESTS NOTIFICATION

New Delhi, the 25th September, 2000

Primary Water Quality Criteria for Bathing Waters:

In a water body or its part, water is subjected to several types of uses. Depending on the types of uses and activities, water quality criteria have been specified to determine its suitability for a particular purpose. Among the various types of uses there is one use that demands highest level of water quality or purity and that is termed as "Designated Best Use" in that stretch of water body. Based on this, water quality requirements have been specified for different uses in terms of primary water quality criteria. The primary water quality criteria for bathing water are specified along with the rationale.

Table 7: PRIMARY WATER QUALITY CRITERIA FOR BATHING WATER

(Water used for organised outdoor bathing)

CRITERIA		RATIONALE
1.Faecal Coliform MPN/100 ml 2. Faecal Streptococci MPN/100 ml	500 (desirable) 2500 (Maximum Permissible) 100 (desirable) 500 (Maximum Permissible)	To ensure low sewage contamination. Faecal coliform and faecal streptococci are considered as they reflect the bacterial pathogenicity. The desirable and permissible limits are suggested to allow for fluctuation in environmental conditions such as seasonal change, changes in flow conditions etc.
2. pH	Between 6.5 -8.5	The range provides protection to the skin and delicate organs like eyes, nose, ears etc. which are directly exposed during outdoor bathing.
3. Dissolved Oxygen	5 mg/l or more	The minimum dissolved oxygen concentration of 5 mg/1 ensures reasonable freedom from oxygen consuming organic pollution immediately upstream which is necessary for preventing production of anaerobic gases (obnoxious gases) from sediment.
4. Biochemical Oxygen demand 3 day,27°C	3 mg/l or less	The Biochemical Oxygen Demand of 3 mg/1 or less of the water ensures reasonable freedom from oxygen demanding pollutants and prevent production of obnoxious gases.

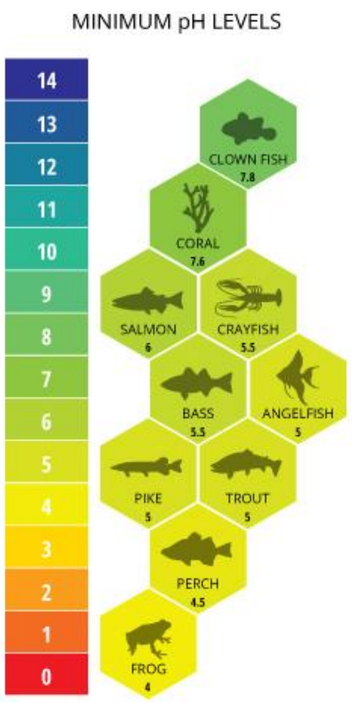
6.3 Water Quality Parameters

6.3.1 pH

The term pH stands for the "power of hydrogen", and it is a measure of the acidity or alkalinity of a solution. The numerical value of pH is determined by the molar concentration of hydrogen ions (H+) present in the solution. The pH scale ranges from 1 to 14, where water with a pH of 7 is considered neutral, pH values below 7 are acidic, and pH values above 7 are considered basic or alkaline (Langland & Cronin, 2003). pH value done by taking the negative logarithm of the H+ concentration (-log(H+)).

$$pH = -\log_{10}[H^+] \text{ or } \log[1/H^+]$$

pH in water can be influenced by various factors, both natural and man-made. Natural changes in pH occur due to interactions with surrounding rock, particularly carbonate forms, and other materials. Precipitation, especially acid rain, and discharges from wastewater or mining operations can also cause fluctuations in pH levels. Additionally, the concentration of carbon dioxide (CO_2) in water can influence pH levels (Hickin, 1995).



The pH of water is important because it affects the health of aquatic organisms and the solubility and toxicity of chemicals and heavy metals in the water. Most aquatic creatures prefer a pH range of 6.5-9.0, though some can live in water with pH levels outside of this range. If the pH of water is too high or too low, the aquatic organisms living within it will die (EPA, 2012).

Humans can tolerate a wider range of pH levels than aquatic organisms, but there are still concerns. pH values greater than 11 can cause skin and eye irritations, as does a pH below 4. A pH value below 2.5 will cause irreversible damage to skin and organ linings. Lower pH levels increase the risk of mobilized toxic metals that can be absorbed, even by humans, and levels above 8.0 cannot be effectively disinfected with chlorine, causing other indirect risks. In addition, pH levels outside of 6.5-9.5 can damage and corrode pipes and other systems, further increasing heavy metal toxicity (Fink, 2005). Therefore, it is important to maintain the pH levels of water within the recommended range of 6.5-8.5, as per CPCB's designated best uses of water (Class A and B).

6.3.2 Electrical Conductivity (EC)

Conductivity is a measure of water's ability to conduct an electrical flow, and it is directly related to the concentration of ions present in the water (Wetzel, 2001). These ions come from dissolved salts and inorganic materials like alkalis, chlorides, sulfides, and carbonate compounds. The more ions present in the water, the higher its conductivity

(Langland & Cronin, 2003). Conversely, the fewer ions in the water, the lower its conductivity. Compounds that dissolve into ions are known as electrolytes (Palermo, 2008).

Salinity and conductivity have a strong correlation, and conductivity is used in algorithms to estimate salinity and TDS, both of which affect water quality and aquatic life. Salinity is specifically important because it affects dissolved oxygen solubility. The higher the salinity level, the lower the dissolved oxygen concentration (DWFS,2014). Temperature affects conductivity by increasing ionic mobility and the solubility of salts and minerals. This can be seen in diurnal variations as a body of water warms up due to sunlight, and conductivity increases, and then cools down at night, decreasing conductivity NSIDC. (2014).

Heavy rainfall or other severe weather events can contribute to flooding, and the effect on conductivity depends on the water body and surrounding soil. In areas with dry and wet seasons, conductivity usually drops overall during the wet season due to the dilution of the water source though the overall conductivity is lower for the season, there are often conductivity spikes as water initially enters a floodplain. If a floodplain contains nutrient-rich or mineralized soil, previously dry salt ions can enter solution as it is flooded, raising the conductivity of water (Sallenave, 2011). A sudden increase or decrease in conductivity in a body of water can indicate pollution. Agricultural runoff or a sewage leak will increase conductivity due to the additional chloride, phosphate, and nitrate ions. In both cases, the additional dissolved solids will have a negative impact on water quality (ESCT, 2013).

Most aquatic species have adapted to specific salinity levels, and salinity values outside of a normal range can result in fish kills due to changes in dissolved oxygen concentrations, osmosis regulation, and TDS toxicity (McManus & Woodson, 2012; Beskenis, 2006; Guiry, 2014).

6.3.3 Dissolved Oxygen

The amount of gaseous oxygen dissolved in water is known as dissolved oxygen, which enters the river water through diffusion from the atmosphere and as a by-product of aquatic plants' photosynthesis (Wetzel, 2001). The presence of dissolved oxygen in the aquatic habitat is crucial for the survival of organisms living in water bodies, including fish and invertebrates. Animals require oxygen to survive, and fish, for instance, can't survive for long in water with less than 5 mg/L of dissolved oxygen (EPA, 2014). Most aquatic plants, fish and zooplankton need oxygen in water in order to breathe. Good oxygen levels are critical for the health of a river system. Slow flowing, polluted river water is often associated with low oxygen conditions, which cannot support much life.

The low level of dissolved oxygen in water indicates contamination and is an important factor in determining water quality, pollution control, and treatment processes. The level of dissolved oxygen in natural and wastewater depends on the physical, chemical, and biochemical activities occurring in water bodies. Oxygen is considered poorly soluble in water, and its solubility is related to temperature and pressure. The introduction of organic waste, especially domestic and animal sewage, industrial waste from paper mills, leather manufacturing, slaughterhouse sewage, and crop wastewater, significantly reduces the DO in river water. The wastes from these industries cause oxygen demand, and they're broken down and decomposed by bacteria into oxygen. Most oxygen-demanding waste is organic.

Low oxygen in water can be fatal to fish and other organisms living in water. A minimum of about 4 mg/L of DO is required for the survival of living organisms in water. Oxygen-depleting substances reduce the available DO. During the summer months, the rate of biological oxidation is significantly increased, yet the DO concentration is at its minimum due to higher temperatures. The DO concentration, temperature, and photosynthesis rate are interdependent and vary diurnally. The decrease in the DO concentration during nights due to the inhibition of photosynthetic activity and the increase in DO concentration due to active photosynthesis of microalgae during the daytime have been observed (Saba et al., 2017).

6.3.4 Biochemical oxygen Demand

Biochemical Oxygen Demand (BOD) is a crucial parameter that quantifies the amount of dissolved oxygen required by aerobic biological organisms to break down organic materials within a river water sample (Armiento, 2016). Diverse sources contribute to BOD, encompassing municipal and industrial wastewater discharges, agricultural runoff, and leachate from landfills. Within rivers, oxygen consumption arises from a combination of aquatic animal respiration, decomposition processes, and various chemical reactions. Wastewater discharged from sewage treatment plants often contains organic substances, which are decomposed by microorganisms, consuming oxygen in the process. Additionally, stormwater runoff from farmland or urban streets, feedlots, and malfunctioning septic systems can introduce oxygen-consuming wastewater.

Several factors influence BOD, including the type and quantity of organic material present, temperature, pH, dissolved oxygen concentration, and the presence of bacteria.

CPCB has recommended a concentration of 3.0 mg/l of biochemical oxygen demand for outdoor bathing. Water having above 3.0 mg/l BOD concentration is not suitable for outdoor bathing. In pristine conditions, rivers generally exhibit a 5-day carbonaceous BOD below 1 mg/L. In moderately polluted scenarios, BOD values fall within the range of 2 to 8 mg/L. Rivers cross the threshold into severe pollution when BOD values exceed 8 mg/L (Grover and Wats, 2013).

The impact of high BOD on the aquatic ecosystem is significant because it can lead to the death of aquatic life. The high levels of BOD can deplete the dissolved oxygen levels in the water, which can cause fish and other aquatic life to suffocate. Additionally, the high levels of BOD can cause the water to become cloudy and murky, making it difficult for aquatic life to thrive.

6.3.5 Total Hardness

The definition of water hardness is based on the measured content of divalent metal cations, with dissolved calcium (Ca^{++}) and magnesium (Mg^{++}) being the two primary divalent cations found in most waters. In natural water sources, calcium and magnesium are typically bound to bicarbonate, sulfate or chloride. The main sources of water hardness are sedimentary rocks, seepage and runoff from soils. Generally, hard waters originate from areas with thick topsoil and limestone formations, with groundwater tending to be harder than surface water. The two main industrial sources of water hardness are the inorganic chemical and mining industries. (Sawyer & McCarty, 1967; Biesecker & George, 1972).

To classify water hardness, general guidelines are as follows: 0 to 60 mg/L as $CaCO_3$ is considered soft water; 61 to 120 mg/L as moderately hard water; 120 to 180 mg/L as hard water; and more than 180 mg/L as very hard water.

The hardness of water is harmful to the boilers and hot water pipes as the deposition of salts occur, which can reduce their efficiency. The hard water is not good for washing as it is difficult for hard water to form lather with soap (Ramya et al 2015). The World Health Organisation states that hard water has no known adverse health effects (Akram, 2018). There are no serious health effects associated with drinking hard water. However solid water acts as a dietary supplement as it contains calcium and magnesium that strengthens bones and teeth (Sengupta, 2013). Hard water contains high concentration of dissolved minerals therefore millions of people think that these dissolved minerals have positive effects on the health of its drinkers ((Sawyer & McCarty, 1967; Biesecker & George, 1972).

6.3.6 Nitrate

Nitrate is a compound that can be found in the environment naturally and synthetically under various conditions. The amount of nitrogen present or both nitrogen and oxygen are used to measure nitrate in drinking water, which is the principal form of combined nitrogen that is present in natural waters. It serves as a nutrient that stimulates plant growth. However, excessive amounts of nitrogen may lead to the proliferation of macrophytes or phytoplankton. Nitrates can be contributed to freshwater through the discharge of sewage and industrial waste, as well as run-off from agricultural fields. Nitrate is the final product of the oxidation of ammonia. Effluents such as sewage contain high levels of ammonia, which can increase nitrate concentrations in receiving waters. High levels of nitrate in river waters may indicate pollution, even though this form of nitrogen can be used as a source of nutrients for plants and encourage plant proliferation (Hamzaraj et al., 2014).

The standard for nitrate in drinking water is 10 mg/L nitrate as N or 45 mg/L nitrate-NO_3. Nitrate in drinking water can cause Methemoglobinemia or blue baby syndrome, which is a significant health problem associated with nitrate.

6.3.7 Fluoride

Fluoride is a natural element that is commonly found in water sources, soil, and various foods. It is the 13th most abundant element, commonly occurring in the minerals fluorspar (CaF_2), cryolite (Na_3AlF_6) and fluorapatite ($3Ca_3(PO_4)_2\ Ca(F,Cl)_2$) while industrial wastes, use of extensive fertilizers and brick kilns are examples of the anthropogenic sources (Cotton & Wilkinson, 1988; Mackay & Mackay, 1989).

Fluoride is beneficial for dental health because it helps strengthen tooth enamel and makes teeth more resistant to acid attacks from bacteria and sugars. However, excessive fluoride intake can lead to health issues (CPHA, 1979). The maximum permissible limit of Fluoride as per IS 10500-2012 for drinking water is 1.5 mg/L. Excessive exposure to fluoride during tooth development, especially in childhood, can lead to a cosmetic issue known as dental fluorosis. This condition results in changes in tooth enamel color and, in more severe cases, pitting or mottling of the teeth. Prolonged exposure to very high levels of fluoride, usually through drinking water with concentrations well above recommended levels, can lead to skeletal fluorosis. This condition affects the bones and joints and can cause pain and limited mobility (Hussain et al., 2010).

6.3.8 Chloride

Chloride (Cl^-) ion is a major inorganic anion found in water and wastewater, occurring naturally in all types of water. It is widely distributed in nature, mainly as the sodium ($NaCl$) and potassium (KCl) salts, and constitutes about 0.05% of the lithosphere (NRCC, 1977). The greatest amount of chloride found in the environment is in the oceans. The salty taste produced by chloride concentrations is variable and dependent on the chemical composition of water. The presence of chloride in river water can be attributed to various sources, such as the dissolution of salts in soil, discharge of effluents from chemical industries, sewage discharge, contamination from refuse leachates, and sea water intrusion in coastal areas. Each of these sources leads to local contamination of river water. Chloride concentration serves as an indicator of sewage pollution in fresh water regions, with the discharge of domestic sewage being the most significant source of chlorides in the waters.

Chloride is an essential element and the main extracellular anion in the body. It is a highly mobile ion involved in maintaining proper osmotic pressure, water balance, and acid–base balance. Small amounts of chlorides are required for normal cell functions in plant and animal life. Fish and aquatic communities cannot survive in high levels of chlorides. The World Health Organization (WHO), Bureau of Indian Standard, and other regulatory bodies provide guidelines for safe levels of chloride in drinking water, typically below 250 milligrams per liter (mg/L) (WHO, 1979).

High chloride concentrations in water can affect the aesthetic quality of the water, imparting a salty taste. While this doesn't pose a direct health risk, it can lead to consumer dissatisfaction with the water's taste and smell. Individuals with certain health conditions, such as hypertension (high blood pressure) or cardiovascular diseases, may need to monitor their salt intake, including chloride. High chloride levels in water can contribute to increased sodium intake. Excessive chloride in water can have negative effects on aquatic ecosystems, particularly in freshwater environments, and can harm aquatic life, including fish and other organisms sensitive to changes in water quality (CNHW, 1983).

6.3.9 Boron

Boron is an element that naturally occurs in the earth's crust and can be found in fruits, vegetables, and some water sources. People encounter boron through food, water, and consumer products containing this element. Boron tends to bind to oxygen, forming a group of compounds known as borates (e.g., borax and boric acid). Once released into the environment, boron does not break down. It enters the environment through both natural processes, such as weathering of soils and rocks, and human-made activities, including manufacturing plants that utilize boron, such as glass manufacturing and coal-burning power plants.

Boron is essential for the normal growth of all plants, but the required amount is relatively low. If boron exceeds a specific tolerance level, depending on the crop, it may lead to injury. The range between boron deficiency and toxicity for many crops is narrow. To sustain an adequate supply of boron, at least 0.02 ppm of boron in irrigation water may be necessary, while to avoid toxicity, boron levels in irrigation water should ideally be lower than 0.3 ppm. Higher boron concentrations may require an evaluation of the intended crop's boron tolerance. Although boron toxicity is not a widespread issue, it can be a crucial parameter for assessing irrigation water quality. Interestingly, plants grown in soils high in lime may tolerate higher boron levels than those grown in non-calcareous soils.

Boron is weakly adsorbed by soils, meaning its actual root-zone concentration may not vary directly with the degree of boron concentration in the irrigation water during plant growth. Symptoms of boron injury may include characteristic leaf 'burning,' chlorosis, and necrosis, although some boron-sensitive species may not exhibit obvious symptoms. Boron toxicity symptoms typically appear on older leaves as yellowing, spotting, or drying of leaf tissues at the tips and edges. This drying and chlorosis often progress toward the center of the leaf, between the veins, as boron accumulates over time (Ayers and Westcot, 1985).

6.3.10 Free Ammonia

Ammonia is a commonly found pollutant in aquatic environments around the world (CEPA, 1999; Camargo & Alonso, 2006). Ammonia occurs naturally in water bodies, arising from the microbiological decomposition of nitrogenous compounds in organic matter. Fish and other aquatic organisms also excrete ammonia. Ammonia may also be discharged directly into water bodies by some industrial processes or as a component of domestic sewage or animal slurry. Ammonia can also arise in waters from the decay of discharged organic waste. Natural (unpolluted) waters contain relatively small amounts of ammonia, usually < 0.02mg/L as N. The presence of ammonia in freshwater has been associated with the acidification of rivers and lakes, eutrophication, and direct toxicity to aquatic organisms (CEPA, 1999; Camargo & Alonso, 2006; Baker et al., 1991). Ammonia exists in aqueous solutions in two forms, ionized (NH_4^+) and unionized (NH_3) and the unionized fraction is toxic to freshwater fish at very low concentration. The relative proportions of ionized and unionized ammonia in water depend on temperature and pH and to a lesser extent on salinity. The concentration of unionized ammonia becomes greater with increasing temperatures and pH and with decreasing salinity.

The toxicity of this compound on aquatic organisms will depend on the chemical form of ammonia, pH, and temperature. Furthermore, it will depend on the time of exposure (Francis-Floyd, 2009). This compound damages the gills, liver, kidney, spleen and other organ tissues of fish, therefore causing breathing difficulties (Benli et al., 2008; Schram et al., 2010). This may lead to physiological alterations and, eventually, exhaustion or death (Schram et al., 2010). Ammonia can cause cell damage and can also affect the antioxidant defence system, thus altering the levels of oxidative stress in fish (EPA, 2013; Sinha et al., 2014). Ammonia can also alter fish behaviour. Fish exposure to sub-lethal concentrations of ammonia can reduce swimming activity (Wicks et al., 2002), foraging behaviour (Tudorache, 2008), and the ability to flee from predators (Tudorache, 2008; McKenzie, 2009).

6.3.11 Sodium Absorption Ratio (S.A.R.)

The sodium adsorption ratio (SAR) is a crucial parameter for managing soil quality in agriculture. It determines the suitability of irrigation water by analyzing the concentrations of different cations, including the primary alkaline and earth alkaline cations in the water. The SAR indicates the relative proportion of sodium to other cations in the water, which affects the soil structure's potential for degradation. If the soil contains excessive sodium, it can lead to sodicity, causing soil structure degradation and higher erosion rates. The SAR value is significant as it predicts the potential for sodium accumulation in the soil. Higher SAR values indicate a higher risk of soil problems due to sodium accumulation, such as decreased permeability and soil structure degradation. Sodic soils, resulting from excessive sodium, can also lead to poor water infiltration, drainage problems, and decreased crop yields (Laxmi et al., 2022).

6.3.12 Total Coliforms (TC) and Faecal Coliforms (FC)

Coliforms are one of the most useful indicator organisms which are easily detectable. Total Coliforms represent a group of 16 species of bacteria that are found in soil, vegetation, animal wastes and human sewage. Their presence gives an idea about the pollution level of the water bodies. Coliforms are called indicators because their presence give an indication of the possibility of presence of other microorganisms including harmful pathogens. Faecal coliforms represents a sub category of TC with 6 species including the harmful E.Coli bacteria. These are determined by the Most Probable Number (MPN) method. MPN method is a statistical, multi-step assay consisting of presumptive, confirmed and completed phases.

CHAPTER – 7

7.1 Result and Discussion

7.1.1 pH

The pH value is expressed as the ratio of $[H^+]$ to $[OH^-]$ (hydroxide ion concentration). Hence, if the $[H^+]$ is greater than $[OH^-]$, the solution is acidic. Conversely, if the $[OH^-]$ is greater than the $[H^+]$, the solution is basic. At 7 pH, the ratio of $[H^+]$ to $[OH^-]$ is equal and, therefore, the solution is neutral. As shown in the equation below, pH is a logarithmic function. A change of one pH unit represents a 10-fold change in concentration of hydrogen ion. In a neutral solution, the $[H^+] = 1 \times 10^{-7}$ mol/L. This represents a pH of 7. BIS (Bureau of Indian Standard) has recommended a desirable limit of 6.5 – 8.5 of pH in drinking water. The limit prescribed by CPCB for class-A; Drinking water source without conventional treatment but after disinfections, class B: Outdoor bathing Organized, class D: Propagation of wild life and class E: Fisheries and Irrigation; all are defined from 6.5 to 8.5.

The pH levels of water samples collected from various monitoring stations across different rivers in India were analyzed during pre-monsoon, monsoon, and post-monsoon seasons. The data were compared with the Bureau of Indian Standard (BIS) recommended desirable limit of 6.5 – 8.5 for pH in drinking water.

Acidic

During the pre-monsoon period, 7 monitoring stations (Kharkhana - Myntdu, Kheronighat - Kopili, Machaigaon - Dirai, Jhanji - Teok, Kampur - Kopili, Sonapur - Lubha, Harangajao - Jatinga) recorded pH values in the range of 4.02 to 6.30. During the monsoon period, 2 monitoring stations exhibited pH ranges from 4.87 to 5.07 at Langrimukh (Kopili) and Kharkhana (Myntdu). Additionally, 1 water quality monitoring station reported pH 4.45 at Kharkhana (Myntdu) during the post-monsoon period, falling below 7.0 and indicating an acidic nature. The presence of acidic conditions in certain monitoring stations raises concerns about the potential impact on aquatic life, as acidic environments can adversely affect the health of fish, insects, and other organisms that form the aquatic food web.

Alkaline

Eight (08) monitoring stations (Kora - Rind, Dabri - Ramganga, Kamalapuram - Papagani, Chandwada - Orsang, Hamirpur - Yamuna, Elunuthi Mangalam - Noyyal, Biligundulu - Cauvery and Pratapgarh - Sai) recorded pH values in the range of 8.55 to 8.82. 3 monitoring stations exhibited pH ranges from 8.61 to 8.76 at Magaral (Cheyyar), Elunuthi Mangalam (Noyyal), and Kamalapuram (Papagani) during the monsoon period. Additionally, 3 water quality monitoring stations reported pH ranges from 8.53 to 8.74 at Pratapgarh (Sai), Patala (Wardha) and Pauni (Wainganga) during the post-monsoon period, surpassing 7.0 and indicating an alkaline condition. Monitoring stations exhibiting alkaline conditions may suggest the presence of minerals in the water, potentially influencing agricultural practices in the surrounding areas.

The highest number of water quality monitoring stations exceeding the acceptable pH limit was 15 during the pre-monsoon season, followed by 5 monitoring stations during the monsoon season and 4 monitoring stations during the post-monsoon period. The higher number of monitoring stations exceeding the acceptable pH limit during the pre-monsoon season may be attributed to the lean season, characterized by lower water flow and reduced dilution capacity. This can lead to an accumulation of pollutants and substances affecting pH.

The hot spot study and GIS map for pH parameter are given below in Table 8 and figure 11.

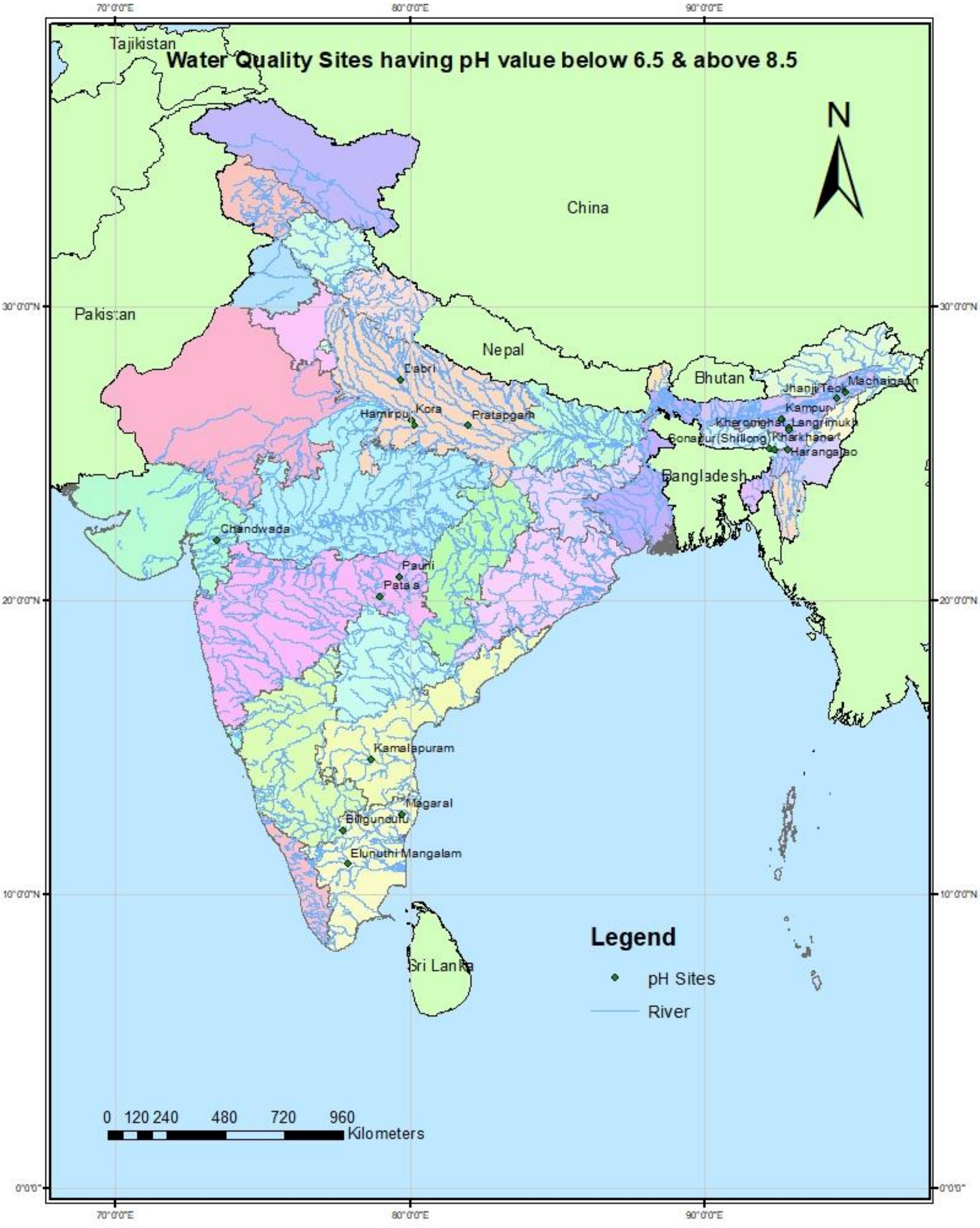
Table 08: Monitoring stations having pH value above 8.5 & below 6.5 in River Water in 2021

S.No.	Monitoring stations	River	CWC Division Office	State	District	Pre-M	M	Post-M
1	Biligundulu	Cauvery	SRD, Coimbatore	Tamil Nadu	Krishnagiri	8.62	-	-
2	Chandwada	Orsang	TD, Surat	Gujarat	Vadodara	8.60	-	-
3	Dabri	Ramganga	MGD-2, Lucknow	U.P.	Shahjahanpur	8.57	-	-
4	Elunuthi Mangalam	Noyyal	SRD, Coimbatore	Tamil Nadu	Erode	8.62	8.64	-
5	Hamirpur	Yamuna	LYD, Agra	U.P.	Hamirpur	8.61	-	-
6	Harangajao	Jatinga	MID, Shillong	Assam	Dima Hasao	6.30	-	-
7	Jhanji/Teok	Teok	MBD, Guwahati	Assam	Jorhat	6.18	-	-
8	Kamalapuram	Papagani	HD, Chennai	A.P.	Kadapa	8.58	8.76	-
9	Kampur	Kopili	UBD, Dibrugarh	Assam	Nagaon	6.20	-	-
10	Kharkhana	Myntdu	MID, Shillong	Meghalaya	West Jaintia Hills	4.02	5.07	4.45
11	Kheronighat	Kopili	UBD, Dibrugarh	Assam	Karbi Anglong	5.70	-	-
12	Kora	Rind	LYD, Agra	U.P.	Fatehpur	8.55	-	-
13	Langrimukh	Kopili	MBD, Guwahati	Assam	Dima Hasao	*	4.87	*
14	Machaigaon	Dirai	MBD, Guwahati	Assam	Sivasagar	6.04	-	-
15	Magaral	Cheyyar	HD, Chennai	Tamil Nadu	Kancheepuram	*	8.61	-
16	Patala	Wardha	WD, Nagpur	Maharashtra	Chandrapur	-	-	8.61
17	Pauni	Wainganga	WD, Nagpur	Maharashtra	Bhandara	-	-	8.74
18	Pratapgarh	Sai	MGD-3, Varanasi	U.P.	Pratapgarh	8.82	-	8.53
19	Sonapur (Shillong)	Lubha	MID, Shillong	Meghalaya	East Jaintia Hills	6.23	-	*

(-) means No Hotspot.

