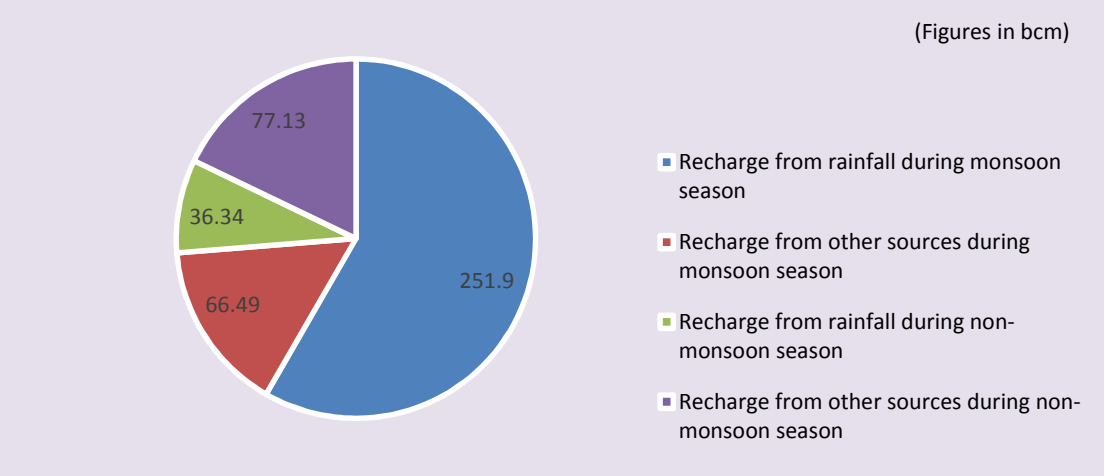
Chapter 2

Management of Ground Water

2.1 Introduction

Ground water is an annually replenishable resource but its availability is non-uniform in space and time. Technically, dynamic ground water refers to the quantity of ground water available in the zone of water level fluctuation, which is replenished annually. As per Dynamic Ground Water Resources of India (as on 31st March 2017)[15] published by CGWB in July 2019, annual replenishable ground water resource for the entire country has been assessed as 432 billion cubic meter (bcm). Keeping 39 bcm for natural discharge, the net annual ground water availability for the entire country is 393 bcm. The sources of ground water recharge are depicted in Chart 2.1.

Chart 2.1: Sources of Ground Water recharge

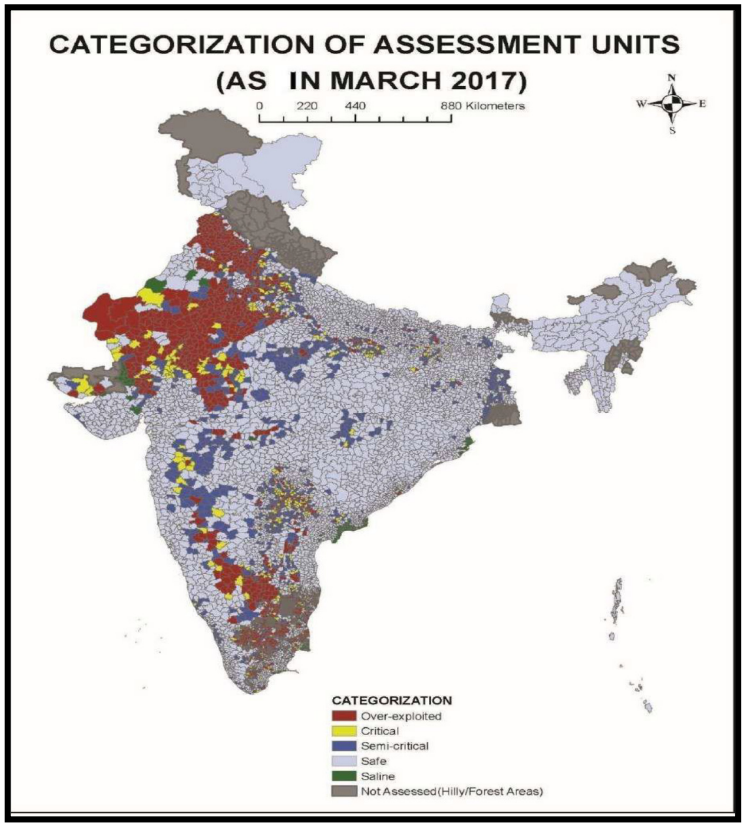


CGWB has categorised ground water assessment units based on the Stage of Extraction of ground water. As per Dynamic Ground Water Resources of India[16] (as on 31st March 2017), out of 6,881 assessment units all over India, 1,186 have been categorised as Over-exploited, 313 as Critical, 972 as Semi-critical, and 4,310 units as Safe (Chart 2.2). There are 100 assessment units which are completely saline.

[15] A report published by CGWB containing an assessment of the status of Ground Water resources, availability and utilisation in the country. The assessment is carried out jointly by CGWB and State Ground Water Departments at periodical intervals.

[16] A report published by CGWB containing an assessment of the status of Ground Water resources, availability and utilisation in the country. The assessment is carried out jointly by CGWB and State Ground Water Departments at periodical intervals.

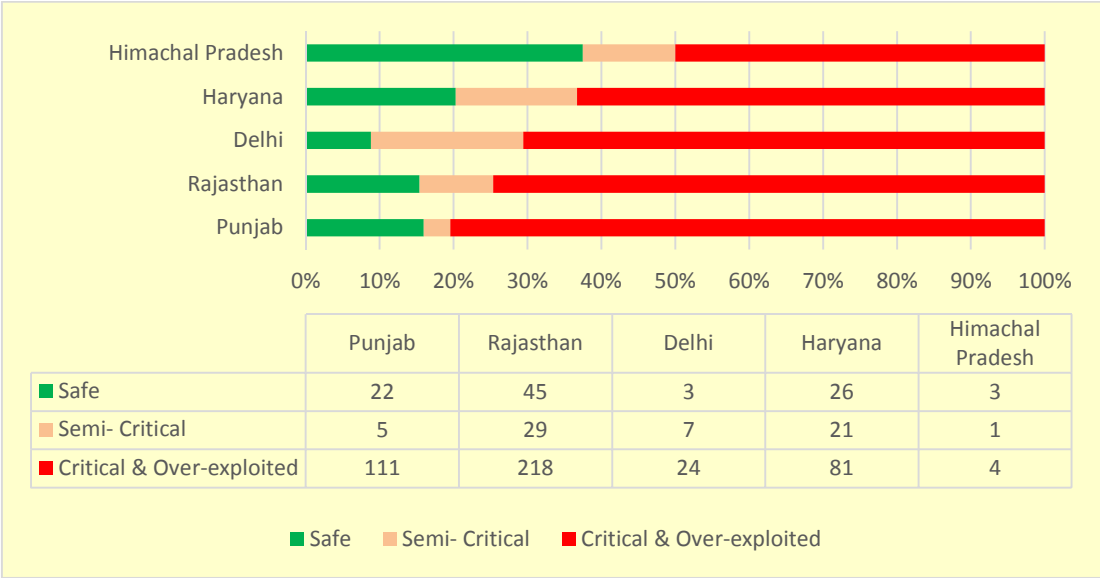
Chart 2.2: Categorisation of Assessment Units



Source: Dynamic Ground Water Resources of India (31 March 2017)

The top five States having the highest percentage of Over-exploited and Critical administrative units are Delhi, Haryana, Himachal Pradesh, Punjab and Rajasthan, as shown in Chart 2.3. The State-wise details are depicted in ***Annexure 2.1***.

