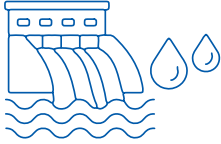


National Sectoral Paper

Water Resources Development

Farm Sector Development Department
National Bank for Agriculture and Rural Development
Mumbai





NABARD's Vision

Development Bank of the
Nation for fostering rural
prosperity

NABARD's Mission

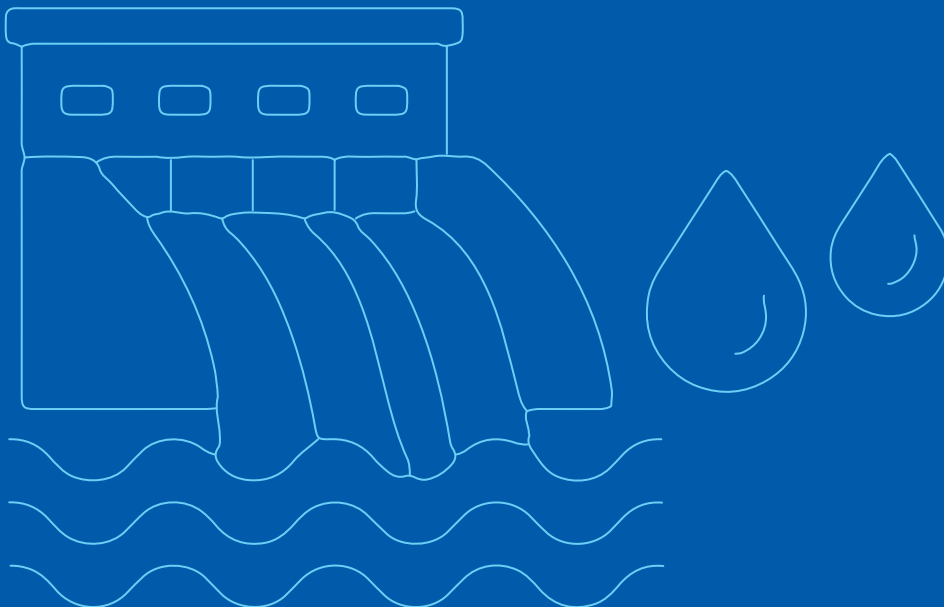
Promote sustainable and equitable
agriculture and rural development
through participative financial
and non-financial interventions,
innovations, technology and
institutional development for
securing prosperity

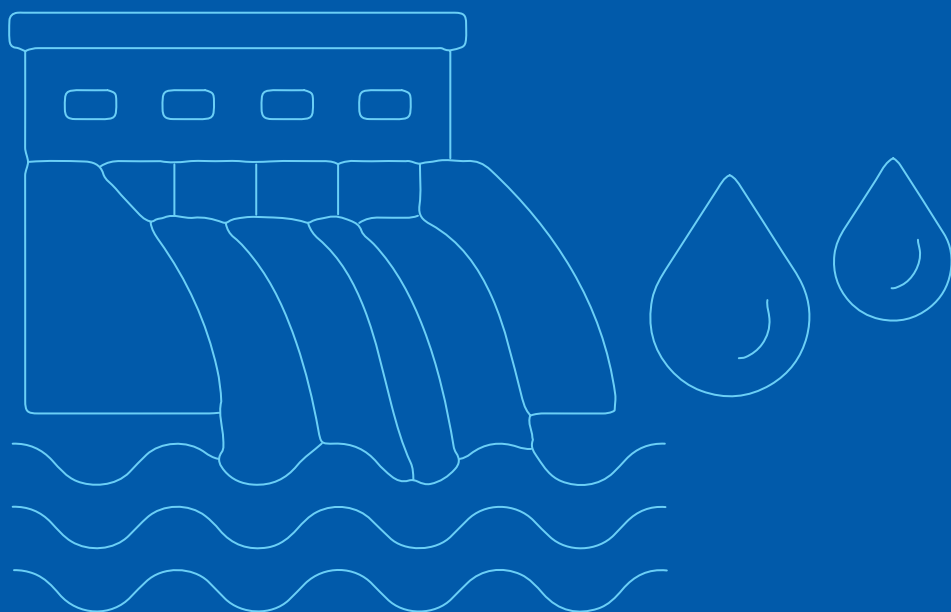
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National Sectoral Paper **Water Resources Development**

Farm Sector Development Department
National Bank for Agriculture and Rural Development
Mumbai





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Foreword

India supports 16% of the global population with just 2.4% of the world's land and only 4% of its freshwater resources—highlighting the immense pressure on the country's limited water supply. Sustainable water resources management is no longer optional—it is essential. In India, over 60% of farming relies on groundwater, much of which is being extracted unsustainably. Add to that pollution and climate change, and our freshwater reserves are under serious stress. Drip & sprinkler irrigation to cut down wastage, rainwater harvesting and Watershed management to restore natural water cycles are few water-smart solutions to recharge groundwater and effectively manage the already stressed water resources in the country,

To feed a growing population without draining our water, we must adopt sustainable intensification—using precision irrigation, integrated water management, and climate-smart farming. Managing the microclimate with vegetation and mulching helps stabilize moisture and reduce evaporation—cutting down the need for synthetic inputs. A water-centered, ecosystem-based approach is the key to resilient agriculture and lasting food security. Recognizing the critical need to conserve, restore, recharge, and reuse water resources, the Ministry of Jal

Shakti (MoJS), Government of India, launched the Jal Shakti Abhiyan (JSA)

NABARD plays a pivotal role in promoting sustainable water resource management for agriculture. Through initiatives like Watershed Development Programmes, Water Campaigns, and Micro-Irrigation Financing, NABARD supports efficient and climate-resilient water use across rural India. It encourages rainwater harvesting, drip irrigation, and community-based watershed management, enhancing soil moisture and crop productivity. By blending financial support with capacity building and institutional development, NABARD ensures that water resources are conserved and equitably used. In the face of growing climate variability and water stress, NABARD's integrated approach strengthens rural resilience, making water a foundation for sustainable and inclusive agricultural growth.

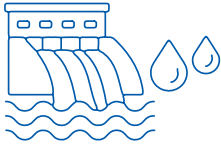
Shaji K V

Chairman

National bank for Agriculture and Rural Development

Mumbai

July 2025



Message

Groundwater has been a cornerstone of India's agricultural and economic development, enabling year-round cultivation and supporting livelihoods across rural India. However, this critical resource is under mounting stress from overextraction, uneven recharge, and growing contamination concerns. Agriculture continues to account for the bulk of groundwater withdrawals, making it central to the sustainability discourse.

As per the groundwater resource assessment report -2024 of Central Ground Water Board (CGWB) India's annual groundwater extraction stands at 245.64 BCM, against an extractable resource of 406.19 BCM resulting in an average national extraction stage of 60.47%. While 73.39% of groundwater assessment units have been categorized as 'safe', 26.6% remain over-exploited/critical/semi-critical/saline category. Contamination from arsenic, fluoride, nitrate, iron, and uranium continues to pose serious health and productivity risks in several pockets.

The Government of India has launched multiple flagship programmes such as Jal Shakti Abhiyan, Atal Bhujal Yojana, Amrit Sarovar, and the "4Rs" strategy—Reduce, Reuse, Recharge, Recycle to promote integrated, participatory, and climate-resilient water resource management. These initiatives stress convergence, community participation, water budgeting, and improved irrigation efficiency. The Modernisation of Command Area Development (MCAD) scheme marks a strategic shift in irrigation management, aiming to enhance on-farm water use efficiency, promote participatory governance, and integrate water sources through cluster-based planning. With a total outlay of ₹1600 crore approved by the Cabinet for implementation by March 2026,

MCAD is positioned to support sustainable agriculture, improve rural livelihoods, and strengthen water security across diverse agro-climatic zones.

This Sectoral Paper presents a comprehensive overview of the water resource landscape in India—from demand-supply assessments and irrigation coverage to credit flow, technological innovations, and governance models. Special emphasis has been laid on participatory watershed development, digitisation of water data, micro-irrigation, community-led institutions, and sustainable financing strategies.

NABARD has been at the forefront of this movement, having facilitated watershed development over 10 million hectares and expanded support for micro-irrigation, water harvesting, and women-led water user groups. By integrating credit with capacity building and institutional development, we aim to strengthen rural resilience and make water the cornerstone of inclusive and sustainable growth.

I congratulate the Technical Advisory team and the Farm Sector Development Department for preparing this timely and insightful document. I am confident that it will serve as a guiding framework for stakeholders engaged in ensuring a water-secure and climate-smart future for Indian agriculture.