(*) means river dry/data not available.

Figure: 11 Water Quality Monitoring stations having pH value below 6.5 & above 8.5 (2021)



7.1.2 Electrical Conductivity (EC)

Conductivity (specific conductance) of an electrolytic solution is a measure of its ability to conduct electricity. The SI unit of conductivity is siemens per meter (S/m). In many cases, conductivity is linked directly to the total dissolved solids (T.D.S.). High quality deionized water has a conductivity of about 5.5 μS/m, typical drinking water in the range of 5-50 mS/m, while sea water about 5 S/m (i.e., sea water's conductivity is one million times higher than that of deionized water). Resistance, R, is proportional to the distance, l, between the electrodes and is inversely proportional to the cross-sectional area. Writing ρ (rho) for the specific resistance (or resistivity) and the specific conductance, κ (kappa) is the reciprocal of the specific resistance.

The conductivity or conductance of a solution is the reciprocal of its resistance and is given of units of µmhos, mhos, or Siemens (all are reciprocal ohms). Resistivity as the inverse of conductivity is defined as the measure of the ability of a solution to resist an electric current flow. The conductivity measurement is directly affected by the number of dissolved ions in the solution and will increase as the quantity and mobility of ions increases. The higher the conductivity reading, the better ability the solution has to conduct electricity. Conversely, the lower the conductivity reading, the poorer ability the solution has to conduct electricity.

BIS has recommended a drinking water standard for total dissolved solids a limit of 500mg/l (corresponding to about EC of 750 μS/cm at 25^0C) that can be extended to a TDS of 2000mg/l (corresponding to about 3000 μS/cm at 25^0C) in case of no alternate source. Water having TDS more than 2000 mg/litre are not suitable for drinking uses. The limit prescribed by CPCB for conductivity as class-E Irrigation, Industrial Cooling, Controlled Waste disposal is less than 2250 µS/cm at 25^0C.

Six (06) water quality monitoring stations – Durvesh (Vaitarna), Elunuthi Mangalam (Noyyal), Luwara (Shetrunji), Varanavasi (Maruthaiyar), Vautha (Sabarmati) and Wadakbal (Sina) – recorded an average electrical conductivity (EC) greater than 2250 µS/cm during the pre-monsoon season. During the monsoon and post-monsoon seasons, Elunuthi Mangalam (Noyyal) and Luwara (Shetrunji) exceeded the threshold of EC 2250 µS/cm respectively.

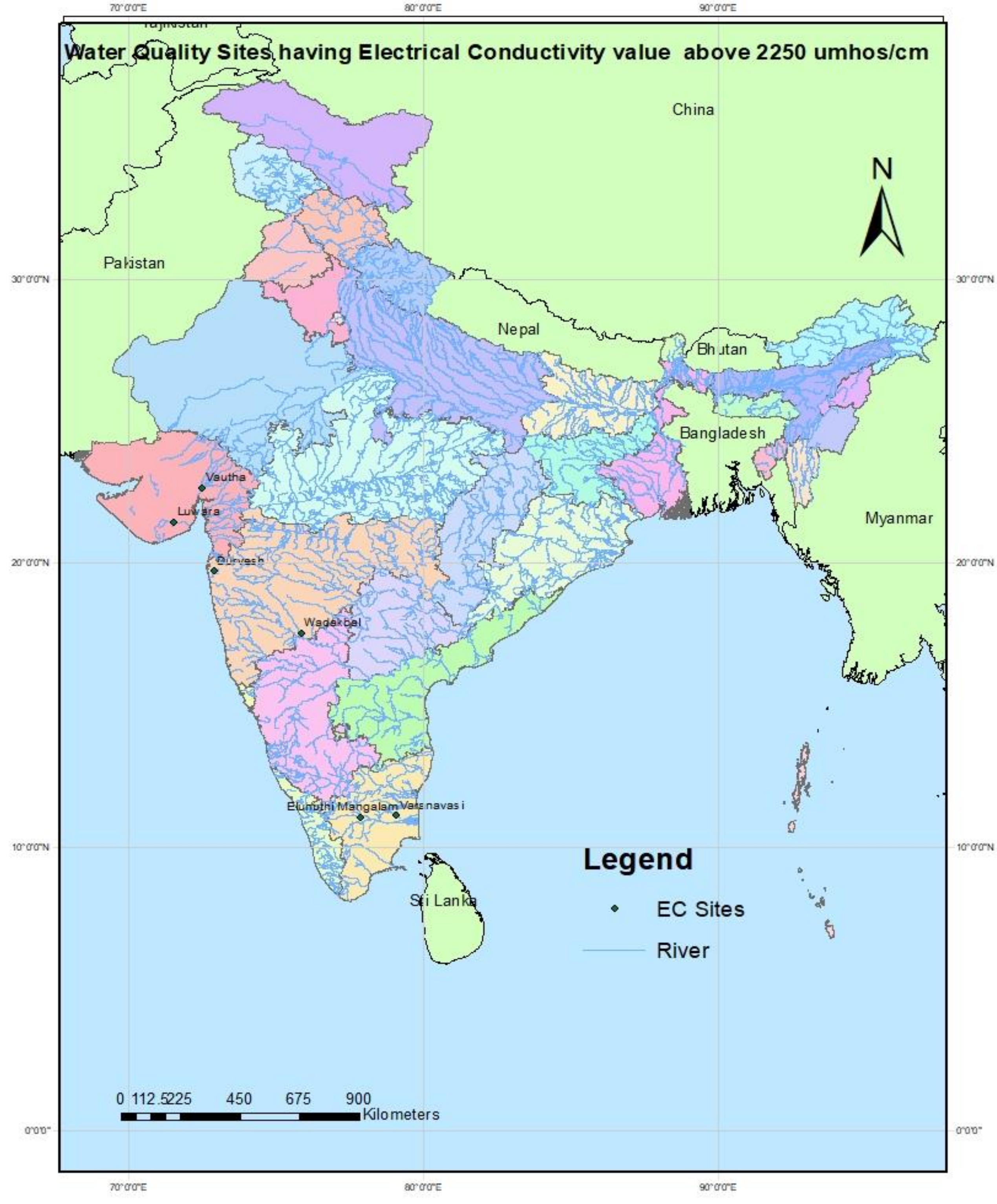
The hot spot study and GIS map for EC parameter are given below in Table 9 and figure 12

Table 09: Monitoring stations having Electrical Conductivity >2250 µS/cm in River Water 2021

S.No.	Monitoring stations	River	CWC Division Office	State	District	Pre-M	M	Post- M
1	Durvesh	Vaitarna	TD, Surat	Maharashtra	Palghar	16435.50	-	-
2	Elunuthi Mangalam	Noyyal	SRD, Coimbatore	Tamil Nadu	Erode	2968.79	3949.40	-
3	Luwara	Shetrunji	MD, Gandhinagar	Gujarat	Bhavnagar	5028.17	-	3451.83
4	Varanavasi	Maruthaiyar	SRD, Coimbatore	Tamil Nadu	Ariyalur	3322.67	-	-
5	Vautha	Sabarmati	Mahi Division	Gujarat	Ahmedabad	2505.60	-	-
6	Wadakbal	Sina	UKD, Pune	Maharashtra	Solapur	2355.00	-	*

(-) means No Hotspot. (*) means river dry/data not available.

Figure 12: Water Quality monitoring stations having electrical Conductivity value greater than 2250 µmhos/cm (2021)



7.1.3 Ammonia as N (NH_3-N)

Ammonia is a colour-less gas with a strong pungent odour. It is easily liquefied and solidified and is very soluble in water. One volume of water will dissolve 1,300 volumes of NH_3. Ammonia will react with water to form a weak base. Ammonia pungent gaseous compound of hydrogen and nitrogen that is highly soluble in water. It is a biologically active compound found in most waters as a normal biological degradation product of nitrogenous organic matter (protein). It also may find its way to ground and surface waters through discharge of industrial process wastes containing ammonia and fertilizers.

Ammonia is used in fertilizers either as the compound itself or as ammonium salts such as sulphate and nitrate. Large quantities of ammonia are used in the production of nitric acid, urea and nitrogen compounds. It is used in the production of ice and in refrigerating plants. "Household ammonia" is an aqueous solution of ammonia. It is used to remove carbonate from hard water. Since ammonia is a decomposition product from urea and protein, it is found in domestic wastewater. Aquatic life and fish also contribute to ammonia levels in a stream. Ammonia is the preferred nitrogen-containing nutrient for plant growth. Ammonia can be converted to nitrite (NO_2) and nitrate (NO_3) by bacteria, and then used by plants. Nitrate and ammonia are the most common forms of nitrogen in aquatic systems. Nitrate predominates in unpolluted waters. Nitrogen can be an important factor controlling algal growth when other nutrients, such as phosphate, are abundant. If phosphate is not abundant it may limit algal growth rather than nitrogen. Ammonia is excreted by animals and produced during decomposition of plants and animals, thus returning nitrogen to the aquatic system. Ammonia is also one of the most important pollutants because it is relatively common but can be toxic, causing lower reproduction and growth, or death. The neutral, unionized form (NH3) is highly toxic to fish and other aquatic life.

The primary agricultural sources include accidental releases of ammonia-rich fertilizer during transport (because of vehicle accident, faulty hose connections, and human error); and livestock waste. The limit prescribed by CPCB for Ammonia (as N) in class-D: Propagation of Wild life and Fisheries is 1.2 mg/l or less.

During the pre-monsoon season, elevated average ammonia values exceeding 1.2 mg/l were noted at 19 water quality Monitoring stations Agra Canal, Baghpat, Baleni, Chilla Gaon, Delhi Railway Bridge, Etawah, Galeta, Gokul Barrage II Mathura D/S, Jawahar Bridge, Agra Kailash Mandir, Near Benpur Village, Mohna, Muri, Noida, Okhla Barrage, Pingalwada, Poiyaghat, Agra, R.S.P, Singasadanapalli, Vautha, Yamuna Expessway Road Bridge,Etmadpur spread across Delhi, Gujarat, Haryana, Odisha, Tamil Nadu, and Uttar Pradesh. Similarly, in the monsoon season, 18 monitoring stations in Delhi, Gujarat, Haryana, Odisha, Tamil Nadu and Uttar Pradesh recorded average ammonia values exceeding 1.2 mg/l. Post-monsoon data for the same year continued to reflect this trend, with 19 monitoring stations in Delhi, Gujarat, Haryana, Odisha, Tamil Nadu, and Uttar Pradesh showing elevated average ammonia levels. 16 water quality onitoring stations Agra Canal, Baghpat, Baleni, Chilla Gaon, Delhi Railway Bridge, Galeta, Gokul

Barrage II Mathura D/S, Jawahar Bridge, Agra, Mohna, Noida, Okhla Barrage, Pingalwada, Poiyaghat Agra, R.S.P Singasadanapalli and Vautha are common in all season (Pre monsoon, monsoon, post monsoon).

The hot spot study and GIS map for ammonia parameter are given below in Table 10 and figure 13.

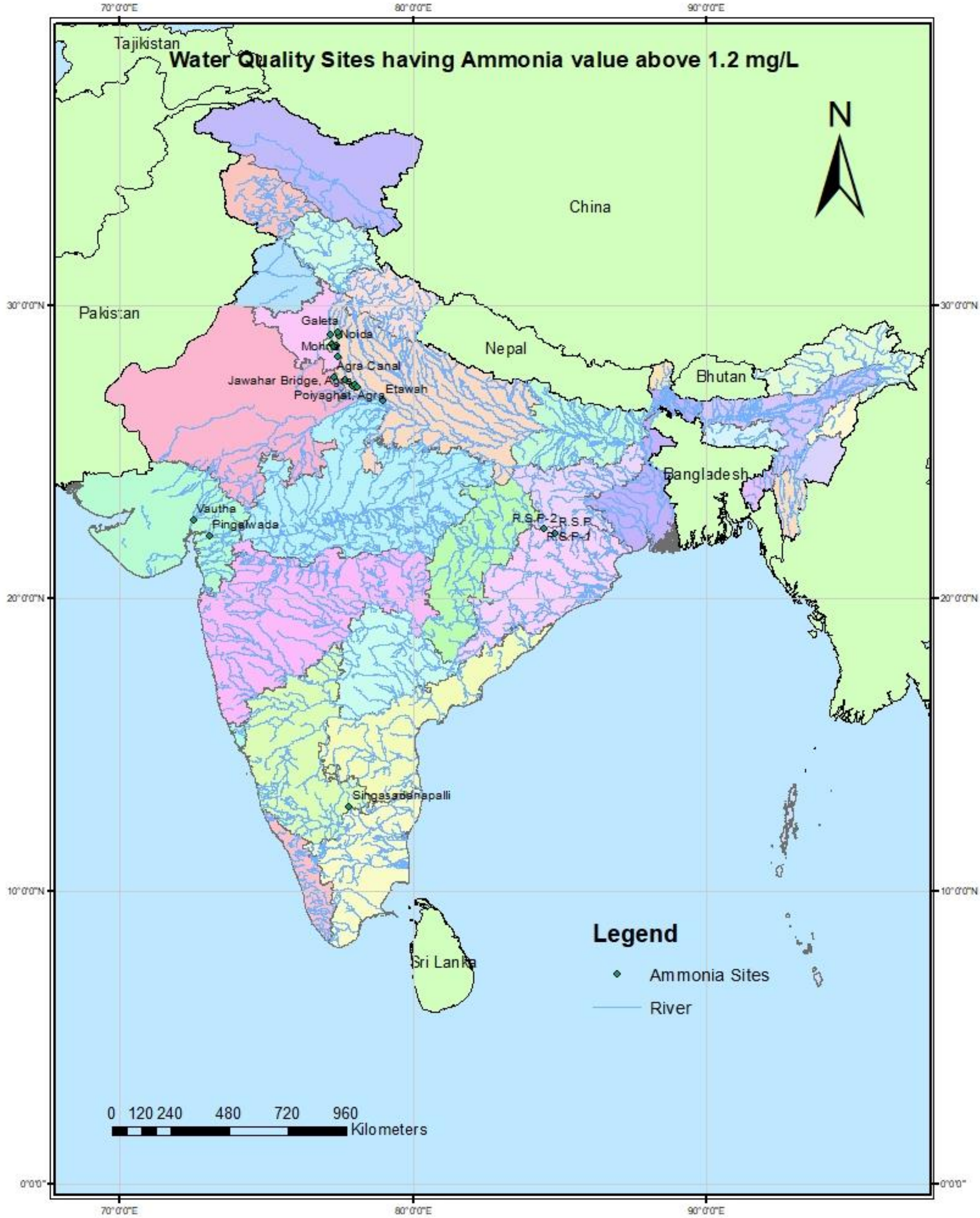
Table 10: Monitoring stations having Ammonia (NH_3)> 1.2 mg/l in River Water in 2021

S.No.	Monitoring stations	River	CWC Division Office	State	District	Pre-M	M	Post- M
1	Agra Canal	Yamuna	UYD, New Delhi	Delhi	South Delhi	7.35	10.16	10.26
2	Baghpat	Yamuna	UYD, New Delhi	U.P.	Baghpat	2.44	1.29	1.42
3	Baleni	Yamuna	UYD, New Delhi	U.P.	Baghpat	2.67	3.19	3.36
4	Chilla Gaon	Hindon Cut	UYD, New Delhi	Delhi	East Delhi	7.78	31.36	21.33
5	Delhi Railway Bridge	Yamuna	UYD, New Delhi	Delhi	North Delhi	12.14	21.91	19.06
6	Etawah	Yamuna	LYD, Agra	U.P.	Etawah	4.69	-	4.63
7	Galeta	Hindon	UYD, New Delhi	U.P.	Baghpat	8.72	7.76	6.62
8	Gokul Barrage II Mathura D/S	Yamuna	UYD, New Delhi	U.P.	Mathura	7.42	6.52	6.10
9	Jawahar Bridge, Agra	Yamuna	LYD, Agra	U.P.	Agra	16.18	2.22	13.88
10	Kailash Mandir, Near Benpur Village	Yamuna	LYD, Agra	U.P.	Agra	16.37	*	*
11	Mohna	Yamuna	UYD, New Delhi	Haryana	Faridabad	9.91	11.02	7.86
12	Noida	Yamuna	UYD, New Delhi	U.P.	Gautam Budh Nagar	13.13	11.34	8.09
13	Okhla Barrage	Yamuna	UYD, New Delhi	Delhi	South Delhi	13.77	5.46	3.94
14	Pingalwada	Dhadhar	TD, Surat	Gujarat	Vadodara	3.15	1.42	1.43
15	Poiyaghat, Agra	Yamuna	LYD, Agra	U.P.	Agra	15.37	2.09	13.66
16	R.S.P	Brahmani	ERD, Bhubaneswar	Odisha	Sundergarh	25.67	3.79	50.22
17	R.S.P-1	Brahmani	ERD, Bhubaneswar	Odisha	Sundergarh	-	1.33	20.38
18	R.S.P-2	Brahmani	ERD, Bhubaneswar	Odisha	Sundergarh	-	1.27	8.09
19	Singasadanapalli	Ponnaiyar	SRD, Coimbatore	Tamil Nadu	Krishnagiri	33.53	13.61	19.03
20	Vautha	Sabarmati	Mahi Division	Gujarat	Ahmedabad	19.28	13.87	14.80
21	Yamuna Expessway Road Bridge, Etamadpur	Yamuna	LYD, Agra	U.P.	Agra	17.14	*	*

(-) means No Hotspot.

(*) means river dry/data not available.

Figure 13: Water Quality monitoring stations having ammonia value above 1.2 mg/L (2021)



7.1.4 Fluoride (F^-)

Fluorine is a fairly common element but it does not occur in the elemental state in nature because of its high reactivity. Fluorine is the most electronegative and reactive of all elements that occur naturally within many types of rock. It exists in the form of fluorides in a number of minerals of which fluorspar, cryolite, fluorite and fluorapatite are the most common. Fluorite (CaF_2) is a common fluoride mineral. Most of the fluoride found in groundwater is naturally occurring from the breakdown of rocks and soils or weathering and deposition of atmospheric particles. Most of the fluorides are sparingly soluble and are present in ground water in small amounts. The occurrence of fluoride in natural water is affected by the type of rocks, climatic conditions, nature of hydro geological strata and time of contact between rock and the circulating ground water. Presence of other ions, particularly bicarbonate and calcium ions also affect the concentration of fluoride in ground water. It is well known that small amounts of fluoride (less than 1.0 mg/l) have proven to be beneficial in reducing tooth decay. Community water supplies commonly are treated with NaF or fluorosilicates to maintain fluoride levels ranging from 0.8 to 1.2 ppm to reduce the incidence of dental carries. However, high concentrations such as 1.5 mg/l of F and above have resulted in staining of tooth enamel while at still higher levels of fluoride ranging between 5.0 and 10 mg/l, further pathological changes such as stiffness of the back and difficulty in performing natural movements may take place.

BIS has recommended an upper desirable limit of 1.0 mg/l of F as desirable concentration of fluoride in drinking water, which can be extended to 1.5 mg/l of fluoride in case no alternative source of water is available. River Water having fluoride concentration of more than 1.5 mg/l are not suitable for drinking purposes. During the pre monsoon, monsoon and post monsoon seasons, the average values of fluoride of all water quality monitoring stations were observed within the permissible limit.

A distinct pattern of elevated average fluoride values, exceeding 1.5 mg/l, emerged during the monsoon season at 2 specific water quality monitoring stations: R.S.P (Brahmani) in Odisha and Lingdem (HS) in Sikkim. This pattern persisted into the post-monsoon season, with both Odisha (R.S.P) and Sikkim (Lingdem (HS)) displaying average fluoride values that surpassed the acceptable limit of 1.5 mg/l.

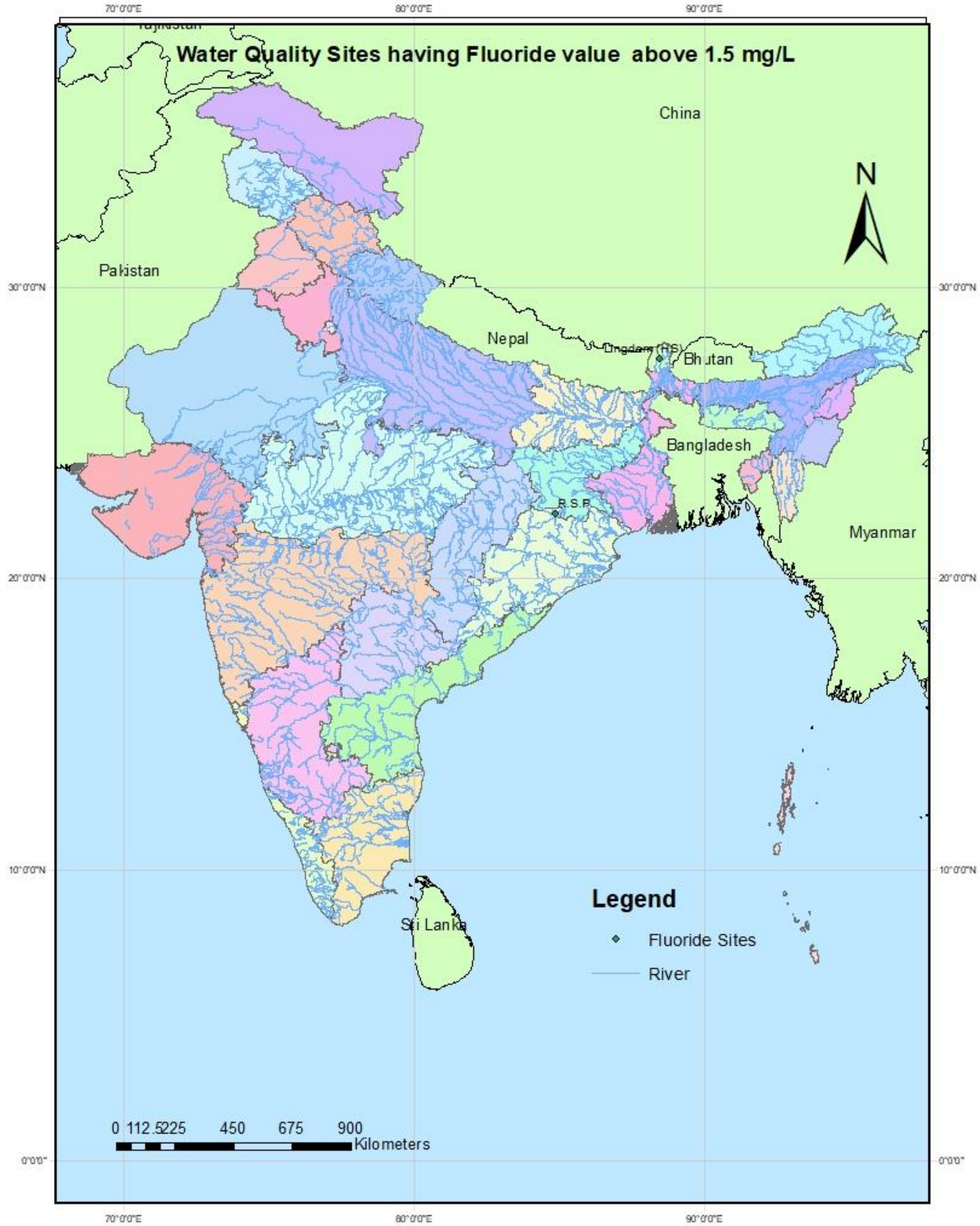
The hot spot study and GIS map for fluoride parameter are given below in Table 11 and figure 14.

Table 11: Monitoring stations having Fluoride concentration above 1.5 mg/l in River Water in 2021

S.No.	Monitoring stations	River	CWC Division Office	State	District	Pre-M	M	Post- M
1	Lingdem (HS)	Talangchu	SID, Gangtok	Sikkim	Mangan	-	4.80	7.23
2	R.S.P	Brahmani	ERD, Bhubaneswar	Odisha	Sundergarh	-	1.53	1.87

(-) means No Hotspot.; (*) means river dry/data not available.

Figure 14: Water Quality Monitoring stations having fluoride value above 1.5 mg/L (2021)



7.1.5 Total Hardness

The acceptable limit according to Indian Standard Drinking Water-Specification, IS 10500: 2012 is 200 mg/l and the permissible limit in the absence of alternate source is 600 mg/l.