Chart 2.3: States having significant number of unsafe units



	Punjab	Rajasthan	Delhi	Haryana	Himachal Pradesh
Safe	22	45	3	26	3
Semi- Critical	5	29	7	21	1
Critical & Over-exploited	111	218	24	81	4

It can be seen from Chart 2.3 that Punjab has the highest percentage (80 *per cent*) of critical and over-exploited units. Out of 138 assessment units in Punjab, only 22 units

(16 *per cent*) are safe and five units (four *per cent*) are semi-critical. The remaining 111 units (80 *per cent*) are critical and over-exploited.

Water being a State subject, the legislation for regulation and development of ground water is to be enacted by the State Governments/Union Territories (UTs). The Department of Water Resources, River Development and Ganga Rejuvenation (DoWR,RD&GR) is responsible for overall planning for the development of ground water resources, establishment of utilisable resources and formulation of policies for exploitation, overseeing of and providing support to State level activities in ground water development. The Central Ground Water Board (CGWB) has the mandate of developing and disseminating technologies and monitoring and implementing national policies for the scientific and sustainable development and management of India's ground water resources, including their exploration, assessment, conservation, augmentation, protection from pollution and distribution. Central Ground Water Authority (CGWA) deals with ground water regulation related issues.

This chapter discusses the mechanism for management of ground water in India. The chapter is divided into two sections. Section A covers issues in assessment of availability, utilisation and quality of ground water and mechanism for monitoring of ground water. Audit observations on functioning of regulatory bodies involved in management of ground water are discussed in Section B.

SECTION A: ASSESSMENT AND MONITORING OF GROUND WATER

2.2 Extraction of Ground Water

The Annual Ground Water Draft (i.e. extraction of ground water) of the entire country for the reference year 2017 has been estimated as 249 bcm, of which 221 bcm i.e. about 89 *per cent* is for used for irrigation. The remaining 11 *per cent* i.e. 28 bcm is used for domestic and industrial purposes. The status of ground water development in India during the period from 2004 to 2017 is given in Table 2.1.

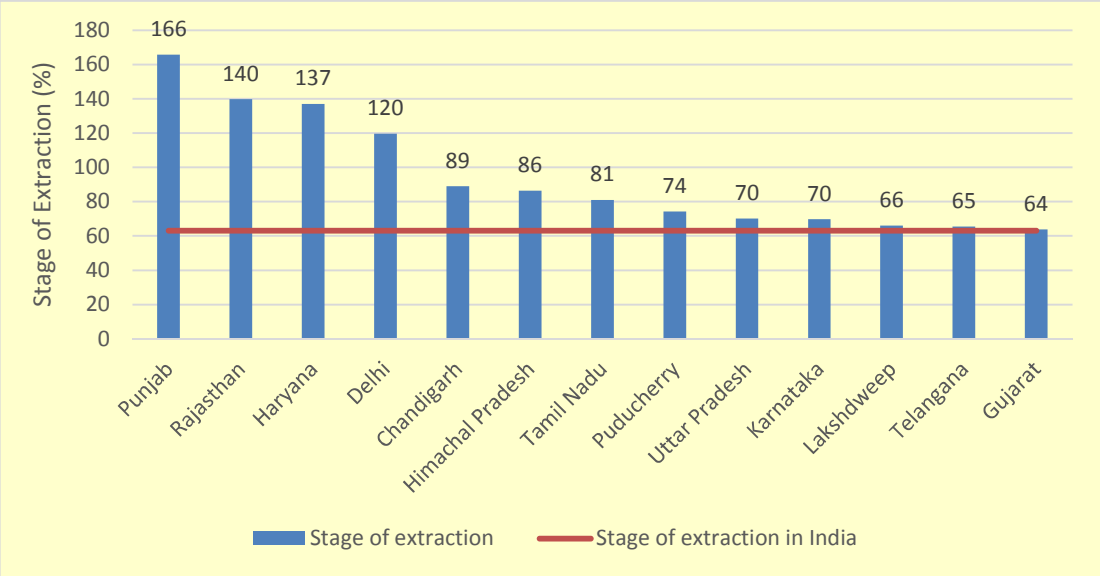
Table 2.1: Comparative status of ground water development

Categorisation	Percentage of blocks during year				
	2004	2009	2011	2013	2017
Safe	71	73	69	69	63
Semi-critical	10	9	11	10	14
Critical	4	3	3	4	5
Over-exploited	15	14	16	16	17
Saline	0	1	1	1	1

The above comparison shows that the percentage of safe blocks has decreased while the percentage of blocks categorised as semi-critical, critical and over-exploited has steadily increased over time.

The percentage of utilisation of ground water with respect to recharge is known as stage of extraction of ground water. The stage of extraction in the country has increased from 58 *per cent* in 2004 to 63 *per cent* in 2017[17]. State wise assessment of ground water resources availability, utilisation and stage of extraction showed that 13 States/UTs[18] had a stage of extraction higher than the overall national stage of extraction, as shown in Chart 2.4.

Chart 2.4: States having stage of extraction of ground water higher than national average



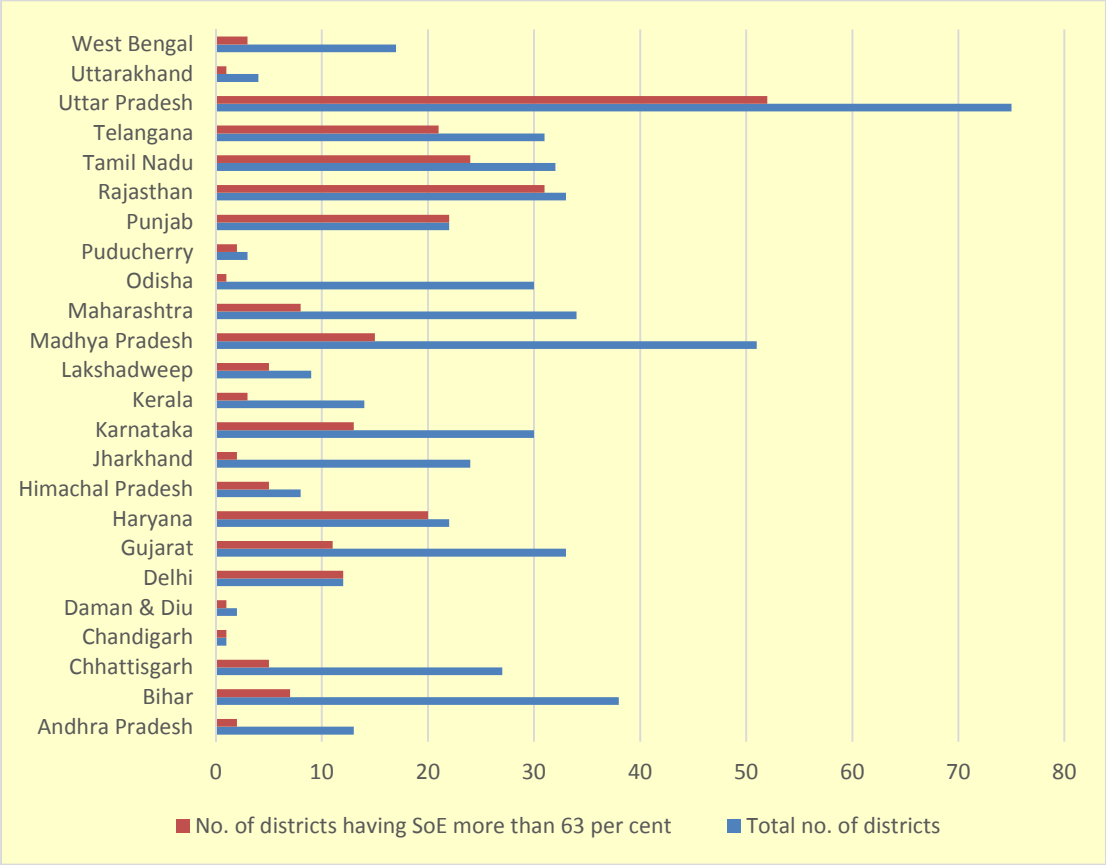
Four States/UTs (Delhi, Haryana, Punjab and Rajasthan) had a stage of extraction of more than 100 *per cent*. This indicated that extraction of ground water has surpassed the recharge of ground water. If unchecked, this may eventually exhaust the ground water resources completely in these States/UTs. The State wise position is shown in ***Annexure 2.2***.