Dr A K Sood

Deputy Managing Director

National Bank for Agriculture and Rural Development

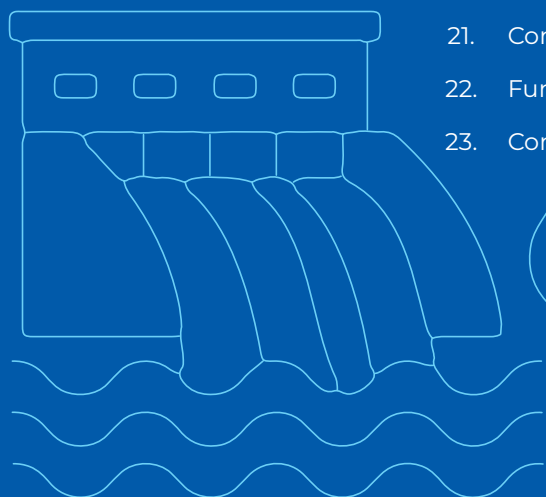
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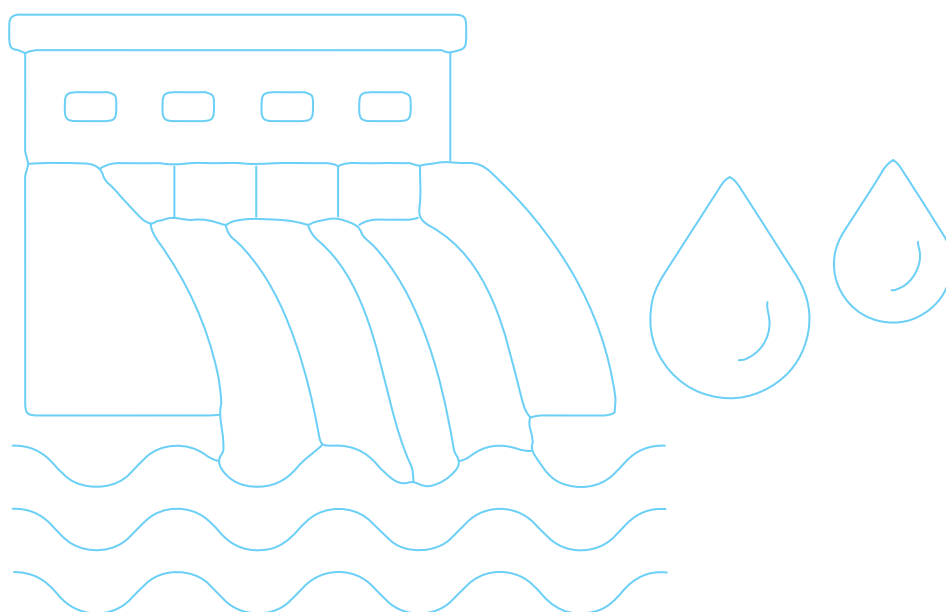
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01 Introduction



Water is one of the most critical resources for sustaining life and is central to socio-economic development. India, with 2.4% of the world's total geographical area and 16% of the world's population, has only 4% of the world's total freshwater resources. The growing population, economy, and impact of climate change make water scarcity a major threat in many parts of the country. Severe water scarcity during droughts affects agriculture and farmers' welfare, leading to a loss in agricultural output and acute agrarian distress. Irrigation has played a crucial role in increasing crop productivity and farmers' profitability in India. Yet, only around 49 % of India's gross cropped area is irrigated. Various sources and methods of irrigation have been adopted in the country. Canal water used to be the main source until the early 1970s, but the overall inefficiencies in the surface irrigation system and subsidy in power supply to the agriculture sector have prompted farmers to shift towards groundwater sources to meet the irrigation requirements of their crops. Groundwater from wells contributes 15%, tube wells account for 47%, canals provide 24%, and tanks supply 3%. Other sources such as rain, rivers, ponds, drainage, surface water, and municipal water make up the remaining. Canal water and groundwater irrigate 87 per cent of the net irrigated area, of which 62 per cent is from groundwater. Well-irrigation is common in alluvial plains except in the deserts of Rajasthan. Plains of UP, Bihar, Gujarat, Karnataka, and Tamil Nadu are the states that are more prominently under well irrigation. Canals are the second most important source of irrigation in India after wells and tube

wells. The canals are irrigating those lands, which have extensive plains, fertile soils and perennial rivers. The plains of North India are mostly canal-irrigated. Other parts are coastal lowlands and some parts of Peninsular India. The states are Andhra Pradesh, Assam, Haryana, Jammu & Kashmir, West Bengal, Punjab Rajasthan, Bihar, Karnataka, Tamil Nadu and Uttar Pradesh. Tank irrigation is more prevalent in the rocky plateau area of the county, where rainfall is uneven and highly seasonal. The Eastern Madhya Pradesh, Chhattisgarh, Orissa, interiors of Tamil Nadu and some parts of Andhra Pradesh have more land under tank irrigation.

As the variability over space and time of rainfall over the country is well known, the development of water resources for irrigated agriculture received high priority in the different Plan periods. This enabled the achievement of food security and export of surplus food grains. Expansion of irrigation facilities to ensure irrigation water for every agriculture land, along with consolidation of the existing systems, has been the main strategy for increasing production of food grains. Irrigation water has been provided through major, medium and minor irrigation projects and command area development.

Water management in India is primarily the responsibility of State Governments and Union Territories, given that water is a state subject. The Central Government provides technical and financial assistance through various schemes and programmes to support these efforts. The minor irrigation sector at the national

level is managed by the Department of Water Resources, River Development and Ganga Rejuvenation (DoWR, RD&GR), along with the Ministries of Agriculture & Farmer's Welfare, Rural Development, and Tribal Affairs. At the State level, respective Ministries and Departments of Water Resources, Agriculture, and Rural Development oversee the sector. Financial assistance is provided to States for constructing minor irrigation schemes through various departments, and many

States offer subsidies for drilling tube wells, digging wells, and purchasing water distribution devices and micro-irrigation equipment like pipes, drip, and sprinkler systems. However, no single government department is solely responsible for developing minor irrigation works, leading to numerous private constructions with or without State Government support, making coordination and monitoring challenging at the State level.



02 Rainfall in India

Variability in the onset, withdrawal and quantum of rainfall during the monsoon season profoundly impacts water resources, power generation, agriculture, economics and ecosystems in the country. The variation in climate is perhaps greater than any other area of similar size in the world. There is a large variation in the amounts of rainfall received at different locations. The average annual rainfall is about 122 cm, but it has great spatial variations. The areas on the Western Ghats and the Sub-Himalayan areas in the North-East and Meghalaya Hills receive heavy rainfall of over 250 cm annually, whereas the Areas of Northern parts of Ladakh and Western Rajasthan receive rainfall of less than 40 cm. The rainfall pattern roughly reflects the different climate regimes of the country, which vary from humid in the northeast (about 180 days of rainfall in a year) to arid in Rajasthan (20 days of rainfall in a year). Due to climatic changes in recent times, high-intensity rainfall events have increased, and the number of rainy days has decreased. In some years, it has been observed that the southwest monsoon has extended beyond its normal withdrawal date.

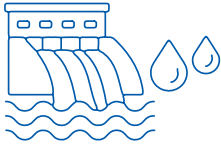
2.1 Normal Annual Rainfall

The rainfall over India has large spatial as well as temporal variability. For the country as a whole, the mean monthly rainfall during July (301 mm) is the highest and contributes about 24.6% of annual rainfall (1219.77 mm). The mean rainfall during August is slightly lower and contributes about 21.9% of annual rainfall. June and September rainfall

are almost similar and contribute 13.8% and 14.5% of annual rainfall, respectively. The mean southwest monsoon (June, July, August & September) rainfall (914 mm) contributes 75.5% of annual rainfall (1219.77 mm). The contribution of premonsoon (March, April & May) rainfall and post-monsoon (October, November & December) rainfall in annual rainfall is mostly the same (11%). The coefficient of variation is higher during the months of November, December, January and February. The Thematic map of the distribution of annual normal rainfall is given in **Figure 2.1**. The map shows that one state, i.e., Rajasthan receives annual rainfall between 250 – 500 mm, 9 states and UTs between 500 mm – 1000 mm, 15 states between 1000 – 2000 mm, 4 states between 2000-3000 mm and 5 states more than 3000 mm in a year.

2.2 Normal Monsoon Rainfall

The SW monsoon is the most significant feature of the Indian climate. The season is spread over four months, but the actual period at a particular place depends on onset and withdrawal dates. It varies from less than 75 days over West Rajasthan to more than 120 days over the south-western regions of the country, contributing to about 75% of the annual rainfall. The onset of the SW monsoon normally starts over the Kerala coast, the southern tip of the country, by 1 June, advances along the Konkan coast in early June and covers the whole country by the middle of July. However, onset occurs about a week earlier over islands in the Bay of Bengal. The monsoon is influenced by global and



local phenomenon like El Nino, northern hemispheric temperatures, sea surface temperatures, snow cover etc. Normal monsoon rainfall of more than 1500 mm is being observed over most parts of northeast India, Konkan & Goa. It ranges from 317 mm in Tamil Nadu state to 6218 mm in Meghalaya state with an average of 914.46 mm.

2.3 Normal Post-monsoon rainfall

North-East (NE) monsoon or post-monsoon season is a transition season associated with the establishment of the north-easterly wind regime over the

Indian subcontinent. Meteorological subdivisions, namely Coastal Andhra Pradesh, Rayalaseema, Tamil Nadu, Kerala and South Interior Karnataka, receive a good amount of rainfall, accounting for about 35% of their annual total in these months. Many parts of Tamil Nadu and some parts of Andhra Pradesh and Karnataka receive rainfall during this season due to the storms forming in the Bay of Bengal. It ranges from 18 mm in Rajasthan state to 910 mm in Puducherry UT, with an average of 200 mm. In the north eastern states, it ranges from it ranges from 169 mm to 315 mm with an average of 239 mm.

