

ASSESSMENT OF ARSENIC CONTAMINATION IN THE INDIAN RIVERS

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How to cite this paper:

Sonkar, Gopal (2023)
Assessment of Arsenic
Contamination in the Indian
Rivers, Journal of Global
Resources, Vol. 09 (01)

DOI:

10.46587/JGR.2023.v09i01.010

Received: 22 Oct. 2022

Reviewed: 30 Nov. 2022

Final Accepted: 25 Dec. 2022


Freely available Online
www.isdesr.org

Abstract: *The present study analyses in order to determine whether or not arsenic contamination exists in rivers and what are cause responsible for it. India has 764 river water quality monitoring sites across the subcontinent. The study analyses 432 monitoring stations due to data availability. The most important rivers in India flow through Himachal Pradesh, Haryana, Punjab Uttarakhand, Uttar Pradesh, Bihar, West Bengal, Assam, Chhattisgarh, Jharkhand, Maharashtra, Karnataka, and others. The current study is shaped by causal research under the applied research approach used by academics and practitioners in river water assessment. Quantitative techniques were implemented during initial secondary data collection & analyses. The study also conducted a content analysis and sweeping review of how institutions in India talk about the origins and effects of arsenic toxicity. The central water commission data has discovered that almost all rivers have arsenic amounts below the permissible limit except eight rivers. Arsenic contamination can be caused by a variety of natural and human activities. However, research indicates that industrial processes are the primary contributor.*

Key word: Industrialisation, Contamination, Toxicity, Discharges, Human activities.

Introduction

Arsenic is an element with properties that are intermediate between those of metals and solid non-metals or semiconductors. Arsenic has a toxicity nature while having a density that ranges from 3.5 to 7 g/cm³ and is rather large in volume (Kapaj, Peterson, Liber, & Bhattacharya, 2006). The World Health Organization (WHO) identified arsenic as “*arsenic has potential public health risk. And arsenic is not a metal but a metalloid, along with non-nutritive metals like antimony, beryllium, cadmium, lead, and mercury, that are known to be harmful when combined with arsenic*” (WHO, 2001; WHO, 2011). Arsenic contamination in the river water bodies is a severe issue. Industrialisation is directly responsible for arsenic contamination. An increasing amount of arsenic contamination created risks living beings to inherently harmful effects (Squibb & Fowler, 1983). The contaminants are released into the water streams due to the many different industrial processes (Sharma, Prasad, & Rupainwar, 1991; Yan & Viraraghavan, 2001).

Ingestion, inhalation, or absorption via the skin are the three routes that arsenic can take into the human body. The vast majority of arsenic consumed or inhaled is efficiently absorbed into the bloodstream via the gastrointestinal tract and lungs. Scratches on the skin are a late symptom of arsenic toxicity and are commonly observed in people who drink contaminated water (Perschagen, 1983). The arsenic in water can cause hyperkeratosis, conjunctivitis, hyperpigmentation, gangrene, cardiovascular diseases, etc. (Kipling, 1977; WHO, 2001). Drinking water containing high levels of arsenic over a prolonged period can cause a condition known as arsenicosis, a chronic sickness (Kapaj, Peterson, Liber, & Bhattacharya, 2006). There has been an increase in the number of miscarriages and spontaneous abortions due to rising arsenic levels in the water supply (Csanady & Straub, 1995). The Arsenic contaminant must be effectively eliminated from waste water to shield the aquatic environment and living beings from potentially damaging effects. The growing concern about protective arsenic contamination in the Indian rivers has encouraged the Indian government through stricter laws (CPCB, 2021).

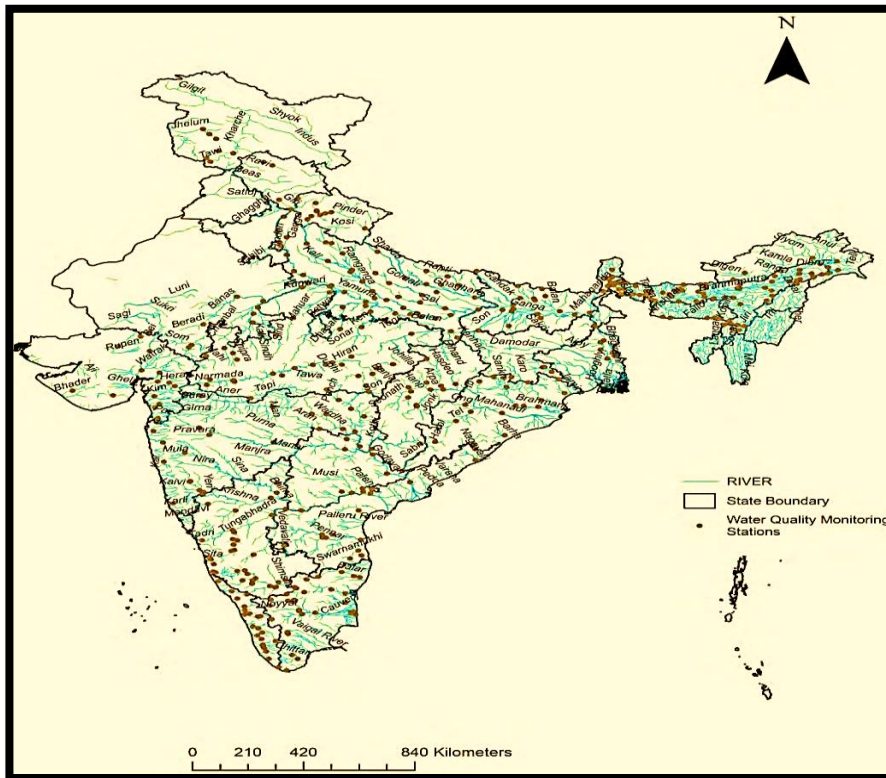
Study Area

Arsenic contaminations were examined at the national level using data from the Central Water Commission. The data included all rivers across India. The following map shows the location of the Indian rivers and monitoring stations. India's river systems may be broken down into four distinct groups: Himalayas River systems, Deccan Plateau River systems, Coasts River systems and the country's Interior River systems (Figure 1). The glaciers in the Himalayas melt the whole year, so rivers that flow from them never dry up. However, these rivers swell to frightening levels during the monsoon. The Gangetic River system is the largest in India, draining roughly one-fourth of the country. The rivers that flow from the Indian peninsular plateau rely heavily on rainwater, and the monsoons give them a second chance after a hot and dry summer.