At the district level, it was seen that out of 565 districts in 24 States/UTs, 267 districts (47 *per cent*) had stage of extraction more than 63 *per cent* (Chart 2.5). The stage of extraction in these 267 districts ranged from 64 *per cent* to 385 *per cent*.

[17] Source: Dynamic Assessment of Ground Water of the respective years

[18] Chandigarh, Delhi, Gujarat, Haryana, Himachal Pradesh, Karnataka, Lakshadweep, Puducherry, Punjab, Rajasthan, Tamil Nadu, Telangana and Uttar Pradesh.

Chart 2.5: Districts having high stage of extraction of ground water



2.3 Assessment of Ground Water

As per the approved (August 2013) Expenditure Finance Committee (EFC) memorandum for 2012-17, the assessment of ground water resources in terms of ground water quantity, utilisation pattern, stage of extraction of ground water, categorisation of units, etc. was to be done every two years by CGWB. Based on this data, Dynamic Ground Water Assessment Report was to be compiled, to enable further planning and management of ground water by CGWB.

During the audit period, CGWB conducted such assessments for 2013 and 2017 and published the Reports in June 2017 and July 2019 respectively. CGWB did not carry out this assessment for 2015 resulting in a gap of four years in assessment between 2013 and 2017.

DoWR,RD&GR stated (October 2019) that it had awarded the work related to automation of estimation of these resources to the Indian Institute of Technology, Hyderabad which is likely to reduce the time period substantially for this process. The Department added (January 2020) that the Department was considering undertaking such assessments through use of better technologies such as heli borne surveys which are expected to be more efficient and thereby help in reducing the time taken for such assessments.

Regular assessment is essential to take up timely interventions for management of ground water. Inability to do the same would hamper the regulation of ground water, as the scenario is dynamic in nature.

2.4 Ground Water Monitoring

CGWB assesses the water level in the country through its observation wells. In the approved Cabinet Note for the Ground Water Management & Regulation Scheme (GWMRS) for the XII Plan period (2012-17), CGWB proposed to increase monitoring of wells to measure ground water level from 15,653 wells to 50,000 wells (by March 2017) through an approved scheme called Ground Water Management & Regulation Scheme (GWMRS) for the XII Plan period (2012-17) having an outlay of ₹ 3,319 crore. CGWB also proposed to undertake Real time Ground Water Monitoring in various aquifers across the country through purpose built wells equipped with Digital Water Level Recorders (DWLRs) and Telemetry[19] in convergence with the ground water component under National Hydrology Project (NHP)[20]. It was observed that as of March 2020, CGWB was still planning and was yet to undertake real time Ground Water monitoring through DWLRs and Telemetry which indicated that progress in this area was not as per targets of the GWMR Scheme.

As of 31 March 2019, a network of only 15,851 observation wells for monitoring water quality (as detailed in ***Annexure 2.3***) were established. Thus, CGWB was falling behind its targets for establishing monitoring wells and for undertaking Real Time Ground Water monitoring, both of which are crucial for efficient management of ground water resources.

2.5 Assessment of Ground Water quantity and quality

2.5.1 Assessment of water levels

CGWB measures ground water levels four times a year during January, March/April/ May, August and November. Ground water samples are collected from these observation wells once a year during the month of March/April/ May to obtain background information of ground water quality changes on regional scale, which is used for planning ground water development and management programmes.

CGWB collected data relating to depth of water level of 15,165 wells in the post-monsoon period in 2018. As per this data, depth of the water level ranged from 0 to 130.20 meters in these wells. In States like Rajasthan, Haryana and Delhi, number of

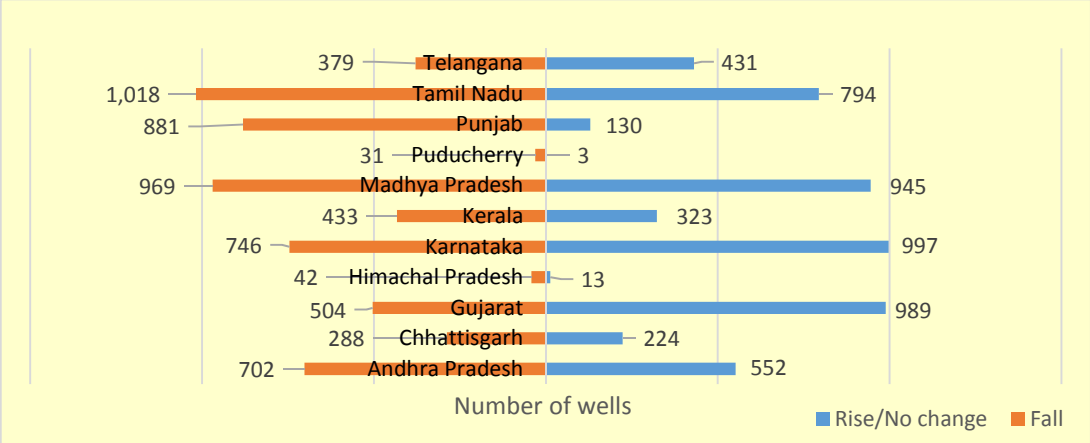
[19] Telemetry is the collection of measurements or other data at remote or inaccessible points and their automatic transmission to receiving equipment for monitoring.