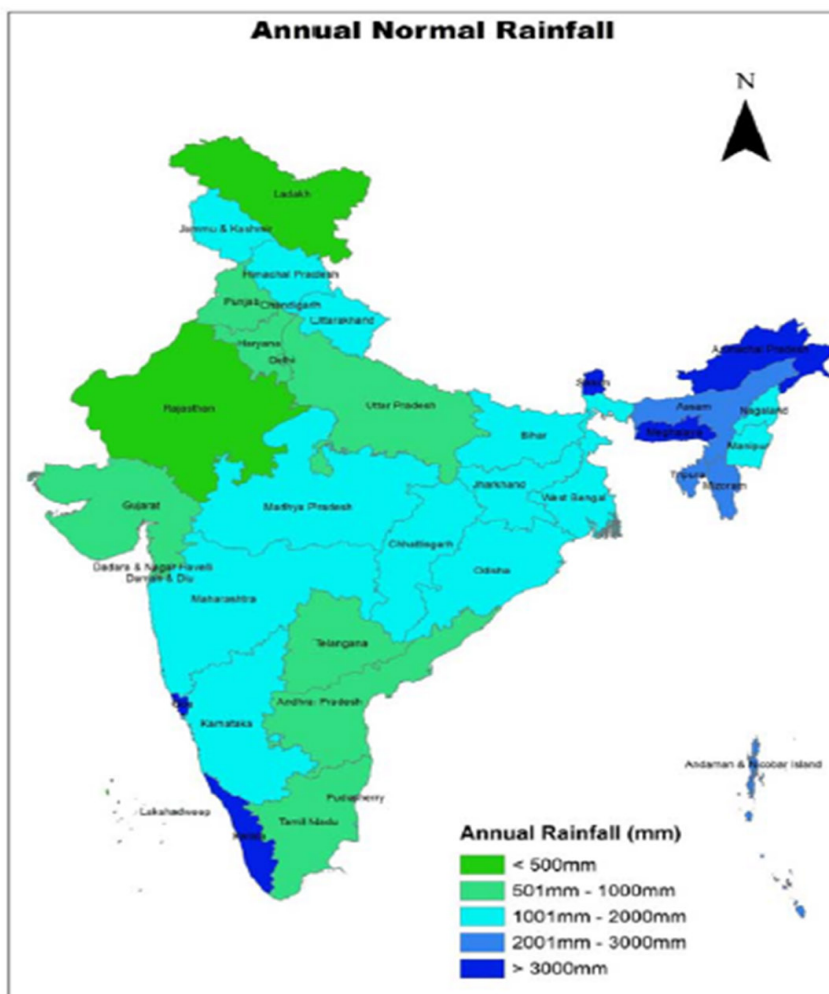


Figure 2.1 : Annual Normal Rainfall in India



03 River Basins of India



The two main sources of water in India are rainfall and the snowmelt of glaciers in the Himalayas. Although snow and glaciers are poor producers of freshwater, they are good distributors as they yield at the time of need, in the hot season. Indeed, about 80 per cent of the flow of rivers in India occurs during the four to five months of the southwest monsoon season. Several important river systems originate in upstream countries and then flow to other countries: the Indus River originates in China and flows to Pakistan; the Ganges-Brahmaputra River system originates partly in China, Nepal and Bhutan and flows to Bangladesh; some minor rivers drain into Myanmar and Bangladesh. However, there are no official records available regarding the quantum of annual flows into or out of the country.

The rivers of India can be classified into the following four groups:

- a. The Himalayan rivers, viz., Ganges, Brahmaputra, and Indus, are formed by melting snow and glaciers as well as rainfall and, therefore, have a continuous flow throughout the year. As these regions receive very heavy rainfall during the monsoon period, the rivers swell and cause frequent floods.
- b. The rivers of the Deccan plateau (with larger rivers such as Mahanadi, Godavari, Krishna, Pennar and Cauvery draining into the Bay of Bengal in the

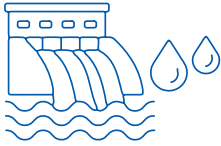
east, and Narmada and Tapi draining into the Arabian Sea in the west), making up most of the southern-central part of the country, are rain-fed and fluctuate in volume, many of them being non-perennial.

- c. The coastal rivers, especially on the west coast south of the Tapi, are short in length with limited catchment areas, most of them being non-perennial.
- d. The rivers of the inland drainage basin in western Rajasthan in the north-western part of the country towards the border with Pakistan are ephemeral, drain towards the salt lakes such as the Sambhar, or are lost in the sands.

For planning purposes, the country is divided into 20 river units (Table 3.1), 14 of which are major river basins, while the remaining 99 river basins have been grouped into six river units. The spatial imbalance of the distribution of water resources can be appreciated by the fact that the Ganges-Brahmaputra-Meghna basin covering 34 per cent of the country's area, contributes about 62 per cent of the water resources. The west-flowing rivers towards the Indus, covering 10 per cent of the area, contribute 4 per cent of the water resources. The remaining 56 per cent of the area contributes 34 per cent to the runoff.

S. No.	River basin unit	Location	Draining into	Catchment area (km ²)	Avg. annual runoff (km ³)	Exploitable surface water (km ³)
1	Ganges	Northern India	Bangladesh	861452	525.02	250.0
	Brahmaputra	Northeast	Bangladesh	194413	537.24	24.0
	Barak	Northeast	Bangladesh	41723	48.36	
2	Minor rivers of the Northeast	Extreme ZNortheast	Myanmar & Bangladesh	36202	31.00	--
3	Subernarekha	Northeast	Bay of Bengal	29196	12.37	6.8
4	Brahmani-Baitarani	Northeast	Bay of Bengal	51822	28.48	18.3
5	Mahanadi	Central-east	Bay of Bengal	141589	66.88	50.0
6	Godavari	Central	Bay of Bengal	312812	110.54	76.3
7	Krishna	Central	Bay of Bengal	258948	78.12	58.0
8	Pennar	Southeast	Bay of Bengal	55213	6.32	6.9
9	Cauvery	South	Bay of Bengal	81155	21.36	19.0
10	East flowing rivers between Mahanadi & Pennar	Central-east coast	Bay of Bengal	86643	22.52	13.1
11	East flowing rivers between Kanyakumari & Pennar	Southeast coast	Bay of Bengal	100139	16.46	16.7
12	West flowing rivers from Tapi to Tadrri	Southwest coast	Arabian sea	55940	113.53	24.3
13	West flowing rivers from Tadrri to Kanyakumari	Central-west coast	Arabian sea	56177	87.41	11.9
14	Tapi	Central-west	Arabian sea	65145	14.88	14.5
15	Narmada	Central-west	Arabian sea	98796	45.64	34.5
16	Mahi	North west	Arabian sea	34842	11.02	3.1
17	Sabarmati	North west	Arabian sea	21674	3.81	1.9
18	West flowing rivers of Kutch and Saurashtra	North west coast	Arabian sea	321851	15.10	15.0
19	Rajasthan Inland basin	North east	-	--	Negligible	-
20	Indus	North West	Pakistan	321289	73.31	46
	Total				1869.35	690.3

(Source: FAO Survey 2010 - Aquastat)



The basic source of water for both Surface Water (SW) and Groundwater (GW) is the same, namely precipitation. Precipitation, in the form of rainfall, occurs only for a few days in a year and varies from 100 mm in the Western parts of Rajasthan

to over 10,000 mm at Cherrapunji of Meghalaya. Therefore, it is essential to conserve the soil profile, aquifers, ponds, lakes, reservoirs, and rivers to ensure water availability during dry periods.