The result of the study showed that total hardness concentration for 4 different monitoring stations, namely Durvesh on Vaitarna River, Luwara on Shetrunji River, Varanavasi on Maruthaiyar River, and Wadakbal on Sina River exceeded the acceptable limit during the pre-monsoon. At the Durvesh monitoring station on Vaitarna River, Maharashtra, and the water quality analysis results showed a value of 2104 mg/L during the pre-monsoon season. However, during the monsoon and post-monsoon seasons, total hardness value did not exceed acceptable limit. At the Luwara monitoring station on Shetrunji River, Gujarat, and the water quality analysis results showed a value of 614 mg/L during the pre-monsoon season. Nevertheless, during the monsoon and post-monsoon seasons, the total hardness value did not exceed the acceptable limit. For the Varanavasi monitoring station in Maruthaiyar River, the water quality analysis results showed a value of 968 mg/L during the pre-monsoon season. However, total hardness value did not exceed the acceptable limit the monsoon and post-monsoon seasons. At the Wadakbal monitoring station in Sina River, the water quality analysis results showed a value of 680 mg/L during the pre-monsoon season. Nevertheless, during the monsoon and post-monsoon seasons, the total hardness value did not exceed the acceptable limit.

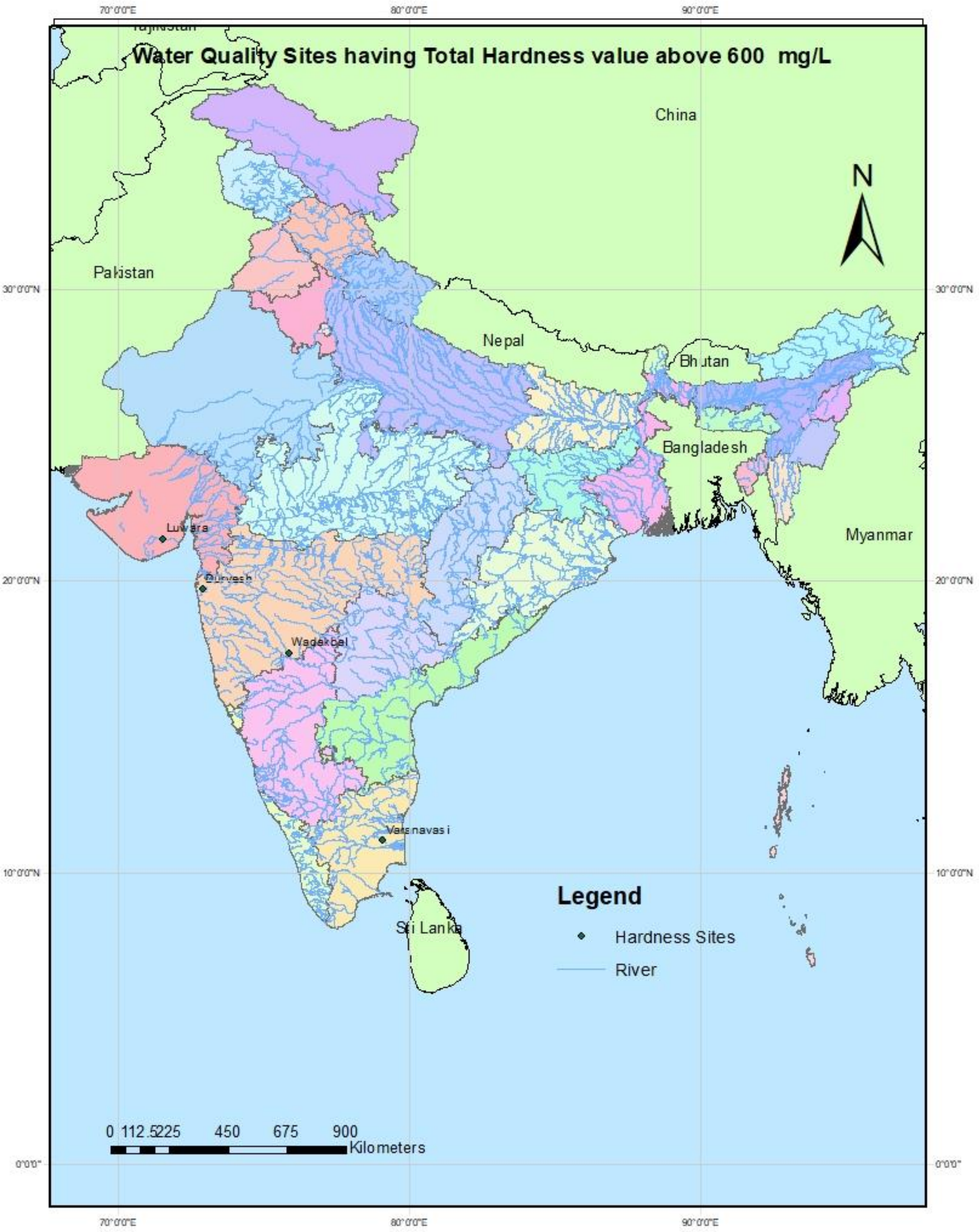
The hot spot study and GIS map for Total hardness are given below in Table 12 and figure 15.

Table 12: Monitoring stations having Total hardness concentration above 600 mg/l in River Water in 2021

S.No.	Monitoring stations	River	CWC Division Office	State	District	Pre-M	M	Post- M
1	Durvesh	Vaitarna	TD, Surat	Maharashtra	Palghar	2104	-	-
2	Luwara	Shetrunji	MD, Gandhinagar	Gujarat	Bhavnagar	614	-	-
3	Varanavasi	Maruthaiyar	SRD, Coimbatore	Tamil Nadu	Ariyalur	968	-	-
4	Wadakbal	Sina	UKD, Pune	Maharashtra	Solapur	680	-	-

(-) means No Hotspot.

Figure 15: Water Quality Monitoring stations having total hardness value above 600 mg/L (2021)



7.1.6 Chloride (Cl-)

Chloride is one of the major inorganic anions in water and wastewater. Chloride ions occur naturally in all types of water. The salty taste produced by chloride concentrations is variable and dependent on the chemical composition of water. The acceptable limit according to Indian Standard Drinking Water-Specification, IS 10500: 2012 is 250 mg/l and the permissible limit in the absence of alternate source is 1000 mg/l. Some waters containing 250 mg Cl-/l may have a detectable salty taste if the cation is sodium. On the other hand, the typical salty taste may be absent in water containing as much as 1000 mg/l when predominant.

Results of the study showed that the chloride concentration levels at Durvesh (Vaitarna river) monitoring station in Maharashtra was observed to be 5624 mg/L during the pre-monsoon season. However, the chloride data remained within the acceptable limit during the monsoon and post-monsoon season of the same year. Similarly, at Luwara (Shetrunji) monitoring station in Gujarat, the chloride level was found to be 1349 mg/L and the chloride data did not exceed the acceptable limit during the monsoon or post-monsoon season.

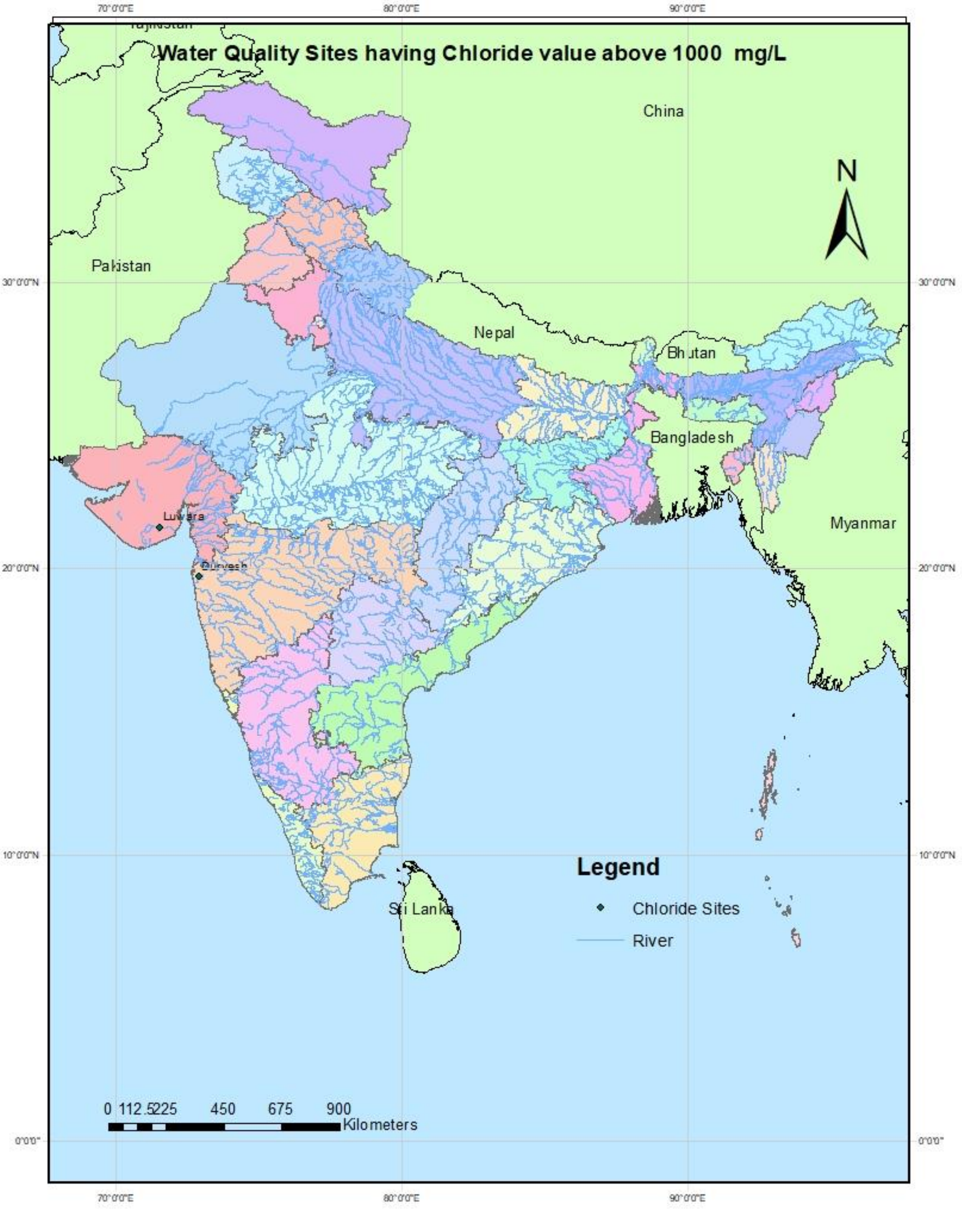
The hot spot study and GIS map for chloride are given below in Table 13 and figure 16.

Table 13: Monitoring stations having Chloride (Cl-) > 1000 mg/l in River Water in 2021

S.No.	Monitoring stations	River	CWC Division Office	State	District	Pre-M	M	Post- M
1	Durvesh	Vaitarna	TD, Surat	Maharashtra	Palghar	5624	-	-
2	Luwara	Shetrunji	MD, Gandhinagar	Gujarat	Bhavnagar	1349	-	-

(-) means No Hotspot.

Figure 16: Water Quality Monitoring stations having chloride value above 1000 mg/L (2021)



7.1.7 Boron (B)

Boron, a chemical element found in the earth's crust, is a crucial component of various natural and industrial processes. It naturally occurs in fruits, vegetables, and water sources, often forming compounds known as borates. These compounds, including borax and boric acid, are extensively utilized in the manufacturing of glass, ceramics, soaps, detergents, cosmetics, medications, and pesticides. Boron is usually a minor constituent of river water. Considered an essential micronutrient for plants, boron also shows indications of being vital for animals and humans. It enters the environment through natural processes like weathering of soils and rocks, as well as human activities such as glass manufacturing and coal-burning power plants.

The Central Pollution Control Board (CPCB) sets a limit of 2 mg/l for boron in specific classes, including irrigation and industrial cooling. The limit prescribed by CPCB for Boron (B) in class-E: Irrigation, Industrial Cooling, Controlled Waste disposals is not greater than 2 mg/l. Monitoring stations during pre-monsoon, monsoon and post-monsoon seasons consistently report average boron values within the permissible limit, highlighting efforts to manage and control boron levels in various water sources.

7.1.8 Nitrate

Nitrogen occurs in water as nitrite (NO_2^-) or nitrate (NO_3^-) anions and in cationic form as ammonium (NH_4^+) and at intermediate oxidation states as a part of organic solutes. Nitrate, the end product of nitrification is generally recorded in natural waters at levels higher than the other nitrogenous parameters. Nitrate serves as a useful indicator of organic pollution of aquatic environments. Natural so of nitrate in rivers include igneous rock, land drains and plant and animal debris. The anthropogenic contribution is enhanced by municipal and industrial wastewater. The oxidation of organic nitrogen by the bacteria in the presence of oxygen produces nitrates. Nitrates are widely used in fertilisers, explosives, food preservatives and as oxidising agents in chemical industries etc. Nitrate is also produced in the soil by the fixation of atmospheric nitrogen (bacteria synthesis). The sources of NO_3^- in natural waters are domestic sewage, agricultural runoffs, decayed animals, vegetables and leachate from refuse dumps.

During the pre-monsoon season, 14 water quality monitoring stations located in Chhattisgarh, Gujarat, Maharashtra, Odisha, Tamil Nadu, and Uttar Pradesh exhibited average Nitrate as N values surpassing 10.16 mg/l (45 mg/L as NO_3^-). This indicates a potential issue with nitrate pollution in these regions even before the onset of monsoon. Subsequently, during the monsoon season, 8monitoring stations in Andhra Pradesh, Chhattisgarh, Gujarat, Madhya Pradesh, Tamil Nadu and Telangana recorded elevated nitrate levels, pointing towards a widespread and persistent concern. Post-monsoon data for the same year continued to highlight this trend, with 12 water quality monitoring stations in Chhattisgarh and Uttar Pradesh maintaining consistently high average Nitrate as N levels.

The hot spot study and GIS map for nitrate are given below in Table 14 and figure 17.

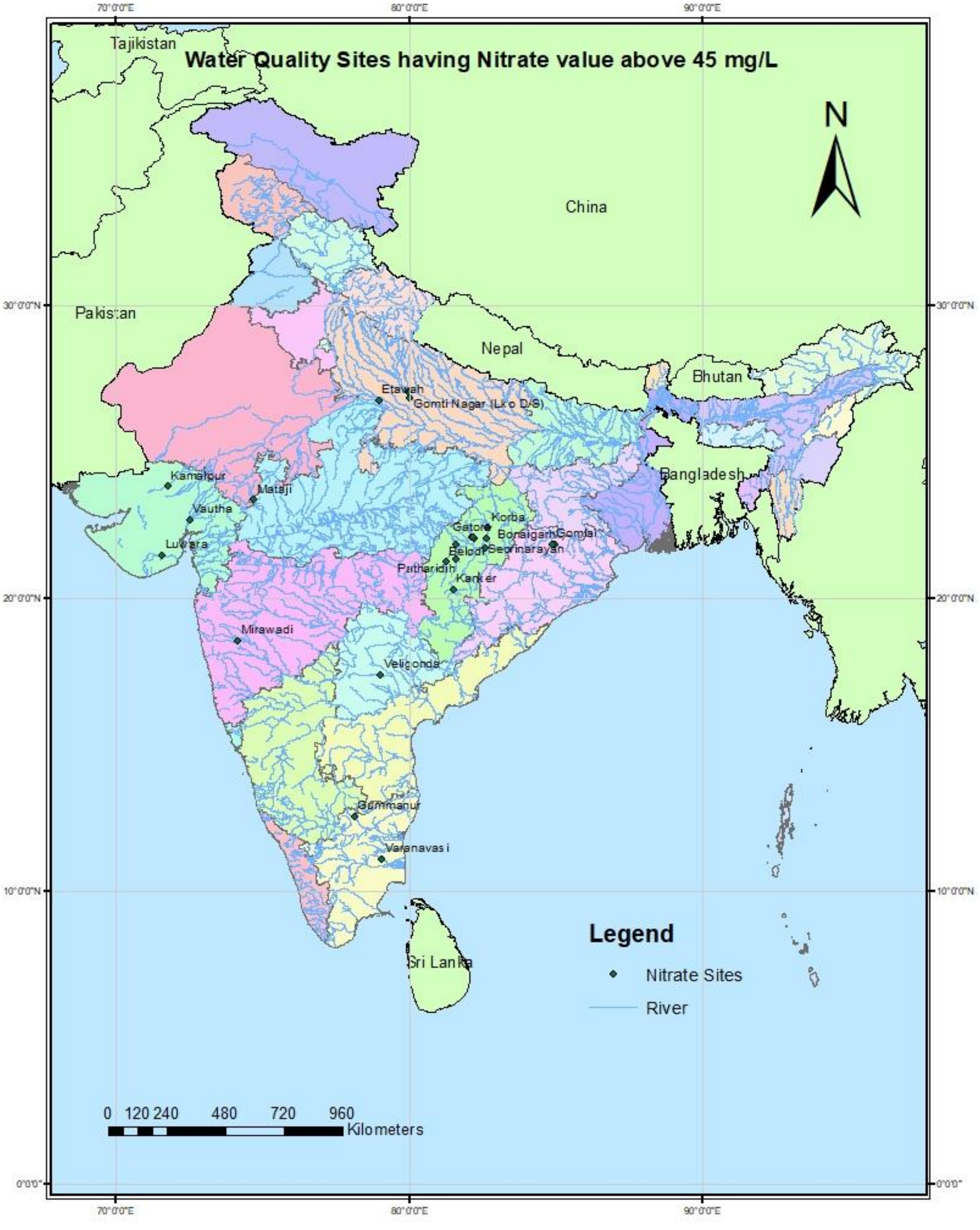
Table 14: Monitoring stations having Nitrate-N (NO_3^--N) > 10.16 mg/l (45mg/l as Nitrate) in River Water in 2021

S.No.	Monitoring stations	River	CWC Division Office	State	District	Pre-M	M	Post- M
1	Andhiyar Khore	Hamp	MD, Burla	Chhattisgarh	Bemetara	-	10.74	16.25
2	Belodi	Seonath	MD, Burla	Chhattisgarh	Durg	14.81	-	11.97
3	Bonaigarh	Brahmani	ERD, Bhubaneswar	Odisha	Sundergarh	12.28	-	-
4	Champa Road Bridge	Hasdeo	MD, Burla	Chhattisgarh	Janjgir-Champa	-	-	10.38
5	Etawah	Yamuna	LYD, Agra	U.P.	Etawah	11.26	-	-
6	Gatora	Arpa	MD, Burla	Chhattisgarh	Bilaspur	26.02	-	11.10
7	Gatora-1	Arpa	MD, Burla	Chhattisgarh	Bilaspur	14.10	-	10.73
8	Gatora-2	Arpa	MD, Burla	Chhattisgarh	Bilaspur	26.83	-	13.43
9	Gomlai	Brahmani	ERD, Bhubaneswar	Odisha	Sundergarh	13.25	-	-
10	Gomti Nagar (Lko D/S)	Gomti	MGD-2, Lucknow	U.P.	Lucknow	10.76	-	-
11	Gummanur	Ponnaiyar	SRD, Coimbatore	Tamil Nadu	Krishnagiri	14.01	10.87	-
12	Kamalpur	Banas	MD, Gandhinagar	Gujarat	Patan	*	11.18	*
13	Kanker	Dhudh	MD, Burla	Chhattisgarh	Kanker	-	-	13.03
14	Kannauj	Kali	MGD-2, Lucknow	U.P.	Kannauj	-	-	10.86
15	Korba	Hasdeo	MD, Burla	Chhattisgarh	Korba	-	-	12.43
16	Luwara	Shetrunji	MD, Gandhinagar	Gujarat	Bhavnagar	-	13.48	-
17	Madhya Bharat Paper Ltd (MBPL)	Hasdeo	MD, Burla	Chhattisgarh	Janjgir-Champa	-	-	11.42
18	Mataji	Mahi	MD, Gandhinagar	M.P.	Ratlam	-	11.30	-
19	Mirawadi	Mula Mutha	UKD, Pune	Maharashtra	Pune	10.84	-	-
20	Patharidih	kharun	MD, Burla	Chhattisgarh	Raipur	10.96	17.47	17.58
21	Seorinarayan	Mahanadi	MD, Burla	Chhattisgarh	Janjgir-Champa	19.95	-	13.70
22	Varanavasi	Maruthaiyar	SRD, Coimbatore	Tamil Nadu	Ariyalur	13.39	-	-
23	Vautha	Sabarmati	Mahi Division	Gujarat	Ahmedabad	12.33	18.70	-
24	Veligonda	Musi	LKD, Hyderabad	Telangana	Nalgonda	-	12.00	*

(-) means No Hotspot.

(*) means river dry/data not available.

Figure 17: Water Quality Monitoring stations having Nitrate value above 45 mg/L (10.16 mg/L as Nitrate-N) (2021)



7.1.9 Dissolved Oxygen

Dissolved oxygen (DO) is a critical factor in maintaining the health of aquatic ecosystems, serving as a primary indicator when assessing the suitability of river water to support aquatic life. Dissolved oxygen is necessary to many forms of life including fish, invertebrates, bacteria and plants. These organisms use oxygen in respiration, similar to organisms on land. Fish and crustaceans obtain oxygen for respiration through their gills, while plant life and phytoplankton require dissolved oxygen for respiration when there is no light for photosynthesis. Microbes such as bacteria and fungi also require dissolved oxygen. These organisms use DO to decompose organic material at the bottom of a body of water. Microbial decomposition is an important contributor to nutrient recycling. However, if there is an excess of decaying organic material (from dying algae and other organisms), in a body of water with infrequent or no turnover (also known as stratification), the oxygen at lower water levels will get used up quicker. The variations in dissolved oxygen observed may also be because of time of the day when it is measured. In aquatic ecosystems, the DO usually occur maximum in the afternoon and minimum during night or when the sunlight is less.

CPCB has recommended 5.0 mg/l concentration of dissolved oxygen for outdoor bathing in Class B. Water having below 5.0 mg/l DO concentration is not suitable for out-door bathing in river.

During the pre-monsoon season, average Dissolved Oxygen (DO) values below 5.0 mg/l were observed at 97 water quality monitoring stations distributed across Andhra Pradesh, Delhi, Gujarat, Haryana, Jharkhand, Karnataka, Madhya Pradesh, Maharashtra, Odisha, Rajasthan, Sikkim, Tamil Nadu, Telangana, Uttar Pradesh, Uttarakhand, and West Bengal. Similarly, during the monsoon season, 138 water quality monitoring stations in Andhra Pradesh, Assam, Delhi, Gujarat, Haryana, Jharkhand, Karnataka, Madhya Pradesh, Maharashtra, Odisha, Rajasthan, Sikkim, Tamil Nadu, Telangana, Uttar Pradesh, Uttarakhand, and West Bengal registered average DO values below 5.0 mg/l. The post-monsoon season of 2021 continued to exhibit this trend, with 83 water quality monitoring stations in Andhra Pradesh, Assam, Delhi, Gujarat, Haryana, Jharkhand, Karnataka, Madhya Pradesh, Maharashtra, Odisha, Puducherry, Rajasthan, Sikkim, Tamil Nadu, Telangana, Uttar Pradesh, Uttarakhand, and West Bengal maintaining DO values below 5.0 mg/l.

The hot spot study and GIS map for DO parameter are given below in Table 15 and figure 18.