[20] National Hydrology Project was approved in April 2016 as a central sector scheme with a total outlay of ₹ 3,679.76 crore with the objective of improving the extent, quality, and accessibility of water resources information, decision support system for floods and basin level resource assessment/planning and strengthening the capacity of targeted water resources professionals and management institutions in India.

wells having water depth more than 40 metres[21] was significant (Rajasthan – 20 *per cent*, Delhi – 10 *per cent* and Haryana – five *per cent*). On the other hand, in states like Meghalaya, Nagaland, Puducherry and Andaman & Nicobar Islands, ground water depth was less than five meters (Meghalaya-100 *per cent*, Nagaland-100 *per cent*, Puducherry-100 *per cent* and Andaman & Nicobar Islands-99 *per cent*). The State wise details are indicated in the ***Annexure 2.4.*** A comparison of depth to water level of post-monsoon 2018 with the decadal mean of post-monsoon (2008-17) relating to data available from 14,387 wells indicated that in 5,115 (about 36 *per cent*) of wells there was a rise in water level. However, 9,260 (about 64 *per cent*) wells showed decline in water level. In 12 wells, there was no change in water level. The State wise details are given in the ***Annexure 2.5***.

In addition to CGWB, 11 States also have their own monitoring wells. The position of rise and fall of water level in the wells monitored by the State agencies is shown in Chart 2.6.

Chart 2.6: Decadal water level fluctuation in State monitored wells



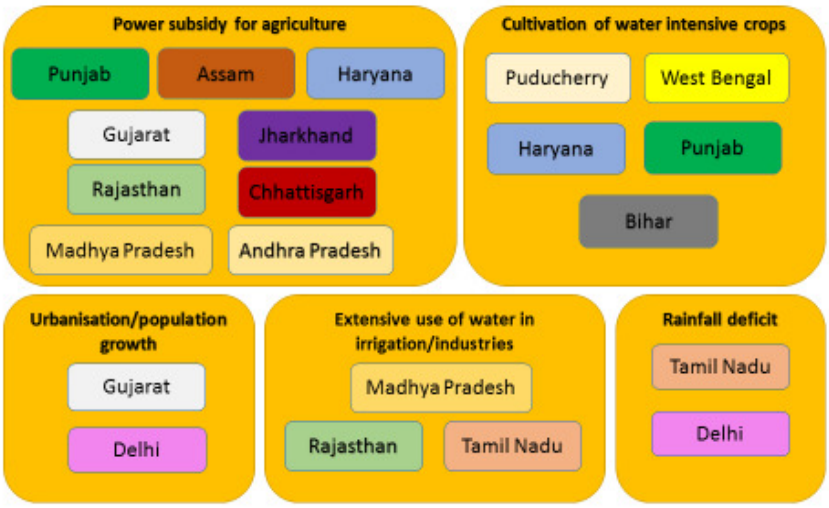
Of the total 11,394 wells monitored by State Government agencies in the 11 States, 5,993 wells (53 *per cent*) indicated fall in water level compared to the decadal water level, while 5,401 wells (47 *per cent*) showed rise or no change in water level. The data presented above indicates a predominant trend of decline in ground water levels as assessed by both CGWB and the States, which is a cause for concern.

2.5.2 Factors affecting Ground Water Quantity

Factors affecting ground water quantity were available in respect of 14 States/UTs. In these States/UTs, power subsidy for agriculture, cultivation of water intensive crops, rainfall deficit and urbanisation/population growth and extensive use of water in irrigation/industries were identified by the States/UTs as the major reasons affecting the quantity of ground water, as shown in Figure 2.1.

[21] Maximum range of depth categorized by CGWB.

Figure 2.1: Factors affecting ground water quantity



For the States/UTs in which this assessment was not conducted, the specific factors affecting ground water quantity were not identified, which could pose a constraint in development of effective strategies for management of ground water.

2.5.3 Assessment of Ground Water Quality

CGWB is required to monitor the water quality every year during the pre-monsoon season. Samples are collected in bottles (one litre) after thoroughly rinsing the bottle with the samples to be collected and the bottles are sealed at the site. Collected ground water samples are analysed for major parameters like Calcium, Magnesium, Potassium, Arsenic, Carbonates, Chlorides, Nitrates, Sulphates, Iron, Fluorides, Electrical Conductivity, pH etc. Sample analysis is carried out as per standard procedures outlined in American Public Health Association (APHA) manual.

CGWB had water quality data as of 2015 only. As per the water quality data for 2015, the number of States and districts (based on 15,165 locations in 32 States tested by CGWB) having contaminants higher than permissible limit (as per BIS standards[22]) are shown in Table 2.2.

Table 2.2: CGWB data on contamination of ground water in excess of limits

Contaminant	Number of States affected	Number of districts affected	Number of locations exceeding limit
Arsenic	19	99	697
Fluoride	23	188	637
Nitrate	20	335	2,015
Iron	25	282	1,389
Salinity	17	167	587

[22] Bureau of Indian Standards (BIS) has prescribed Drinking Water Specifications (last revised in 2012).

Excess levels of contaminants in ground water pose a serious health hazard. For instance, Audit noticed that 305 of the 697 locations (i.e. 44 *per cent*) where ground water was found to be contaminated with high levels of Arsenic were in West Bengal alone. Similarly, ground water in Punjab was found to be contaminated with higher than permissible levels of Arsenic (13 locations), Fluoride (18 locations) and Salinity (nine locations). The lack of up to date data on water quality also adversely affects development of a timely and focussed approach for appropriate ground water management strategies besides preventing assessment of progress made through implementation of such strategies.

Apart from CGWB, nine[23] States/UTs were also monitoring ground water quality. The number of locations exceeding limits prescribed by BIS as per quality data of monitoring wells of States/UTs is shown in Table 2.3.

Table 2.3: Contamination of ground water in excess of limits in State monitored wells

State/UT	Number of locations exceeding limit					
	Arsenic	Fluoride	Nitrate	Iron	Salinity	Chloride
Andhra Pradesh	-	755	3,828	-	-	439
Gujarat	-	187	20	-	628	471
Himachal Pradesh	Test not conducted	0	0	0	0	0
Karnataka	-	135	467	158	65	14
Odisha	-	34	138	627	27	265
Puducherry	-	-	26	8	10	13
Punjab	-	1	0	9	0	0
Tamil Nadu	Test not conducted	76	126	Test not conducted	404	106
Telangana	-	150	416	-	31	9

Note: Blank fields indicate that data was not provided by the concerned State agency

As per CGWB data (Table 2.2) there were a total of 637 locations having excess Fluoride content. However, the data available with Andhra Pradesh (Table 2.3) showed 755 locations having excess Fluoride content in the ground water in that State alone. Similarly, CGWB's data for nitrate showed that 2,015 locations had nitrate beyond the permissible limit; whereas the data available with Andhra Pradesh showed that 3,828 locations had excess nitrate. This indicated that the number of observation wells maintained by CGWB were inadequate to comprehensively monitor the ground water. This also indicates the need to integrate the findings of CGWB and States so as to provide more reliable indicators in respect of the ground water scenario in the country.