Objective

The study aims to track the concentration of arsenic metal contamination in Indian rivers and its cause.

Figure 01: Indian Rivers Location with Monitoring Stations



Sources: Central Water Commission, Ministry of Jal Shakti

Research Methodology and Sources

The first step in the study must define arsenic contamination through the literature review. Then, quantitative methods were introduced during secondary data collection and analysis. The study did a broad overview of discourses and content analysis about arsenic contaminant sources and impacts on the human being in the Indian context. Excel was used for statistical analysis to determine maximum, minimum, average, and standard deviation.

Secondary Data

The secondary data were collected from the “Central Water Commission” in New Delhi. The Commission has collected data in three different seasons viz, monsoon (2016 and 2017), summer (2014, 2016, 2017 and 2018), and winter (2014, 2015, 2016, 2017, 2019). The Central Water Commission has collected 2834 samples from 432 river water quality monitoring sites across the Indian subcontinent. The data summarised on arsenic contamination in annexure no. one.

Result and Discussion

Annexure no. one is a list of Indian rivers that determine the presence of arsenic concentration between 0 to 13.33. Telangana, Assam, Uttar Pradesh, Kerala, Madhya Pradesh, Tamil Nadu, Uttarakhand and Delhi have 23 rivers with arsenic toxicity levels between 9 to 13.33 g/L. West Bengal, Assam, Uttar Pradesh, Bihar, Chhattisgarh, Haryana, Jharkhand, Maharashtra, Kerala, Karnataka, Orissa, Gujrat, Uttarakhand and Punjab have 191 rivers with arsenic contamination between 5 to 9 g/L. According to the statistics, “arsenic concentrations are found to be most rivers below the acceptable limit except eight rivers (Godavari, Brahmaputra, Ghaghra,

Pamba, Ganga, Burhner, Ramganga and Arasalar) where concentration to be found above 10 g/L.

However, it is hard to believe only one institutional data (Central Water Commission) because CPCB study put many industries in a list of red, orange, green and white categories (Red-60, Orange- 82, Green- 63, and white- 36). The arsenic toxicity caused by 16 industries ranks among the highest in India (based on using arsenic-containing products in manufacturing).

The Arsenic Contamination in the Indian Rivers

Arsenic is widespread in the Indian environment and its various geographical unit, including troposphere, earth crust, natural surface water, and groundwater. Arsenic toxicity is discharged into the Indian environment by various natural and human activities, including erosional reactions, biological activity¹, and industrial discharges (Kapaj, Peterson, Liber, & Bhattacharya, 2006; CPCB, Central Pollution Control Board (Ministry of Environment, Forest & Climate Change, Government of India), 2016). Natural factors are mostly to blame for arsenic accumulation in the Indian environment, and Indian activities (man-made) have exacerbated the situation by using arsenic-containing products in manufacturing industries. Indian tanneries, steel mills, paint & pigment factories, mines, electroplating plants, petroleum refineries, and power plants that use fossil fuels contribute to arsenic contamination (CPCB, Central Pollution Control Board (Ministry of Environment, Forest & Climate Change, Government of India), 2016; Central Water Commission , 2021). However, arsenical substances will have lasting effects on the Indian ecosystems, at least in the immediate area (Squibb & Fowler, 1983; WHO, 2011).

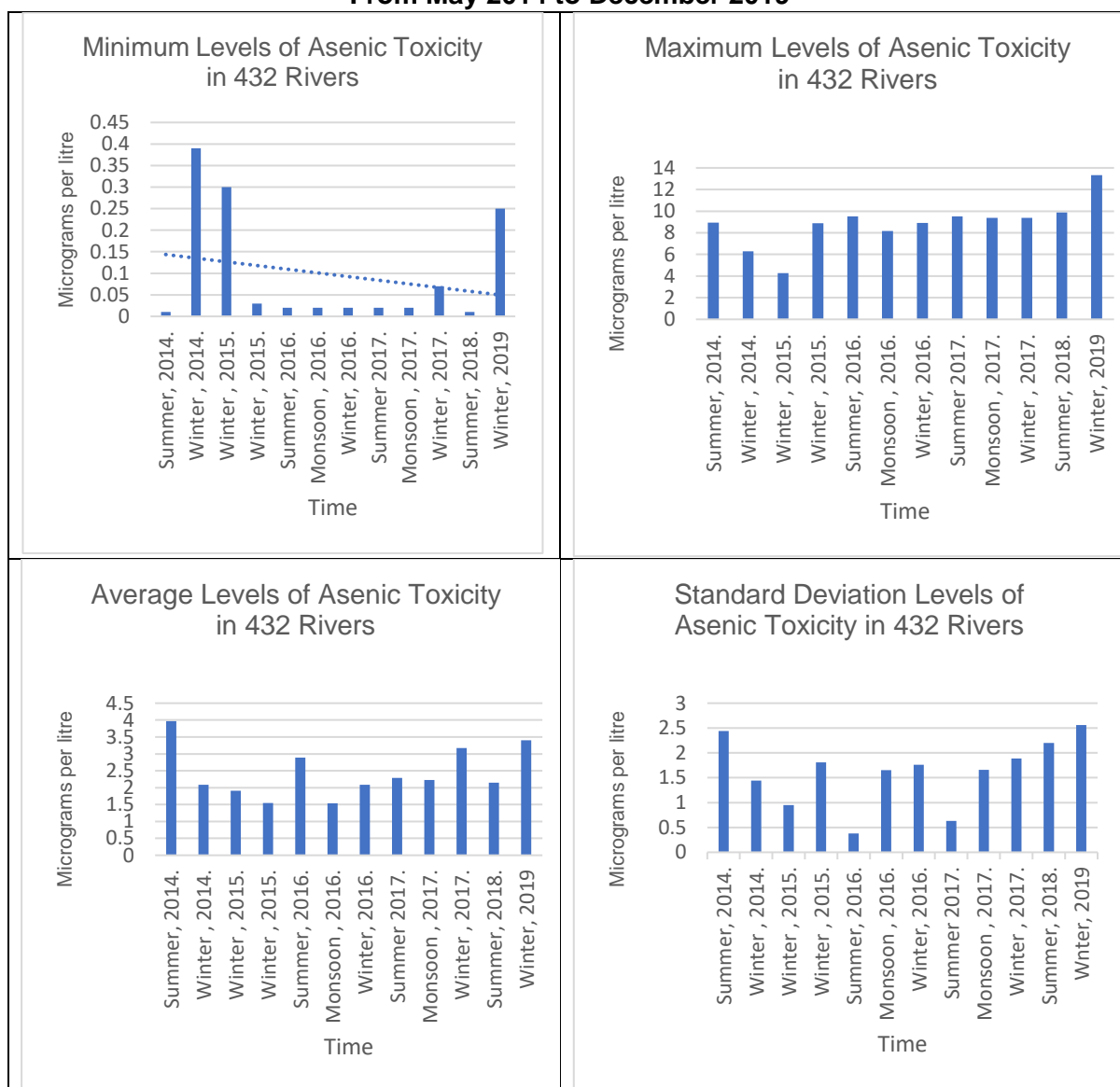
The collected data were analysed and compared to the Indian Standards, which specify acceptable levels of arsenic contamination in rivers water, except eight rivers with 55 rivers were alarming levels category. Drinking water arsenic levels over 0.01 mg/L (10 g/L) are not considered safe by the Bureau of Indian Standards (Standards, 2015). Arsenic levels can be found to be ranging from 0.01 to 13.33 g/L. The Porakundi water quality monitoring station on the Arasalar river recorded arsenic levels as high as 13.33 micrograms per litre on December 2019. Mostly arsenic toxicity concentration is substantially below that is considered safe by the Bureau of Indian Standards (Central Water Commission , 2021). The following table classified Indian rivers according to Hazards prone (Red colour), Alarming stage (Yellow colour) and Moderate (orange colour) with their level of arsenic toxicity.