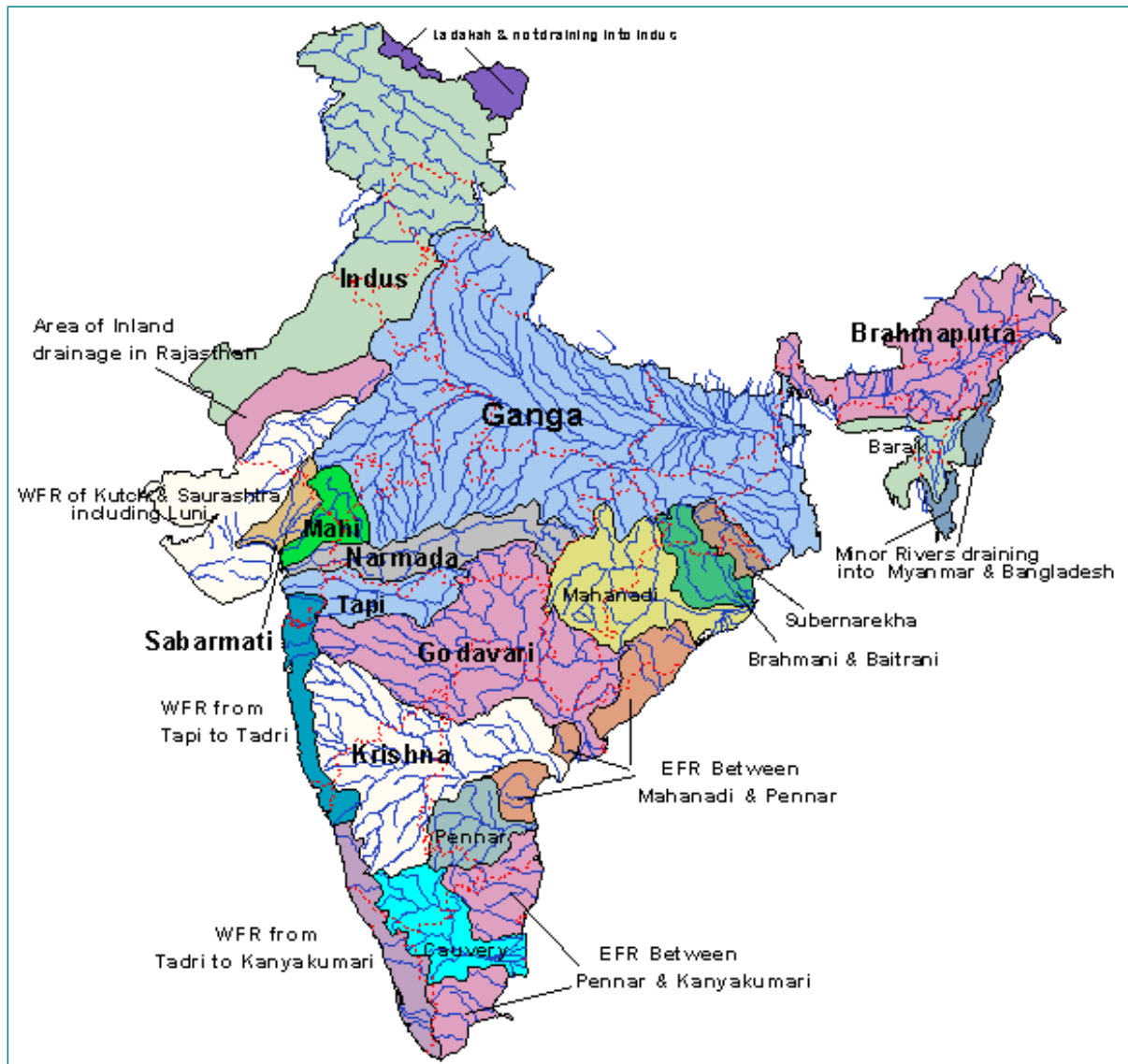


Figure 3.1 : River Basins of India

The average annual precipitation over the country is estimated at 4000 BCM, of which a part goes towards increasing groundwater storage, a part is lost as evapotranspiration, and the remaining appears as surface water. The water resources potential of the country, assessed from time to time by different agencies and as per the last assessment carried out by the Central Water Commission in 1993 for both surface and groundwater as one system, has been assessed at 1869 BCM (Table 3.2). Within the limitations of physiographic conditions, socio-political environment, legal and constitutional constraints, and the technology available at hand, the

utilizable water resources of the country have been assessed at 1122 BCM, which includes 690 BCM of from surface water and 432 BCM of groundwater sources. It is, however, possible to augment additional surface water resources up to 200 BCM if the Trans-basin transfer of water is taken up to the full extent as proposed under the National Perspective Plan. The Central Groundwater Board (CGWB) has estimated that it is possible to increase the groundwater availability by about 36 BCM through Rainwater Harvesting and Artificial Recharge over an area of 45 mha through non-committed surplus monsoon runoff.

Table 3.2 : Estimates of Water Resources of India

Agency	Estimate in BCM	Deviation from 1869 BCM
Dr. A.N. Khosla (1949)	1,673	-10.0%
Central Water & Power Commission (1954 -66)	1,881	+0.6%
National Commission on Agriculture	1,850	-1.0%
Central Water Commission (1988)	1,880	+0.6%
Central Water Commission (1993)	1,869	-



04 Hydrological Setup of India

4.1 Groundwater Occurrence

The groundwater behaviour in the Indian sub-continent is highly complicated due to the occurrence of diversified geological formations with considerable lithological and chronological variations, complex tectonic framework, climatological dissimilarities and various hydrochemical conditions. Studies carried out over the years have revealed that aquifer groups in alluvial/soft rocks even transcend the surface basin boundaries. Broadly, two groups of rock formations have been identified depending on characteristically different hydraulics of groundwater, viz. Porous Formations and Fissured Formations.

4.1.1 Porous Formation

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

Unconsolidated Formations: The areas covered by alluvial sediments of river basins and coastal and deltaic tracts constitute the unconsolidated formations. These are by far the most significant groundwater reservoirs for large-scale and extensive development. The hydrogeological environment and groundwater regime in the Indo-Ganga-Brahmaputra basin indicate the existence of potential aquifers having enormous fresh groundwater reserves. Bestowed with a high incidence of rainfall and covered by a thick pile of porous sediments, these groundwater reservoirs get replenished every year and are being used heavily. In these areas, in addition to the Annual Replenishable Groundwater Resources available in the zone of water level fluctuation (Dynamic Groundwater Resource), there exists a huge groundwater reserve in the deeper

passive recharge zone below the zone of fluctuation as well as in the deeper confined aquifers which remains largely unexplored as yet. Although the mode of development of groundwater is primarily through dug wells, dug cum bore well, and cavity wells, thousands of tube wells have been constructed during the last few decades.

Semi-consolidated Formations: The semi-consolidated formations normally occur in narrow valleys or structurally faulted basins. The Gondwanas, Lathis, Tipams, Cuddalore sandstones and their equivalents are the most extensive productive aquifers in this category. Under favorable situations, these formations give rise to free-flowing wells. In selected tracts of northeastern India, these water-bearing formations are quite productive. The Upper Gondwanas, which are generally arenaceous, in general, constitute prolific aquifers.

4.1.2 Fissured Formations (Consolidated Formations)

The consolidated formations occupy almost two-thirds of the country. These formations, except vesicular volcanic rocks have negligible primary porosity. From the hydrogeological point of view, fissured rocks are broadly classified into four types viz. igneous and metamorphic rocks (excluding volcanic and carbonate rocks), volcanic rocks, consolidated sedimentary rocks and Carbonate rocks.

Igneous and Metamorphic Rocks Excluding Volcanic and Carbonate Rocks: The most common rock types under this category are granites, gneisses, charnockites, khondalites, quartzites, schists and associated phyllites, slates, etc. These rocks possess negligible primary porosity but attain porosity



and permeability due to fracturing and weathering. Groundwater yield also depends on the rock type and grade of metamorphism. Generally, the granites, Khondalites and biotite gneisses have better yield potential as compared to charnockites.

Volcanic Rocks: The predominant types of volcanic rocks are the basaltic lava flows of the Deccan Plateau. The highly variable water-bearing properties of different flow units control groundwater occurrence in Deccan Traps. The Deccan Traps usually have poor to moderate permeability depending on the presence of primary and secondary fractures.

Consolidated Sedimentary Rocks Excluding Carbonate Rocks:

Consolidated sedimentary rocks occur in Cuddapahs, Vindhyan and their equivalents. The formations consist of conglomerates, sandstones, shales.

The presence of bedding planes, joints, contact zones and fractures controls the groundwater occurrence, movement and yield potential.

Carbonate Rocks: Limestones in the Cuddapah, Vindhyan and Bijawar group of rocks dominate the carbonate rocks other than marbles and dolomites. In carbonate rocks, the circulation of water creates solution cavities, thereby increasing the permeability of the aquifers. The solution activity leads to widely contrasting permeabilities within short distances.

4.2 Hydrogeological Units and their Groundwater Potential

The hydrogeological map of India is depicted in **Figure 4.1**, and the geographical distribution of

Table 4.1: Aquifer System in the Country

System	Coverage	Groundwater potential
Unconsolidated formations: alluvial	Indo-Gangetic, Brahmaputra plains	Enormous reserves down to 600 m depth. High rain fall and hence recharge is ensured. Can support large-scale development through deep tube wells
	Coastal Areas	Reasonably extensive aquifers but risk of saline water intrusion
	Part of Desert area – Rajasthan and Gujarat	Scanty rainfall. Negligible recharge. Salinity hazards. Groundwater Availability at great depths.
Consolidated/ semi-consolidated formations: sedimentaries, basalts and crystalline rocks	Peninsular Areas	Availability depends on secondary porosity developed due to weathering, fracturing etc. Scope for GW availability at shallow depths (20- 40 m) in some areas and deeper depths (100-200 m) in other areas. Varying yields.
Hilly	Hilly states	Low storage capacity due to quick runoff

hydrogeological units, along with their Groundwater potential, is given in **Table 4.1. Aquifer system of India**: Based on the hydrogeological characteristics, the entire country has been classified into 14 Principal Aquifer Systems and 42 major aquifers. Alluvium is the major aquifer system which covers maximum area of around 31% of the entire country and is present in Uttar Pradesh, Bihar, West Bengal, Assam, Odisha and Rajasthan. The sandstone aquifer covers around 8% area in the country and found in Chhattisgarh, Andhra Pradesh, Madhya Pradesh, Gujarat, Karnataka and Rajasthan. The rest of the country is covered with the other formations that cover around 60% of the area. Among these, the Basalt aquifer covers a maximum of around 17% area of the country and is mainly spread over Maharashtra, Madhya Pradesh, Gujarat, Rajasthan and Karnataka. Shale aquifer accounts for around 7% of the area in the country and is available mostly in Chhattisgarh, Andhra Pradesh, Madhya Pradesh, Rajasthan and in the northeastern states as well as in the Himalayan terrain. Limestone aquifer covers a very small area of around 2% of the country and is mainly available in the states of Chhattisgarh, Andhra

Pradesh, Karnataka, and Gujarat and in the Himalayan states. Around 20% of the country's area is covered by the Banded Gneissic Complex (BGC) and Gneiss aquifers, which are available in almost all the peninsular states as well as the Himalayan states. The rest 15% of the entire area is covered by aquifers namely; Schist, Granite, Quartzite, Charnockite, Khondalite, Laterites and Intrusive.

Analysis of shallow and deeper aquifer data based on groundwater level monitoring of 25000 Wells monitored during the year for the year 2022-23 by CGWB indicates a rise in water level in more than 50% of the monitored wells compared to the previous decade. However, water level declines are also seen in 35-55% of wells. In the pre-monsoon period, shallow water levels of less than 2m were observed in parts of Arunachal Pradesh, Assam, Karnataka, Kerala, Odisha, TN and West Bengal. Depth to water levels were deeper (10-40m) in northwest India. In deeper aquifers, water levels mostly ranged from 5-20m. Levels deeper than 40m were seen in parts of Andhra Pradesh, Chhattisgarh, Gujarat, Haryana, Karnataka, Kerala, MP, and Maharashtra.