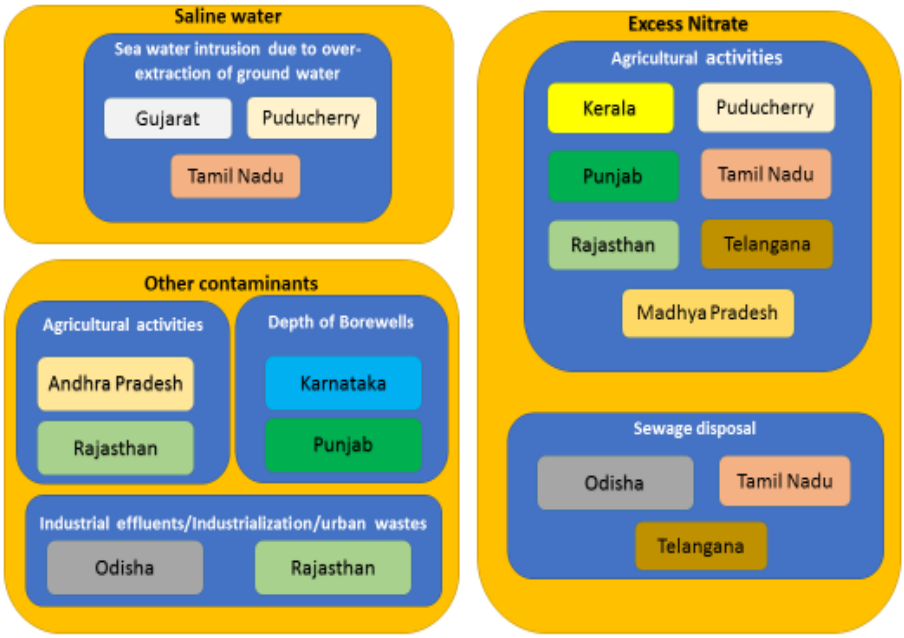
[23] These nine states include six states i.e. Andhra Pradesh, Himachal Pradesh, Karnataka, Tamil Nadu Telangana and Puducherry which have their own regulation for Ground Water.

DoWR,RD&GR stated (September 2020) that monitoring of ground water quality was done every year and the data shared through the India WRIS portal. Audit however, noticed (October 2020) that the WRIS portal contained data as of 2015-16 only.

2.5.4 Factors affecting Ground Water Quality

Broadly, the quality of ground water is affected by Anthropogenic (generated by human activity) and Geogenic (generated by geological process) activities. The factors affecting ground water quality were available in respect of 11 States/UTs (Figure 2.2).

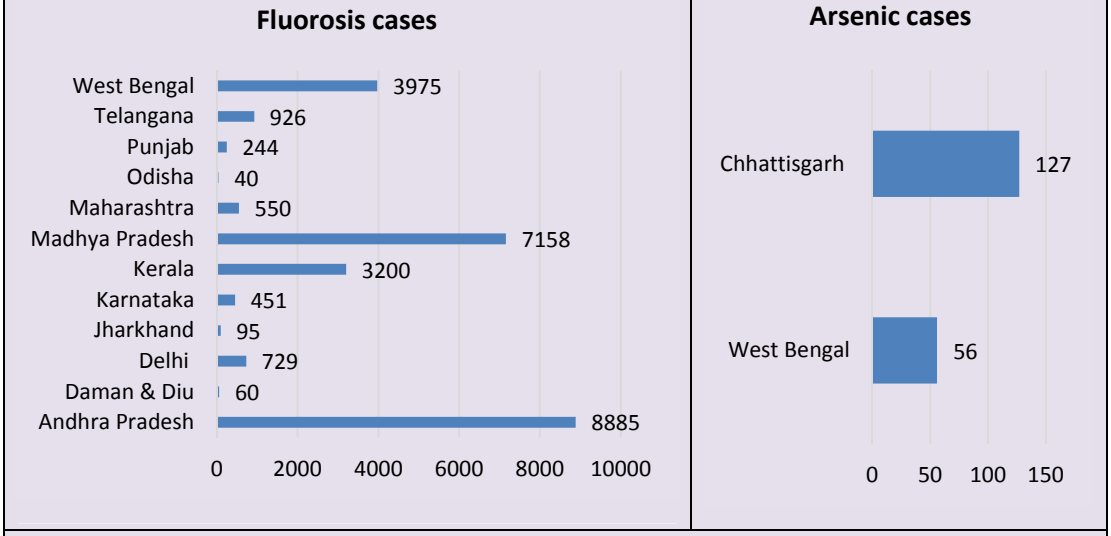
Figure 2.2: Factors affecting ground water quality



Most of the States/UTs that conducted assessment of change in quality of ground water reported excessive use of fertilizers and pesticides, disposal of industrial and municipal waste and sea water intrusion as factors for deterioration of ground water quality. This also poses serious health issues for the general populace. Information on cases of fluorosis and arsenic poisoning were provided by 15 States[24] (Chart 2.7).

[24] Data was available for the period 2013-18 (Andhra Pradesh, Delhi, Haryana, Kerala, Puducherry, West Bengal – Bankura District for Fluorosis and Nadia District for Arsenic), 2013-19 (Madhya Pradesh), 2017-18 (Daman & Diu, Karnataka-Vijayapura District, Punjab and Telangana) and 2017-19 for Maharashtra. For three states i.e. Chattisgarh, Odisha and Jharkhand, information regarding period was not available.

Chart 2.7: Cases of Fluoride and Arsenic poisoning



No cases of fluorosis reported from sampled districts of Haryana and Puducherry. No cases of Arsenic reported from Daman & Diu, Haryana, Jharkhand, Karnataka, Madhya Pradesh, Maharashtra, Odisha, Puducherry and Telangana.

The number of cases of fluorosis was significant in Andhra Pradesh, West Bengal and Madhya Pradesh. West Bengal was also affected by the problem of Arsenic poisoning. In the absence of any such assessment by the remaining States/UTs, the threats due to contamination of ground water could not be ascertained in these States/UTs, which might, in turn, affect planning and development of appropriate strategies for management of ground water.

SECTION B: FUNCTIONING OF REGULATORY BODIES

2.6 Model Bill on Ground Water

To enable the States to enact Ground Water Legislation, DoWR,RD&GR circulated (2005) a Model Bill to all the States/UTs for regulation and development of ground water. In view of the changing ground water scenario, the Department constituted a committee for re-drafting the Model Bill viz. Ground Water (Sustainable Management) Bill, 2017. As of December 2019, the Model Bill was under review as per the suggestions of NITI Aayog.

2.7 Legislative framework in States/UTs

The Table 2.4 shows the position of ground water legislation as of December 2019 in the 33 States/UTs.

Table 2.4: Implementation of legislation on ground water

States in which legislation has been fully implemented	States in which legislation has been partially implemented	States in which legislation has not been implemented
Assam Chandigarh Dadra and Nagar Haveli Goa Himachal Pradesh Jammu and Kashmir Punjab Karnataka Kerala Lakshadweep Puducherry West Bengal Telangana Uttar Pradesh Odisha	Andhra Pradesh Bihar Maharashtra Uttarakhand	Arunachal Pradesh Chhattisgarh Daman & Diu Delhi Gujarat Haryana Jharkhand Madhya Pradesh Manipur Meghalaya Nagaland Rajasthan Tamil Nadu Tripura

Out of 33 States/UTs, 19 States/UTs had enacted legislation. In four States, Audit found that legislation was only partially implemented. The details in these four States are given in Table 2.5.