Table 15: Monitoring stations having Dissolved Oxygen (DO) <5.0 mg/l in River Water in 2021

S.No.	Monitoring stations	River	CWC Division Office	State	District	Pre-M	M	Post- M
1	Adityapur	Kharkai	ERD, Bhubaneswar	Jharkhand	Saraikela Kharsawan	2.77	3.31	-
2	Agra Canal	Yamuna	UYD, New Delhi	Delhi	South Delhi	2.88	1.99	1.20
3	Altuma	Ramial	ERD, Bhubaneswar	Odisha	Dhenkanal	4.58	3.99	-
4	Ambari	Kaljani	LBD, Jalpaiguri	West Bengal	Cooch Behar	-	4.43	-
5	Anakapali	Sarada	ERD, Bhubaneswar	A.P.	Visakhapatnam	4.70	3.03	3.80
6	Anandapur	Baitarani	ERD, Bhubaneswar	Odisha	Keonjhar	3.95	3.53	-
7	Aradei	Aradei	ERD, Bhubaneswar	Odisha	Keonjhar	4.78	3.38	4.28
8	Bakchachu	Bakchachu	SID, Gangtok	Sikkim	Mangan	-	4.62	-
9	Bakhari	Wainganga	WD, Nagpur	M.P.	Seoni	-	4.72	-
10	Baladoba	Sankosh	LBD, Jalpaiguri	Assam	Dhubri	-	4.34	-
11	Balighat	Burhabalang	ERD, Bhubaneswar	Odisha	Balasore	4.10	4.19	-
12	Banpur	Mathabhanga/ Bhagirathi	LGD-3, Berhampore	West Bengal	Nadia	2.01	3.01	4.67
13	Bareilly	Ramganga	MGD-2, Lucknow	U.P.	Bareilly	-	4.93	-
14	Baridhi	Subarnarekha	ERD, Bhubaneswar	Jharkhand	East Singhbhum	3.44	3.08	3.83
15	Baripada	Burhabalang	ERD, Bhubaneswar	Odisha	Mayurbhanj	4.09	4.11	-
16	Barobisha	Sankosh	LBD, Jalpaiguri	West Bengal	Alipurduar	-	4.44	-
17	Basti	Kwano	MGD-1, Lucknow	U.P.	Basti	4.22	4.76	-
18	Basti D/S	Kwano	MGD-1, Lucknow	U.P.	Basti	-	4.43	-
19	Bendrahalli	Suvarnavathi	CD, Bangalore	Karnataka	Chamarajanagar	-	4.88	-
20	Bido	Brahmani	ERD, Bhubaneswar	Odisha	Dhenkanal	-	3.88	4.81
21	Bolani	Brahmani	ERD, Bhubaneswar	Odisha	Sundergarh	3.58	3.84	-
22	Bonaigarh	Brahmani	ERD, Bhubaneswar	Odisha	Sundergarh	4.83	3.81	-
23	Bop	Lachungchu	SID, Gangtok	Sikkim	Mangan	-	4.37	4.60
24	Burhanpur	Tapi	TD, Surat	M.P.	Burhanpur	4.83	-	-
25	Champasari	Mahananda	LBD, Jalpaiguri	West Bengal	Darjeeling	4.74	4.55	-
26	Champua	Baitarani	ERD, Bhubaneswar	Odisha	Keonjhar	4.42	3.47	-
27	Chapra	Jalangi/ Bhagirathi	LGD-3, Berhampore	West Bengal	Nadia	-	4.24	-
28	Chel	Chel	LBD, Jalpaiguri	West Bengal	Jalpaiguri	-	4.79	4.40
29	Chengalpet	Palar	HD, Chennai	Tamil Nadu	Chengalpet	-	4.57	-
30	Chepan	Raidak-I	LBD, Jalpaiguri	West Bengal	Alipurduar	4.92	4.31	4.60
31	Chilla Gaon	Hindon Cut	UYD, New Delhi	Delhi	East Delhi	0.42	1.38	1.30
32	Coronation	Teesta	LBD, Jalpaiguri	West Bengal	Darjeeling	-	4.53	4.70
33	Daund	Bhima	UKD, Pune	Maharashtra	Pune	3.75	4.28	-
34	Delhi Railway	Yamuna	UYD, New Delhi	Delhi	North Delhi	0.00	1.69	0.23

S.No.	Monitoring stations	River	CWC Division Office	State	District	Pre-M	M	Post- M
	Bridge							
35	Diana	Jaldhaka	LBD, Jalpaiguri	West Bengal	Jalpaiguri	-	4.67	4.80
36	Domohani	Teesta	LBD, Jalpaiguri	West Bengal	Jalpaiguri	-	4.91	-
37	Domuhani	Subarnarekha	ERD, Bhubaneswar	Jharkhand	East Singhbhum	3.42	2.75	3.36
38	English Bazar	Mahananda	LGD-3, Berhampore	West Bengal	Malda	4.24	4.24	-
39	Etawah	Yamuna	LYD, Agra	U.P.	Etawah	-	2.37	2.05
40	Galeta	Hindon	UYD, New Delhi	U.P.	Baghpat	0.00	0.00	0.00
41	Gandlapet	Peddavagu	UGD, Hyderabad	Telangana	Nizamabad	4.23	-	-
42	Gazoldoba	Teesta	LBD, Jalpaiguri	West Bengal	Jalpaiguri	3.40	4.47	4.60
43	GH.Rd.Bridge	Subarnarekha	ERD, Bhubaneswar	Jharkhand	East Singhbhum	4.24	3.38	4.73
44	Ghatshila	Subarnarekha	ERD, Bhubaneswar	Jharkhand	East Singhbhum	4.38	3.74	-
45	Ghish	Ghish	LBD, Jalpaiguri	West Bengal	Jalpaiguri	-	4.44	4.20
46	Ghugumari	Torsa	LBD, Jalpaiguri	West Bengal	Cooch Behar	-	4.30	-
47	Gokul Barrage II Mathura D/S	Yamuna	UYD, New Delhi	U.P.	Mathura	2.79	3.66	3.33
48	Golokganj	Sankosh	LBD, Jalpaiguri	Assam	Dhubri	-	4.47	3.90
49	Gomlai	Brahmani	ERD, Bhubaneswar	Odisha	Sundergarh	4.91	3.80	-
50	Gomti Nagar (Lko D/S)	Gomti	MGD-2, Lucknow	U.P.	Lucknow	0.68	3.08	-
51	Gopalkheda	Purna	TD, Surat	Maharashtra	Akola	-	4.53	4.43
52	Gopiballavpur	Subarnarekha	ERD, Bhubaneswar	West Bengal	Jhargram	-	3.83	4.99
53	Gopurajapuram	Puravidlyanar	HD, Chennai	Tamil Nadu	Nagapattinam	-	4.36	4.63
54	Govindpur(NH-5)	Burhabalang	ERD, Bhubaneswar	Odisha	Balasore	3.70	4.00	4.89
55	Gudari	Vamsadhara	ERD, Bhubaneswar	Odisha	Rayagada	4.19	3.11	-
56	Gunupur	Vamsadhara	ERD, Bhubaneswar	Odisha	Rayagada	3.84	3.81	4.99
57	Hanskhali	Churni/ Bhagirathi	LGD-3, Berhampore	West Bengal	Nadia	3.28	3.15	4.58
58	Hasimara	Torsa	Lower Brahmaputra Division, Jalpaiguri	West Bengal	Alipurduar	-	4.56	4.90
59	Indupur	Brahmani	ERD, Bhubaneswar	Odisha	Kendrapara	4.03	3.71	4.45
60	Irrukkankudi	Vaippar	SRD, Coimbatore	Tamil Nadu	Virudhunagar	-	-	3.59
61	Jaldhaka NH-31	Jaldhaka	LBD, Jalpaiguri	West Bengal	Jalpaiguri	-	4.58	-
62	Jamshedpur	Subarnarekha	ERD, Bhubaneswar	Jharkhand	East Singhbhum	4.34	3.34	4.58
63	Jamsolaghat	Subarnarekha	ERD, Bhubaneswar	Odisha	Mayurbhanj	4.43	3.94	-
64	Jaraikela	Koel	ERD, Bhubaneswar	Odisha	Sundergarh	4.58	4.28	4.76
65	Jawahar Bridge, Agra	Yamuna	LYD, Agra	U.P.	Agra	2.45	2.41	2.43
66	Jenapur	Brahmani	ERD, Bhubaneswar	Odisha	Jajpur	-	4.38	4.85
67	Kailash Mandir,	Yamuna	LYD, Agra	U.P.	Agra	2.32	*	*

S.No.	Monitoring stations	River	CWC Division Office	State	District	Pre-M	M	Post- M
	Near Benpur Village							
68	Kamalanga	Brahmani	ERD, Bhubaneswar	Odisha	Angul	-	4.44	-
69	Karnal	Yamuna	UYD, New Delhi	Haryana	Karnal	*	*	2.80
70	Kasganj	Kali	MGD-2, Lucknow	U.P.	Etah	2.98	-	-
71	Kashinagar	Vamsadhara	ERD, Bhubaneswar	Odisha	Gajapati	4.36	4.22	-
72	Keesara	Munneru	LKD, Hyderabad	A.P.	Krishna	4.39	4.97	-
73	Kenduapada	Kanijhari	ERD, Bhubaneswar	Odisha	Keonjhar	4.91	4.49	3.91
74	Keonjhar	Aradei	ERD, Bhubaneswar	Odisha	Keonjhar	3.64	4.17	-
75	Kulpatanga	Kharkai	ERD, Bhubaneswar	Jharkhand	East Singhbhum	3.67	3.42	4.65
76	Kusei	Baitarani	ERD, Bhubaneswar	Odisha	Keonjhar	-	2.97	-
77	Lachen	Lachen Chu	SID, Gangtok	Sikkim	Mangan	4.84	4.49	-
78	Lingdem (HS)	Talangchu	SID, Gangtok	Sikkim	Mangan	4.78	3.70	*
79	Lodhikheda	Jam	WD, Nagpur	M.P.	Chhindwara	-	4.88	4.07
80	Lucknow	Gomti	MGD-2, Lucknow	U.P.	Lucknow	1.92	2.40	*
81	Lupungdih	Subarnarekha	ERD, Bhubaneswar	Jharkhand	Saraikela Kharsawan	2.45	3.18	3.34
82	Madhabarida	Badanadi	ERD, Bhubaneswar	Odisha	Ganjam	4.29	4.24	4.55
83	Madhira	Wyra	LKD, Hyderabad	Telangana	Khammam	2.97	-	-
84	Majitar	Rangit	LBD, Jalpaiguri	Sikkim	South Sikkim	*	4.87	3.80
85	Manderial	Chambal	CD, Jaipur	Rajasthan	Karauli	0.00	0.00	0.00
86	Mathabhanga	Jaldhaka	LBD, Jalpaiguri	West Bengal	Cooch Behar	3.30	4.39	4.60
87	Mekhliganj	Teesta	LBD, Jalpaiguri	West Bengal	Cooch Behar	-	4.19	4.20
88	Melli	Teesta	SID, Gangtok	Sikkim	Namchi	-	4.57	-
89	Melliaputty	Mahendratanaya	ERD, Bhubaneswar	A.P.	Srikakulam	3.99	3.39	-
90	Mirawadi	Mula Mutha	UKD, Pune	Maharashtra	Pune	4.15	3.30	4.22
91	Mohna	Yamuna	UYD, New Delhi	Haryana	Faridabad	1.43	2.77	0.97
92	Moradabad	Ramganga	MGD-2, Lucknow	U.P.	Moradabad	2.37	4.16	*
93	Mungoli	Penganga	WD, Nagpur	Maharashtra	Yavatmal	4.80	-	-
94	Murappanadu	Tambraparani	SRD, Coimbatore	Tamil Nadu	Tuticorin	4.71	-	-
95	Muri	Subarnarekha	ERD, Bhubaneswar	Jharkhand	Ranchi	4.19	3.08	4.56
96	Musala	Baitarani	ERD, Bhubaneswar	Odisha	Keonjhar	4.84	3.23	-
97	Nagrakata	Jaldhaka	LBD, Jalpaiguri	West Bengal	Jalpaiguri	-	4.77	4.70
98	Nallathur	Nandalar	HD, Chennai	Puducherry	Karaikal	*	-	4.39
99	Nandira	Brahmani	ERD, Bhubaneswar	Odisha	Angul	4.96	3.97	-
100	Nashik	Godavari	UGD, Hyderabad	Maharashtra	Nasik	3.69	-	2.86
101	Neora	Naora	LBD, Jalpaiguri	West Bengal	Jalpaiguri	4.54	4.58	4.70
102	Noida	Yamuna	UYD, New Delhi	U.P.	Gautam Budh Nagar	0.26	0.42	0.00
103	Noukaghat	Mahananda	LBD, Jalpaiguri	West Bengal	Jalpaiguri	-	4.54	4.60

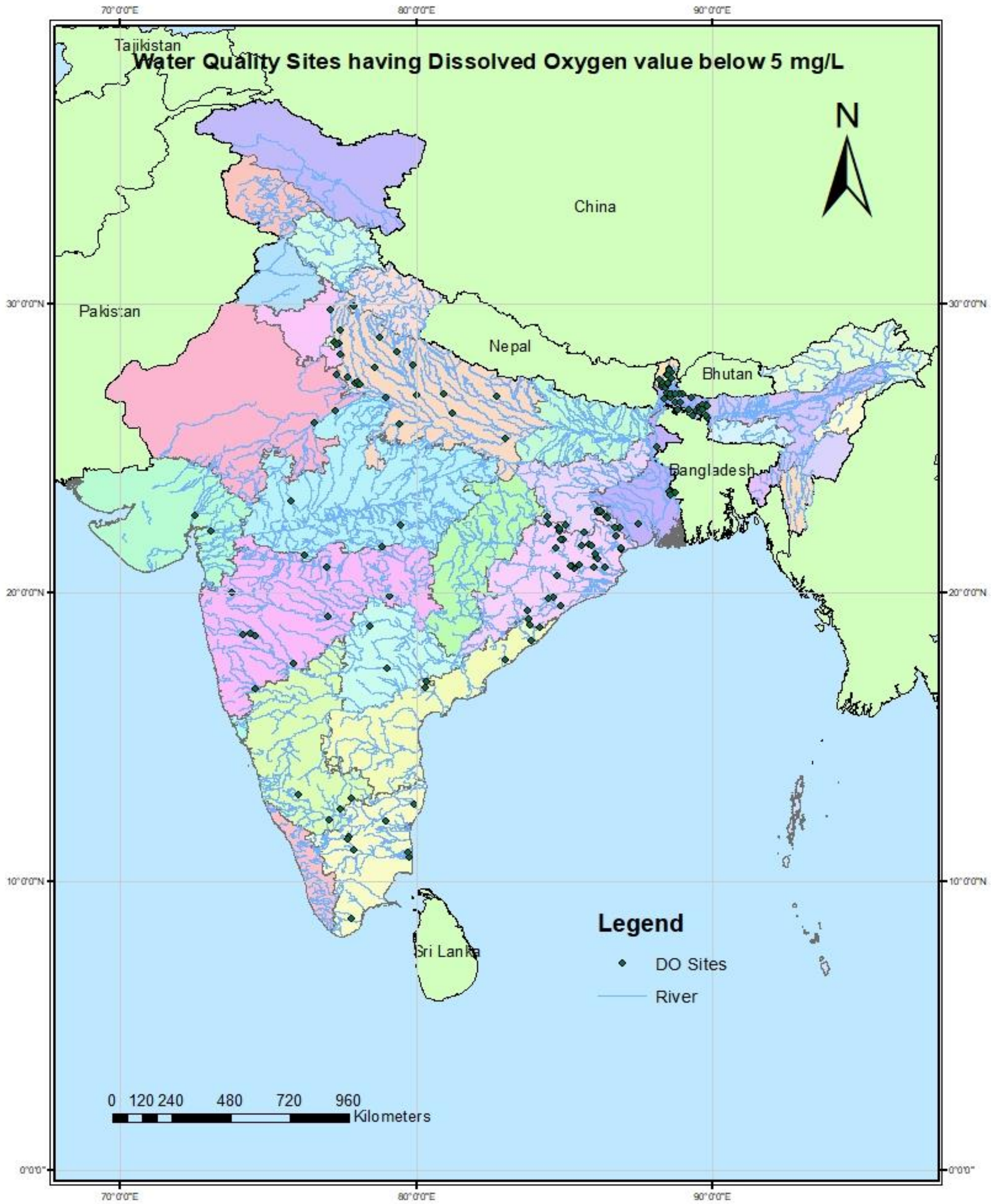
S.No.	Monitoring stations	River	CWC Division Office	State	District	Pre-M	M	Post- M
104	Okhla Barrage	Yamuna	UYD, New Delhi	Delhi	South Delhi	0.27	2.04	0.73
105	Orai Rath marg Road Bridge, Chikasi	Betwa	LYD, Agra	U.P.	Jalaun	4.58	4.92	-
106	Pali	Chambal	CD, Jaipur	Rajasthan	Sawai-madhopur	0.00	-	0.00
107	Panposh	Brahmani	ERD, Bhubaneswar	Odisha	Sundergarh	4.85	3.70	4.47
108	Panposh-1	Sankh	ERD, Bhubaneswar	Odisha	Sundergarh	4.90	4.10	-
109	Panposh-2	Koel	ERD, Bhubaneswar	Odisha	Sundergarh	4.03	4.27	4.86
110	Pargaon	Bhima	UKD, Pune	Maharashtra	Pune	4.15	4.49	4.72
111	Phurtshachu HS	Rangit	SID, Gangtok	Sikkim	Geyzing	3.94	4.39	-
112	Pingalwada	Dhadhar	TD, Surat	Gujarat	Vadodara	0.66	2.35	0.50
113	Poiyaghat, Agra	Yamuna	LYD, Agra	U.P.	Agra	2.27	2.32	3.10
114	Purna	Purna	UGD, Hyderabad	Maharashtra	Parbhani	4.22	-	-
115	Purunagarh	Brahmani	ERD, Bhubaneswar	Odisha	Deogarh	4.47	3.54	4.30
116	Purushottampur	Rushikulya	ERD, Bhubaneswar	Odisha	Ganjam	4.32	3.74	-
117	R.S.P	Brahmani	ERD, Bhubaneswar	Odisha	Sundergarh	2.91	3.07	3.30
118	R.S.P-1	Brahmani	ERD, Bhubaneswar	Odisha	Sundergarh	3.52	3.01	4.41
119	R.S.P-2	Brahmani	ERD, Bhubaneswar	Odisha	Sundergarh	3.31	2.92	4.80
120	Raebareli	Sai	MGD-2, Lucknow	U.P.	Raebareli	4.43	2.23	*
121	Rajghat	Subarnarekha	ERD, Bhubaneswar	Odisha	Mayurbhanj	4.65	3.81	-
122	Rangma Range	Lachen Chu	SID, Gangtok	Sikkim	Mangan	-	4.44	4.90
123	Rangpo Check post	Rangpo Chu	SID, Gangtok	Sikkim	Pakyong	-	4.48	4.30
124	Roorkee D/S	Solani	HGD, Haridwar	Uttarakhand	Haridwar	0.00	0.83	1.91
125	Rothak	Rangit	SID, Gangtok	Sikkim	Soreng	-	4.68	4.70
126	Sakbari	Rangit	SID, Gangtok	Sikkim	Geyzing	-	4.69	-
127	Sankalang	Teesta	SID, Gangtok	Sikkim	Mangan	-	4.57	2.38
128	Sankosh LRP	Sankosh	LBD, Jalpaiguri	West Bengal	Alipurduar	-	4.65	-
129	Sevanur	Chittar	SRD, Coimbatore	Tamil Nadu	Erode	-	3.99	4.88
130	Shahjahanpur	Khannaut	MGD-2, Lucknow	U.P.	Shahjahanpur	3.75	3.85	*
131	Shaladang	Torsa	LBD, Jalpaiguri	West Bengal	Cooch Behar	-	4.47	4.80
132	Singasadanapalli	Ponnaiyar	SRD, Coimbatore	Tamil Nadu	Krishnagiri	0.00	0.00	0.53
133	Singimari	Jaldhaka	LBD, Jalpaiguri	West Bengal	Cooch Behar	-	4.62	4.20
134	Singtam	Rani khola	SID, Gangtok	Sikkim	Pakyong	-	4.47	4.80
135	Sorada	Rushikulya	ERD, Bhubaneswar	Odisha	Ganjam	3.73	4.07	4.26
136	Srikakulam	Nagavali	ERD, Bhubaneswar	A.P.	Srikakulam	4.48	3.24	-
137	Suldaguri	Torsa	LBD, Jalpaiguri	West Bengal	Cooch Behar	4.96	4.39	4.50
138	Swampatana	Baitarani	ERD, Bhubaneswar	Odisha	Keonjhar	4.64	3.49	4.39

S.No.	Monitoring stations	River	CWC Division Office	State	District	Pre-M	M	Post- M
139	T Bekuppe	Arkavathy	CD, Bangalore	Karnataka	Ramanagara	*	1.81	3.83
140	Talcher	Brahmani	ERD, Bhubaneswar	Odisha	Angual	-	3.71	-
141	Tarumchu	Tarumchu	SID, Gangtok	Sikkim	Mangan	-	4.17	4.50
142	Terwad	Panchganga	UKD, Pune	Maharashtra	Kolhapur	4.64	4.66	*
143	Thevur	Sarabenga	SRD, Coimbatore	Tamil Nadu	Salem	*	4.32	-
144	Thimmanahalli	Yagachi	CD, Bangalore	Karnataka	Hassan	4.73	-	-
145	Tikarapara	Mahanadi	MD, Burla	Odisha	Angul	4.90	4.43	-
146	Tilga	Sankh	ERD, Bhubaneswar	Jharkhand	Simdega	-	3.72	-
147	Tufanganj	Raidak-I	LBD, Jalpaiguri	West Bengal	Cooch Behar	-	4.55	-
148	Ujjain	Shipra	CD, Jaipur	M.P.	Ujjain	*	-	2.90
149	Urachikottai	Cauvery	SRD, Coimbatore	Tamil Nadu	Erode	-	4.41	-
150	Vautha	Sabarmati	Mahi Division	Gujarat	Ahmedabad	0.00	0.5	0.00
151	Vazhavachanur	Ponnaiyar	HD, Chennai	Tamil Nadu	Thiruvannamalai	-	4.21	-
152	Veligonda	Musi	LKD, Hyderabad	Telangana	Nalgonda	3.80	4.46	3.96
153	Wadakbal	Sina	UKD, Pune	Maharashtra	Solapur	-	3.90	*
154	Yamuna Expessway Road Bridge, Etamadpur	Yamuna	LYD, Agra	U.P.	Agra	1.80	*	*
155	Yuksum	Rateychu	SID, Gangtok	Sikkim	Geyzing	-	-	3.90

(-) means No Hotspot.

(*) means river dry/data not available.

Figure 18: Water Quality Monitoring stations having Dissolved Oxygen below 5.0 mg/L (2021)



7.1.10 Biochemical Oxygen Demand

Biochemical oxygen demand is the amount of dissolved oxygen needed (i.e., demanded) by aerobic biological organisms to break down organic material present in a given water sample at certain temperature over a specific time period (Kaiser, 1998). Biochemical oxygen demand (BOD) holds unique significance in assessing the pollution of river water caused by wastewater discharge from sources such as sewage, industries, and agricultural fields. This parameter is important for river pollution control management and assessing the self-purifying capacity of the river. BOD serves as a comprehensive indicator of river water quality, reflecting the impact of various human activities on the ecosystem and providing essential information for pollution control and environmental management.

During the pre-monsoon season, average Biochemical Oxygen Demand (BOD) values exceeding 3.0 mg/l were observed at 90 water quality monitoring stations distributed across Andhra Pradesh, Delhi, Gujarat, Haryana, Himachal Pradesh, Karnataka, Madhya Pradesh, Maharashtra, Rajasthan, Tamil Nadu, Telangana, Uttar Pradesh, and Uttarakhand. Similarly, in the monsoon season, 101 water quality monitoring stations in Delhi, Gujarat, Haryana, Himachal Pradesh, Karnataka, Madhya Pradesh, Maharashtra, Rajasthan, Tamil Nadu, Telangana, Uttar Pradesh, and Uttarakhand recorded average BOD values surpassing 3.0 mg/l. The post-monsoon season of 2021 continued to exhibit this trend, with 67 water quality monitoring stations in Delhi, Gujarat, Haryana, Himachal Pradesh, Karnataka, Madhya Pradesh, Maharashtra, Rajasthan, Tamil Nadu, Telangana, Uttar Pradesh, and Uttarakhand displaying BOD values above 3.0 mg/l.

The hot spot study and GIS map for biochemical oxygen demand are given below in Table 16 and figure 19.

Table 16: Monitoring stations having biochemical oxygen Demand (BOD) > 3.0 mg/l in River Water in 2021

S.No.	Monitoring stations	River	CWC Division Office	State	District	Pre-M	M	Post- M
1	A.B.Road Crossing	Parwati	CD, Jaipur	M.P.	Guna	*	9.52	-
2	A.P. Puram	Chittar	SRD, Coimbatore	Tamil Nadu	Tirunelveli	*	-	3.79
3	Agra Canal	Yamuna	UYD, New Delhi	Delhi	South Delhi	39.40	20.35	27.63
4	Akbarpur	Chhoti sarju	MGD-3, Varanasi	U.P.	Ambedkar Nagar	3.24	3.27	-
5	Allahabad	Ganga	MGD-3, Varanasi	U.P.	Prayagraj	3.11	3.58	3.38
6	Ambgaon	Chulband	WD, Nagpur	Maharashtra	Bhandara	17.05	7.52	-
7	Ankinghat	Ganga	MGD-2, Lucknow	U.P.	Kanpur Nagar	4.96	-	-
8	Arnota	Uttangan	LYD, Agra	U.P.	Agra	-	5.72	-
9	Asthi	Wainganga	WD, Nagpur	Maharashtra	Gadchiroli	-	9.15	-
10	Auraiya	Yamuna	LYD, Agra	U.P.	Auraiya	5.26	5.99	9.36
11	Bakhari	Wainganga	WD, Nagpur	M.P.	Seoni	-	16.44	6.53
12	Baluaghat	Ganga	MGD-3, Varanasi	U.P.	Varanasi	3.33	3.80	3.54
13	Bamni(Nagpur)	Wardha	WD, Nagpur	Maharashtra	Chandrapur	21.17	12.47	-
14	Banda	Ken	LYD, Agra	U.P.	Banda	4.76	-	-

S.No.	Monitoring stations	River	CWC Division Office	State	District	Pre-M	M	Post- M
15	Baranwada	Banas	CD, Jaipur	Rajasthan	Sawai-madhopur	*	6.86	-
16	Bareilly	Ramganga	MGD-2, Lucknow	U.P.	Bareilly	5.78	10.15	6.83
17	Basti	Kwano	MGD-1, Lucknow	U.P.	Basti	6.45	6.07	4.58
18	Basti D/S	Kwano	MGD-1, Lucknow	U.P.	Basti	4.80	7.50	4.80
19	Basti U/S	Kwano	MGD-1, Lucknow	U.P.	Basti	-	5.45	3.58
20	Bhatpalli	Peddavagu	WD, Nagpur	Telangana	Asifabad	3.88	3.99	-
21	Bhitaura	Ganga	MGD-2, Lucknow	U.P.	Fatehpur	3.91	4.71	4.48
22	Birdghat	Rapti	MGD-1, Lucknow	U.P.	Gorakhpur	3.75	4.21	-
23	Bhitoor	Ganga	MGD-2, Lucknow	U.P.	Kanpur	4.02	3.92	4.05
24	Burhanpur	Tapi	TD, Surat	M.P.	Burhanpur	4.53	-	-
25	Chilla Gaon	Hindon Cut	UYD, New Delhi	Delhi	East Delhi	27.82	29.59	48.33
26	Chittorgarh	Gambhiri	CD, Jaipur	Rajasthan	Chittorgarh	*	5.33	*
27	Dabri	Ramganga	MGD-2, Lucknow	U.P.	Shahjahanpur	3.72	4.27	-
28	Delhi Railway Bridge	Yamuna	UYD, New Delhi	Delhi	North Delhi	48.12	39.35	34.00
29	Dhaneta	Kitcha/Bahgul	MGD-2, Lucknow	U.P.	Bareilly	5.18	4.89	3.52
30	Dholpur	Chambal	LYD, Agra	Rajasthan	Dholpur	-	3.56	3.86
31	Elunuthi Mangalam	Noyyal	SRD, Coimbatore	Tamil Nadu	Erode	4.18	7.23	7.14
32	Etawah	Yamuna	LYD, Agra	U.P.	Etawah	26.40	22.14	28.44
33	Gaisabad	Bearma	LYD, Agra	M.P.	Damoh	*	7.47	*
34	Galeta	Hindon	UYD, New Delhi	U.P.	Baghpat	58.75	30.69	61.55
35	Ghazipur	Ganga	MGD-3, Varanasi	U.P.	Ghazipur	3.48	3.76	3.27
36	Gokul Barrage II Mathura D/S	Yamuna	UYD, New Delhi	U.P.	Mathura	39.94	22.02	27.12
37	Gomti Nagar (Lko D/S)	Gomti	MGD-2, Lucknow	U.P.	Lucknow	30.77	18.77	13.83
38	Gorakhpur D/S	Rapti	MGD-1, Lucknow	U.P.	Gorakhpur	3.58	3.27	-
39	Gummanur	Ponnaiyar	SRD, Coimbatore	Tamil Nadu	Krishnagiri	7.85	7.46	16.41
40	Hamirpur	Yamuna	LYD, Agra	U.P.	Hamirpur	3.79	-	3.34
41	Hathi Khana	Ganga	MGD-2, Lucknow	U.P.	Fatehgarh	4.62	3.77	-
42	Hivra	Wardha	WD, Nagpur	Maharashtra	Wardha	-	15.96	4.20
43	Jajmau	Ganga	MGD-2, Lucknow	U.P.	Kanpur	5.13	5.17	4.04
44	Jawahar Bridge, Agra	Yamuna	LYD, Agra	U.P.	Agra	25.60	26.19	38.40
45	Kailash Mandir, Near Benpur Village	Yamuna	LYD, Agra	U.P.	Agra	20.40	*	*
46	Kalanaur	Yamuna	UYD, New Delhi	U.P.	Saharanpur	5.08	5.23	-
47	Kannauj	Kali	MGD-2, Lucknow	U.P.	Kannauj	6.02	4.99	-
48	Kanpur	Ganga	MGD-2, Lucknow	U.P.	Kanpur Nagar	3.80	-	-
49	Kasganj	Kali	MGD-2, Lucknow	U.P.	Etah	19.42	7.54	7.17
50	Katri Umrauli	Ganga	MGD-2, Lucknow	U.P.	Kannauj	3.62	-	-
51	Kaziupura	Ramganga	MGD-2, Lucknow	U.P.	Moradabad	6.02	4.99	3.80
52	Keesara	Munneru	LKD, Hyderabad	A.P.	Krishna	4.15	-	-
53	Keolari	Wainganga	WD, Nagpur	M.P.	Seoni	3.85	3.41	-