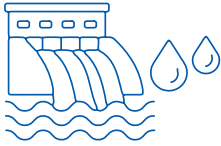
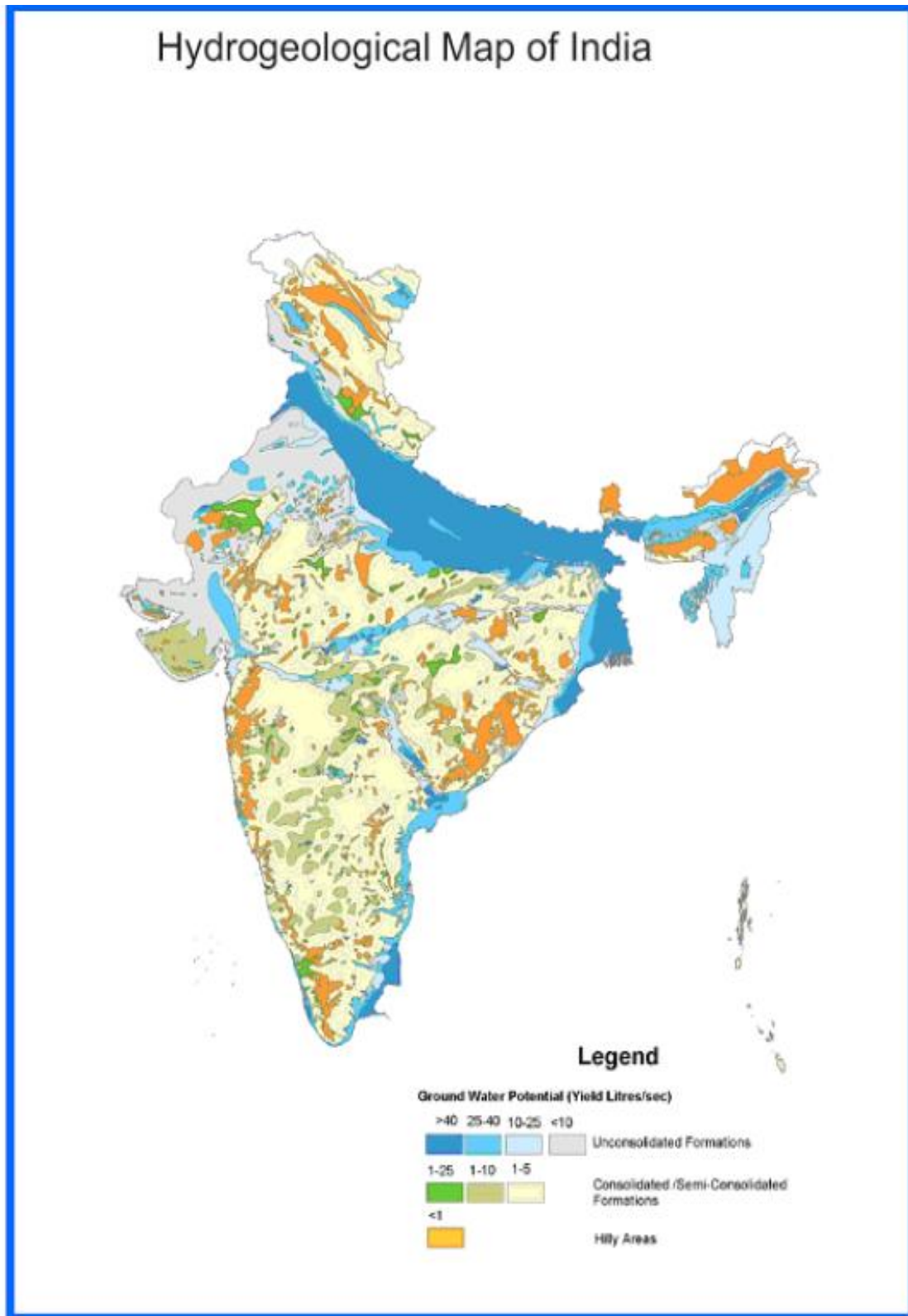
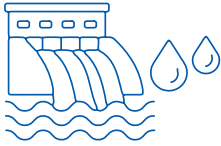


Figure 4.1 : Hydrogeological Map of India





05 Groundwater in India



India is one of the largest users of groundwater in various sectors like agriculture, domestic and industrial. The potential use of Groundwater irrigation has increased at a very rapid pace since the 1970s. Groundwater sustainability and its availability play a vital role in ensuring livelihood as well as food security across the country, especially in (UP, Panjab, Haryana, WB, etc.) where economies depend on agriculture. Rural agriculture and drinking water sectors depend partly or wholly on groundwater through pumping and/or springs or rivers due to facile access. However, urban populations highly rely on groundwater due to unreliable and deficient quality of water supplies from other sources. Unplanned Intensive irrigation and domestic and industrial use of Groundwater created serious problems for the scientific community in planning the management of groundwater. Saltwater encroachment near the coast, depletion in water tables, water logging, drying of aquifers, pollution of groundwater and salinity, etc., are major consequences of overexploitation. Deterioration in groundwater quality by various causes is another serious issue. Despite the cumulative effort of different stakeholders, 24.72% of groundwater blocks are semi-critical, critical, or overexploited. Moreover, aquifer depletion in the most populated and economically productive areas of the country encourages us to understand and create an overall scenario of the Indian aquifer system.

5.1 Groundwater Recharge

It is evident that various groundwater-

related issues are likely to reduce the availability of freshwater for irrigation, domestic, and industrial purposes. Recognizing this, the Central Ground Water Board (CGWB) has initiated several protective and legislative measures concerning groundwater quality, aquifer mapping, and regime monitoring to address groundwater management challenges. This write-up seeks to unpack the complexities of the Indian aquifer system through an examination of the water table, groundwater resources, and aquifer disposition.

The dynamic groundwater resources are also known as Annual Groundwater Recharge since they get recharged every year from rainfall and other sources (secondary sources) such as applied irrigation water, surface water bodies, water conservation structures, etc. As part of the assessment, 'Annual Extractable Groundwater Resource' as well as 'Annual Groundwater Extraction' are assessed for each assessment unit (block/taluka/mandal/tehsils/firka etc.). The 'Stage of Groundwater Extraction' is then computed as the ratio of 'Annual Groundwater Extraction' with respect to 'Annual Extractable Groundwater Resource' and is usually expressed in percentage. Based on the stage of extraction, the assessment units are categorized as Safe ($\leq 70\%$), Semi-Critical ($>70\%$ and $\leq 90\%$), Critical ($>90\%$ and $\leq 100\%$) and Over-Exploited ($>100\%$).

As per the 2024 assessment of India's dynamic groundwater resources, which was conducted jointly by the Central Groundwater Board (CGWB) and state groundwater departments, the Total

Annual Ground Water Recharge for the entire country has been assessed as 446.90 billion cubic meter (bcm) and the Annual Extractable Ground Water Resources for the entire country is 406.19 bcm with total natural discharges at 41.05 bcm. The overall contribution of rainfall (both monsoon & nonmonsoon) recharge to country's total annual ground water recharge is 60% and the share of recharge from 'Other sources' viz. canal seepage, return flow from irrigation, recharge from tanks, ponds and water conservation structures taken together is 40%. The assessment is based on the methodology recommended by Groundwater Estimation Committee -2015 (GEC-2015). The entire assessment has been carried out using the GIS based web portal 'India- Groundwater Resource Estimation System (IN-GRES)' developed by CGWB in association with IIT- Hyderabad. IN-GRES provides a common and standardized platform for GW Resource Assessment for the entire country (Central and State Governments).

Table 5.1 : Groundwater Resources scenario

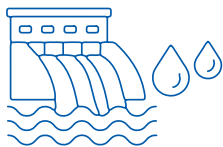
1.	Total Annual Groundwater Recharge	446.90 bcm
2.	Annual Extractable Groundwater Resources	406.19 bcm
3.	Annual Groundwater Extraction	245.64 bcm
4.	Stage of Groundwater Extraction	60.47 %

The contribution in Annual Groundwater Recharge from rainfall during monsoon season is more than 70% in the states/ UT of Goa, Gujarat, Jharkhand, Kerala, Madhya Pradesh, Manipur, Meghalaya, Mizoram, Rajasthan and Daman & Diu. The overall contribution of rainfall (both

monsoon & non-monsoon) recharge to the country's total annual groundwater recharge is 61%, and the share of recharge from 'Other sources' viz. canal seepage, return flow from irrigation, recharge from tanks, ponds and water conservation structures taken together is 39 %.

Annual Groundwater Recharge is significantly high in the Indus-Ganga-Brahmaputra alluvial belt in the North, East and North East India covering the states of Punjab, Haryana, Uttar Pradesh, Bihar, West Bengal and valley areas of North Eastern States, where rainfall is plenty and thick piles of unconsolidated alluvial formations are conducive for recharge. Annual Groundwater Recharge in these regions varies from 0.25 to more than 0.5 m. The coastal alluvial belt, particularly the Eastern Coast, also has relatively high annual groundwater recharge, in the range of 0.25 to more than 0.5 m. In western India, particularly Rajasthan and parts of northern Gujarat with arid climates, the annual groundwater recharge is scanty, mostly up to 0.025 m. Similarly, in major parts of the southern peninsula, covered with hard rock terrains, annual groundwater recharge mostly ranges from 0.10 to 0.15 m. This is primarily because of the comparatively low infiltration and storage capacity of the rock formations prevailing in the region. The remaining part of Central India is mostly characterized by moderate recharge in the range of 0.10 to 0.25 m.

The overall estimate of Annual Groundwater Recharge for the entire country shows an increase of 1.45 bcm in the present assessment as compared to



the last assessment i.e. 2020. The Annual Extractable Groundwater Resources shows an increase of 0.46 bcm.