Table 2.5: Incomplete implementation of legislation on ground water

Sl. No.	State	Audit observation
1.	Andhra Pradesh	The Andhra Pradesh Water Land & Trees Act was enacted in 2002 and the Andhra Pradesh Water, Land and Trees Authority (APWALTA) was constituted (2002) under this Act. APWALTA was to be re-constituted every two years for members nominated under sub-section (k) and every three years for members nominated under sub-section (l) and (m) of section 3 of this act. APWALTA was constituted in 2002 and it was reconstituted in 2004. Further reconstitution of APWALTA has not taken place after the bifurcation of the State in June 2014. In addition to APWALTA, Water, Land and Trees Authority (WALTA) were also to be constituted at district and mandal levels. District level WALTA was constituted in all the 13 districts in 2002-03. However, in three selected districts viz. Anantapuramu, Chitoor and YSR Kadapa, reconstitution of the district level WALTA authorities was not found on record. As per the WALTA Rules, 2004, dedicated staff was to be provided to carry out WALTA functions. This was, however, not done and multiple departments were dealing with ground water. Government of Andhra Pradesh stated (July 2019) that necessary steps would be initiated in this regard.
2.	Bihar	The Bihar Ground Water (Regulation and Control of Development and Management) Act 2006 was passed (January 2007). Though the Act enabled the State Government to make rules for the purpose of the Act, rules/regulations to implement the Act were not framed even after a lapse of 12 years. Further, as per this Act, State Ground Water Authority (SGWA) was to be constituted which was not constituted as of March 2019.
3.	Maharashtra	The State Legislative Assembly passed the Maharashtra Groundwater (Development and Management) Act, 2009 which was notified and made effective from 01 June 2014 to facilitate and ensure sustainable, equitable and adequate supply of groundwater. However, Rules for implementation of the Act were not finalised (October 2019). In the absence of Rules, important

Sl. No.	State	Audit observation
		provisions in the Act such as notifying area for regulating use of groundwater, preparation of Integrated Watershed Development and Management plan, registration of owners of wells, registration of drilling rig owners and operators were not implemented.
4.	Uttarakhand	The Uttarakhand Water Management and Regulatory Act was passed in 2013 to provide for the establishment of the Uttarakhand Water Management and Regulatory Authority for regulating water resources. As the matter relating to appointment of Chairperson and Members was pending in court, the Water Management and Regulatory Authority could not be established. As such the Act could not be made functional and rules were not framed.

In six other States, enactment of the ground water legislation was pending for various reasons, which are briefly mentioned in Table 2.6.

Table 2.6: Ground Water legislations under process in States/UTs

Sl. No.	State	Reason for not implementing Ground Water legislation
1.	Chhattisgarh	The draft bill for regulation of ground water was pending at the State Government level since 2012. In the meantime, the regulation of ground water was being done by CGWA.
2.	Delhi	The Delhi Jal Board (DJB) was established under sub- section 3 of Section 1 of Delhi Water Board Act, 1998 (Delhi Act 4 of 1998). The Act provided that DJB may plan, regulate and manage the extraction of ground water in Delhi in consultation with CGWA as one of the functions of the Board. In January 2011, Delhi Water Board (Amendment) Bill, 2011 was proposed by DJB, which enlarged the scope to include therein the regulation, control and development of ground water. The proposed amendment was meant to provide 'Planning for regulation, control and development' of ground water as one of the functions of the board instead of only 'extraction and management' of ground water. However, the amendment bill was yet to be enacted by the Legislative Assembly despite lapse of more than seven years.
3.	Jharkhand	A draft bill for Jharkhand Ground Water Development and Management (Regulation and Control) Act was prepared (2006) by the Directorate of Ground Water, which was yet to be passed as of March 2019. The regulation of ground water was being done by CGWA.
4.	Madhya Pradesh	A draft bill to regulate and control the development of ground water resources was prepared on the basis of the model bill circulated by DoWR, RD&GR, which was yet to be approved as of March 2019.
5.	Rajasthan	During 2006 to 2017, Ground Water Department and the State Water Resources Planning Department prepared five draft bills[25].However, none of these bills was enacted (January 2019).
6.	Tamil Nadu	The Tamil Nadu Ground Water (Development and Management) Act, 2003 was repealed in September 2013 to enact a comprehensive law to develop and manage ground water. However, the new Act was yet to be enacted as of March 2019. A draft model bill was circulated (May 2016)

[25] (i) The Rajasthan Regulation and Control of Development and Management of Ground Water Bill 2006 (ii) The Rajasthan Regulation and Control of Development and Management of Ground Water Bill 2011. (iii) The Rajasthan Ground Water (Regulation of Drinking Water Purpose) Bill 2012 (iv) Water Resources Management Bill 2012 (passed in Rajasthan legislation but not converted into act) and (v) Rajasthan Ground Water Regulation, Conservation and Management Bill 2016, 2017.

Sl. No.	State	Reason for not implementing Ground Water legislation
		by the Government of India for comments from the stakeholders, which was pending finalisation. The State Government stated (March 2019) that a comprehensive Act would be enacted after receipt of the final draft bill from the Government of India.

The remaining States/UTs had not taken action to enact legislation for ground water.

2.8 Meetings of CGWB and CGWA

CGWB

As per the order issued by DoWR,RD&GR (June 2000) reconstituting the Board, members of CGWB were required to meet at least once in three months. Audit observed that against the requirement of 28 meetings[26] during 2012-2019, only two meetings of CGWB were held (July 2013 and April 2015). No further meetings of CGWB were held after April 2015. Considering its role as the national body for providing inputs for management of ground water, the infrequent meetings of CGWB indicate the limited extent of its involvement in the proper guidance and monitoring for sustainable development and management of ground water resources of the country.

Department accepted (September 2020) the observation and assured that meetings of CGWB would be conducted periodically.

CGWA

CGWA is chaired by the Chairman of CGWB and has 15 members including five Special Invitees from different Ministries/ Departments. Audit noticed that there was no prescribed frequency of meetings of the CGWA. During the period 2013-18, only 11 meetings of CGWA were held. These meetings were held at irregular intervals ranging from four to 12 months. As the apex body for regulation and management of ground water in the country, infrequent meetings of CGWA may affect the discharge of functions of the Authority.

2.9 Human Resource constraints faced by Central agencies managing Ground Water

CGWB carries out its activities through 18 Regional Offices, 17 Divisional offices and 11 State unit offices located in States/UTs. CGWB had a sanctioned strength (March 2019) of 4,012 personnel, out of which 2,745 i.e. 68 *per cent* belonged to Scientific and Engineering category, who carry out most of the important functions of CGWB relating to data collection, compilation and monitoring issues relating to ground water. The remaining 32 *per cent* belong to Ministerial categories.