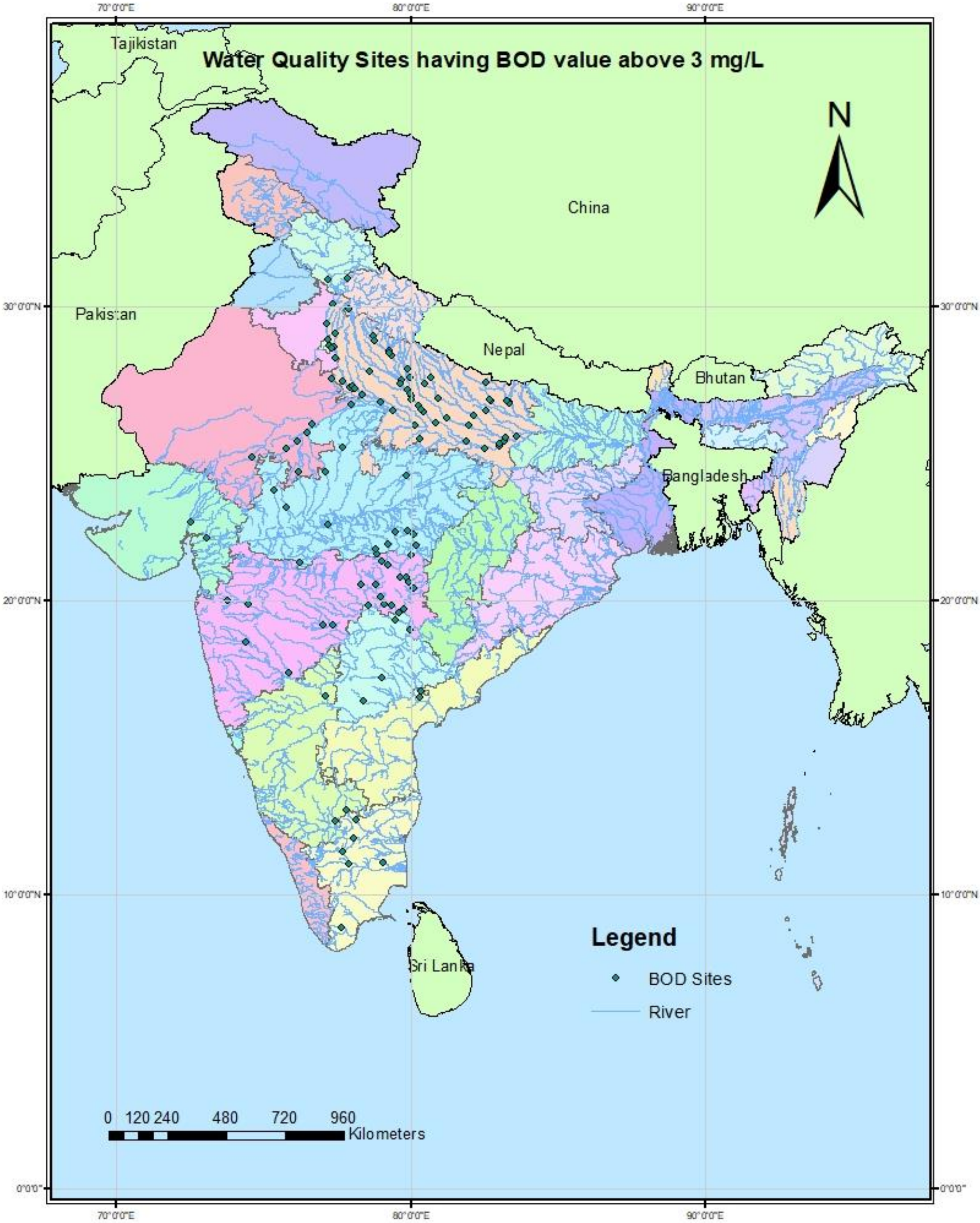
S.No.	Monitoring stations	River	CWC Division Office	State	District	Pre-M	M	Post- M
54	Khatoli	Parwati	CD, Jaipur	Rajasthan	Kota	-	6.53	-
55	Kokiwada	Pench	WD, Nagpur	M.P.	Chhindwara	-	8.96	-
56	Kopergaon	Godavari	UGD, Hyderabad	Maharashtra	Ahmednagar	5.55	-	3.61
57	Kota-By Pass Hanging Road Bridge u/s ok Kota City	Chambal	CD, Jaipur	Rajasthan	Kota	-	7.07	-
58	Kumhari	Wainganga	WD, Nagpur	M.P.	Balaghat	-	6.33	-
59	Lodhikheda	Jam	WD, Nagpur	M.P.	Chhindwara	-	22.03	18.77
60	Lucknow	Gomti	MGD-2, Lucknow	U.P.	Lucknow	30.91	22.80	19.80
61	Madhira	Wyra	LKD, Hyderabad	Telangana	Khammam	4.87	-	-
62	Magardhara	Wainganga	WD, Nagpur	M.P.	Balaghat	-	4.00	22.38
63	Mahalgaon	Wainganga	WD, Nagpur	Maharashtra	Gondia	-	5.75	-
64	Mandawara	Chambal	CD, Jaipur	Rajasthan	Kota	4.28	17.55	7.47
65	Mawi	Yamuna	UYD, New Delhi	U.P.	Shamli	5.49	4.63	6.85
66	Mehandipur	Ganga	MGD-2, Lucknow	U.P.	Kannauj	4.17	-	-
67	Mirzapur	Ganga	MGD-3, Varanasi	U.P.	Mirzapur	3.23	3.46	3.59
68	Mohna	Yamuna	UYD, New Delhi	Haryana	Faridabad	49.01	19.92	43.42
69	Moradabad	Ramganga	MGD-2, Lucknow	U.P.	Moradabad	24.06	12.77	11.42
70	Mungoli	Penganga	WD, Nagpur	Maharashtra	Yavatmal	29.30	15.93	8.33
71	Nanded	Godavari	UGD, Hyderabad	Maharashtra	Nanded	6.36	-	-
72	Nandgaon	Wunna	WD, Nagpur	Maharashtra	Wardha	3.10	11.27	-
73	Nashik	Godavari	UGD, Hyderabad	Maharashtra	Nasik	3.71	3.89	4.50
74	Neemsar	Gomti	MGD-2, Lucknow	U.P.	Sitapur	3.83	-	-
75	Noida	Yamuna	UYD, New Delhi	U.P.	Gautam Budh Nagar	60.69	32.32	37.92
76	Okhla Barrage	Yamuna	UYD, New Delhi	Delhi	South Delhi	50.03	28.39	38.33
77	P.G. Bridge	Penganga	WD, Nagpur	Maharashtra	Yavatmal	-	15.19	-
78	Pachawali	Sindh	LYD, Agra	M.P.	Shivpuri	3.65	-	-
79	Palla	Yamuna	UYD, New Delhi	Delhi	North West Delhi	7.29	10.97	6.58
80	Papan	Ganjal	ND, Bhopal	M.P.	Harda	3.60	-	-
81	Pargaon	Bhima	UKD, Pune	Maharashtra	Pune	-	3.60	3.93
82	Parmat Ghat	Ganga	MGD-2, Lucknow	U.P.	Kanpur	4.15	3.89	3.56
83	Parsohan Ghat	Budhi Rapti	MGD-1, Lucknow	U.P.	Siddarthnagar	5.72	3.41	3.10
84	Patala	Wardha	WD, Nagpur	Maharashtra	Chandrapur	13.73	18.68	9.80
85	Patansaongi	Chandrabhaga	WD, Nagpur	Maharashtra	Nagpur	3.70	8.28	-
86	Pauni	Wainganga	WD, Nagpur	Maharashtra	Bhandara	-	10.25	7.97
87	Pingalwada	Dhadhar	TD, Surat	Gujarat	Vadodara	13.39	9.03	13.60
88	Poiyaghat, Agra	Yamuna	LYD, Agra	U.P.	Agra	23.12	31.06	34.80
89	Pratapgarh	Sai	MGD-3, Varanasi	U.P.	Pratapgarh	-	3.60	3.15
90	Purna	Purna	UGD, Hyderabad	Maharashtra	Parbhani	8.31	-	-
91	Raebareli	Sai	MGD-2, Lucknow	U.P.	Raebareli	7.27	12.10	11.67
92	Ramakona	Kanhan	WD, Nagpur	M.P.	Chhindwara	17.67	11.95	-
93	Regauli	Rapti	MGD-1, Lucknow	U.P.	Gorakhpur	4.47	3.43	-

S.No.	Monitoring stations	River	CWC Division Office	State	District	Pre-M	M	Post- M
94	Roorkee D/S	Solani	HGD, Haridwar	Uttarakhand	Haridwar	38.46	35.53	26.83
95	Saidpur	Ganga	MGD-3, Varanasi	U.P.	Ghazipur	3.03	3.68	3.66
96	Sakhara	Wainganga	WD, Nagpur	Maharashtra	Gadchiroli	-	5.53	-
97	Sakmur	Wardha	WD, Nagpur	Maharashtra	Chandrapur	10.03	21.53	-
98	Salawad	Kalisindh	CD, Jaipur	Rajasthan	Jhalawar	-	11.89	-
99	Satrapur	Kanhan	WD, Nagpur	Maharashtra	Nagpur	-	10.20	-
100	Shahjahanpur	Khannaut	MGD-2, Lucknow	U.P.	Shahjahanpur	15.68	19.36	16.90
101	Singasadanapalli	Ponnaiyar	SRD, Coimbatore	Tamil Nadu	Krishnagiri	52.93	31.55	19.74
102	Sitapur	Sarayan	MGD-2, Lucknow	U.P.	Sitapur	5.47	3.37	-
103	Suddakallu	Dindi	LKD, Hyderabad	Telangana	Mahaboob Nagar	4.05	-	-
104	Sultanpur	Gomti	MGD-3, Varanasi	U.P.	Sultanpur	4.22	3.83	3.58
105	T Bekuppe	Arkavathy	CD, Bangalore	Karnataka	Ramanagara	-	8.78	10.05
106	Tal	Chambal	CD, Jaipur	M.P.	Ratlam	*	8.00	*
107	Tekra	Pranhita	WD, Nagpur	Maharashtra	Gadchiroli	-	8.09	-
108	Thoppur	Thoppaiyar	SRD, Coimbatore	Tamil Nadu	Salem	*	*	4.19
109	Tihar Khera	Ramganga	MGD-2, Lucknow	U.P.	Bareilly	-	4.91	4.50
110	Tondarpur	Sukheta	MGD-2, Lucknow	U.P.	Hardoi	8.67	3.71	-
111	Tuini	Tons	UYD, New Delhi	Uttarakhand	Dehradun	3.37	3.90	-
112	Ujjain	Shipra	CD, Jaipur	M.P.	Ujjain	*	14.77	19.30
113	Urachikottai	Cauvery	SRD, Coimbatore	Tamil Nadu	Erode	-	4.74	6.55
114	V S Bridge	Ganga	MGD-3, Varanasi	U.P.	Varanasi	3.06	3.76	3.10
115	Varanasi	Ganga	MGD-3, Varanasi	U.P.	Varanasi	3.41	3.69	3.05
116	Varanavasi	Maruthaiyar	SRD, Coimbatore	Tamil Nadu	Ariyalur	3.59	-	-
117	Vautha	Sabarmati	Mahi Division	Gujarat	Ahmedabad	36.85	27.90	28.78
118	Veligonda	Musi	LKD, Hyderabad	Telangana	Nalgonda	4.49	4.71	5.23
119	Wadakbal	Sina	UKD, Pune	Maharashtra	Solapur	5.43	3.32	*
120	Wairagarh	Khobragadi	WD, Nagpur	Maharashtra	Gadchiroli	*	8.25	-
121	Yadgir	Bhima	LKD, Hyderabad	Karnataka	Yadgir	4.09	-	-
122	Yamuna Expessway Road Bridge, Etamadpur	Yamuna	LYD, Agra	U.P.	Agra	26.40	*	*
123	Yashwant Nagar	Giri	UYD, New Delhi	H.P.	Simaur	5.15	3.11	3.13

(-) means No Hotspot.

(*) means river dry/data not available.

Figure 19: Water Quality Monitoring stations having Biochemical Oxygen Demand above 3.0 mg/L (2021)



7.1.11 Total Coliform

Coliform organisms serve as indicators of water pollution, and they are commonly rod-shaped bacteria. Due to the challenge of isolating and identifying pathogenic bacteria in wastes and polluted waters, which are typically present in lower numbers, total coliforms are employed as a general indicator for potential contamination with pathogenic organisms. Notably, many coliform bacteria inhabit the soil, potentially serving as the source for those found in water, especially river water. Total coliform encompasses all types of coliforms in river water, whether pathogenic or non-pathogenic. Within various waterborne pathogens, a diverse range of minimum infectious dose levels exists for causing human infections.

The standard method involves determining the most probable number (MPN) of coliforms in the water sample. Coliform organisms are widely recognized as suitable microbial indicators of drinking water quality due to their ease of detection and enumeration in water. The coliform group primarily consists of species from genera such as Citrobacter, Enterobacter, Escherichia, Klebsiella, including faecal coliforms. Although coliform organisms may not be directly linked to the presence of viruses in drinking water, the coliform test remains essential for monitoring the microbial quality of public water supplies. This bacterial group is present in large numbers throughout all seasons, possibly attributed to the addition of sewage and various forms of waste, higher concentrations of suspended particles, and the dark coloration of receiving water.

During the pre-monsoon season, the average value of Total Coliforms (TC) exceeding 500 MPN/100 ml was observed at 207 water quality monitoring stations located in Andhra Pradesh, Chhattisgarh, Delhi, Gujarat, Haryana, Himachal Pradesh, Karnataka, Madhya Pradesh, Maharashtra, Odisha, Rajasthan, Tamil Nadu, Telangana, Uttar Pradesh, and Uttarakhand. During the monsoon season, the average value of Total Coliforms (TC) exceeding 500 MPN/100 ml was observed at 301 water quality monitoring stations located in Andhra Pradesh, Chhattisgarh, Delhi, Gujarat, Haryana, Himachal Pradesh, Karnataka, Madhya Pradesh, Maharashtra, Odisha, Rajasthan, Tamil Nadu, Telangana, Uttar Pradesh, and Uttarakhand. The post-monsoon season of 2021 continued to exhibit this trend, with 247 water quality monitoring stations in Andhra Pradesh, Chhattisgarh, Delhi, Gujarat, Haryana, Himachal Pradesh, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Odisha, Rajasthan, Tamil Nadu, Telangana, Uttar Pradesh, and Uttarakhand showing elevated average TC levels.

The hot spot study and GIS map for total coliforms parameter are given below in table 17 and figure 20.

Table 17: Monitoring stations having Total Coliform (TC) 500 MPN in River Water in 2021

S.No.	Monitoring stations	River	CWC Division Office	State	District	Pre-M	M	Post- M
1	A.B.Road Crossing	Parwati	CD, Jaipur	M.P.	Guna	*	448889	170000
2	A.P. Puram	Chittar	SRD, Coimbatore	Tamil Nadu	Tirunelveli	*	54000	9967
3	Abu Road	Banas	MD, Gandhinagar	Rajasthan	Sirohi	3967	3391	3083
4	Addoor	Gurupur	SWRD, Kochi	Karnataka	Dakshina Kannada	*	1733	800
5	Akbarpur	Chhoti sarju	MGD-3, Varanasi	U.P.	Ambedkar Nagar	12033	9260	6967
6	Akkihebbal	Hemavati	CD, Bangalore	Karnataka	Mandya	*	2237	*
7	Aklera	Parwan	CD, Jaipur	Rajasthan	Jhalawar	*	73500	*
8	Alanthurai	Noyyal	SRD, Coimbatore	Tamil Nadu	Coimbatore	41333	54800	12483
9	Allahabad	Ganga	MGD-3, Varanasi	U.P.	Prayagraj	12247	10540	8433
10	Ambarampalayam	Bharathapuzha	SRD, Coimbatore	Tamil Nadu	Coimbatore	25450	16354	27900
11	Ambasamudram	Vaigai	SRD, Coimbatore	Tamil Nadu	Theni	97500	92000	42667
12	Ambgaon	Chulband	WD, Nagpur	Maharashtra	Bhandara	*	2262	772
13	Ankinghat	Ganga	MGD-2, Lucknow	U.P.	Kanpur Nagar	5600	5493	6160
14	Arangaly	Chalakudy	SWRD, Kochi	Kerala	Thrissur	*	2167	800
15	Arjunwad	Krishna	UKD, Pune	Maharashtra	Kolhapur	160000	9769	*
16	Arnota	Uttangan	LYD, Agra	U.P.	Agra	*	12650	*
17	Ashramam	Pazhayar	SWRD, Kochi	Tamil Nadu	Kanyakumari	*	2100	2400
18	Asthi	Wainganga	WD, Nagpur	Maharashtra	Gadchiroli	-	1111	770
19	Auraiya	Yamuna	LYD, Agra	U.P.	Auraiya	25338	61840	66740
20	Avarankuppam	Palar	SRD, Coimbatore	Tamil Nadu	Vellore	*	33656	9017
21	Avershe	Seetha	SWRD, Kochi	Karnataka	Udupi	*	1700	800
22	Ayilam	Vamanapuram	SWRD, Kochi	Kerala	Thiruvananthapuram	*	1800	1700
23	Ayodhya	Ghaghra	MGD-1, Lucknow	U.P.	Ayodhya	3517	3627	3633
24	Badalapur	Ulhas	UKD, Pune	Maharashtra	Thane	59400	88857	57167
25	Baghpat	Yamuna	UYD, New Delhi	U.P.	Baghpat	*	*	195000
26	Bakhari	Wainganga	WD, Nagpur	M.P.	Seoni	*	7126	5923
27	Baleni	Yamuna	UYD, New Delhi	U.P.	Baghpat	1161667	729267	1398333
28	Balrampur	Rapti	MGD-1, Lucknow	U.P.	Gonda	3657	3620	3980
29	Baluaghat	Ganga	MGD-3, Varanasi	U.P.	Varanasi	14267	15047	9350
30	Bamni(Nagpur)	Wardha	WD, Nagpur	Maharashtra	Chandrapur	3822	4007	1083
31	Banda	Ken	LYD, Agra	U.P.	Banda	24957	10500	6220
32	Bangapani	Gauri Ganga	MGD-1, Lucknow	Uttarakhand	Pithoragarh	2350	2989	2720
33	Bansi	Rapti	MGD-1, Lucknow	U.P.	Siddarthnagar	3767	4387	4450

S.No.	Monitoring stations	River	CWC Division Office	State	District	Pre-M	M	Post- M
34	Bantwal	Nethravathi	SWRD, Kochi	Karnataka	Dakshina Kannada	*	1733	-
35	Baranwada	Banas	CD, Jaipur	Rajasthan	Sawai-madhopur	*	410000	35000
36	Bareilly	Ramganga	MGD-2, Lucknow	U.P.	Bareilly	18200	17953	19767
37	Barod	Kalisindh	CD, Jaipur	Rajasthan	Kota	40000	90111	22000
38	Basantpur(Ganga)	Ganga	MGD-2, Lucknow	U.P.	Bijnaur	5800	5367	5817
39	Basoda	Betwa	LYD, Agra	M.P.	Vidisha	*	2160	*
40	Basti	Kwano	MGD-1, Lucknow	U.P.	Basti	5717	6353	6383
41	Basti D/S	Kwano	MGD-1, Lucknow	U.P.	Basti	6133	6293	6760
42	Basti U/S	Kwano	MGD-1, Lucknow	U.P.	Basti	5250	5407	5767
43	Bawapuram	Tungabhadra	LKD, Hyderabad	A.P.	Kurnool	4220	906	1153
44	Belne Bridge	Gad	CD, Bangalore	Maharashtra	Sindhudurg	*	1749	*
45	Bendrahalli	Suvarnavathi	CD, Bangalore	Karnataka	Chamarajanagar	*	1048	*
46	Bhadrachelam	Godavari	LGD, Hyderabad	Telangana	Khammam	1760	752	2148
47	Bhatpalli	Peddavagu	WD, Nagpur	Telangana	Asifabad	1316	3055	712
48	Bhind	Kunwari	LYD, Agra	M.P.	Bhind	*	2700	*
49	Bhitaura	Ganga	MGD-2, Lucknow	U.P.	Fatehpur	5514	5987	6180
50	Biligundulu	Cauvery	SRD, Coimbatore	Tamil Nadu	Krishnagiri	42368	10769	13833
51	Birdghat	Rapti	MGD-1, Lucknow	U.P.	Gorakhpur	5350	6420	6133
52	Bhitoor	Ganga	MGD-2, Lucknow	U.P.	Kanpur	7283	8433	9383
53	Byladahalli	Haridra	CD, Bangalore	Karnataka	Davanagere	*	4260	*
54	Chandrika Devi (Lko U/S)	Gomti	MGD-2, Lucknow	U.P.	Lucknow	9017	12769	12933
55	Chindnar	Indravathi	LGD, Hyderabad	Chhattisgarh	Dantewada	728	663	1353
56	Chitrasani	Balaram	MD, Gandhinagar	Gujarat	Banaskantha	2800	1495	*
57	Chittorgarh	Gambhiri	CD, Jaipur	Rajasthan	Chittorgarh	*	114667	*
58	Cholachagudda	Malaprabha	CD, Bangalore	Karnataka	Bagalkot	9200	10515	*
59	Chopan	Sone	MGD-3, Varanasi	U.P.	Sonbhadra	5329	5373	3067
60	Chunchunkatte	Cauvery	CD, Bangalore	Karnataka	Mysore	*	1538	*
61	Dabri	Ramganga	MGD-2, Lucknow	U.P.	Shahjahanpur	6567	7693	14500
62	Dameracherla	Musi	LKD, Hyderabad	Telangana	Nalgonda	4428	1082	1362
63	Daund	Bhima	UKD, Pune	Maharashtra	Pune	35000	6573	*
64	Delhi Railway Bridge	Yamuna	UYD, New Delhi	Delhi	North Delhi	35940000	12026667	4583333
65	Deongaon Bridge	Bhima	LKD, Hyderabad	Karnataka	Bijapur	4483	605	1222
66	Deosugar	Krishna	LKD, Hyderabad	Karnataka	Raichur	5300	1287	1300
67	Derol Bridge	Sabarmati	MD,	Gujarat	Sabarkantha	3275	3438	*

S.No.	Monitoring stations	River	CWC Division Office	State	District	Pre-M	M	Post- M
			Gandhinagar					
68	Dhalegaon	Godavari	UGD, Hyderabad	Maharashtra	Parbhani	900	796	1767
69	Dhaneta	Kitcha/Bahgul	MGD-2, Lucknow	U.P.	Bareilly	8020	8380	8283
70	Dholpur	Chambal	LYD, Agra	Rajasthan	Dholpur	1687	4700	3040
71	Duddhi	Kanhar	MGD-3, Varanasi	U.P.	Sonbhadra	6633	6400	4717
72	Elgin Bridge	Ghaghra	MGD-1, Lucknow	U.P.	Barabanki	2733	3193	3660
73	Elunuthi Mangalam	Noyyal	SRD, Coimbatore	Tamil Nadu	Erode	21618	34580	14367
74	Erinjipuzha	Payaswani	SWRD, Kochi	Kerala	Kasargod	*	1413	1700
75	Etawah	Yamuna	LYD, Agra	U.P.	Etawah	518750	361429	462000
76	Faizabad U/S	Ghaghra	MGD-1, Lucknow	U.P.	Faizabad	3566.66	3400	3733.33
77	Fatehgarh	Ganga	MGD-2, Lucknow	U.P.	Farrukhabad	4033	5900	5983
78	Gaisabad	Bearma	LYD, Agra	M.P.	Damoh	*	1443	*
79	Galeta	Hindon	UYD, New Delhi	U.P.	Baghpat	22000000	16429333	60333333
80	Gandhavayal	Gandhayar	SRD, Coimbatore	Tamil Nadu	Coimbatore	41660	83408	17467
81	Gandlapet	Peddavagu	UGD, Hyderabad	Telangana	Nizamabad	1766	846	2050
82	Ganguwala	Yamuna	UYD, New Delhi	H.P.	Sirmaur	5875	1780	5347
83	Ganod	Bhadar	MD, Gandhinagar	Gujarat	Rajkot	3880	5299	2033
84	Garhakota	Sonar	LYD, Agra	M.P.	Sagar	*	615	*
85	Garhmukteshwar	Ganga	MGD-2, Lucknow	U.P.	Hapur	3400	5973	5383
86	Garrauli	Dhasan	LYD, Agra	M.P.	Chhatarpur	1128	2075	515
87	Ghat	Sarju	MGD-1, Lucknow	Uttarakhand	Pithoragarh	2560	2608	2483
88	Ghazipur	Ganga	MGD-3, Varanasi	U.P.	Ghazipur	13500	11320	8017
89	Gokak	Ghataprabha	CD, Bangalore	Karnataka	Belgaum	*	2065	*
90	Gokul Barrage II Mathura D/S	Yamuna	UYD, New Delhi	U.P.	Mathura	909214	401600	1970500
91	Gomti Nagar (Lko D/S)	Gomti	MGD-2, Lucknow	U.P.	Lucknow	90000	93231	93667
92	Gorakhpur D/S	Rapti	MGD-1, Lucknow	U.P.	Gorakhpur	5250	6313	6367
93	Gorakhpur U/S	Rapti	MGD-1, Lucknow	U.P.	Gorakhpur	4450	4827	4683
94	GR Bridge	Godavari	UGD, Hyderabad	Maharashtra	Parbhani	1190	715	967
95	Gummanur	Ponnaiyar	SRD, Coimbatore	Tamil Nadu	Krishnagiri	28340	11228	22650
96	Halady	Halady	SWRD, Kochi	Karnataka	Udupi	*	1333	1300
97	Halia	Halia	LKD, Hyderabad	Telangana	Nalgonda	4400	897	1205
98	Hamirpur	Yamuna	LYD, Agra	U.P.	Hamirpur	23125	30214	17000
99	Haralahalli	Tungabhadra	CD, Bangalore	Karnataka	Haveri	*	5354	*