The table's arsenic toxicity concentrations range from 5 to 14 micrograms per litre. Above 10 micrograms per litre considers hazards in nature (red colour). Below 10 to 7 micrograms is considered an alarming stage (yellow colour), and between 5 to 7 micrograms are moderate. Still, the effects of arsenic have nonetheless been observed in the health problems mentioned before. According to Central Water Commission, eight rivers have arsenic toxicity above levels that Godavari (Telangana), Brahmaputra (Assam), Ghaghra (Uttar Pradesh), Pamba (Kerala), Ganga (Uttar Pradesh), Burhner (Madhya Pradesh), Ramganga (Uttar Pradesh), Arasalar, (Tamil Nadu). Commission did not justify which part of Ganga in Utter Pradesh has arsenic toxicity because Ganga is flowing in many districts in Utter Pradesh with the same problem associated with other rivers. The fifteen rivers: Bagmathi, Ganga (Shahzadpur), Ganga (Buxar), Alakananda, Yamuna (Delhi Rly

¹¹ Certain microorganisms produce volatile methylarsines as a by-product of their activity in the process of refining copper and lead ores.

Bridge), Rind, Ganga (Rishikesh), Alaknanda (Rudraprayag), Payaswani, Bhagirath (Koteshwar), Ganga(Kachlabridge), Bhagirathi, Yamuna (Aauriya), Ganga (Bhitora), Yamuna (Pratapur) were found with arsenic levels between 9 to 10 g/L in Uttarakhand, Delhi, Uttar Pradesh and Kerala. More than 100 rivers contained arsenic contamination between 7 to 9 g/L in West Bengal, Assam, Uttar Pradesh, Bihar, Chhattisgarh, Haryana, Jharkhand, Karnataka, Maharashtra, Kerala, Karnataka, Orissa, Gujrat, Uttarakhand, and Punjab.

Graph 01: The Statistics Analyses of Arsenic Contaminations in 432 Indian Rivers: From May 2014 to December 2019



Sources: Central Water Commission, Ministry of Jal Shakti

According to the statistics, “arsenic concentrations are determined to be virtually rivers below the authorised range except eight rivers.” This conclusion is to be reached after analysing the information. However, it is not easy to put all faith in the findings of a single administration (the Central Water Commission). The numerous studies conducted by the CPCB indicate that heavy metal toxicity levels in industrial regions might be excessive in river water. The CPCB has classified many industries into its list’s red, orange, green and white categories. According to CPCB studies “Pulp & Paper (Paper manufacturing with or without pulping), Chlor Alkali, Dyes and Dye Intermediates, Pesticides (Technical) (excluding Formulation), Oil Refinery

(Mineral oil or Petro refineries), Tanneries, Petrochemicals (manufacture of and not merely use of raw material), Cement, Thermal Power Plants, Iron & Steel (Involving processes from ore/scrap, and Integrated Steel Plants), Zinc Smelter, Copper Smelter, Aluminium Smelter, Glass and fibre glass production and processing, Industrial carbon including electrodes and graphite blocks, activated carbon, carbon black etc., Paints and Varnishes (excluding blending/mixing), Synthetic detergent and soap, Photographic films and chemicals, Chemical, petrochemical and electro chemicals including manufacture of acids such as Sulphuric Acid, Nitric Acid, Phosphoric Acid etc., Industry or process involving metal treatment or process such as pickling, surface coating, paint baking, paint stripping, heat treatment, phosphating or finishing etc., Industry or process involving electroplating operations, Asbestos and asbestos based industries and Mining and ore-beneficiation” industries produce arsenic containing waste water which is main reason of arsenic toxicity in above mention state rivers (Ministry of Statistics and Programme Implementation, 2010).