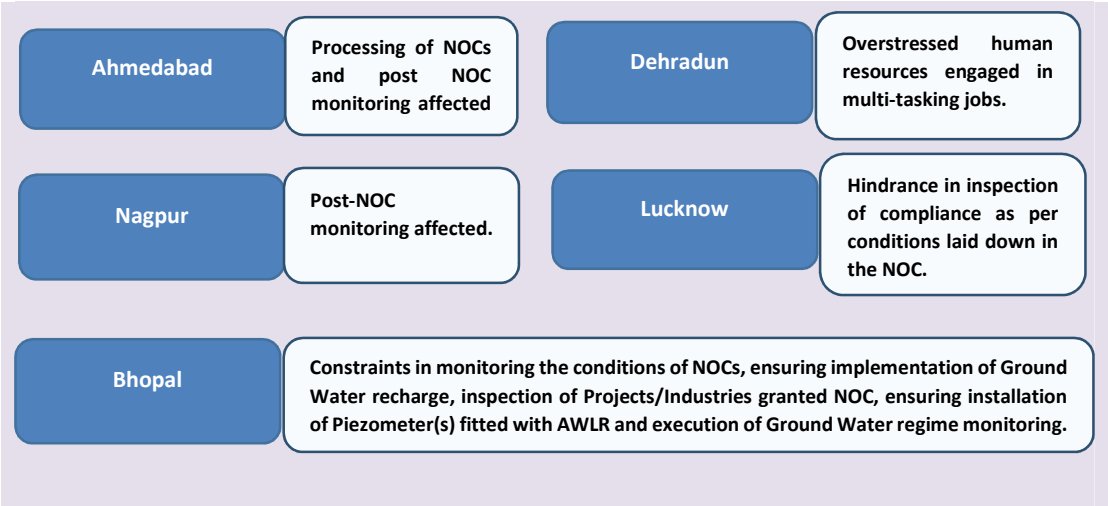
[26] Four meetings in a year for seven years (2012-19).

There was shortage of human resources in every category including Scientific and Engineering categories in CGWB and its regional and divisional offices. Over the period 2014 to 2019, vacancies remained highest in the scientific category ranging from 33.48 *per cent* (2015) to 37.51 (March 2019). Vacancies in engineering category ranged from 24.14 *per cent* (2014) to 27.41 *per cent* (2018) while in the Ministerial category, the vacancies ranged from 25.47 *per cent* (2014) to 30.51 *per cent* (2015). As of March 2019, there was a vacancy of 26.93 *per cent* and 26.60 *per cent* in the engineering and Ministerial categories respectively.

Audit observed that CGWB was unable to fill up the vacancies as their revised Recruitment Rules (RRs) were not approved by the Department. CGWB sent amended draft RRs for various posts to DoWR,RD&GR during 2016 to 2017. For 13 posts (including that of Chairman, CGWB), as detailed in ***Annexure 2.6***, amended draft RRs were sent to the Department as early as April 2016. However, these were not finalised by the Department as of November 2019.

Audit also observed that there was delay in completing the administrative procedures for filling up posts. As of June 2018, the Departmental Promotion Committee (DPC)[27] was under process for filling up 394 posts (96 Scientific, 168 Engineering and 130 Ministerial posts). It was observed that out of 394 posts, only 84 posts could be filled up (13 Scientific, 31 Engineering and 40 Ministerial posts) by April 2019. Thus, 310 posts were yet to be filled up as of April 2019 which indicated the slow progress in filling up posts. Some of the Regional Offices of CGWB reported to Audit that shortage of human resources was affecting their working (Figure 2.3).

Figure 2.3: Human Resource constraints in Regional offices of CGWB



[27] As per the old RRs

In spite of shortage of technical workforce, some of the Regional Offices had also deputed their technical staff (Scientific and Engineering) for administrative work as detailed in Table 2.7.

Table 2.7: Technical staff deputed for administrative work

Sl. No.	Regional Office	Details
1.	North Himalayan Region, Dharamshala	5 Scientific/Technical staff were deployed for administrative work such as Drawing and Disbursement Officer (DDO), Establishment Section, Accounts Section, Store Section, Legal work, etc.
2.	Western Region, Jaipur	6 Scientists were deployed to discharge duties as DDO, Vigilance Officer, Rajbhasha Officer, etc.
3.	Uttaranchal Region, Dehradun	3 Scientists were deployed to discharge duties as DDO, Public Information Officer (PIO), Hindi Officer etc.
4.	North West Himalayan Region, Jammu	4 Scientific/Technical staff were deployed for administrative work such as DDO, Officer in Charge(Store and vehicle), Hindi Officer, etc.
5.	South Eastern Coastal Region, Chennai	9 Scientists (Scientist D/Assistant Hydro-geologist) were deployed to function as "Persons in-charge of Stores and Stock".
6.	Southern Region, Hyderabad	3 Scientists were deployed to discharge duties as DDO.
7.	North Western Region, Chandigarh	5 Scientists discharged duties as DDO

DoWR,RD&GR stated (January 2020) that the process of augmenting the human resources takes time due to the involvement of various recruitment agencies and other related formalities; however the Department was taking action such as outsourcing some of the work so that the existing technical personnel of CGWB could be appropriately utilised.

2.10 Institutional framework for Ground Water management in States/UTs

As of March 2019, out of 33 states, only 14 states[28] had dedicated departments/agencies dealing with ground water related issues.

Absence of a dedicated department for dealing with ground water related issues may result in lack of coordination among the multiple agencies as well as gaps in the mechanisms for management of groundwater, as observed in the case of Telangana, mentioned in Box 2.1.

Box 2.1: Coordination issues in management of ground water in Telangana

In Telangana, coordination among the departments involved with issues related to management of ground water was inadequate, as-

i) Telangana State Pollution Control Board while giving 'Consent to Establish' to industries did not incorporate any conditions to obtain permission/NOC from State Ground Water Department (SGWD) for ground water abstraction.

[28] Andhra Pradesh, Haryana, Himachal Pradesh, Jharkhand, Karnataka, Kerala, Madhya Pradesh, Odisha, Punjab, Puducherry, Rajasthan, Tamil Nadu, Uttar Pradesh and West Bengal.

ii) While rejecting the application (for permission/NOC) of Industry, the State Ground Water Department (SGWD) conveyed to the concerned WALTA authority to seize the existing borewells (if any) available in the premises of the Industry. However, the details of action taken by the authorities were not communicated to SGWD.

iii) Based on the proposals from various departments for conducting survey and investigation to identify sites for establishing Artificial Recharge Structures (ARS), the GWD recommended various sites for such ARS. However, the SGWD had no information, whether the ARS recommended by them were established or not.

iv) On implementation of Act in the State, all the wells were to be registered with the authority. However, the Administrator of the State WALTA Authority (Commissioner, Rural Development Department) did not have the details regarding the number of wells registered after implementation of the Act.

v) As per section 4 of WALTA, the authority shall meet at least once in three months as such place and time as the Chairman may decide. However, no meeting was conducted during the period 2013-14 to 2017-18.

2.11 Constraints faced by States/UTs

2.11.1 Human Resource constraints

In the 14 States having a dedicated department/agency for management of ground water, Audit observed shortage of personnel (as of March 2018) in agencies of 11 such States/UTs dealing with ground water, as shown in Table 2.8.