5.2 Groundwater Extraction

The assessment of ground water extraction is carried out considering the Minor Irrigation Census data and sample surveys carried out by the State Ground Water Departments. The Total Annual Ground Water Extraction of the entire country for the year 2024 has been estimated as 245.64 bcm. The agriculture sector is the largest consumer of groundwater resources, accounting for 87% of the total annual groundwater extraction, which amounts to 213.29 bcm. The domestic use accounts for 11% (28.07 bcm), while industrial use represents 2% (4.28 bcm) of total annual groundwater extraction of the Country. In the states/UTs of, Arunachal Pradesh, Delhi, Goa, Kerala, Manipur, Meghalaya, Mizoram, Nagaland, Tripura, Andaman and Nicobar, Chandigarh, Jammu and Kashmir, Ladakh, Lakshadweep the ground water extraction for domestic uses is more than 40 %.

Stage of Groundwater Extraction:

The overall stage of groundwater extraction in the country is 60.47 %. The over-exploited assessment units are mostly concentrated in :(i) the north western part of the country including parts of Punjab, Haryana, Delhi and Western Uttar Pradesh where even though the replenishable resources are abundant, there have been indiscriminate withdrawals of ground water leading to over-exploitation; (ii) the western part of the country, particularly in parts of

Rajasthan and Gujarat, where due to arid climate, groundwater recharge itself is limited, leading to stress on the resource and (iii) the southern part of peninsular India including parts of Karnataka, Tamil Nadu Telangana and Andhra Pradesh, where due to inherent characteristics of crystalline aquifers, the ground water availability is low. In some areas of the country, good continuous rainfall and management practices like ground water augmentation and conservation measures taken up under Central and State Government initiatives have resulted in improvement in ground water situation. The State/UT wise distribution of Stage of Groundwater Extraction is as follows:

1. Stage of Groundwater Extraction > 100%: Punjab, Rajasthan, Dadra and Nagar Haveli and Daman and Diu, Haryana, and Delhi.
2. Stage of Groundwater Extraction > 90% to 100%: Nil
3. Stage of Groundwater Extraction > 70% to 90%: Tamil Nadu, Uttar Pradesh, Puducherry and Chandigarh.
4. Stage of Groundwater Extraction < 70%: Andhra Pradesh, Arunachal Pradesh, Assam, Bihar, Chhattisgarh, Goa, Gujarat, Himachal Pradesh, Jharkhand, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Manipur, Meghalaya, Mizoram, Nagaland, Odisha, Sikkim, Telangana, Tripura, Uttarakhand, West Bengal, Andaman and Nicobar, Jammu and Kashmir, Ladakh, Lakshadweep.

Categorization of Assessment

Units : In the present assessment, the total annual groundwater recharge in the country has been assessed as 446.90 bcm. Keeping an allocation for natural discharge, the annual extractable ground water resource has been assessed as 406.19bcm. The annual groundwater extraction (as in 2024) is 245.64 bcm. The average stage of groundwater extraction for the country as a whole works out to be about 60.47 %. Out of the total 6746 assessment units (Blocks/ Mandals/ Talukas) in the country, 751 units in various States/ UTs (11.13%) have been categorized as 'Over-exploited' indicating ground

water extraction exceeding the annual replenished ground water recharge. In, 206 (3.05 %) assessment units, the stage of groundwater extraction is between 90-100% and have been categorized as 'Critical'. There are 711 (10.54 %) "Semi-critical" units, where the stage of ground water extraction is between 70 % and 90 % and 4951 (73.39 %) 'Safe' units, where the stage of Ground water extraction is less than 70 %. Apart from these, there are 127(1.88%) assessment units, which have been categorized as 'Saline' as major part of the ground water in phreatic aquifers in these units is brackish or saline.

Table 5.2 : Categorization of Assessment Units as per GWRA-2024

Sl. No.	Category	Number of Assessment Units		Recharge worthy Area		Annual Extractable Groundwater Resource	
		Number	%	in lakh sq. km	%	(in bcm)	%
1	Safe	4951	73.39	16.51	66.57	301.17	74.14
2	Semi Critical	711	10.54	2.82	11.40	45.76	11.27
3	Critical	206	3.05	0.88	3.55	13.23	3.26
4	Over Exploited	751	11.13	4.20	16.93	46.02	11.33
5	Saline	127	1.88	0.38	1.55	NA	NA
	TOTAL	6746		24.80		406.19	

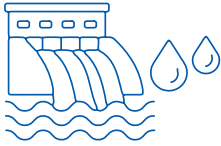
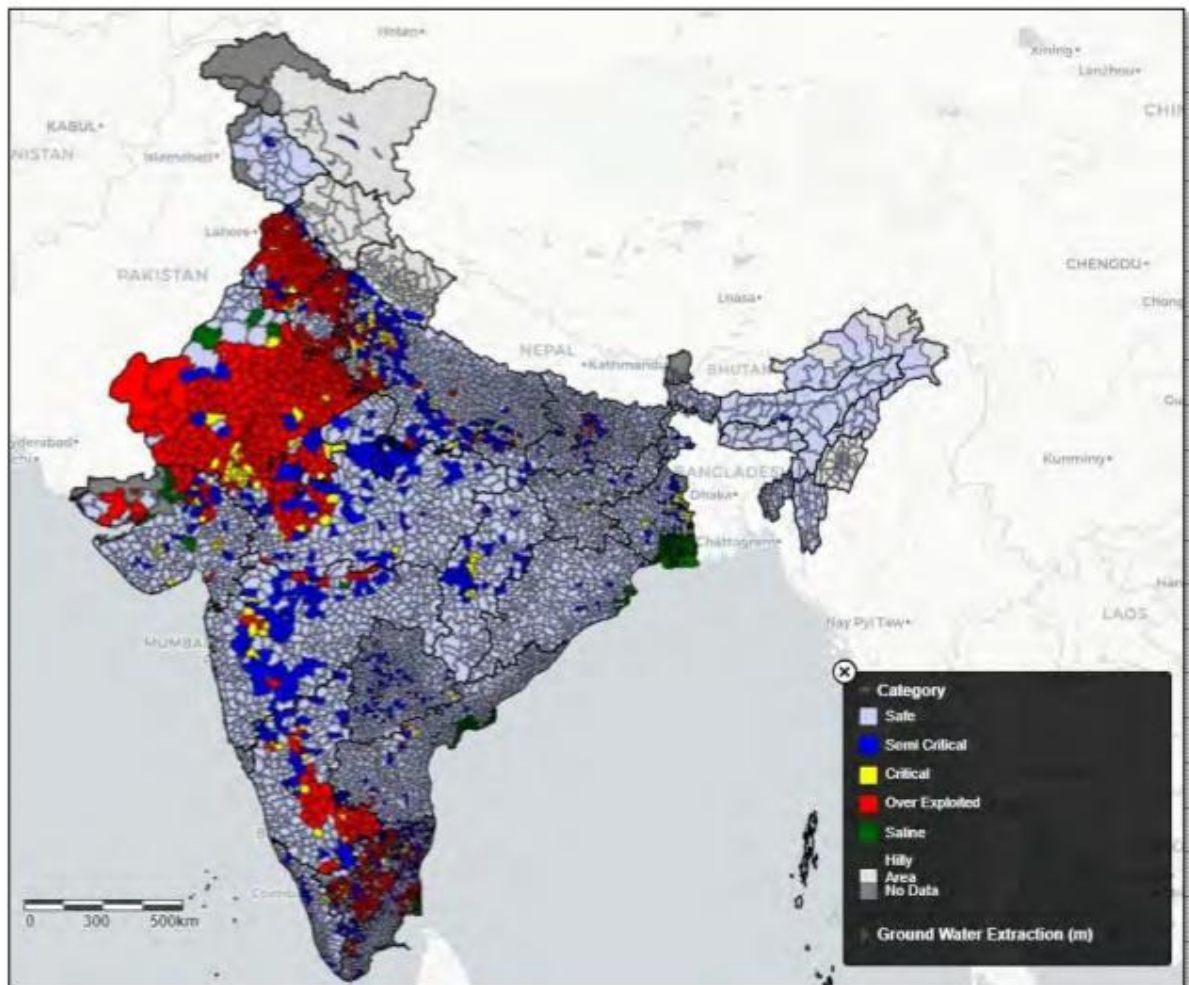


Figure 5.1 : Categorization of Assessment Units



The percentage of Over-exploited and Critical administrative units are more than 25% of the total units in the State/ UT of Delhi, Haryana, Punjab, Rajasthan, Tamil Nadu, Dadra & Nagar Haveli, and Daman & Diu . Similarly, out of 2480.22 thousand sq km recharge worthy area of the country, 419.93 thousand sq km (16.93%) are under 'Over-Exploited', 88.16 thousand sq km (3.55 %) are under 'Critical', 282.77 thousand sq km

(11.40%) are under 'Semi-Critical', 1651.03 thousand sq km (66.57 %) are under 'Safe' and 38.31 thousand sq km (1.55%) are under 'Saline' category assessment units. Out of 406.19bcm of Total Annual Extractable Resources of the country, 45.02bcm (11.33%) are under 'Over-Exploited', 13.23bcm (3.26%) are under 'Critical', 45.76bcm (11.27%) are under 'Semi-Critical', 301.17bcm (74.14%) are under 'Safe' category assessment units.