Table 01: List of Rivers Containing Hazards, Alarming and Moderate levels of Arsenic Toxicity

Hazards 	Rivers Name Alarming  Moderate 	Ranges of Arsenic Contain (g/L)
Godavari (Telangana), Brahmaputra (Assam), Ghaghra (Uttar Pradesh), Pamba (Kerala), Ganga (Uttar Pradesh), Burhner (Madhya Pradesh), Ramganga (Uttar Pradesh), Arasalar, (Tamil Nadu)		14 -10
Bagmathi, Ganga (Shahzadpur), Ganga (Buxar), Alakananda, Yamuna (Delhi Rly Bridge), Rind, Ganga (Rishikesh), Alaknanda (Rudraprayag), Payaswani, Bhagirath (Koteshwar), Ganga (Kachlabridge), Bhagirathi, Yamuna (Aauriya), Ganga (Bhitaura), Yamuna (Pratapur).		9-10
Wardha Bamni (Wardha), Kunderu, Gomti, Rangpochu, Churni, Kosi, Bhagirath(Uttarkashi), Vamanapuram, Kamala-Balan, Damanganga, Ghagra, Gomti (Sultanpur), Sakkar, Hiran, Ganga (Patna), Narmada, Hasdeo, Ganga (Kanpur), Yamuna (Rajapur), Ganjal, Subansiri, Ramganga (Dabri), Dhansiri, Yamuna (Hamirpur), Ganga (Mirzapur), Ganga (Ankinghat), Narmada (Barmanghat), Kabini, Gumra, Yamuna (Mathura), Ganga (Hathidah), Teesta (Sankalan), Sankosh, Kwano, Sher, Ponnaiyar, Subansiri (Chouldhowaghat), Moyar, Yamuna (Agra), Vamsadhara, Yamuna (Mawi), Gomti (Neemsar), Pulanthodu (Pulamanthole), Sai (Raibareli), Wardha (Hivra).		9-8
Beki (Beki Road Bridge), Bagmathi, Chaliyar, Aliyar, Pranhitha, Teesta (Sevoke), Pennar, Gomti (Lucknow), Burhi Gandak (Sikandarpur), Ramganga (Bareilly), Wainganga, Jalangi, Kharkai, Chalakudy, Wainganga, Dikhow, Narmada(Dindori), Wunna, Brahmaputra (Dhubri), Kanhan, Tambrapani, Ganga (Fatehgarh), Cheyyar, Dudhnai, Longai, Chhoti Sarju (Akabarpur), Narmada (Hoshangabad), Periyar, Barak (A.P.Ghat), Vaitarna, Barak (B.P. Ghat), Sharda, Godavari (Bhadrachalam) Bhagirathi (Kalna (Flow)), Teesta (Khanitar), Kopili, Ganga (Haridwar), Yamuna(Kalanaur), Narmada (Garudeshwar), Raidak-II (Barobisha), Rukni, Muvvattupuzha, Kamala-Balan, Desang, Ganga (Varanasi), Subarnarekhan (Jamsolghat), Tuini, Yamuna (Mohana (Yamuna)), Yamuna (Etawah), Ranganadi, Sai (Pratapgarh), Arkavathi.		8-7
Sone, Dhaleshwari, Suruliari, Penganga (P.G.Bridge), Bagh, Bhavani, Dikhow, Raidak-I, Subarnarekha, Sabari, Yamuna (Palla), Sonkosh, Brahmani, Subarnarekha (Muri), Teesta (Domohani), Mahi, Padma/Mahananda (English Bazar), Aghanashini, Jiabharali, (Bhalukpong), Jiabharali (Jiabharali NT Road), Bhavani, Rapti , Kinnerasani, Sagaileru, Ganga(Azmabad), Gandak, Torsa, Ganga (Garhamukteshwar), Lohit, Desang, Balaram, Rapti, Parwati, Sone (Japla), Kiul, Sheturni, Lowara, Champamati, Sone (Kuldah Bridge), Saryu (Ayodhya), Kopili, Kamang, Desang (Dillighat), Peddavagu, Wainganga, Halia, Kutyadi.		7-6
Bhagirathi, Hemavathi, Ken, Siang, Tons, Kopili, Rapti, Bhagirath (Tehri), Tambrapani, Kanhan, Cauvery, Sabarmati (Derol Bridge), Seonath, Som, Mahi, Valapatnam, Tirap, Naora, Sankh, Tungabhadra, Brahmaputra(Dibrugarh), Meenachi, Ken, Kim, Thirumalairajanar, Godavari, Vanjiyar, Brahmaputra (Neamatighat), Ganga (Allahabad), Buridehing, Gandak, Achankovil, Bugi, Haladi, Bhadar, Hindon, Koel, Torsa, Manimala, Palar, Ganga (Farakka), Mahanadi (Basantpur), Hamp Andhiyar,Brahmaputra (Pandur), Godavari, Bharathapuzha, Chambal, Wainganga.		6-5

Sources: Central Water Commission, Ministry of Jal Shakti

List of the 60 types of water polluting industries in India as identified by the Central Pollution Control Board. Around 70 percent of all toxic water industrial pollution comes from just seven states.

Maharashtra is responsible for 15.9 percent of the country's total toxic water pollution, with Gujarat coming in at a close second at 15.5 percent and Tamil Nadu in third at 8.5 percent. Bihar ranks fourth, with 8.4 per cent of the total toxic pollution load, and Uttar Pradesh is close behind at 7.3 per cent. Madhya Pradesh and Orissa are also significant contributors to this pollution, accounting for 7 percent and 6.2 percent, respectively (CPCB, Parivesh: A News Letter from ENVIS Centre - Central Pollution Control Board, 2017; CPCB, Final Report on Inventorization of 17 Category /GPI/ Red Category Industries, 2016).

CPCB estimates that six states are responsible for 68 percent of the country's total industrial heavy metal water pollution load, with arsenic toxicity being the primary concern in this area. The state of Bihar has the most significant percentage, at 15.1 percent, followed by Maharashtra, at 14.2 percent. Orissa is responsible for 12.1 percent of the country's metal pollution as a state. Madhya Pradesh is responsible for 12.1 percent of this type of pollution, with 7.4 percent coming from West Bengal. The metal pollution load in Uttar Pradesh is 6.6 percent of the Indian load, placing it in sixth place. The iron and steel industry is the most significant contributor to the total arsenic toxic pollution load in all states except Assam, Gujarat, Goa, Kerala, Rajasthan, and Tamil Nadu. Industries include petrochemicals and fertilisers in Gujarat, distilleries in Goa, fertilisers and aluminium in Kerala, oil refining in Assam, leather goods in Tamil Nadu, and fertilisers in Rajasthan, which all play a significant role (CPCB, CEPI Technical Reports, 2011; CPCB, Final Report on Inventorization of 17 Category /GPI/ Red Category Industries, 2016).