Table 2.8: Shortage of human resources in States/UTs

Sl. No	State/UT	SS	PIP	Vacancy	Vacancy %
1.	Andhra Pradesh	661	337	324	49
2.	Himachal Pradesh	9	2	7	78
3.	Jharkhand	58	27	31	53
4.	Karnataka	369	68	301	82
5.	Kerala	499	418	81	16
6.	Madhya Pradesh	451	281	170	38
7.	Odisha	325	170	155	48
8.	Puducherry	190	69	121	64
9.	Punjab	67	59	8	12
10.	Tamil Nadu	609	342	267	44
11.	Uttar Pradesh	692	456	236	34
	Total	**3,930**	**2,229**	**1,701**	**43**

SS: Sanctioned Strength; PIP: Persons in Position

Thus, there was a vacancy ranging between 12 and 82 *per cent* in the Departments/Agencies dealing with ground water at State/UT level. Such vacancies posed constraints in the effective discharge of functions by the State/UT agencies. In Odisha, Atomic Absorption Spectrophotometer, to be used for determination of Arsenic in ground water, was not utilised during 2008-18 due to absence of staff and therefore, Arsenic was not tested in ground water. In Tamil Nadu, exploration and drilling work, random check and monitoring of NOCs issued and collection and testing of water samples were affected due to shortage of staff.

2.11.2 Infrastructure constraints

Audit observed that due to lack of infrastructure and facilities, some of the State agencies were not able to carry out requisite laboratory tests which affected the management of ground water in the State (Figure 2.4).

Figure 2.4: Infrastructure constraints in States

Andhra Pradesh	• Four regional labs (level II) at Vishakhapatnam, Rajamahendravaram, Kurnool and Kadapa were established. All the four labs were functioning. • After bifurcation (June 2014), the existing centralized laboratory at Hyderabad was allotted to Telangana State but new laboratory was not established in Andhra Pradesh. • In the Water Quality Laboratory, Dowleswaram, East Godavari district, water quality data for both pre and post monsoon (2010 to 2015) and for pre-monsoon (2017) were not analysed as the instruments were not in working condition. Further, this lab could not analyse the Arsenic level in ground water samples as it did not have the necessary equipment.
Bihar	• There was no infrastructure with State agency associated with Ground water management and regulation. State government had not taken any action in this regard. Thus, there was no testing of ground water and consequent management by the State agency.
Kerala	• Due to unavailability of vehicles, proper inspections, enquiries and studies were not carried out. • All the machinery and equipment were many years old and required replacement. • Though pumping tests were to be done for all 14 districts, there were only four pumping test units available for scientific aquifer management. • All three labs in Thiruvananthapuram, Kozikode and Ernakulam are functional, but at Thiruvananthapuram, the 'Atomic Absorption Spectrophotometer was under repair and Arsenic analysis could not be conducted. The Kozhikode Lab faced serious space constraint; LPG cylinder was kept in a room with minimum ventilation along with chemicals and acids. Supporting staff posts viz. Chemical Assistant, Laboratory Attender and Office Assistant were vacant. Vacancy issues were prevalent at Ernakulam also.
Madhya Pradesh	• There were seven labs to test the quality of ground water located at Bhopal, Jabalpur, Ujjain, Gwalior, Sagar, Satna and Balaghat. All seven labs were working. • It was reported by the Water Resources Department (December 2018) that up-gradation of laboratory and data centre equipment, software and hardware were required. A demand for ₹ 40 lakh was raised and approval of the same has been sought. In the absence of upgraded infrastructure, testing of samples was constrained.
Maharashtra	• Though the Maharashtra Groundwater (Development and Management) Act, 2009 was passed with effect from 01 June 2014, rules for implementation of the Act were not finalised. Pending notification of Rules, detailed needs analysis for assessing the infrastructure requirement was not done by the Government. • In the absence of assessment, the requirement and adequacy of testing could not be ascertained in audit.
Odisha	• In Directorate of Ground Water Development, there are five Water Quality Laboratories, eight Divisional Data Processing Centres and

	one State Level Ground Water Data Processing Centre. However, up-gradation of hardware and software, database of software and water quality laboratories was required. • Audit observed that no proposal regarding up-gradation of hardware and software, database of software was sent to the higher authority by Directorate of Ground Water development.
Tamil Nadu	• Only 30 of the required 388 geophysical resistivity meters were available in nine divisions; of the 53 old geophysical instruments, 23 were not in working condition and obsolete. There was also shortage of chemical equipment which affected testing processes. • Though there was a requirement of 1,190 piezometers, new piezometers were not drilled and no logger was available in good condition to carry out exploration and geophysical logging; the server and plotter were non-functional and obsolete. • Water samples were not tested for presence of iron due to limited number of laboratories. Out of 9,032 water samples to be collected and tested, only 3,870 were collected and tested (2017). • Purchases of various equipment amounting to ₹ 24.92 crore approved by DoWR,RD&GR (August 2018) were yet to be made as of January 2019.

2.12 Conclusion

Over the period from 2004 to 2017, there has been a decline in the percentage of assessment units categorised as safe, whereas the percentage of blocks categorised as semi-critical, critical and over-exploited has steadily increased. The overall stage of extraction of ground water has increased from 58 *per cent* in 2004 to 63 *per cent* in 2017. There are 13 States/UTs that have a higher stage of extraction ranging from 64 *per cent* (Gujarat) to 166 *per cent* (Punjab). This indicates that timely interventions are required to check the depletion of ground water levels.

The ground water samples in a number of States were found to be contaminated by high levels of Arsenic, Nitrate, Fluoride and Iron. Significant shortcomings were noticed in the mechanism for assessing the quality of ground water. The Central Ground Water Board (CGWB) conducted assessment of ground water resources after a gap of four years against the prescribed frequency of two years. Although it is required to monitor the water quality every year, CGWB possesses data on water quality only as of 2015. The absence of up to date data affects timely and focussed intervention to prevent further deterioration and deprives the CGWB of the means for assessing the effectiveness of such interventions in maintaining envisaged ground water levels and quality.

CGWB could establish a network of only 15,851 observation wells for monitoring water quality, against the target of 50,000 wells planned during the XII Plan period (2012-17). The Real Time Ground Water Monitoring through wells equipped with Digital Water Level Recorders (DWLRs) and Telemetry, envisaged to be done during the XII Plan period by CGWB was still in the planning stage as of March 2020.

Although water is a State subject, only 19 States (as of December 2019) had laws regulating ground water and only 14 States/UTs had dedicated agencies to deal with issues relating to ground water.

Both CGWB and State agencies dealing with ground water faced shortage of staff, which adversely affected discharge of their duties such as monitoring of No Objection Certificates issued, testing of water samples, etc. Many States/UTs did not have the required infrastructure for carrying out tests for ground water. The State agencies were unable to carry out requisite laboratory tests, which affected the management of ground water.

2.13 Recommendations

1. The Department may ensure that assessment of ground water resources, water level and quality is done at the prescribed intervals so as to maintain current data on the status of ground water in the country and to utilise such data for planning management strategies.
2. The Department may take action to increase the number of observation wells with Digital Water Level Recorders and Telemetry to monitor ground water in line with the targets committed under the Ground Water Management and Regulation Scheme/ National Hydrology Project.
3. The Department may take expeditious action to revise the Model Bill and also pursue with the remaining States for bringing comprehensive laws/regulations to deal with ground water management.
4. The Department should address the human resource constraints of CGWB/CGWA by also engaging with other experts and going for strategic partnerships to ensure smooth functions in processes of groundwater management and governance.
5. For effective implementation of Ground Water Regulation and Management, Department should address the human resource crunch reported by the State Governments and also encourage them to adopt latest technologies for assessment and monitoring of ground water.