S.No.	Monitoring stations	River	CWC Division Office	State	District	Pre-M	M	Post- M
100	Hariharapura	Tunga	CD, Bangalore	Karnataka	Chikamagalur	1650	2323	*
101	Hathi Khana	Ganga	MGD-2, Lucknow	U.P.	Fatehgarh	10617	10560	7717
102	Hivra	Wardha	WD, Nagpur	Maharashtra	Wardha	-	2891	805
103	Hogenakkal	Chinnar	SRD, Coimbatore	Tamil Nadu	Dharmapuri	*	*	102250
104	Holehonnur	Bhadra	CD, Bangalore	Karnataka	Shimoga	*	1623	*
105	Honnali	Tungabhadra	CD, Bangalore	Karnataka	Davanagere	*	2584	*
106	Huvinhedgi	Krishna	LKD, Hyderabad	Karnataka	Raichur	1675	739	1715
107	Irrukkankudi	Vaippar	SRD, Coimbatore	Tamil Nadu	Virudhunagar	*	*	2300
108	Jagdalpur	Indravathi	LGD, Hyderabad	Chhattisgarh	Bastar	1128	567	1863
109	Jajmau	Ganga	MGD-2, Lucknow	U.P.	Kanpur	15167	18467	18833
110	Jaunpur	Gomti	MGD-3, Varanasi	U.P.	Jaunpur	11380	9460	8100
111	Jawahar Bridge, Agra	Yamuna	LYD, Agra	U.P.	Agra	537500	501333	654000
112	Jhansi Mirjapur Highway Road Bridge	Betwa	LYD, Agra	U.P.	Hamirpur	2193	*	*
113	K M Vadi	Cauvery/ Lakshmanthirth	CD, Bangalore	Karnataka	Mysore	*	4448	*
114	Kabirganj	Sharda	MGD-1, Lucknow	U.P.	Pilibhit	3280	3593	3683.33
115	Kachlabridge	Ganga	MGD-2, Lucknow	U.P.	Badaun	5667	6293	6233
116	Kailash Mandir, Near Benpur Village	Yamuna	LYD, Agra	U.P.	Agra	272000	*	*
117	Kalampur	Kaliyar	SWRD, Kochi	Kerala	Ernakulam	*	1500	1700
118	Kalanaur	Yamuna	UYD, New Delhi	U.P.	Saharanpur	2869250	27067	50000
119	Kallooppara	Manimala	SWRD, Kochi	Kerala	Pathanamthitta	*	1325	1300
120	Kalpi	Yamuna	LYD, Agra	U.P.	Jalaun	35000	41800	*
121	Kamalpur	Banas	MD, Gandhinagar	Gujarat	Patan	*	1700	*
122	Kannauj	Kali	MGD-2, Lucknow	U.P.	Kannauj	9650	13240	14283
123	Kanpur	Ganga	MGD-2, Lucknow	U.P.	Kanpur Nagar	14429	18343	16667
124	Karad	Krishna	UKD, Pune	Maharashtra	Satara	90000	2700	*
125	Karathodu	Kadalundi	SWRD, Kochi	Kerala	Malappuram	*	1867	1300
126	Karnal	Yamuna	UYD, New Delhi	Haryana	Karnal	*	*	730000
127	Kasganj	Kali	MGD-2, Lucknow	U.P.	Etah	12167	9414	10350
128	Katri Umrauli	Ganga	MGD-2, Lucknow	U.P.	Kannauj	9340	8247	8483
129	Kaziupura	Ramganga	MGD-2, Lucknow	U.P.	Moradabad	13600	10420	8817
130	Keesara	Munneru	LKD, Hyderabad	A.P.	Krishna	3138	784	2048
131	Kellodu	Vedavathi	CD, Bangalore	Karnataka	Chitradurga	*	2978	*

S.No.	Monitoring stations	River	CWC Division Office	State	District	Pre-M	M	Post- M
132	Keolari	Wainganga	WD, Nagpur	M.P.	Seoni	-	3620	2922
133	Khanpur	Mahi	MD, Gandhinagar	Gujarat	Anand	1418	2666	2450
134	Khatoli	Parwati	CD, Jaipur	Rajasthan	Kota	13000	137700	23333
135	Kidangoor	Meenachil	SWRD, Kochi	Kerala	Kottayam	*	1700	1300
136	Kodumudi	Cauvery	SRD, Coimbatore	Tamil Nadu	Erode	11520	14777	21100
137	Koggedoddi	Arkavathy	CD, Bangalore	Karnataka	Ramanagara	15000	1661	*
138	Kokiwada	Pench	WD, Nagpur	M.P.	Chhindwara	*	5021	2995
139	Kollegal	Cauvery	CD, Bangalore	Karnataka	Chamarajanagar	3300	1386	*
140	Konta	Sabari	LGD, Hyderabad	Chhattisgarh	Bastar	694	821	2350
141	Kopergaon	Godavari	UGD, Hyderabad	Maharashtra	Ahmednagar	4850	1645	2925
142	Kora	Rind	LYD, Agra	U.P.	Fatehpur	1860	2690	1468
143	Kota-By Pass Hanging Road Bridge u/s ok Kota City	Chambal	CD, Jaipur	Rajasthan	Kota	*	65000	*
144	Kudige	Cauvery	CD, Bangalore	Karnataka	Kodagu	*	2365	*
145	Kudlur	Palar	SRD, Coimbatore	Karnataka	Chamarajanagar	*	30800	16725
146	Kuldahbridge	Sone	MGD-3, Varanasi	M.P.	Sidhi	6900	5927	3867
147	Kumbidi	Bharathapuzha	SWRD, Kochi	Kerala	Palakkad	*	1225	1700
148	Kumhari	Wainganga	WD, Nagpur	M.P.	Balaghat	503	3037	1018
149	Kuniyil	Chaliyar	SWRD, Kochi	Kerala	Malappuram	*	1833	1300
150	Kuppelur	Kumudavathi	CD, Bangalore	Karnataka	Haveri	*	2850	*
151	Kurundwad	Krishna	UKD, Pune	Maharashtra	Kolhapur	-	19377	*
152	Kuttiyadi	Kuttyadi	SWRD, Kochi	Kerala	Kozhikode	*	1325	800
153	Kuzhithurai	Thambraparni	SWRD, Kochi	Tamil Nadu	Kanyakumari	*	2400	2200
154	Lakkavalli	Bhadra	CD, Bangalore	Karnataka	Chikamagalur	6350	1620	*
155	Lakshmanapatti	Kodaganar	SRD, Coimbatore	Tamil Nadu	Dindigul	*	*	24967
156	Lalpur	Sengar	LYD, Agra	U.P.	Kanpur Dehat	*	1576	*
157	Lodhikheda	Jam	WD, Nagpur	M.P.	Chhindwara	*	4944	4045
158	Lucknow	Gomti	MGD-2, Lucknow	U.P.	Lucknow	84714	86133	85400
159	Luwara	Shetrunji	MD, Gandhinagar	Gujarat	Bhavnagar	1993	6593	1790
160	M H Halli	Hemavati	CD, Bangalore	Karnataka	Hassan	*	754	*
161	Madamon	Pamba	SWRD, Kochi	Kerala	Pathanamthitta	*	1250	1100
162	Madhira	Wyra	LKD, Hyderabad	Telangana	Khammam	5466	549	2145
163	Madla	Ken	LYD, Agra	M.P.	Panna	*	1462	940
164	Magardhara	Wainganga	WD, Nagpur	M.P.	Balaghat	*	3648	1738
165	Mahalgaon	Wainganga	WD, Nagpur	Maharashtra	Gondia	*	4832	538
166	Maighat	Gomti	MGD-3, Varanasi	U.P.	Jaunpur	12050	9187	7400
167	Malakkara	Pampa	SWRD, Kochi	Kerala	Pathanamthitta	*	2267	1100

S.No.	Monitoring stations	River	CWC Division Office	State	District	Pre-M	M	Post- M
168	Malkhed	Kangna	LKD, Hyderabad	Karnataka	Gulbarga	4393	690	2378
169	Manakkad	Thodupuzha	SWRD, Kochi	Kerala	Idukki	*	2167	1700
170	Mancherial	Godavari	UGD, Hyderabad	Telangana	Mancherial	4574	1713	1360
171	Mandawara	Chambal	CD, Jaipur	Rajasthan	Kota	264133	59133	29000
172	Mangaon	Kal	UKD, Pune	Maharashtra	Raigad	1100	11286	*
173	Mankara	Bharathapuzha	SWRD, Kochi	Kerala	Palakkad	*	2267	1300
174	Mantralayam	Tungabhadra	LKD, Hyderabad	A.P.	Kurnool	4646	533	1513
175	Marella	Gundlakamma	LKD, Hyderabad	A.P.	Prakasam	8450	798	3040
176	Marol	Varada	CD, Bangalore	Karnataka	Haveri	*	6537	*
177	Mataji	Mahi	MD, Gandhinagar	M.P.	Ratlam	1445	5970	3517
178	Mawi	Yamuna	UYD, New Delhi	U.P.	Shamli	143250	562133	76167
179	Mehandipur	Ganga	MGD-2, Lucknow	U.P.	Kannauj	12600	5287	4560
180	Mejaroad	Tons	MGD-3, Varanasi	U.P.	Prayagraj	7917	8447	5667
181	Mirawadi	Mula Mutha	UKD, Pune	Maharashtra	Pune	160000	32923	2700
182	Mirzapur	Ganga	MGD-3, Varanasi	U.P.	Mirzapur	10487	9413	7150
183	Mohana	Betwa	LYD, Agra	U.P.	Jalaun	2950	4107	11400
184	Mohna	Yamuna	UYD, New Delhi	Haryana	Faridabad	4101250	996667	1948333
185	Moradabad	Ramganga	MGD-2, Lucknow	U.P.	Moradabad	20000	19793	20717
186	Mungoli	Penganga	WD, Nagpur	Maharashtra	Yavatmal	*	3840	1142
187	Munugodu	Edduvagu	LKD, Hyderabad	A.P.	Guntur	3414	615	1332
188	Muradpur	Vashishti	UKD, Pune	Maharashtra	Ratnagiri	24000	29182	*
189	Murappanadu	Tambraparani	SRD, Coimbatore	Tamil Nadu	Tuticorin	13920	21350	7900
190	Musiri	Cauvery	SRD, Coimbatore	Tamil Nadu	Thiruchirapalli	15400	16323	20033
191	Nagothane	Amba	UKD, Pune	Maharashtra	Raigad	90000	24000	*
192	Nallamaranpatty	Amaravathi	SRD, Coimbatore	Tamil Nadu	Karur	*	10420	8050
193	Nanded	Godavari	UGD, Hyderabad	Maharashtra	Nanded	7375	2107	1558
194	Nandgaon	Wunna	WD, Nagpur	Maharashtra	Wardha	2523	5979	5467
195	Nashik	Godavari	UGD, Hyderabad	Maharashtra	Nasik	1800	3583	3350
196	Neeleswaram	Periyar	SWRD, Kochi	Kerala	Ernakulam	*	2333	1300
197	Neemsar	Gomti	MGD-2, Lucknow	U.P.	Sitapur	7517	8892	8460
198	Nellipally	Kallada	SWRD, Kochi	Kerala	Kollam	*	1243	1100
199	Nellithurai	Bhavani	SRD, Coimbatore	Tamil Nadu	Coimbatore	*	92000	*
200	Noida	Yamuna	UYD, New Delhi	U.P.	Gautam Budh Nagar	61750000	34940000	87500000
201	Nowrangpur	Indravathi	LGD,	Odisha	Nowrangpur	1203	1129	1968

S.No.	Monitoring stations	River	CWC Division Office	State	District	Pre-M	M	Post- M
			Hyderabad					
202	Odenthurai	Kallar	SRD, Coimbatore	Tamil Nadu	Coimbatore	58580	85583	27833
203	Orai Rath marg Road Bridge, Chikasi	Betwa	LYD, Agra	U.P.	Jalaun	1788	8150	11280
204	P.G.Bridge	Penganga	WD, Nagpur	Maharashtra	Yavatmal	1152	5410	580
205	Pachawali	Sindh	LYD, Agra	M.P.	Shivpuri	11300	3373	1468
206	Pachegaon	Pravara	UGD, Hyderabad	Maharashtra	Ahmednagar	985	1810	1907
207	Padardibadi	Mahi	MD, Gandhinagar	Rajasthan	Dungarpur	3100	5177	3317
208	Palakkadavu	Karuvannur	SWRD, Kochi	Kerala	Thrissur	*	1105	1300
209	Paleru Bridge	Paleru	LKD, Hyderabad	A.P.	Krishna	1392	621	1195
210	Pali	Chambal	CD, Jaipur	Rajasthan	Sawai-madhopur	*	70000	*
211	Paliakalan	Sharda	MGD-1, Lucknow	U.P.	Lakhimpur Khiri	2760	3500	3817
212	Palla	Yamuna	UYD, New Delhi	Delhi	North West Delhi	664444	779286	82667
213	Paramkudi	Vaigai	SRD, Coimbatore	Tamil Nadu	Ramanathapuram	*	*	26200
214	Pargaon	Bhima	UKD, Pune	Maharashtra	Pune	1700	18769	3300
215	Parmat Ghat	Ganga	MGD-2, Lucknow	U.P.	Kanpur	12033	11067	12117
216	Parsohan Ghat	Budhi Rapti	MGD-1, Lucknow	U.P.	Siddarthnagar	3717	3900	4033
217	Patala	Wardha	WD, Nagpur	Maharashtra	Chandrapur	*	1987	707
218	Patansaongi	Chandrabhaga	WD, Nagpur	Maharashtra	Nagpur	*	4244	2662
219	Pathagudem	Indravathi	LGD, Hyderabad	Chhattisgarh	Bijapur	1178	569	1398
220	Pattazhy	Kallada	SWRD, Kochi	Kerala	Kollam	*	1933	700
221	Pauni	Wainganga	WD, Nagpur	Maharashtra	Bhandara	4286	6625	4900
222	Pen	Bhogeshwari	UKD, Pune	Maharashtra	Raigad	17000	*	*
223	Perumannu	Valapatnam	SWRD, Kochi	Kerala	Kannur	*	2333	1300
224	Perur	Godavari	UGD, Hyderabad	Telangana	Mulugu	1452	821	1020
225	Phulgaon	Bhima	UKD, Pune	Maharashtra	Pune	-	26600	*
226	Poanta	Yamuna	UYD, New Delhi	H.P.	Simaur	24100	3813	40333
227	Poiyaghat, Agra	Yamuna	LYD, Agra	U.P.	Agra	314615	391667	526000
228	Polavaram	Godavari	LGD, Hyderabad	A.P.	West Godavari	1178	569	1398
229	Pratap pur	Yamuna	LYD, Agra	U.P.	Prayagraj	1178	569	1398
230	Pratapgarh	Sai	MGD-3, Varanasi	U.P.	Pratapgarh	10717	9147	7167
231	Pudur	Kannadipuzha	SWRD, Kochi	Kerala	Palakkad	*	2400	1700
232	Pulamanthole	Pulanthodu	SWRD, Kochi	Kerala	Palakkad	*	2033	1700
233	Pulikukku	Kumaradhara	SWRD, Kochi	Karnataka	Dakshina Kannada	*	1733	1300
234	Purna	Purna	UGD, Hyderabad	Maharashtra	Parbhani	1350	805	1352
235	Raebareli	Sai	MGD-2, Lucknow	U.P.	Raebareli	15167	12293	12417

S.No.	Monitoring stations	River	CWC Division Office	State	District	Pre-M	M	Post- M
236	Rajamundry	Godavari	LGD, Hyderabad	A.P.	East Godavari	1424	834	1583
237	Rajapur	Yamuna	LYD, Agra	U.P.	Chitrakoot	13883	17873	14300
238	Rajegaon	Pranhita	WD, Nagpur	M.P.	Balaghat	782	3921	645
239	Rajghat (Agra)	Betwa	LYD, Agra	U.P.	Lalitpur	1661	2164	1533
240	Ramakona	Kanhan	WD, Nagpur	M.P.	Chhindwara	3145	8164	843
241	Ramamangalam	Muvattupuzha	SWRD, Kochi	Kerala	Ernakulam	*	1467	1100
242	Rangeli	Som	MD, Gandhinagar	Rajasthan	Dungarpur	1697	2332	6450
243	Regauli	Rapti	MGD-1, Lucknow	U.P.	Gorakhpur	4083	4087	4167
244	Renukaji	Giri	UYD, New Delhi	H.P.	Sirmaur	6000	4533	10667
245	Sahijana	Betwa	LYD, Agra	U.P.	Hamirpur	20875	15207	10640
246	Saidpur	Ganga	MGD-3, Varanasi	U.P.	Ghazipur	10367	10893	6950
247	Saigaon	Manjira	UGD, Hyderabad	Karnataka	Bidar	3565	1737	1243
248	Sakhara	Wainganga	WD, Nagpur	Maharashtra	Gadchiroli	*	5961	1080
249	Sakleshpura	Hemavati	CD, Bangalore	Karnataka	Hassan	1700	3798	*
250	Sakmur	Wardha	WD, Nagpur	Maharashtra	Chandrapur	-	3216	818
251	Salawad	Kalisindh	CD, Jaipur	Rajasthan	Jhalawar	*	65000	*
252	Saloora	Manjira	UGD, Hyderabad	Telangana	Nizamabad	1832	1065	1615
253	Samdoli	Warna	UKD, Pune	Maharashtra	Sangli	8000	12000	*
254	Sangam(LGD)	Kinnerasani	LGD, Hyderabad	Telangana	Bhadradri Kothagudem	1850	1918	1322
255	Sangod	Parwan	CD, Jaipur	Rajasthan	Kota	*	112875	*
256	Santeguli	Aghnanashini	SWRD, Kochi	Karnataka	Uthara Kannada	*	1567	700
257	Saradaput	Sabari	LGD, Hyderabad	Chhattisgarh	Malkangiri	635	861	1463
258	Sarangpur	Kalisindh	CD, Jaipur	M.P.	Rajgarh	*	131286	*
259	Sarati	Nira	UKD, Pune	Maharashtra	Pune	3000	8856	*
260	Satna	Tons	MGD-3, Varanasi	M.P.	Satna	9020	8580	6917
261	Satrapur	Kanhan	WD, Nagpur	Maharashtra	Nagpur	2200	7169	1522
262	Savandapur	Bhavani	SRD, Coimbatore	Tamil Nadu	Erode	43917	17477	33983
263	Seohara	Ramganga	MGD-2, Lucknow	U.P.	Bijnaur	5580	5300	5467
264	Seondha	Sindh	LYD, Agra	M.P.	Datia	8317	2294	916
265	Sevanur	Chittar	SRD, Coimbatore	Tamil Nadu	Erode	*	13750	15400
266	Shahjahanpur	Khannaut	MGD-2, Lucknow	U.P.	Shahjahanpur	6100	7071	6800
267	Shahzadpur	Ganga	MGD-3, Varanasi	U.P.	Kaushambi	9550	10580	7483
268	Shastri Bridge	Ganga	MGD-3, Varanasi	U.P.	Prayagraj	10087	10960	8467
269	Shimoga	Tunga	CD, Bangalore	Karnataka	Shimoga	*	3747	*
270	Singasadanapalli	Ponnaiyar	SRD, Coimbatore	Tamil Nadu	Krishnagiri	9622308	10675000	7616667

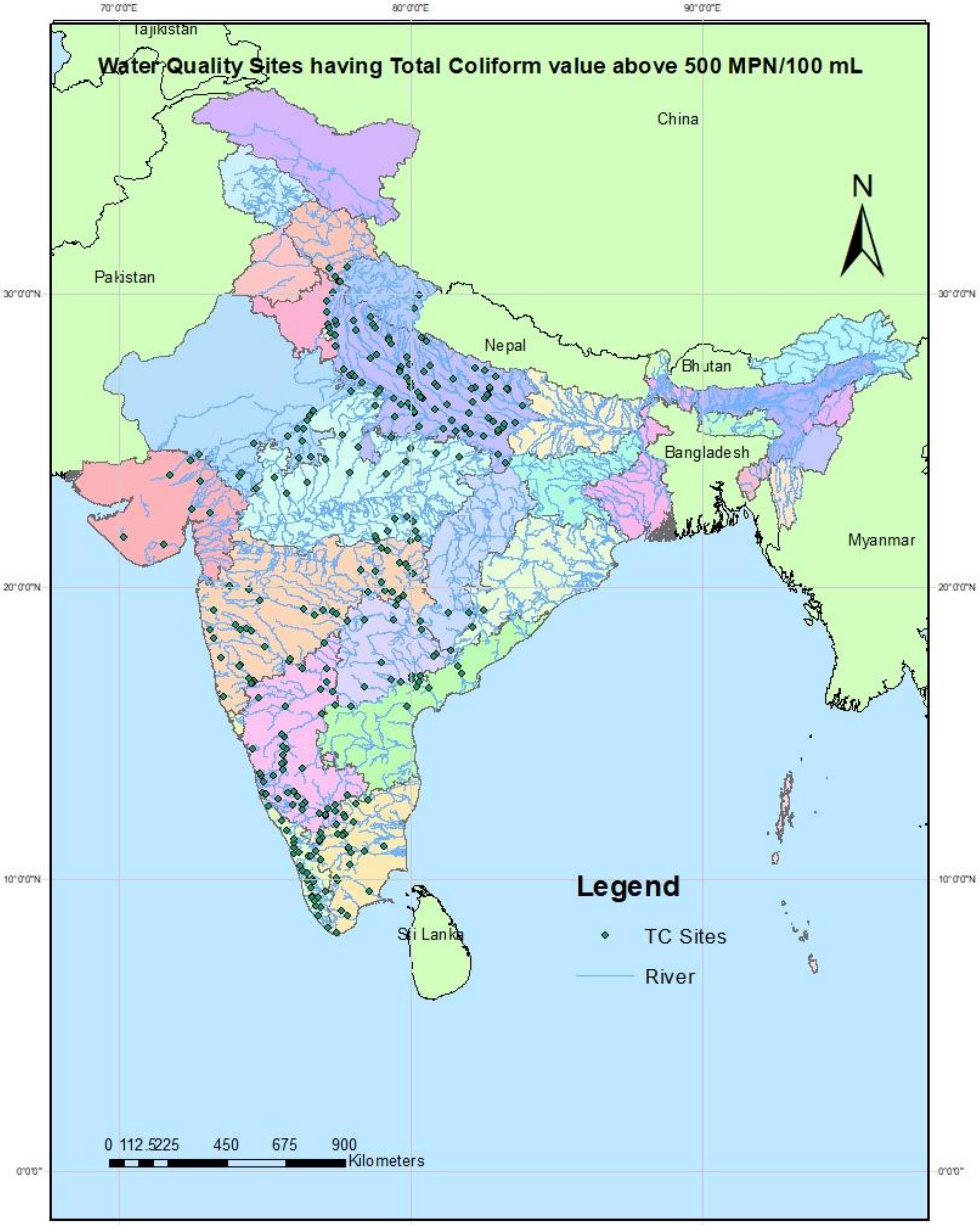
S.No.	Monitoring stations	River	CWC Division Office	State	District	Pre-M	M	Post- M
271	Sitapur	Sarayan	MGD-2, Lucknow	U.P.	Sitapur	6583	7060	7625
272	Suddakallu	Dindi	LKD, Hyderabad	Telangana	Mahaboob Nagar	-	733	1228
273	Sultanpur	Gomti	MGD-3, Varanasi	U.P.	Sultanpur	14287	10467	7567
274	T Bekuppe	Arkavathy	CD, Bangalore	Karnataka	Ramanagara	*	7786	*
275	T K Halli	Shimsha	CD, Bangalore	Karnataka	Mandya	*	2140	*
276	T Narsipura	Kabini	CD, Bangalore	Karnataka	Mysore	17000	4341	*
277	T.Ramapuram	Hagari	LKD, Hyderabad	Karnataka	Bellary	3933	795	1112
278	Takali	Bhima	UKD, Pune	Maharashtra	Solapur	-	1040	*
279	Tal	Chambal	CD, Jaipur	M.P.	Ratlam	*	201800	*
280	Tanda D/S	Ghaghra	MGD-1, Lucknow	U.P.	Ambedkar Nagar	3867	4060	3733
281	Tanda U/S	Ghaghra	MGD-1, Lucknow	U.P.	Ambedkar Nagar	3367	3453	2933
282	Terwad	Panchganga	UKD, Pune	Maharashtra	Kolhapur	35000	17246	*
283	Thengumarahada	Bhavani / Moyar	SRD, Coimbatore	Tamil Nadu	Nilgiris	18967	26608	7250
284	Theni	Vagai/Suruliar	SRD, Coimbatore	Tamil Nadu	Theni	27220	34075	13517
285	Thevur	Sarabenga	SRD, Coimbatore	Tamil Nadu	Salem	*	9760	27267
286	Thimmanahalli	Yagachi	CD, Bangalore	Karnataka	Hassan	7900	5806	*
287	Thoppur	Thoppaiyar	SRD, Coimbatore	Tamil Nadu	Salem	*	*	7933
288	Thotathinkadavu	Iruvazhinjipuzha	SWRD, Kochi	Kerala	Kozhikode	*	1767	1100
289	Thumpamon	Achankovil	SWRD, Kochi	Kerala	Pathanamthitta	-	2100	800
290	Tihar Khera	Ramganga	MGD-2, Lucknow	U.P.	Bareilly	14200	14427	14417
291	Tondarpur	Sukheta	MGD-2, Lucknow	U.P.	Hardoi	7925	7457	7300
292	Tuini	Tons	UYD, New Delhi	Uttarakhand	Dehradun	9300	2480	3113
293	Turtipar	Ghaghra	MGD-1, Lucknow	U.P.	Ballia	3633	3453	2933
294	Udi	Chambal	LYD, Agra	U.P.	Etawah	2779	4007	3240
295	Ujjain	Shipra	CD, Jaipur	M.P.	Ujjain	*	194545	1750000
296	Urachikottai	Cauvery	SRD, Coimbatore	Tamil Nadu	Erode	25756	41700	18700
297	V S Bridge	Ganga	MGD-3, Varanasi	U.P.	Varanasi	11007	10047	7567
298	Vandiperiyar	Periyar	SWRD, Kochi	Kerala	Idukki	*	1550	1700
299	Varanasi	Ganga	MGD-3, Varanasi	U.P.	Varanasi	13880	12433	8650
300	Varanavasi	Maruthaiyar	SRD, Coimbatore	Tamil Nadu	Ariyalur	5200	34580	27883
301	Vautha	Sabarmati	Mahi Division	Gujarat	Ahmedabad	312600	356667	223333
302	Veligonda	Musi	LKD, Hyderabad	Telangana	Nalgonda	5700	1573	1247
303	Vijayawada	Krishna	LKD, Hyderabad	A.P.	Krishna	4048	1204	1863
304	Wadenapally	Krishna	LKD,	Telangana	Nalgonda	4146	743	1648

S.No.	Monitoring stations	River	CWC Division Office	State	District	Pre-M	M	Post- M
			Hyderabad					
305	Wadakbal	Sina	UKD, Pune	Maharashtra	Solapur	4000	8000	*
306	Wairagarh	Khobragadi	WD, Nagpur	Maharashtra	Gadchiroli	*	4470	-
307	Warunji	Koyna	UKD, Pune	Maharashtra	Satara	-	15167	*
308	Yadgir	Bhima	LKD, Hyderabad	Karnataka	Yadgir	3533	904	1563
309	Yamuna Expessway Road Bridge, Etamadpur	Yamuna	LYD, Agra	U.P.	Agra	810000	*	*
310	Yashwant Nagar	Giri	UYD, New Delhi	H.P.	Simaur	28000	2700	7983
311	Yelli	Godavari	UGD, Hyderabad	Maharashtra	Nanded	604	1449	1500
312	Yennehole	Swarna	SWRD, Kochi	Karnataka	Udupi	*	1867	800

(-) means No Hotspot.