Conclusions

The 432 river water quality stations showed that eight rivers had levels above the permissible limit, and 55 rivers had levels in the "alarming" range. The CPCB study indicates that industrial regions may have excessive pollution levels in river water. As a consequence, the CPCB has divided a wide range of industries into "red," "orange," "green," and "white" categories. Industrial pollution is a significant contributor to the overall river pollution problem in India. However, there is a lack of accurate data on the types and quantities of emissions (discharges) from different industries. This lack of information strictly constrains effective river water pollution management, pointing to the need to adopt alternative ways to estimate river water pollution parameters at the polluter level.

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Annexure 01: List of 432 Water Quality Monitoring Stations and Rivers in Presence of Arsenic Contamination: During the May 2014 to December 2019. (Arsenic (in µg/L))

	Water Quality Site	River	Max	Min
1	Porakudi	Arasalar	13.33	3.04
2	Changsari	Brahmaputra	12.6	0.36
3	Moradabad	Ranganga	10.85	0.26
4	Mohgaon	Burhner	10.76	0.71
5	Madamon	Pamba	10.45	0.03
6	Mirzapur	Ganga	10.36	0.17
7	Bhadrachalam	Godavari	10.17	4.7
8	Faizabad U/S	Ghaghra	10.11	0.08
9	Ekmighat	Bagmathi	9.87	0.09
10	Shahzadpur	Ganga	9.71	1.27
11	Buxar	Ganga	9.53	0.53
12	Srinagar	Alakananda	9.52	1.56
13	Delhi Rly Bridge	Yamuna	9.45	0.11
14	Kora	Rind	9.39	0.19
15	Rishikesh	Ganga	9.38	1.85
16	Rudraprayag	Alaknanda	9.38	0.83
17	Erinjipuzha	Payaswani	9.3	1.62
18	Koteshwar	Bhagirath	9.27	0.5
19	Kachlabridge	Ganga	9.15	0.44
20	Katwa	Bhagirathi	9.14	0.11
21	Aauriya	Yamuna	9.13	1.96
22	Bhitaura	Ganga	9.02	0.44
23	Pratapour	Yamuna	9.01	0.2
24	Bamni (Wardha)	Wardha	8.98	0.77
25	Alladupalli	Kunderu	8.96	0.35
26	Maighat	Gomti	8.95	1.08

27	Rangpo	Rangpochu	8.95	8.95
28	Hanskhali	Churni	8.91	0.82
29	Baltara	Kosi	8.88	0.26
30	Uttarkashi	Bhagirath	8.88	0.02
31	Ayilam	Vamanapuram	8.87	0.08
32	Jai Nagar	Kamala-Balan	8.86	0.43
33	Vapi	Damanganga	8.81	0.02
34	Turtipar	Ghagra	8.8	0.33
35	Sultanpur	Gomti	8.76	1.58
36	Gadarwara	Sakkar	8.75	0.25
37	Patan	Hiran	8.71	0.29
38	Patna	Ganga	8.69	0.69
39	Manot	Narmada	8.68	0.22
40	Bamnidih	Hasdeo	8.67	8.67
41	Kanpur	Ganga	8.67	0.39
42	Rajapur	Yamuna	8.61	1.09
43	Chhidgaon	Ganjal	8.56	0.03
44	Badatighat	Subansiri	8.55	0.26
45	Dabri	Ranganga	8.53	0.12
46	Numaligarh	Dhansiri	8.43	0.3
47	Hamirpur	Yamuna	8.41	2.25
48	Mirzapur	Ganga	8.41	0.77
49	Ankinghat	Ganga	8.4	0.12
50	Barmanghat	Narmada	8.35	0.31

51	Muthankera	Kabini	8.35	1.24
52	Gumrabazar	Gumra	8.34	0.64
53	Mathura	Yamuna	8.34	1.09
54	Hathidah	Ganga	8.31	1.07
55	Sankalan	Teesta	8.29	8.29
56	Sankosh LRP	Sankosh	8.27	3.01
57	Basti	Kwano	8.26	0.2
58	Belkhedi	Sher	8.23	0.08
59	Gummanur	Ponnaiyar	8.19	0.25
60	Chouldhowaghat	Subansiri	8.18	0.03
61	Thengumarahada	Moyar	8.17	0.21
62	Agra	Yamuna	8.16	1.38
63	Gunupur	Vamsadhara	8.16	0.07
64	Mawi	Yamuna	8.16	0.73
65	Neemsar	Gomti	8.1	0.17
66	Pulamanthole	Pulanthodu	8.09	1
67	Raibareli	Sai	8.03	0.55
68	Hivra	Wardha	8.01	0.17
69	Beki Road Bridge	Beki	7.98	2.5
70	Hayaghat	Bagmathi	7.97	0.03
71	Kuniyil	Chaliyar	7.97	2.24
72	Ambarampalayam	Aliyar	7.96	0.1
73	Tekra	Pranhitha	7.96	0.2
74	Sevoke	Teesta	7.95	7.95
75	Chennur	Pennar	7.93	0.17
76	Lucknow	Gomti	7.93	1.9
77	Sikandarpur	Burhi Gandak	7.93	0.58
78	Bareilly	Ramganga	7.92	0.3
79	Kumhari	Wainganga	7.92	0.44
80	Chapra	Jalangi	7.88	0.26
81	Adityapur	Kharkai	7.78	1.09
82	Arangaly	Chalakudy	7.75	2.04
83	Keolari	Wainganga	7.75	0.47
84	Sivasagar	Dikhow	7.74	0.03
85	Dindori	Narmada	7.73	0.87
86	Nandgaon	Wunna	7.68	0.1
87	Dhubri	Brahmaputra	7.66	7.66
88	Ramakona	Kanhan	7.65	1.26
89	Murappanadu	Tambrapani	7.62	0.01
90	Fatehgarh	Ganga	7.55	0.64
91	Magaral	Cheyar	7.55	7.55
92	Dudhnai	Dudhnai	7.54	0.37
93	Fakirabazar	Longai	7.54	1.2
94	Akabarpur	Chhoti Sarju	7.5	0.22
95	Hoshangabad	Narmada	7.43	0.49
96	Neeleswaram	Periyar	7.43	0.72
97	A.P.Ghat	Barak	7.42	1.28
98	Durvesh	Vaitarna	7.42	0.07
99	B.P. Ghat	Barak	7.41	0.71
100	Paliakalan	Sharda	7.4	0.51
101	Bhadrachalam	Godavari	7.39	0.62
102	Kalna (Flow)*	Bhagirathi	7.39	0.16
103	Khanitar	Teesta	7.39	7.39
104	Kampur	Kopili	7.38	0.43
105	Haridwar	Ganga	7.37	0.51
106	Kalanaur	Yamuna	7.37	0.52
107	Garudeshwar	Narmada	7.29	0.03