Table 5.3 : State-wise Groundwater Resources of India, 2024

ANNUAL EXTRACTABLE RESOURCE OF ASSESSMENT UNITS UNDER DIFFERENT CATEGORIES IN INDIA(2024)										
S.No.	State/Union Territories	Total Annual Extractable Resource of Assessed Units (in mcm)	Safe		Semi-Critical		Critical		Over-Exploited	
			Total Annual Extractable Resource (in mcm)	%	Total Annual Extractable Resource (in mcm)	%	Total Annual Extractable Resource (in mcm)	%	Total Annual Extractable Resource (in mcm)	%
1	Andhra Pradesh	26411.44	25186.08	95.36	897.37	3.40	66.13	0.25	261.89	0.99
2	Arunachal Pradesh	3455.95	3455.95	100.00						
3	Assam	20891.31	20849.84	99.80	41.47	0.20				
4	Bihar	30954.51	28524.13	92.15	1995.40	6.45	314.09	1.01	120.90	0.39
5	Chhattisgarh	12927.34	10132.06	78.38	2334.88	18.06	460.40	3.56		
6	Goa	307.97	307.97	100.00						
7	Gujarat	25578.51	20121.22	78.66	2389.22	9.34	860.67	3.36	2207.40	8.63
8	Haryana	9358.58	2138.84	22.85	568.22	6.07	547.44	5.85	6104.07	65.22
9	Himachal Pradesh	1010.37	1010.37	100.00						
10	Jharkhand	5757.56	5302.35	92.09	259.77	4.51	132.32	2.30	63.13	1.10
11	Karnataka	16881.48	10783.49	63.88	2358.88	13.97	1021.40	6.05	2717.70	16.10
12	Kerala	5129.67	4240.06	82.66	752.74	14.67	136.86	2.67		
13	Madhya Pradesh	33989.73	23437.40	68.95	6464.26	19.02	554.63	1.63	3533.45	10.40
14	Maharashtra	31147.44	25212.56	80.95	4317.33	13.86	902.27	2.90	715.28	2.30
15	Manipur	466.08	466.07	100.00						
16	Meghalaya	1532.31	1532.31	100.00						
17	Mizoram	190.30	190.30	100.00						
18	Nagaland	562.18	562.18	100.00						
19	Odisha	16041.33	15546.24	96.91	495.09	3.09				
20	Punjab	17633.77	3250.53	18.43	1044.85	5.93	720.19	4.08	12618.20	71.56
21	Rajasthan	11374.61	1216.98	10.70	930.04	8.18	977.91	8.60	8249.68	72.53
22	Sikkim	217.48	217.48	100.00						
23	Tamil Nadu	19461.53	9197.84	47.26	3550.20	18.24	1619.24	8.32	5094.25	26.18
24	Telangana	18442.87	16150.68	87.57	1742.45	9.45	120.90	0.66	428.83	2.33
25	Tripura	1180.14	1180.14	100.00						
26	Uttar Pradesh	66375.17	47105.34	70.97	12109.78	18.24	3520.44	5.30	3639.61	5.48
27	Uttarakhand	1964.07	1583.97	80.65	380.10	19.35				
28	West Bengal	23562.00	19403.24	82.35	3007.80	12.77	1150.97	4.88		
29	Andaman And Nicobar	338.56	338.56	100.00						
30	Chandigarh	49.62	49.62	100.00						
31	Dadra and Nagar Haveli	115.78							115.78	100.00
32	Delhi	341.90	72.34	21.16	12.16	3.56	128.28	37.52	129.12	37.77
33	Jammu And Kashmir	2303.30	2303.30	100.00						
34	Ladakh	60.68	54.85	90.39	5.83	9.61				
35	Lakshadweep	5.70	4.31	75.60	1.39	24.40				
36	Puducherry	173.48	40.58	23.39	108.82	62.73			24.07	13.88
	Grand Total	406194.73	301169.18	74.14	45768.05	11.27	13234.14	3.26	46023.37	11.33

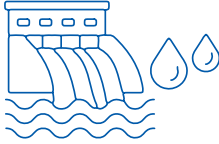


Table 5.4 : State/UT-Wise Area of Assessment Units under different Categories, as per GWRA-2024

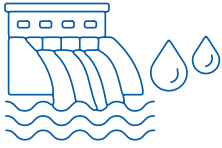
AREA OF ASSESSMENT UNITS UNDER DIFFERENT CATEGORIES IN INDIA (2024)												
S.N o.	States/Union Territories	Total Recharge Worthy Area of Assessed Units (in sq.km)	Safe		Semi-Critical		Critical		Over-Exploited		Saline	
			Recharge Worthy Area (in sq.km)	%	Recharge Worthy Area (in sq.km)	%	Recharge Worthy Area (in sq.km)	%	Recharge Worthy Area (in sq.km)	%	Recharge Worthy Area (in sq.km)	%
1	Andhra Pradesh	140378.61	123819.54	88.20	7947.83	5.66	236.68	0.17	2278.23	1.62	6096.33	4.34
2	Arunachal Pradesh	5721.38	5721.38	100								
3	Assam	68817.93	68617.51	99.71	200.42	0.29						
4	Bihar	90348.7	82188.75	90.97	6818.28	7.55	900.68	1	440.99	0.49		
5	Chhattisgarh	106078.71	88869.46	83.78	14090.19	13.28	3119.06	2.94				
6	Goa	2209.59	2209.59	100								
7	Gujarat	162778.14	115335.48	70.85	14572.01	8.95	7712.28	4.74	16271.58	10	8886.8	5.46
8	Haryana	43205.82	12269.36	28.4	2129.8	4.93	2675.04	6.19	26131.63	60.48		
9	Himachal Pradesh	3468	3468	100								
10	Jharkhand	60646.73	56718.24	93.52	2396.09	3.95	1068.48	1.76	463.92	0.76		
11	Karnataka	170730.9216	99734.80719	58.41637	23383.92443	13.696	12357.11	7.2378	35255.08	20.649		
12	Kerala	27047.53	22161.1	81.93	4109.06	15.19	777.38	2.87				
13	Madhya Pradesh	269333.27	189531.16	70.37	52998.18	19.68	4249.07	1.58	22554.86	8.37		
14	Maharashtra	260349.01	204777.39	78.65	40751.55	15.65	7709.54	2.96	6333.63	2.43	776.89	0.30
15	Manipur	2559	2559	100.00								
16	Meghalaya	8135.45	8135.45	100								
17	Mizoram	3149.41	3149.41	100.00								
18	Nagaland	3855.07	3855.07	100								
19	Odisha	121593.15	116071.86	95.46	3339.96	2.75					2181.33	1.79
20	Punjab	50175.27	8964.13	17.87	3827.5	7.63	1597.32	3.18	35786.32	71.32		
21	Rajasthan	317010.74	46283.9	14.6	17908.38	5.65	21084.64	6.65	222797.93	70.28	8935.89	2.82
22	Sikkim	1496	1496	100								
23	Tamil Nadu	108613.35	45614.89	42.00	19244.96	17.72	8540.25	7.86	33301.69	30.66	1911.56	1.76
24	Telangana	105777.24	89950.81	85.04	12119.96	11.46	875.67	0.83	2830.80	2.68		
25	Tripura	6197.84	6197.84	100								
26	Uttar Pradesh	229554.18	154506.56	67.31	48296.28	21.04	12464	5.43	14287.33	6.22		
27	Uttarakhand	6491.88	5339.7	82.25	1152.18	17.75						
28	West Bengal	79765.77	60842.07	76.28	7099.53	8.9	2316.07	2.9			9508.1	11.92
29	Andaman And Nicobar	1276.39	1276.39	100								
30	Chandigarh	11400	11400	100								
31	Dadra and Nagar Haveli and Daman and Diu	526.9							526.9	100		
32	Delhi	1487.61	330.23	22.19869	41.949	2.8199	481.412	32.361	634.02	42.62		
33	Jammu And Kashmir	8571.96	8571.96	100								
34	Ladakh	963	873	90.65	90	9.35						
35	Lakshadweep	26.21	22.58	86.15	3.63	13.85						
36	Puducherry	483	170	35.20	252.35	52.25			40.65	8.42	20.00	4.14
	Grand Total	2480223.76	1651032.62	66.57	282774.01	11.40	88164.69	3.55	419935.56	16.93	38316.90	1.54

5.3 Groundwater Exploration

Groundwater Exploration is carried to study the sub-surface hydrogeological set up of the aquifer to evaluate aquifer parameters. Geophysical investigations are used for exploration of groundwater and in delineating the underground structures which control the occurrence, distribution and movement of groundwater. Both surface and subsurface (well logging) geophysical techniques are utilized in the search for groundwater and the proper construction of water wells. As a standard practice, the results of these geophysical studies are integrated with hydrogeological and geomorphological investigations to ensure a solid foundation for their conclusions. Once constructed, a tube-well is developed to increase its specific capacity to prevent sand rushing into the well and to obtain maximum well life. Thereafter, pumping tests are conducted for evaluating aquifer parameters i.e. Transmissivity, storage coefficient and well parameters viz. specific capacity and well efficiency, with a view to evolve efficient design for tube wells, assessment of yield capabilities and spacing criteria for tube wells.

The Borehole geophysics is used in groundwater to obtain information pertaining to lithology, fractures, permeability, porosity and water quality so as to delineate subsurface disposition of aquifers. Borehole-geophysical logging determines the character and thickness of the different lithological/Hydro-geologic units in drilled pilot boreholes. Saline / brackish water bearing aquifers are present in different parts of India. Fresh water bearing aquifers are often intervened by the saline water aquifers. Such information is essential for proper

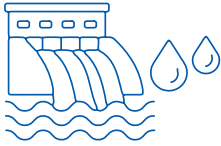
placement of casing and screens in water-supply wells and for characterizing and remediation of problems related to ground-water salinity. The proper positioning and condition of casing and screen pipes in a well can be rapidly evaluated with geophysical borehole logging. Surface geophysical surveys specially the traditional Electrical Resistivity survey in soft and hard rock formations are commonly employed to delineate the groundwater bearing zones/structures, pin-pointing sites for construction of boreholes and providing inputs for formulating proposals for constructing artificial recharge structures. Geophysical survey are also conducted for delineating the bedrock topography and sandy horizon of non – perennial channel. In recent times, Transient-Electromagnetic techniques (TEM) are also being used for identifying the sub-surface layers parameters in term of Resistivity and thickness as is done through Electrical resistivity surveys. TEM surveys, however, takes less time in comparison to the conventional Electrical resistivity survey.