(*) means river dry/data not available.

Figure 20: Water Quality Monitoring stations having Total Coliform above 500 MPN/100ml (2021)



7.1.12 Faecal Coliform

The faecal coliform groups of microorganisms typically originate from the feces of humans and other animals. They are more specific, referring to coliforms residing in the intestinal tract of both humans and many other animals. The intestinal tracts of humans contain numerous coliform bacteria, with each person discharging 100 to 400 billion faecal coliforms daily. Coliform bacteria such as Escherichia coli serve as crucial indicators of pollution resulting from faecal material of human and animal origin.

Detecting all waterborne faecal pathogens proves challenging. Pathogens are relatively scarce in water, posing difficulties in direct and time-consuming monitoring. Instead, monitoring faecal coliform levels is preferred due to the observed correlation.

Various indicators of faecal contamination are commonly employed to identify faecal coliform in river water. The abundance of these indicators is assumed to correlate with the density of pathogenic microorganisms originating from faecal sources. Consequently, it serves as an indication of the sanitary risk associated with various water utilizations.

During the pre-monsoon season, the average value of Faecal Coliforms (FC) exceeding 500 MPN/100 ml was observed at 174 water quality Monitoring stations located in Andhra Pradesh, Delhi, Gujarat, Haryana, Himachal Pradesh, Karnataka, Madhya Pradesh, Maharashtra, Rajasthan, Tamil Nadu, Telangana, Uttar Pradesh, and Uttarakhand. In the monsoon season, 240 water quality monitoring stations in Andhra Pradesh, Delhi, Gujarat, Haryana, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Rajasthan, Tamil Nadu, Telangana, Uttar Pradesh, and Uttarakhand recorded average FC values exceeding 500 MPN/100 ml. The post-monsoon season continued to exhibit this trend, with 186 water quality monitoring stations in Andhra Pradesh, Chhattisgarh, Delhi, Gujarat, Haryana, Himachal Pradesh, Karnataka, Madhya Pradesh, Maharashtra, Odisha, Rajasthan, Tamil Nadu, Telangana, Uttar Pradesh, and Uttarakhand showing elevated average FC levels.

The hot spot study and GIS map for faecal coliform are given below in Table 18 and figure 21.

Table 18: Monitoring stations having Faecal Coliforms (FC) 500 MPN in River Water in 2021

S.No.	Monitoring stations	River	CWC Division Office	State	District	Pre-M	M	Post- M
1	A.B.Road Crossing	Parwati	CD, Jaipur	M.P.	Guna	*	105556	23000
2	A.P. Puram	Chittar	SRD, Coimbatore	Tamil Nadu	Tirunelveli	*	2200	788
3	Abu Road	Banas	MD, Gandhinagar	Rajasthan	Sirohi	1857	521	563
4	Addoor	Gurupur	SWRD, Kochi	Karnataka	Dakshina Kannada	*	800	*
5	Akbarpur	Chhoti sarju	MGD-3, Varanasi	U.P.	Ambedkar Nagar	7550	4947	3600
6	Akkihebbal	Hemavati	CD, Bangalore	Karnataka	Mandya	*	515	*
7	Aklera	Parwan	CD, Jaipur	Rajasthan	Jhalawar	*	18538	*
8	Alanthurai	Noyyal	SRD, Coimbatore	Tamil Nadu	Coimbatore	2267	1852	-
9	Allahabad	Ganga	MGD-3, Varanasi	U.P.	Prayagraj	7573	5720	5000
10	Ambarampalayam	Bharathapuzha	SRD, Coimbatore	Tamil Nadu	Coimbatore	1670	1115	827
11	Ambasamudram	Vaigai	SRD, Coimbatore	Tamil Nadu	Theni	14550	780	1397
12	Ambgaon	Chulband	WD, Nagpur	Maharashtra	Bhandara	*	558	-
13	Ankinghat	Ganga	MGD-2, Lucknow	U.P.	Kanpur Nagar	2929	2813	3200
14	Arangaly	Chalakudy	SWRD, Kochi	Kerala	Thrissur	*	733	-
15	Arjunwad	Krishna	UKD, Pune	Maharashtra	Kolhapur	-	1754	*
16	Arnota	Uttangan	LYD, Agra	U.P.	Agra	*	7850	*
17	Ashramam	Pazhayar	SWRD, Kochi	Tamil Nadu	Kanyakumari	*	1167	-
18	Auraiya	Yamuna	LYD, Agra	U.P.	Auraiya	21375	39927	45400
19	Avarankuppam	Palar	SRD, Coimbatore	Tamil Nadu	Vellore	*	2611	518
20	Avershe	Seetha	SWRD, Kochi	Karnataka	Udupi	*	875	-
21	Ayilam	Vamanapuram	SWRD, Kochi	Kerala	Thiruvananthapuram	*	657	-
22	Ayodhya	Ghaghra	MGD-1, Lucknow	U.P.	Ayodhya	1717	1873	1783
23	Badalapur	Ulhas	UKD, Pune	Maharashtra	Thane	28480	11407	14333
24	Baghpat	Yamuna	UYD, New Delhi	U.P.	Baghpat	*	*	5650
25	Bakhari	Wainganga	WD, Nagpur	M.P.	Seoni	*	1150	-
26	Baleni	Yamuna	UYD, New Delhi	U.P.	Baghpat	565000	72800	70000
27	Balrampur	Rapti	MGD-1, Lucknow	U.P.	Gonda	1771	1800	2000
28	Baluaghat	Ganga	MGD-3, Varanasi	U.P.	Varanasi	8727	7720	5350
29	Bamni(Nagpur)	Wardha	WD, Nagpur	Maharashtra	Chandrapur	1183	614	-
30	Banda	Ken	LYD, Agra	U.P.	Banda	18443	8022	4760
31	Bangapani	Gauri Ganga	MGD-1, Lucknow	Uttarakhand	Pithoragarh	1150	1600	1400
32	Bansi	Rapti	MGD-1, Lucknow	U.P.	Siddarthnagar	1850	2313	2250
33	Bantwal	Nethravathi	SWRD, Kochi	Karnataka	Dakshina Kannada	*	767	-

S.No.	Monitoring stations	River	CWC Division Office	State	District	Pre-M	M	Post- M
34	Baranwada	Banas	CD, Jaipur	Rajasthan	Sawai-madhopur	*	79286	10100
35	Bareilly	Ramganga	MGD-2, Lucknow	U.P.	Bareilly	8900	9287	10067
36	Barod	Kalisindh	CD, Jaipur	Rajasthan	Kota	3267	12533	6050
37	Basantpur(Ganga)	Ganga	MGD-2, Lucknow	U.P.	Bijnaur	2933	2733	2950
38	Basoda	Betwa	LYD, Agra	M.P.	Vidisha	*	1638	*
39	Basti	Kwano	MGD-1, Lucknow	U.P.	Basti	2817	3280	3233
40	Basti D/S	Kwano	MGD-1, Lucknow	U.P.	Basti	3233	3187	3400
41	Basti U/S	Kwano	MGD-1, Lucknow	U.P.	Basti	2717	2773	2833
42	Bawapuram	Tungabhadra	LKD, Hyderabad	A.P.	Kurnool	1527	-	657
43	Bhadrachelam	Godavari	LGD, Hyderabad	Telangana	Khammam	543	-	1193
44	Bhatpalli	Peddavagu	WD, Nagpur	Telangana	Asifabad	542	607	-
45	Bhind	Kunwari	LYD, Agra	M.P.	Bhind	*	1775	*
46	Bhitaura	Ganga	MGD-2, Lucknow	U.P.	Fatehpur	2957	3147	3120
47	Biligundulu	Cauvery	SRD, Coimbatore	Tamil Nadu	Krishnagiri	-	814	638
48	Birdghat	Rapti	MGD-1, Lucknow	U.P.	Gorakhpur	2667	3320	3133
49	Bhitoor	Ganga	MGD-2, Lucknow	U.P.	Kanpur	3950	4327	4717
50	Chandrika Devi (Lko U/S)	Gomti	MGD-2, Lucknow	U.P.	Lucknow	5467	12046	6700
51	Chindnar	Indravathi	LGD, Hyderabad	Chhattisgarh	Dantewada	-	-	860
52	Chitrasani	Balaram	MD, Gandhinagar	Gujarat	Banaskantha	723	-	*
53	Chittorgarh	Gambhiri	CD, Jaipur	Rajasthan	Chittorgarh	*	8867	*
54	Cholachagudda	Malaprabha	CD, Bangalore	Karnataka	Bagalkot	-	1310	*
55	Chopan	Sone	MGD-3, Varanasi	U.P.	Sonbhadra	3100	3127	1772
56	Dabri	Ramganga	MGD-2, Lucknow	U.P.	Shahjahanpur	3400	3947	7450
57	Dameracherla	Musi	LKD, Hyderabad	Telangana	Nalgonda	1182	502	828
58	Daund	Bhima	UKD, Pune	Maharashtra	Pune	28000	2691	*
59	Delhi Railway Bridge	Yamuna	UYD, New Delhi	Delhi	North Delhi	5210667	2392000	1183333
60	Deongaon Bridge	Bhima	LKD, Hyderabad	Karnataka	Bijapur	2440	-	927
61	Deosugar	Krishna	LKD, Hyderabad	Karnataka	Raichur	1843	578	845
62	Derol Bridge	Sabarmati	MD, Gandhinagar	Gujarat	Sabarkantha	1015	-	*
63	Dhalegaon	Godavari	UGD, Hyderabad	Maharashtra	Parbhani	-	-	1068
64	Dhaneta	Kitcha/Bahgul	MGD-2, Lucknow	U.P.	Bareilly	4000	4287	4200
65	Dholpur	Chambal	LYD, Agra	Rajasthan	Dholpur	1343	3373	2380
66	Duddhi	Kanhar	MGD-3,	U.P.	Sonbhadra	4150	3593	2550

S.No.	Monitoring stations	River	CWC Division Office	State	District	Pre-M	M	Post- M
			Varanasi					
67	Elgin Bridge	Ghaghra	MGD-1, Lucknow	U.P.	Barabanki	1583	1633	1840
68	Elunuthi Mangalam	Noyyal	SRD, Coimbatore	Tamil Nadu	Erode	1497	963	832
69	Erinjipuzha	Payaswani	SWRD, Kochi	Kerala	Kasargod	*	573	-
70	Etawah	Yamuna	LYD, Agra	U.P.	Etawah	352500	252857	302000
71	Faizabad U/S	Ghaghra	MGD-1, Lucknow	U.P.	Faizabad	1716.66	1720	1833
72	Fatehgarh	Ganga	MGD-2, Lucknow	U.P.	Farrukhabad	2150	3047	3000
73	Gaisabad	Bearma	LYD, Agra	M.P.	Damoh	*	1060	*
74	Galeta	Hindon	UYD, New Delhi	U.P.	Baghpat	18966667	2466400	15500000
75	Gandhavayal	Gandhayar	SRD, Coimbatore	Tamil Nadu	Coimbatore	926	2908	868
76	Gandlapet	Peddavagu	UGD, Hyderabad	Telangana	Nizamabad	658	569	1197
77	Ganguwala	Yamuna	UYD, New Delhi	H.P.	Sirmaur	770	-	1667
78	Ganod	Bhadar	MD, Gandhinagar	Gujarat	Rajkot	577	1249	-
79	Garhmukteshwar	Ganga	MGD-2, Lucknow	U.P.	Hapur	1800	3007	2700
80	Garrauli	Dhasan	LYD, Agra	M.P.	Chhatarpur	885	1498	-
81	Ghat	Sarju	MGD-1, Lucknow	Uttarakhand	Pithoragarh	1320	1377	1233
82	Ghazipur	Ganga	MGD-3, Varanasi	U.P.	Ghazipur	7900	6567	3950
83	Gokul Barrage II Mathura D/S	Yamuna	UYD, New Delhi	U.P.	Mathura	89843	38067	120417
84	Gomti Nagar (Lko D/S)	Gomti	MGD-2, Lucknow	U.P.	Lucknow	45000	47923	47000
85	Gorakhpur D/S	Rapti	MGD-1, Lucknow	U.P.	Gorakhpur	2717	3280	3250
86	Gorakhpur U/S	Rapti	MGD-1, Lucknow	U.P.	Gorakhpur	2250	2527	2450
87	GR Bridge	Godavari	UGD, Hyderabad	Maharashtra	Parbhani	-	-	728
88	Gummanur	Ponnaiyar	SRD, Coimbatore	Tamil Nadu	Krishnagiri	2726	-	893
89	Halady	Halady	SWRD, Kochi	Karnataka	Udupi	*	723	-
90	Halia	Halia	LKD, Hyderabad	Telangana	Nalgonda	1016	-	752
91	Hamirpur	Yamuna	LYD, Agra	U.P.	Hamirpur	18738	21336	12040
92	Haralahalli	Tungabhadra	CD, Bangalore	Karnataka	Haveri	*	789	*
93	Hariharapura	Tunga	CD, Bangalore	Karnataka	Chikamagalur	615	-	*
94	Hathi Khana	Ganga	MGD-2, Lucknow	U.P.	Fatehgarh	5417	5393	3933
95	Hogenakkal	Chinnar	SRD, Coimbatore	Tamil Nadu	Dharmapuri	*	*	4050
96	Holehonnur	Bhadra	CD, Bangalore	Karnataka	Shimoga	*	510	*
97	Honnali	Tungabhadra	CD, Bangalore	Karnataka	Davanagere	*	576	*
98	Huvinhedgi	Krishna	LKD, Hyderabad	Karnataka	Raichur	798	-	1140

S.No.	Monitoring stations	River	CWC Division Office	State	District	Pre-M	M	Post- M
99	Jagdalpur	Indravathi	LGD, Hyderabad	Chhattisgarh	Bastar	-	-	1093
100	Jajmau	Ganga	MGD-2, Lucknow	U.P.	Kanpur	7483	9547	9750
101	Jaunpur	Gomti	MGD-3, Varanasi	U.P.	Jaunpur	6700	5247	4383
102	Jawahar Bridge, Agra	Yamuna	LYD, Agra	U.P.	Agra	382500	325333	404000
103	Jhansi Mirjapur Highway Road Bridge	Betwa	LYD, Agra	U.P.	Hamirpur	1775	*	*
104	Kabirganj	Sharda	MGD-1, Lucknow	U.P.	Pilibhit	1920	1843	1867
105	Kachlabridge	Ganga	MGD-2, Lucknow	U.P.	Badaun	3100	3253	3100
106	Kailash Mandir, Near Benpur Village	Yamuna	LYD, Agra	U.P.	Agra	226000	*	*
107	Kalampur	Kaliyar	SWRD, Kochi	Kerala	Ernakulam	*	825	-
108	Kalanaur	Yamuna	UYD, New Delhi	U.P.	Saharanpur	60750	4500	5983
109	Kallooppara	Manimala	SWRD, Kochi	Kerala	Pathanamthitta	*	620	-
110	Kalpi	Yamuna	LYD, Agra	U.P.	Jalaun	28000	29110	*
111	Kannauj	Kali	MGD-2, Lucknow	U.P.	Kannauj	5133	6760	7217
112	Kanpur	Ganga	MGD-2, Lucknow	U.P.	Kanpur Nagar	7314	9621	8500
113	Karad	Krishna	UKD, Pune	Maharashtra	Satara	5000	1167	*
114	Karathodu	Kadalundi	SWRD, Kochi	Kerala	Malappuram	*	780	-
115	Karnal	Yamuna	UYD, New Delhi	Haryana	Karnal	*	*	15000
116	Kasganj	Kali	MGD-2, Lucknow	U.P.	Etah	6733	4807	5233
117	Katri Umrauli	Ganga	MGD-2, Lucknow	U.P.	Kannauj	4700	4107	4267
118	Kaziupura	Ramganga	MGD-2, Lucknow	U.P.	Moradabad	6820	5400	4467
119	Keesara	Munneru	LKD, Hyderabad	A.P.	Krishna	1172	-	1275
120	Kellodu	Vedavathi	CD, Bangalore	Karnataka	Chitradurga	*	778	*
121	Keolari	Wainganga	WD, Nagpur	M.P.	Seoni	-	823	527
122	Khanpur	Mahi	MD, Gandhinagar	Gujarat	Anand	545	-	-
123	Khatoli	Parwati	CD, Jaipur	Rajasthan	Kota	-	5810	7383
124	Kidangoor	Meenachil	SWRD, Kochi	Kerala	Kottayam	*	757	-
125	Kodumudi	Cauvery	SRD, Coimbatore	Tamil Nadu	Erode	1116	1130	993
126	Koggedoddi	Arkavathy	CD, Bangalore	Karnataka	Ramanagara	3350	610	*
127	Kollegal	Cauvery	CD, Bangalore	Karnataka	Chamarajanagar	780	889	*
128	Konta	Sabari	LGD, Hyderabad	Chhattisgarh	Bastar	-	-	1532
129	Kopergaon	Godavari	UGD, Hyderabad	Maharashtra	Ahmednagar	1823	-	1520
130	Kora	Rind	LYD, Agra	U.P.	Fatehpur	1450	1714	1118
131	Kota-By Pass	Chambal	CD, Jaipur	Rajasthan	Kota	*	16160	*

S.No.	Monitoring stations	River	CWC Division Office	State	District	Pre-M	M	Post- M
	Hanging Road Bridge u/s ok Kota City							
132	Kudlur	Palar	SRD, Coimbatore	Karnataka	Chamarajanagar	*	1088	833
133	Kuldahbridge	Sone	MGD-3, Varanasi	M.P.	Sidhi	4280	3387	2067
134	Kumbidi	Bharathapuzha	SWRD, Kochi	Kerala	Palakkad	*	705	-
135	Kumhari	Wainganga	WD, Nagpur	M.P.	Balaghat	-	704	-
136	Kuniyil	Chaliyar	SWRD, Kochi	Kerala	Malappuram	*	527	-
137	Kurundwad	Krishna	UKD, Pune	Maharashtra	Kolhapur	*	1531	*
138	Kuttiyadi	Kuttyadi	SWRD, Kochi	Kerala	Kozhikode	*	685	-
139	Kuzhithurai	Thambraparni	SWRD, Kochi	Tamil Nadu	Kanyakumari	*	1167	-
140	Lakkavalli	Bhadra	CD, Bangalore	Karnataka	Chikamagalur	890	-	*
141	Lakshmanapatti	Kodaganar	SRD, Coimbatore	Tamil Nadu	Dindigul	*	*	1143
142	Lalpur	Sengar	LYD, Agra	U.P.	Kanpur Dehat	*	1109	*
143	Lodhikheda	Jam	WD, Nagpur	M.P.	Chhindwara	*	842	-
144	Lucknow	Gomti	MGD-2, Lucknow	U.P.	Lucknow	45143	44267	42560
145	Luwara	Shetrunji	MD, Gandhinagar	Gujarat	Bhavnagar	562	1020	-
146	Madhira	Wyra	LKD, Hyderabad	Telangana	Khammam	2132	-	1243
147	Madla	Ken	LYD, Agra	M.P.	Panna	*	1115	700
148	Mahalgaon	Wainganga	WD, Nagpur	Maharashtra	Gondia	*	1827	-
149	Maighat	Gomti	MGD-3, Varanasi	U.P.	Jaunpur	7600	5033	3750
150	Malakkara	Pampa	SWRD, Kochi	Kerala	Pathanamthitta	*	1000	-
151	Malkhed	Kangna	LKD, Hyderabad	Karnataka	Gulbarga	890	-	1032
152	Manakkad	Thodupuzha	SWRD, Kochi	Kerala	Idukki	*	1000	-
153	Mancherial	Godavari	UGD, Hyderabad	Telangana	Mancherial	970	657	892
154	Mandawara	Chambal	CD, Jaipur	Rajasthan	Kota	21533	4528	4983
155	Mangaon	Kal	UKD, Pune	Maharashtra	Raigad	-	1871	*
156	Mankara	Bharathapuzha	SWRD, Kochi	Kerala	Palakkad	*	1267	-
157	Mantralayam	Tungabhadra	LKD, Hyderabad	A.P.	Kurnool	1474	-	827
158	Marella	Gundlakamma	LKD, Hyderabad	A.P.	Prakasam	2968	-	1947
159	Marol	Varada	CD, Bangalore	Karnataka	Haveri	*	937	*
160	Mataji	Mahi	MD, Gandhinagar	M.P.	Ratlam	1007	806	665
161	Mawi	Yamuna	UYD, New Delhi	U.P.	Shamli	9450	58873	8183
162	Mehandipur	Ganga	MGD-2, Lucknow	U.P.	Kannauj	7633	10313	8940
163	Mejaroad	Tons	MGD-3, Varanasi	U.P.	Prayagraj	4833	4800	3017
164	Mirawadi	Mula Mutha	UKD, Pune	Maharashtra	Pune	800	8638	600
165	Mirzapur	Ganga	MGD-3, Varanasi	U.P.	Mirzapur	6313	5213	4083

S.No.	Monitoring stations	River	CWC Division Office	State	District	Pre-M	M	Post- M
166	Mohana	Betwa	LYD, Agra	U.P.	Jalaun	2238	2779	7760
167	Mohna	Yamuna	UYD, New Delhi	Haryana	Faridabad	327625	65920	1388333
168	Moradabad	Ramganga	MGD-2, Lucknow	U.P.	Moradabad	10660	10460	10750
169	Mungoli	Penganga	WD, Nagpur	Maharashtra	Yavatmal	*	1597	-
170	Munugodu	Edduvagu	LKD, Hyderabad	A.P.	Guntur	568	-	868
171	Muradpur	Vashishti	UKD, Pune	Maharashtra	Ratnagiri	5000	1727	*
172	Murappanadu	Tambraparani	SRD, Coimbatore	Tamil Nadu	Tuticorin	546	1043	1207
173	Musiri	Cauvery	SRD, Coimbatore	Tamil Nadu	Thiruchirapalli	1433	1478	890
174	Nagothane	Amba	UKD, Pune	Maharashtra	Raigad	-	2193	*
175	Nallamaranpatty	Amaravathi	SRD, Coimbatore	Tamil Nadu	Karur	*	888	-
176	Nanded	Godavari	UGD, Hyderabad	Maharashtra	Nanded	3083	1040	1035
177	Nandgaon	Wunna	WD, Nagpur	Maharashtra	Wardha	1397	1227	1135
178	Nashik	Godavari	UGD, Hyderabad	Maharashtra	Nasik	678	1529	1773
179	Neeleswaram	Periyar	SWRD, Kochi	Kerala	Ernakulam	*	800	-
180	Neemsar	Gomti	MGD-2, Lucknow	U.P.	Sitapur	3967	4462	4260
181	Nellithurai	Bhavani	SRD, Coimbatore	Tamil Nadu	Coimbatore	*	1100	*
182	Noida	Yamuna	UYD, New Delhi	U.P.	Gautam Budh Nagar	12812500	7010000	15400000
183	Nowrangpur	Indravathi	LGD, Hyderabad	Odisha	Nowrangpur	-	-	1122
184	Odenthurai	Kallar	SRD, Coimbatore	Tamil Nadu	Coimbatore	2152	3186	722
185	Orai Rath marg Road Bridge, Chikasi	Betwa	LYD, Agra	U.P.	Jalaun	2375	6049	7660
186	P.G.Bridge	Penganga	WD, Nagpur	Maharashtra	Yavatmal	600	953	-
187	Pachawali	Sindh	LYD, Agra	M.P.	Shivpuri	8275	2136	998
188	Pachegaon	Pravara	UGD, Hyderabad	Maharashtra	Ahmednagar	-	653	1103
189	Padardibadi	Mahi	MD, Gandhinagar	Rajasthan	Dungarpur	826	1129	613
190	Paleru Bridge	Paleru	LKD, Hyderabad	A.P.	Krishna	-	-	817
191	Pali	Chambal	CD, Jaipur	Rajasthan	Sawai-madhopur	*	11000	*
192	Paliakalan	Sharda	MGD-1, Lucknow	U.P.	Lakhimpur Khiri	1480	1779	1900
193	Palla	Yamuna	UYD, New Delhi	Delhi	North West Delhi	53667	69357	17458
194	Paramkudi	Vaigai	SRD, Coimbatore	Tamil Nadu	Ramanathapuram	*	*	2160
195	Pargaon	Bhima	UKD, Pune	Maharashtra	Pune	-	2931	1400
196	Parmat Ghat	Ganga	MGD-2, Lucknow	U.P.	Kanpur	6050	5760	6367
197	Parsohan Ghat	Budhi Rapti	MGD-1, Lucknow	U.P.	Siddarthnagar	2050	1947	2033

S.No.	Monitoring stations	River	CWC Division Office	State	District	Pre-M	M	Post- M
198	Patala	Wardha	WD, Nagpur	Maharashtra	Chandrapur	*	510	510
199	Patansaongi	Chandrabhaga	WD, Nagpur	Maharashtra	Nagpur	*	1036	798
200	Pathagudem	Indravathi	LGD, Hyderabad	Chhattisgarh	Bijapur	-	-	927
201	Pattazhy	Kallada	SWRD, Kochi	Kerala	Kollam	*	700	-
202	Pauni	Wainganga	WD, Nagpur	Maharashtra	Bhandara	2636	1283	-
203	Pen	Bhogeshwari	UKD, Pune	Maharashtra	Raigad	3000	*	*
204	Perumannu	Valapatnam	SWRD, Kochi	Kerala	Kannur	*	823	-
205	Perur	Godavari	UGD, Hyderabad	Telangana	Mulugu	-	-	685
206	Phulgaon	Bhima	UKD, Pune	Maharashtra	Pune	-	2750	*
207	Poanta	Yamuna	UYD, New Delhi	H.P.	Simaur	2183	-	3917
208	Poiyaghat, Agra	Yamuna	LYD, Agra	U.P.	Agra	255308	280000	340000
209	Polavaram	Godavari	LGD, Hyderabad	A.P.	West Godavari	-	-	1853
210	Pratap pur	Yamuna	LYD, Agra	U.P.	Prayagraj	7625	14947	8360
211	Pratapgarh	Sai	MGD-3, Varanasi	U.P.	Pratapgarh	6650	5140	4083
212	Pudur	Kannadipuzha	SWRD, Kochi	Kerala	Palakkad	*	1100	-
213	Pulamanthole	Pulanthodu	SWRD, Kochi	Kerala	Palakkad	*	767	-
214	Pulikukku	Kumaradhara	SWRD, Kochi	Karnataka	Dakshina Kannada	*	715	-
215	Purna	Purna	UGD, Hyderabad	Maharashtra	Parbhani	-	-	893
216	Raebareli	Sai	MGD-2, Lucknow	U.P.	Raebareli	7767	6267	6233
217	Rajamundry	Godavari	LGD, Hyderabad	A.P.	East Godavari	-	-	1068
218	Rajapur	Yamuna	LYD, Agra	U.P.	Chitrakoot	10700	17913	10100
219	Rajghat (Agra)	Betwa	LYD, Agra	U.P.	Lalitpur	1353	1461	1097
220	Ramakona	Kanhan	WD, Nagpur	M.P.	Chhindwara	832	1801	-
221	Ramamangalam	Muvattupuzha	SWRD, Kochi	Kerala	Ernakulam	*	593	-
222	Rangeli	Som	MD, Gandhinagar	Rajasthan	Dungarpur	-	-	1048
223	Regauli	Rapti	MGD-1, Lucknow	U.P.	Gorakhpur	2000	2120	2083
224	Renukaji	Giri	UYD, New Delhi	H.P.	Sirmaur	-	-	1622
225	Sahijana	Betwa	LYD, Agra	U.P.	Hamirpur	15788	10887	7940
226	Saidpur	Ganga	MGD-3, Varanasi	U.P.	Ghazipur	6307	5480	3833
227	Saigaon	Manjira	UGD, Hyderabad	Karnataka	Bidar	1433	1022	910
228	Sakhara	Wainganga	WD, Nagpur	Maharashtra	Gadchiroli	*	1210	-
229	Sakleshpura	Hemavati	CD, Bangalore	Karnataka	Hassan	700	765	*
230	Sakmur	Wardha	WD, Nagpur	Maharashtra	Chandrapur	-	693	-
231	Salawad	Kalisindh	CD, Jaipur	Rajasthan	Jhalawar	*	19117	*
232	Saloora	Manjira	UGD, Hyderabad	Telangana	Nizamabad	-	656	858
233	Samdoli	Warna	UKD, Pune	Maharashtra	Sangli	-	3250	*
234	Sangam(LGD)	Kinnerasani	LGD,	Telangana	Bhadradri	548	-	915