108	Barobisha	Raidak-II	7.22	1.64
109	Dholai	Rukni	7.22	0.1
110	Ramamangalam	Muvvattupuzha	7.16	0.44
111	Jhanjharpur	Kamala-Balan	7.11	0.06
112	Nanglamoraghat	Desang	7.1	0.17
113	Varanasi	Ganga	7.09	1.04
114	Jamsolghat	Subarnareka	7.08	0.95
115	Tuini	Tuini	7.08	0.45
116	Mohana (Yamuna)	Yamuna	7.04	0.12
117	Etawah	Yamuna	7.03	1.09
118	Ranganadi NT-Road Xing	Ranganadi	7.03	0.16
119	Pratapgarh	Sai	7.02	0.1
120	T. Bekuppe	Arkavathi	7.02	0.38
121	Chopan	Sone	7	0.43
122	Matijuri	Dhaleshwari	6.99	0.29
123	Theni	Suruliar	6.97	0.41
124	P.G.Bridge	Penganga	6.94	0.64
125	Rajegaon	Bagh	6.94	0.64
126	Savandapur	Bhavani	6.94	0.19
127	Bihubar	Dikhow	6.85	0.04
128	Tufanganj	Raidak-I	6.84	1.52
129	Ghatsila	Subarnareka	6.83	1.01
130	Konta	Sabari	6.83	0.91
131	Palla	Yamuna	6.81	0.4
132	Golaghat	Sonkosh	6.76	0.02
133	Gomlai	Brahmani	6.75	0.52
134	Muri	Subarnareka	6.74	1.33
135	Domohani	Teesta	6.71	2.46
136	Mataji	Mahi	6.68	0.25
137	English Bazar	Padma/Mahana nda	6.67	0.13
138	Santeguli	Aghanashini	6.64	0.65
139	Bhalukpong	Jiabharali	6.62	0.06
140	Jiabharali NT Road	Jiabharali	6.6	0.08
141	Nellithurai	Bhavani	6.57	0.66
142	Balrampur	Rapti	6.56	0.29
143	Sangam K	Kinnerasani	6.54	0.27
144	Nandipalli	Sagaileru	6.5	1.58
145	Azmabad	Ganga	6.47	0.17
146	Lalganj	Gandak	6.47	0.35
147	Hasimara	Torsa	6.43	1.91
148	Garhamukteshwar	Ganga	6.4	1.51
149	Dholabazar	Lohit	6.39	0.4
150	Desangpani	Desang	6.36	0.12
151	Chitrasani	Balaram	6.3	0.18
152	Birdghat	Rapti	6.27	0.62
153	Khatoli	Parwati	6.27	0.42
154	Japla	Sone	6.26	0.24
155	Lakhisarai	Kiul	6.26	0.02

156	Lowara	Sheturni	6.25	0.12
157	Behalpur	Champamati	6.24	6.24
158	Kuldah Bridge	Sone	6.22	0.28
159	Ayodhya	Saryu	6.21	0.03
160	Dharamtul	Kopili	6.2	0.14
161	Seppa	Kamang	6.16	0.02
162	Dillighat	Desang	6.15	0.36
163	Bhatpalli	Peddavagu	6.09	1.33
164	Ashti	Wainganga	6.07	0.58
165	Halia	Halia	6.07	1.79
166	Kuttyadi	Kuttyadi	6.07	0.48
167	Kalna (EBB)	Bhagirathi	5.99	0.91
168	Sakleshpur	Hemavathi	5.98	0.03
169	Banda	Ken	5.97	0.19
170	Passighat	Siang	5.95	0.67
171	Meja Road	Tons	5.88	0.19
172	Jagibhakatgaon	Kopili	5.85	0.33
173	Regauli	Rapti	5.85	0.32
174	Tehri	Bhagirath	5.85	1.14
175	Kuzhithurai	Tambrapani	5.84	2.58
176	Satrapur	Kanhan	5.84	0.15
177	Biligundullu	Cauvery	5.82	0.47
178	Derol Bridge	Sabarmati	5.8	0.14
179	Ghatora	Seonath	5.8	5.8
180	Rangeli	Som	5.8	0.18
181	Paderdibadi	Mahi	5.78	0.27
182	Perumannu	Valapatnam	5.73	0.4
183	Udaipur (Tirap)	Tirap	5.73	0.05
184	Neora	Naora	5.71	5.71
185	Tilga	Sankh	5.68	0.3
186	Honnali	Tungabhadra	5.67	0.55
187	Dibrugarh	Brahmaputra	5.66	0.37
188	Kidangoor	Meenachi	5.64	1.48
189	Madla	Ken	5.63	0.07
190	Motinaroli	Kim	5.62	0.04
191	Thengudi	Thirumalairajan ar	5.58	5.58
192	Mancherial	Godavari	5.57	0.93
193	Peralam	Vanjiyar	5.56	5.56
194	Neamatighat	Brahmaputra	5.55	0.24
195	Allahabad	Ganga	5.54	1.16
196	Chenimari	Buridehing	5.49	0.14
197	Tribeni	Gandak	5.49	0.46
198	Thumpamon	Achankovil	5.48	1.77
199	Dimapara	Bugi	5.47	0.45
200	Haladi	Haladi	5.4	0.32
201	Ganod	Bhadar	5.39	1.11
202	Galeta	Hindon	5.38	0.51