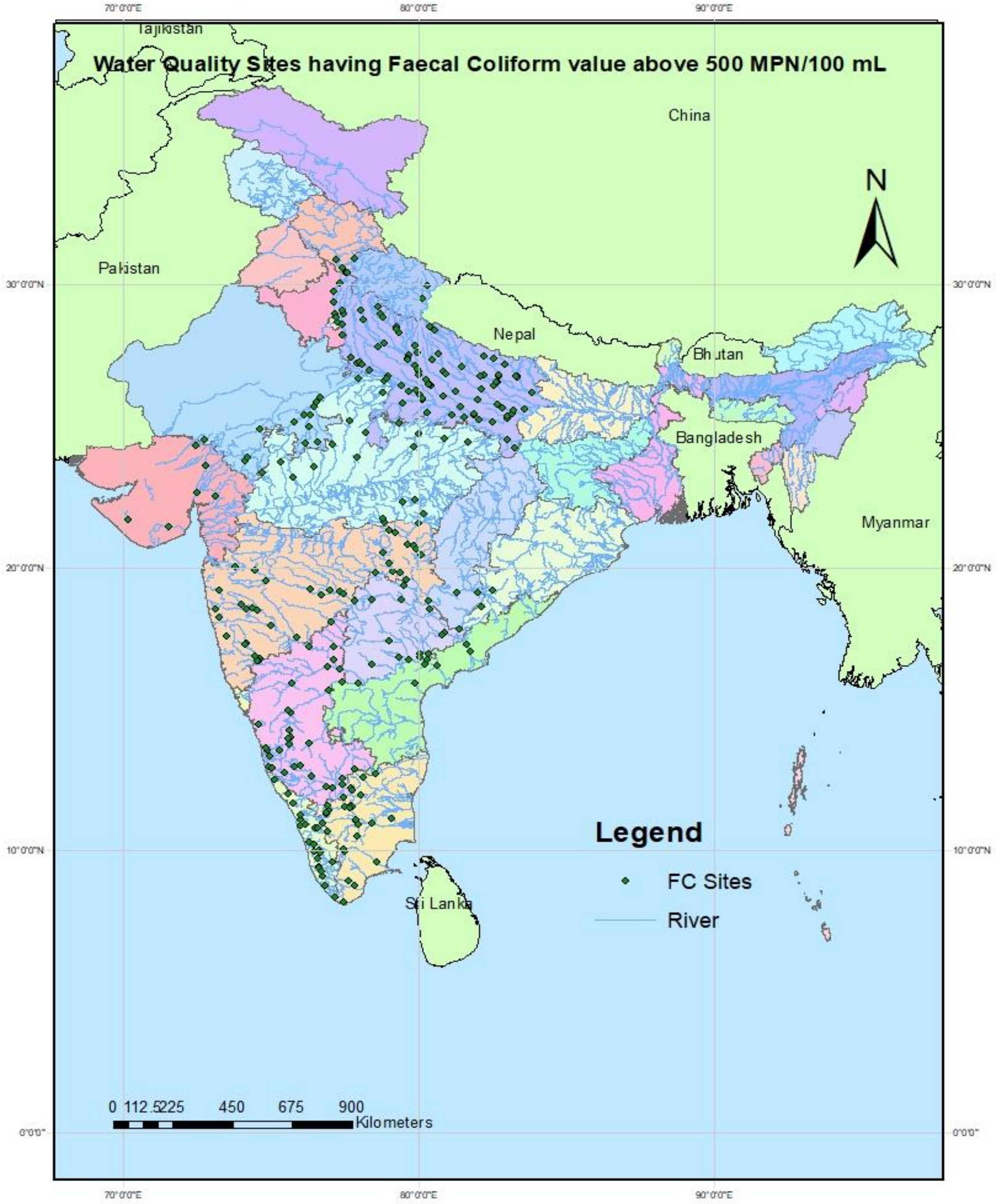
S.No.	Monitoring stations	River	CWC Division Office	State	District	Pre-M	M	Post- M
			Hyderabad		Kothagudem			
235	Sangod	Parwan	CD, Jaipur	Rajasthan	Kota	*	21313	*
236	Santeguli	Aghnanashini	SWRD, Kochi	Karnataka	Uthara Kannada	*	1005	-
237	Saradaput	Sabari	LGD, Hyderabad	Chhattisgarh	Malkangiri	-	-	825
238	Sarangpur	Kalisindh	CD, Jaipur	M.P.	Rajgarh	*	17286	*
239	Sarati	Nira	UKD, Pune	Maharashtra	Pune	-	833	*
240	Satna	Tons	MGD-3, Varanasi	M.P.	Satna	5620	4880	3633
241	Satrapur	Kanhan	WD, Nagpur	Maharashtra	Nagpur	-	2191	-
242	Savandapur	Bhavani	SRD, Coimbatore	Tamil Nadu	Erode	1805	1165	1472
243	Seohara	Ramganga	MGD-2, Lucknow	U.P.	Bijnaur	2860	2773	2733
244	Seondha	Sindh	LYD, Agra	M.P.	Datia	6717	1516	701
245	Sevanur	Chittar	SRD, Coimbatore	Tamil Nadu	Erode	*	958	-
246	Shahjahanpur	Khannaut	MGD-2, Lucknow	U.P.	Shahjahanpur	3100	3600	3440
247	Shahzadpur	Ganga	MGD-3, Varanasi	U.P.	Kaushambi	5550	5893	4100
248	Shastri Bridge	Ganga	MGD-3, Varanasi	U.P.	Prayagraj	6573	5680	4817
249	Shimoga	Tunga	CD, Bangalore	Karnataka	Shimoga	*	584	*
250	Singasadanapalli	Ponnaiyar	SRD, Coimbatore	Tamil Nadu	Krishnagiri	1662923	2482500	738333
251	Sitapur	Sarayan	MGD-2, Lucknow	U.P.	Sitapur	3467	3580	3825
252	Suddakallu	Dindi	LKD, Hyderabad	Telangana	Mahaboob Nagar	-	-	742
253	Sultanpur	Gomti	MGD-3, Varanasi	U.P.	Sultanpur	8160	6413	3650
254	T Bekuppe	Arkavathy	CD, Bangalore	Karnataka	Ramanagara	*	2630	*
255	T Narsipura	Kabini	CD, Bangalore	Karnataka	Mysore	2700	1338	*
256	T.Ramapuram	Hagari	LKD, Hyderabad	Karnataka	Bellary	1290	-	705
257	Tal	Chambal	CD, Jaipur	M.P.	Ratlam	*	17460	*
258	Tanda D/S	Ghaghra	MGD-1, Lucknow	U.P.	Ambedkar Nagar	2100	2093	1800
259	Tanda U/S	Ghaghra	MGD-1, Lucknow	U.P.	Ambedkar Nagar	1650	1760	1500
260	Terwad	Panchganga	UKD, Pune	Maharashtra	Kolhapur	*	6800	*
261	Thengumarahada	Bhavani / Moyar	SRD, Coimbatore	Tamil Nadu	Nilgiris	920	931	897
262	Theni	Vagai/Suruliar	SRD, Coimbatore	Tamil Nadu	Theni	2626	882	1460
263	Thevur	Sarabenga	SRD, Coimbatore	Tamil Nadu	Salem	*	612	732
264	Thimmanahalli	Yagachi	CD, Bangalore	Karnataka	Hassan	2200	616	*
265	Thoppur	Thoppaiyar	SRD, Coimbatore	Tamil Nadu	Salem	*	*	587
266	Thumpamon	Achankovil	SWRD, Kochi	Kerala	Pathanamthitta	*	775	-
267	Tihar Khera	Ramganga	MGD-2, Lucknow	U.P.	Bareilly	7100	7413	7400

S.No.	Monitoring stations	River	CWC Division Office	State	District	Pre-M	M	Post- M
268	Tondarpur	Sukheta	MGD-2, Lucknow	U.P.	Hardoi	9313	3857	3720
269	Tuini	Tons	UYD, New Delhi	Uttarakhand	Dehradun	656	-	600
270	Turtipar	Ghaghra	MGD-1, Lucknow	U.P.	Ballia	1850	1760	1500
271	Udi	Chambal	LYD, Agra	U.P.	Etawah	2146	2867	2460
272	Ujjain	Shipra	CD, Jaipur	M.P.	Ujjain	*	31409	1045000
273	Urachikottai	Cauvery	SRD, Coimbatore	Tamil Nadu	Erode	948	872	815
274	V S Bridge	Ganga	MGD-3, Varanasi	U.P.	Varanasi	6567	5753	3550
275	Vandiperiyar	Periyar	SWRD, Kochi	Kerala	Idukki	*	535	-
276	Varanasi	Ganga	MGD-3, Varanasi	U.P.	Varanasi	8193	7060	4467
277	Varanavasi	Maruthaiyar	SRD, Coimbatore	Tamil Nadu	Ariyalur	2715	1840	823
278	Vautha	Sabarmati	Mahi Division	Gujarat	Ahmedabad	137467	36333	31500
279	Veligonda	Musi	LKD, Hyderabad	Telangana	Nalgonda	1672	705	725
280	Vijayawada	Krishna	LKD, Hyderabad	A.P.	Krishna	680	635	1295
281	Wadenapally	Krishna	LKD, Hyderabad	Telangana	Nalgonda	2218	-	1045
282	Wadakbal	Sina	UKD, Pune	Maharashtra	Solapur	*	700	*
283	Wairagarh	Khobragadi	WD, Nagpur	Maharashtra	Gadchiroli	*	753	-
284	Warunji	Koyna	UKD, Pune	Maharashtra	Satara	*	6333	*
285	Yadgir	Bhima	LKD, Hyderabad	Karnataka	Yadgir	1350	594	950
286	Yamuna Expessway Road Bridge, Etamadpur	Yamuna	LYD, Agra	U.P.	Agra	556000	*	*
287	Yashwant Nagar	Giri	UYD, New Delhi	H.P.	Simaur	7500	-	-
288	Yelli	Godavari	UGD, Hyderabad	Maharashtra	Nanded	-	767	1175
289	Yennehole	Swarna	SWRD, Kochi	Karnataka	Udupi	*	667	-

(-) means No Hotspot.

(*) means river dry/data not available.

Figure 21: Water Quality Monitoring stations having Faecal Coliform above 500 MPN/100ml (2021)



7.1.13 Sodium Adsorption Ratio (SAR)

The Sodium adsorption ratio (SAR) is an irrigation water quality parameter used in the management of sodium-affected soils. It is an indicator of the suitability of water for use in agricultural irrigation, as determined from the concentrations of the main alkaline and earth alkaline cations present in the water. It is also a standard diagnostic parameter for the sodicity hazard of a soil as determined from analysis of pore water extracted from the soil. SAR is a measure of the amount of sodium (Na^{+}) relative to calcium (Ca^{2+}) and magnesium (Mg^{2+}) in the water extracted from a saturated soil paste. Soils that have values for sodium adsorption ratio of 13 or more may have an increased dispersion of organic matter and clay particles, reduced saturated hydraulic conductivity and aeration, and a general degradation of soil structure.

SAR allows assessment of the state of flocculation or of dispersion of clay aggregates in a soil. Sodium and potassium ions facilitate the dispersion of clay particles while calcium and magnesium promote their flocculation. The behaviour of clay aggregates influences the soil structure and affects the permeability of the soil whose directly depends on the water infiltration rate. It is important to accurately know the nature and the concentrations of cations at which the flocculation occurs: critical flocculation concentration (CFC). The SAR parameter is also used to determine the stability of colloids in suspension in water.

Although SAR is only one factor in determining the suitability of water for irrigation, in general, the higher the sodium adsorption ratio, the less suitable the water is for irrigation. Irrigation using water with high sodium adsorption ratio may require soil amendments to prevent long-term damage to the soil.

During the pre-monsoon, monsoon, and post-monsoon seasons consistently demonstrated that the average values of SAR (Sodium Adsorption Ratio) at all water quality Monitoring stations remained within the permissible limit of Class E, as designated by the Central Pollution Control Board (CPCB) for the best uses of water. This observation indicates that the levels of sodium relative to other ions in the water were within the acceptable range, suggesting no significant deterioration in water quality with respect to SAR during these periods.

CHAPTER – 8

Conclusion

The study conducted covered a total of 772 water quality monitoring stations situated in important rivers across the country to identify water quality hotspots. The study report is based on the average values recorded during pre-monsoon, monsoon, and post-monsoon seasons at these monitoring stations for the two years. The report provides a detailed analysis of 13 water quality parameters, highlighting the water quality status at various locations in India. The report also sheds light on the variations observed in the parameters essential for both the Central Pollution Control Board (CPCB) and Bureau of Indian Standards (BIS) classifications, along with parameters specific to the primary water quality criteria for bathing water as per the Ministry of Environment, Forest and Climate Change (MoEFCC). Based on the water quality data analysis, the following observations have been found:

pH

The pH levels analysis of the water quality at various monitoring stations showed dynamic variations. During the study period, Kharkhana located in Meghalaya state, along the Myntdu River, had the lowest pH of 4.02 during the pre-monsoon period. Meanwhile, Pratapgarh, Uttar Pradesh (Sai River) had the highest pH of 8.82. The pre-monsoon season recorded the highest number of water quality monitoring stations exceeding the acceptable pH limit. There were 15 monitoring stations, followed by 5 monitoring stations during the monsoon season and 4 monitoring stations during the post-monsoon period.

Electrical Conductivity

Six (06) water quality monitoring stations - Durvesh (Vaitarna), Elunuthi Mangalam (Noyyal), Luwara (Shetrunji), Varanavasi (Maruthaiyar), Vautha (Sabarmati) and Wadakbal (Sina) recorded an average electrical conductivity (EC) greater than 2250 µS/cm in the pre-monsoon season. In the monsoon and post-monsoon seasons, Elunuthi Mangalam (Noyyal) and Luwara (Shetrunji) exceeded the threshold of EC > 2250 µS/cm, respectively. The highest conductivity recorded was at Durvesh on the Vaitarna River in the state of Maharashtra, which was 16,435.50 µS/cm during 2021.

Ammonia as N (NH_3-N)

The highest concentrations of ammonia were observed at three different locations in India. R.S.P. (Brahmani River) in Odisha recorded the highest concentration of 50.22 mg/L during the post-monsoon season. Ninteen (19) water quality monitoring stations during the pre-monsoon season, 18 monitoring stations during the monsoon season, and 19 monitoring stations during the post-monsoon season had ammonia concentrations exceeding the acceptable limit. Sixteen (16) water quality monitoring stations were common across all seasons (pre-monsoon, monsoon, and post-monsoon). During the study period 21 monitoring monitoring stations situated along 7 rivers exhibited ammonia concentrations above 1.2 mg/L.

Fluoride

During the monsoon season, 2 water quality monitoring stations, R.S.P (Brahmani) in Odisha and Lingdem (HS) in Sikkim, displayed a distinct pattern of elevated average fluoride values exceeding 1.5 mg/l. In the post-monsoon season, both Odisha (R.S.P) and Sikkim (Lingdem (HS)) recorded average fluoride values that surpassed the acceptable limit of 1.5 mg/l. The maximum fluoride concentration was recorded as 7.23 mg/L during the post-monsoon season at Lingdem (HS) water quality monitoring station.

Total Hardness

Water quality exceeded at four different monitoring stations during the pre-monsoon season.These monitoring stations were Durvesh in the Vaitarna River, Luwara in the Shetrunji River, Varanavasi in the Maruthaiyar River, and Wadakbal in the Sina River. The highest total hardness value was recorded at Durvesh, Maharashtra in the Vaitarna River, Maharashtra, with a value of 2104 mg/L.

Chloride

Two (02) water quality monitoring stations, Durvesh (Vaitarna River) in Maharashtra and Luwara (Shetrunji River) in Gujarat, recorded chloride levels that exceeded the permissible limit. The highest value of 5624 mg/L was observed at Durvesh (Vaitarna River) during the pre-monsoon season. At Luwara (Shetrunji) monitoring station in Gujarat, the chloride concentration slightly increased from 1349 during the pre-monsoon seasons.

Boron

The Central Pollution Control Board (CPCB) sets a limit of 2 mg/l for boron in specific classes, including irrigation and industrial cooling. The limit prescribed by CPCB for Boron (B) in Class-E (Irrigation, Industrial Cooling, Controlled Waste disposals) is not greater than 2 mg/l. Monitoring stations consistently show average boron values within the acceptable permissible limit during pre-monsoon, monsoon, and post-monsoon seasons.

Nitrate

The concentration of nitrate was found to be the highest in Gatora-2 (Arpa, Chhattisgarh) during the pre-monsoon period. Fourteen (14) water quality monitoring stations exceeded the acceptable limit for nitrate concentrations during the pre-monsoon season, 8 monitoring stations during the monsoon season. During the post-monsoon period, 12 water quality monitoring stations had Nitrate as N values surpassing 10.16 mg/L (45 mg/L as NO_3^-). This indicates a worsening of water quality and raises serious concerns about nitrate contamination in rivers. The number of monitoring stations exceeding the acceptable limit in the pre-monsoon season was 14, while in post monsoon season decreased to 12. Similarly, in the monsoon season of only 8 monitoring stations exceeded the acceptable limit.

Dissolved Oxygen

There were 7 water quality Monitoring stations located at Yamuna (Delhi Railway Bridge), Hindon (Galeta), Chambal (Manderial and Pali), Solani (Roorkee D/S),Sabarmati(Vautha) and Ponnaiyar (Singasadanapalli) rivers that observed dissolved oxygen (DO) levels of 0.0 mg/L in the pre-monsoon season. During the monsoon season, 4 water quality monitoring stations situated at river Sabarmati (Vautha), Hindon (Galeta), Chambal (Manderial), and Ponnaiyar (Singasadanapalli) recorded DO levels of 0.0 mg/L. In the post-monsoon season, 5 water quality monitoring stations located at Yamuna (Noida), Hindon (Galeta), Sabarmati (Vautha) and Chambal (Manderial and Pali) rivers also reported DO levels of 0.0 mg/L. During the pre-monsoon season, 97 water quality monitoring stations reported average Dissolved Oxygen (DO) values below 5.0 mg/L. During the monsoon season, 138 water quality monitoring stations observed the same issue. Moreover, in the post-monsoon season, 83 water quality monitoring stations exhibited DO values below 5.0 mg/L.

Biochemical Oxygen Demand

During the post-monsoon season, the Hindon river in Uttar Pradesh recorded the highest BOD level of 61.55 mg/L during post-monsoon season. Ninty (90) water quality monitoring stations recorded average BOD values exceeding 3.0 mg/l during the pre-monsoon season and 101 monitoring stations recorded the same during the monsoon season. During post-monsoon season, 67 water quality monitoring stations displayed BOD values above 3.0 mg/l.

Total Coliform

The highest microbial content was observed during the post-monsoon season, reaching 87,500,000 MPN/100ml. The highest total coliform values were observed during the pre-monsoon, monsoon, and post-monsoon seasons at the Noida water quality monitoring station (Yamuna River) in Uttar Pradesh. The values recorded were: 61,750,000, 34,940,000, and 87,500,000 MPN/100ml. During the pre-monsoon season, 207 water quality monitoring stations recorded an average value of Total Coliforms (TC) exceeding 500 MPN/100 ml. During the monsoon season, 301 water quality monitoring stations recorded an average value of Total Coliforms (TC) exceeding 500 MPN/100 ml. In the post-monsoon season, this number increased to 247 monitoring stations.

Faecal coliform

During the pre-monsoon season of that year, the Galeta water quality monitoring station observed the highest faecal coliform levels, with a value of 18,966,667 MPN/100 ml. In 2021, 174 water quality monitoring stations recorded Faecal Coliforms (FC) exceeding 500 MPN/100 ml during the pre-monsoon season. During the monsoon season, this number increased to 240, and during the post-monsoon season, 186 monitoring stations showed elevated average FC levels. Moving to 2022, during the pre-monsoon season, 199 water quality monitoring stations recorded average FC values exceeding 500 MPN/100 ml.

Sodium Adsorption Ratio (SAR)

All the samples have been found within the acceptable limit of the SAR.

ABBREVIATION

Ammonia	= NH_3
Andhra Pradesh	= AP
Alpha Benzenehexachloride	= BHC
Biochemical Oxygen Demand	= BOD
Bureau of Indian Standards	= BIS
Boron	= B
Calcium	= Ca^{+2}
Cauvery Division	= CD
Central Pollution Control Board	= CPCB
Central Water Commission	= CWC
Chambal Division	= CD
Chenab Division	= CD
Chloride	= Cl^-
Dissolved Oxygen Dichlorodiphenyltrichloroethane	= DO = DDT
Eastern Rivers Division	= ERD
Electrical Conductance	= EC
Godavari Division	= GD
Himachal Pradesh	= HP
Himalayan Ganga Division	= HGD
Hydrology Division Hot Spring	= HD = HS
Iron	= Fe
Lower Krishna Division	= LKD
Lower Yamuna Division	= LYD
Madhya Pradesh	= MP
Magnesium	= Mg^{+2}
Mahanadi Division	= MD
Mahi Division	= MD
Middle Brahmaputra Division	= MBD
Middle Ganga Division	= MGD
Monsoon Season	=M
Narmada Division	= ND
Nitrate	= NO_3^-
Non-Monsoon Season	=NM
Sodium Absorption Ratio	= SAR
South Western Rivers Division	= SWRD
Southern Rivers Division	= SRD
Sulphate	= SO_4^{-2}
Tapi Division	= TD
Total Dissolved Solids	= TDS
Total Coliforms	= TC
Total Hardness	= TH
Upper Yamuna Division	= UYD
Uttar Pradesh	= UP
Wainganga Division	= WGD
Rourkela Steel Plant	= RSP
Madhya Bharat Paper Ltd	=MBPL

Annexure-I

Water Quality Laboratories of CWC& NABL accreditation Status

Out of 23 Water Quality Laboratories in CWC, 22 laboratories received accreditation from NABL as on August, 2024.

List of Water Quality Labs in CWC			
S. No.	**Location of laboratory**	**Level of Laboratory**	**Organisation**
1	National River Water Quality Laboratory, New Delhi	III	YBO, New Delhi
2	Lower Cauvery Water Quality Laboratory, Coimbatore	III	C&SRO, Coimbatore
3	Upper and Middle Ganga Water Quality Laboratory, Varanasi	III	LGBO, Patna
4	Krishna and Godavari River Water Quality Laboratory, Hyderabad	III	K&GBO, Hyderabad
5	Upper Cauvery Water Quality Laboratory, Bangalore	II	MSO, Bangalore
6	South Western Flowing Rivers Water Quality Laboratory, Kochi	II	C&SRO, Coimbatore
7	Upper Krishna Division Water Quality Laboratory, Pune	II	K&GBO, Hyderabad
8	Mahi Division Water Quality Laboratory, Gandhinagar	II	MTBO, Gandghinagar
9	Lower Yamuna Water Quality Laboratory, Agra	II	YBO, New Delhi
10	Eastern Rivers Water Quality Laboratory, Bhubaneswar	II	M&ERO, Bhubaneswar
11	Hydrology Division, Chennai	II	C&SRO, Coimbatore
12	Wainganga Division, Nagpur	II	MCO, Nagpur
13	Chenab Division, Jammu	II	IBO, Chandigarh
14	Middle Ganga Division -I, Lucknow	II	UGBO, Lucknow
15	Mahanadi Division, Raipur	II	M&ERO, Bhubaneswar
16	Middle Brahmaputra Division, Guwahati	III	BBO, Guwahati
17	Lower Brahmaputra Division, Jalpaiguri	II	T&BDBO, Kolkata
18	U.B. Division, Dibrugarh	II	BBO, Guwahati
19	Lower Ganga Division-3, Berhampore	II	T&BDBO, Kolkata
20	Lower Ganga Division-2, Patna	II	LGBO, Patna
21	Narmada Division, Bhopal	II	NBO, Bhopal
22	Tapi Division, Surat	II	MTBO, Gandhinagar
23	Himalayan Ganga Division, Haridwar	II	UGBO, Lucknow

Annexure-II

List of Parameters analyzed in different levels of Water Quality Labs of CWC

S. No.	Level-I	Level-II	Level-III
1	Temperature	Temperature	Temperature
2	Colour	Ph	pH
3	Odour	Electrical Conductivity	Electrical Conductivity
4	pH	Total Dissolved Solids	Total Dissolved Solids
5	Electrical Conductivity	Turbidity	Turbidity
6	Dissolved Oxygen	Dissolved Oxygen	Dissolved Oxygen
7		Biochemical Oxygen Demand	Biochemical Oxygen Demand
8		Chemical Oxygen Demand	Chemical Oxygen Demand
9		Sodium	Sodium
10		Calcium	Calcium
11		Magnesium	Magnesium
12		Potassium	Potassium
13		Carbonate	Carbonate
14		Bicarbonate	Bicarbonate
15		Chloride	Chloride
16		Sulphate	Sulphate
17		Fluoride	Fluoride
18		Boron	Boron
19		Ammonia (Nitrogen)	Ammonia (Nitrogen)
20		Nitrate	Nitrate
21		Nitrite	Nitrite
22		Silicate	Silicate
23		Phosphate	Phosphate
24		Total Coliform	Total Coliform
25		F. Coliform	F. Coliform
26			Arsenic
27			Cadmium
28			Chromium
29			Copper
30			Iron
31			Lead
32			Nickel
33			Mercury
34			Zinc
35			Alpha Benzenehexachloride (BHC), Beta BHC, Gama BHC (Lindane)
36			OP-Dichlorodiphenyltrichloroethane (OP DDT), PP-DDT
37			AlphaEndosulphan, Beta Endosulphan,
38			Aldrin, Dieldrin,
39			Carbaryl (Carbamate),
40			Malathian, Methyl parathion
41			Anilophos, Chloropyriphos

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