203	Jaraikele	Koel	5.36	0.63
204	Ghugumari	Torsa	5.32	2.16
205	Kalloopara	Manimala	5.32	2.4
206	Kudlur	Palar	5.29	3.26
207	Farakka	Ganga	5.28	0.69
208	Basantpur	Mahanadi	5.22	2.92
209	Andhiyar Kore	Hamp	5.21	5.21
210	Pandu	Brahmaputra	5.17	0.4
211	Perur	Godavari	5.17	0.49
212	Kumbidi	Bharathapuzha	5.16	2.14
213	Dholpur	Chambal	5.11	0.1
214	Pauni	Wainganga	5.11	0.7
215	Akkihebbal	Hemavathi	4.99	0.11
216	Duddhi	Kanhar	4.96	0.69
217	Koelwar	Sone	4.92	0.36
218	Chanwada	Orsang	4.9	0.27
219	Garrauli	Dhasan	4.9	1.76
220	Berhampore	Bhagirathi	4.88	0.92
221	Dhamkund	Chenab	4.87	0.85
222	Sandia	Narmada	4.87	0.07
223	Karathodu	Kadalundi	4.81	1.16
224	Nagalamadike	Pennar	4.78	4.78
225	Khanpur	Mahi	4.76	0.34
226	Sripalpur	Punpun	4.75	0.12
227	Urachikottai	Cauvery	4.75	0.13
228	Mankara	Bharathapua	4.72	0.59
229	Mohgaoan	Burhner	4.72	0.37
230	Avarankuppam	Palar	4.7	4.7
231	Chel	Chel	4.7	4.7
232	Barod	Kali Sindh	4.68	0.23
233	Diana	Diana	4.68	4.68
234	Kodumudi	Cauvery	4.67	1.19
235	Madhira	Wyra	4.59	0.99
236	Margherita	Buridehing	4.59	0.06
237	Singla-Bazar	Rangit	4.59	4.59
238	Suklai	Suklai	4.59	0.08
239	Pattazhy	Kallada	4.54	0.47
240	Seondha	Sind	4.53	0.44
241	Udi	Chambal	4.52	0.41
242	Pingalwada	Dhadher	4.51	0.45
243	Ashramam	Pazhayar	4.49	2.73
244	Bhomoraguri	Brahmaputra	4.43	0.16
245	Elginbridge	Ghagra	4.42	0.13
246	Matigara	Balason	4.42	2.11
247	Bokajan	Dhansiri	4.41	0.14
248	Panbari	Burisuti	4.38	4.38
249	Moradabad	Ramganga	4.37	1.18
250	Gadat	Ambika	4.32	1.06
251	Dheng Bridge	Bagmathi	4.3	0.56

252	Mohana (Betwa)	Betwa	4.25	0.4
253	Pudur	Kannadipuza	4.25	1.57
254	Bansi	Rapti	4.24	0.02
255	Chuchankatte	Cauvery	4.24	1.79
256	Malakkara	Pampa	4.24	1.41
257	Shahijina	Betwa	4.23	0.15
258	Puthimari NH Road crossing		4.19	0.14
259	Wairagarh	Khobragarhi	4.19	0.32
260	Tonk	Banas	4.168	0.21
261	Rajghat	Betwa	4.16	0.93
262	Musiri	Cauvery	4.1	0.47
263	Pagladiya N.T.Road Crossing		4.09	0.07
264	Kudige	Cauvery	4.08	0.05
265	Wadenapally	Krishna	4.07	0.15
266	Panposh	Brahmani	4.02	1.17
267	Kalampur	Kaliyar	4.01	0.87
268	T.K.Halli	Shimsha	4.01	0.51
269	Prem Nagar	Chenab	3.98	0.77
270	Aklera	Parwan	3.96	0.548
271	Deoprayag	Bhagirath	3.95	0.17
272	Elunuthi managalam	Noyyal	3.94	0.94
273	Sibbari	Dareng	3.93	0.21
274	Nallammaranpatty	Amaravathi	3.92	2.1
275	Mantralayam	Tungabhadra	3.91	3.81
276	Puthimari D.R.F.	Puthimari	3.9	0.01
277	Talcher	Brahmani	3.9	0.13
278	Sangam J	Jhelum	3.87	0.25
279	Ghat	Sarju	3.86	0.82
280	Kokrajhar	Gaurang	3.86	1.78
281	Ambasamudram	Vaigai	3.85	3.85
282	Sonapurhat	Mahananda	3.85	1.58
283	Murti	Murti	3.81	3.81
284	Abu Road	Banas	3.79	1.28
285	Safapora	Jhelum	3.79	0.23
286	Majhitar	Rangit	3.78	3.78
287	Tikarpara	Mahanadi	3.78	1.08
288	A.P. Puram	Chittar	3.77	0.02
289	Pathagudem	Indravathi	3.74	0.29
290	Dawki	Umngot	3.73	0.1
291	Gopalkheda	Purna	3.73	0.74
292	Naharkatia	Buridehing	3.73	0.34
293	Miao	Neo dihing	3.69	0.24
294	Chepan	Raidak-I	3.68	2.54
295	Holehonur	Bhadra	3.67	0.15
296	Purushottampur	Rushikulya	3.66	0.92
297	Jammu Tawi	Chenab/Tawi	3.64	0.53
298	Harlahalli	Tungabhadra	3.63	0.61
299	Polavaram	Godavari	3.63	0.06

300	Ghish	Ghish	3.62	3.62
301	Sakmur	Wardha	3.62	0.88
302	Jaldhaka NH-31	Jaldhaka	3.61	2.03
303	Kudalaiyathur	Vellar	3.61	1.5
304	Yashwant nagar	Giri	3.6	0.17
305	Tezpur	Brahmaputra	3.58	0.1
306	Labha	Mahananda	3.54	0.39
307	Mekhliganj	Teesta	3.49	3.13
308	Akhnoor	Chenab	3.47	0.55
309	Ram Munshi Bagh	Jhelum	3.45	0.01
310	Shimoga	Tunga	3.45	0.49
311	Badlapur	Ulhas	3.44	3.04
312	Champasari	Mahananda	3.41	2.75
313	Nagrakata	Jaldhaka	3.4	3.4
314	T. Narasipur	Kabini	3.39	0.75
315	Byaladahalli	Haridra	3.36	0.93
316	Gelabil	Doyang	3.35	0.3
317	Vandiperiyar	Periyar	3.35	1.43
318	Bantwal	Nethravathi	3.34	1.55
319	Malkhed	Kagna	3.34	0.18
320	Sonapur	Digaru	3.34	0.03
321	Namsai	Neo dihing	3.3	0.28
322	Marella	Gundlakama	3.27	3.27
323	Teesta-Bazar	Teesta	3.27	1.51
324	Simga	Seonath	3.25	3.25
325	Pancharatna	Brahmaputra	3.19	0.09
326	Kashinagar	Vamsadhara	3.18	0.29
327	Mandleshwar	Narmada	3.17	0.07
328	Vautha	Sabarmati	3.17	0.02
329	M.H. Halli	Hemavathi	3.16	1.14
330	Gopurajapuram	Cauvery/ Puravidaiya ar	3.15	3.15
331	Nowrangpur	Indravathi	3.15	0.27
332	Jamshedpur	Subarnareka	3.14	0.74
333	Rampur	Jonk	3.13	3.13
334	Salebhata	Ong	3.1	1.87
335	Kollegal	Cauvery	3.07	0.65
336	Matunga	Kalanadi	3.05	0.14
337	Nallathur	Nandalar	3.04	2.06
338	K.M. Vadi	Lakshmantirtha	3.03	3.03
339	Mahuwa	Purna	3.02	0.24
340	Manas NH Crossing	Manas	2.98	1.3
341	Thoppur	Thoppaiyar	2.9	2.9
342	Damarcherla	Musi	2.88	2.05
343	Addoor	Gurupur	2.86	2.86
344	Handia	Narmada	2.78	0.18
345	Farakka/(HR)	Feeder Canal	2.77	0.39
346	Huvin Hedgi	Krishna	2.76	0.18

347	Yennehole	Yennehole	2.75	0.02
348	Karad	Krishna	2.72	2.72
349	Tezu	Lohit	2.72	0.17
350	Udaipur (Chandra)	Chenab/ Chandra	2.69	2.69
351	Keesara	Munneru	2.68	1.28
352	Kulsi	Kulsi	2.68	0.06
353	Tandi	Chenab/Bhaga	2.68	2.68
354	Baranwada	Banas	2.668	0.74
355	Kamalapuram	Papagni	2.66	0.63
356	Mathabhanga	Jaldhaka	2.65	1.16
357	Burhanpur	Tapi	2.59	0.27
358	Kheronighat	Kopili	2.59	0.3
359	Arjunwad	Krishna	2.54	2.54
360	Belne Bridge	Gad	2.53	1.84
361	Sulurpet	Kalingi	2.53	2.53
362	Hogenakkal	Chinnar	2.52	2.52
363	Vazhavachanur	Ponnaiyar	2.52	0
364	Marol	Varada	2.5	2.5
365	Thimmanahalli	Yagachi	2.48	0.38
366	Nellore	Pennar	2.45	1.7
367	Avershe	Sita	2.44	0.36
368	Govindapur	Burhabalang	2.42	0.38
369	Jenapur	Brahmani	2.41	0.54
370	Srikakulam	Nagavali	2.41	1.01
371	Phulgaon (Seasonal)	Varna	2.39	2.39
372	Paleru Bridge	Paleru	2.35	0.08
373	Sundergarh	Ib	2.34	0.92
374	Ujjain	Sipra	2.338	0.02
375	Chengalpet	Palar	2.33	0.59
376	Kantamal	Tel	2.31	2.1
377	Kharkhana	Surma/Myntdu	2.31	0.25
378	Kurubhata	Mand	2.27	2.12
379	Bawapuram	Tungabhadra	2.25	2.25
380	Pati	Goi	2.25	0.34
381	Samdoli	Varna	2.23	2.23
382	Bamni (Banjar)	Banjar	2.19	0.1
383	Kesinga	Tel	2.19	2.15
384	Fulertal	Barak	2.17	0.1
385	Warunji	Koyna	2.16	2.16
386	Gokak	Ghataprabha	2.15	2.15
387	Alutuma	Ramyala	2.12	0.27
388	Sarangkheda	Tapi	2.1	0.04

389	Anandpur	Ganga	2.07	0.11
390	Kogaon	Kundi	2.04	0.02
391	Therriaghat	Umsohrynkiev	2.04	0.53
392	Gaya	Harohar/Phalgu	1.96	0.6
393	Mathanguri	Beki	1.96	1.04
394	A B Road Xing	Parwati	1.87	0.09
395	Tal	Chambal	1.8	0.98
396	T. Ramapuram	Hagari	1.79	1.79
397	Mangaon (Seasonal)	Kal	1.77	1.77
398	Menangudi	Cauvery/Noolar	1.74	1.74
399	Aie NH Crossing	Aie	1.73	1.73
400	Champua	Ganga	1.71	0.03
401	Mahidpur	Sipra	1.63	0.34
402	Purna	Purna	1.61	1.61
403	Coronation	Teesta	1.53	1.53
404	Poanta	Yamuna	1.53	0.61
405	Koperagaon	Godavari	1.43	1.43
406	Kurundwad	Krishna	1.43	1.43
407	Gajaldoba	Teesta	1.1	1.1
408	Kamalpur	Banas	1.05	0.82
409	Pachegaon	Pravara	0.95	0.95
410	Sangod	Parwan	0.9	0.05
411	Pachauli	Sind	0.71	0.71
412	Arcot	Palar	0.68	0.66
413	Chittorgarh	Gambhiri	0.648	0.648
414	Yadgir	Bhima	0.6	0.6
415	Jagdapur	Indravathi	0.35	0.35
416	Dhulsar	Uri	0.26	0.26
417	Villupuram	Ponnaiyar	0.07	0.07
418	Annasaval	Nattar	0	0
419	Baronda	Pairi	0	0
420	Beki Mathanguri	Beki	0	0
421	Bendrahalli	Suvarnavathi	0	0
422	Cholachguda	Malaprabha	0	0
423	Golakganj	Dhansiri	0	0
424	Jondhra	Seonath	0	0
425	Kellodu	Vedavathi	0	0
426	Kuppelur	Kumudavathi	0	0
427	Manendragarh	Hasdeo	0	0
428	Naidupet	Swarnamukhi	0	0
429	Pathardhi	Kharun	0	0
430	Rajim	Mahanadi	0	0
431	Sevanur	Chittar	0	0
432	Thevur	Sarabenga	0	0