06

Constitutional Provisions for Management of Water Resources



Water is a subject matter included in Entry 17 of List II (State List), subject to the provisions of Entry 56 of List I (Union List) under the Seventh Schedule of the Constitution. Entry 17 of List II of the Seventh Schedule provides that “Water, that is to say, water supplies, Irrigation and canals, drainage and embankments, water storage and waterpower subject to the provisions of Entry 56 of List I.”

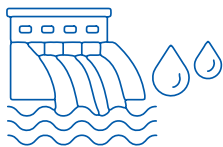
Entry 56 of List I (Union List) of the Seventh Schedule provides that “Regulation and development of inter-State rivers and river valleys to the extent to which such

regulation and development under the control of the Union is declared by Parliament by law to be expedient in the public interest.” As such, the Union Government is conferred with powers to regulate and develop Inter-State rivers under Entry 56 of List I of the Seventh Schedule to the extent declared by the Parliament by law to be expedient in the public interest. The Union Government also has the power to make laws for the adjudication of disputes relating to waters of Inter-State River or river valleys under Article 262 of the Constitution.



07

National Water Policy



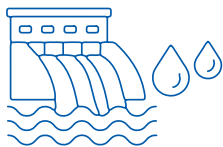
Central Government formulated the National Water Policy in 1987, which was subsequently reviewed and revised in the year 2002 and 2012. The main objective of the National Water Policy is to take cognizance of the existing situation in water sector, to propose a framework for creation of a system of laws and institutions and a plan of action with a unified national perspective in planning, management and use of water resources. At present the National Water Policy - 2012 is in effect. The “National Water Policy – 2012” was adopted by the National Water Resources Council in its 6th meeting held in December 2012. Later a Committee was constituted by the erstwhile MoWR for suggesting roadmap for implementation of National Water Policy - 2012 under the Chairmanship of Dr. S.R. Hashim, Former Chairman, UPSC & Former Member, Planning Commission. The Committee has submitted its report in September, 2013.

However, to address the present challenges in water sector, revision of National Water Policy (2012) has been

envisaged by Ministry of Jal Shakti and a committee has been constituted, on 05.11.2019 under the chairmanship of Dr. Mihir Shah, to draft the National Water Policy. The Committee undertook a process of wide-ranging consultations to ensure that the process of drafting the policy is as inclusive as possible and the best possible policy emerges from this process of co-creation. Ten meetings and Five consultation meetings of the Drafting Committee for revision of National Water Policy were conducted (November, 2019 - October, 2020), in which the consultations were held with the State Governments/ UTs, Central Ministries, Non- Governmental Organisations, Academia and Water Experts from all over the country. Based on the consultations and deliberations, the Drafting Committee submitted three drafts of National Water Policy on 17.08.2020, 17.10.2020 and 01.11.2020 respectively. The final draft of National Water Policy dated 07.11.2020 has been submitted by the Drafting Committee to the Ministry of Jal Shakti.



08 National Water Framework Bill 2016



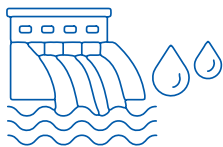
The National Water Policy (2012) emphasizes the need to evolve a National Water Framework Law as an umbrella statement of general principles governing the exercise of legislative/ executive powers by the Centre, the States and the local governing bodies. Subsequently on 03.07.2012, the Ministry had constituted a Committee under the Chairmanship of Dr. Y. K. Alagh to draft National Water Framework Law. The Committee submitted its Report in May, 2013. The report submitted by Dr. Y. K. Alagh Committee was circulated to the States/ UTs for comments and were also placed before the Forum of Water Resources / Irrigation Ministers of States for wider consultations in its meeting held on 29.05.2013. Later on 28.12.2015, Erstwhile MoWR, RD&GR constituted a Committee under the Chairmanship of Dr. Mihir Shah to examine the provisions of the draft National Water Framework Bill and suggest changes/ modifications. The Committee submitted its Final Report to the Ministry on 18.07.2016

which was circulated to all States/UTs and concerned Central Ministries for their comments on the proposed National Water Framework Bill. Subsequently on 20.01.2017, the Secretary of the Erstwhile Ministry of Water Resources River Development & Ganga Rejuvenation and on 14.03.2017, the Hon'ble Minister of Water Resources River Development & Ganga Rejuvenation has requested all States/UTs to pass suitable resolutions in their State Assemblies in support of the draft National Water Framework Bill, 2016. The Bill was circulated to States/UTs and the concerned Central Ministries for obtaining their comments. Comments on the draft bill have been received from 11 States viz., Rajasthan, Tamil Nadu, Madhya Pradesh, Kerala, Karnataka, Odisha, Gujarat, Uttar Pradesh, Maharashtra, Bihar and Jharkhand whereas, interim response have been received from 5 States/UTs viz., Uttarakhand, Punjab, Arunachal Pradesh, NCT of Delhi and Lakshadweep. Response from other States / UTs is awaited.



09

River Basin Management Bill



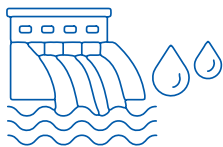
DoWR,RD&GR had constituted a Committee on 06.03.2012 under the Chairmanship of Justice (Retd.) T.S. Doabia to study the activities that are required for optimum development of river basin and changes required in the existing River Board Act, 1956 for achievement of the same. The Committee submitted its Report in November, 2012 to the Ministry which includes a draft River Basin Management Bill, 2012. The same was circulated among all States, Union Territories and related Union Ministries by the Ministry. Subsequently, a Committee under the Chairmanship of Dr. Mihir Shah was constituted on 28.12.2015 by the Ministry to examine the provisions of the draft River Basin Management Bill, 2012 and suggest changes/modifications therein taking into account inter-alia the emerging challenges in the water sector, reuse of waste water after treatment, the likely impact of climate change on water resources, importance of river restoration/rejuvenation, water contamination issues

etc. DoWR,RD&GR has constituted an Expert Group in the Ministry to further review and finalize the bill. Director (NWP), CWC is representing CWC in the group. A one-day brainstorming session was held to deliberate upon various issues related to River Basin Management Bill, 2018 on 03.06.2019 at Vigyan Bhawan, New Delhi. Representatives from States/Union Territories concerned Central Ministries, experts and other officials from Ministry of Jal Shakti, officers from CWC, CGWB, NIH and other officers participated in the deliberations. The response of Central Water Commission on the comments of States during brain storming session was sent to the Department of Water Resources River Development & Ganga Rejuvenation on 25.10.2019. Central Water Commission also provided its response on the comments of public/stake holders which were sent to the Department of Water Resources, River Development & Ganga Rejuvenation on 22.04.2020.



10

Water Demand and Management



As per Land Use Statistics for 2021-22, the geographical area of our country is 328.7 million hectares, of which around 54.8% is agricultural land, 141.00 million hectares is the reported net sown area and 219.16 million hectares is the gross cropped area with a cropping intensity of 155.4%. Net area sown comprises of 42.8% of the total geographical area. At all India level, total cropped area has increased by 66.1 percent in 2021-22 as compared to 1950-51 (131.89 million hectares in 1950-51 to 219.15 million hectares in 2021-22). The net irrigated area during 2021-22 was 77.9 million hectare (55.2% of net sown area of 141.00 million ha and 44.8% is under rainfed conditions), out of which 24.7% was accounted by canal source of irrigation, 2.8 % by tanks, 47.3 % by Tube wells, 13.2 % by other wells and remaining 12.0 % is irrigated by other source of irrigation. The gross irrigated area in 2021-22 was estimated at 120.3 million hectare, which was 54.9 % of the gross cropped area. Almost 78% of India's freshwater demand (Central Water Commission 2010) comes from the agricultural sector. India is facing an unprecedented water stress situation. Per capita water availability, which was more than 5178 cubic meters per year in 1951, reached 1544 cubic meters a year in 2011 and is estimated to shrink further to 1174 cubic meters per year by 2051. The major problem that ails the groundwater sector is the over-extraction of the resource, resulting in depletion/decline in the water table in many areas of the country. The groundwater level in certain parts of India (especially the north-western region) is on a declining trajectory, and to top it all, owing to the global incidence

of climate change, India has witnessed a negative departure in rainfall from its Long Period Average in more than 50% of the last twenty years. Irrigation water is crucial for agricultural production and food security in India. Given the limited and uneven distribution of water resources, irrigation provides a powerful management tool against erratic rainfall, making it economically viable to grow high-yield seed varieties and apply adequate plant nutrition and pest control, thereby boosting yields. There is a gap in irrigation potential created and utilised by major and medium irrigation projects, which has inefficiency connotations.

10.1 Minor Irrigation Schemes in Agriculture

All groundwater and surface water schemes (flow and lift) with a Culturable Command Area (CCA) of less than 2000 ha are classified as minor irrigation schemes. Minor irrigation schemes, due to their small capital requirements, shorter execution times, and better flow control, play an essential role in this context. They contribute substantially to irrigation nationwide, ensuring sustained agricultural and economic growth. These schemes are especially important in uneven terrain and hilly areas, where they result in the efficient use of water, a rapidly depleting resource. Minor irrigation projects involve small investments with short gestation periods, directly benefiting farmers. Groundwater schemes, providing reliable year-round irrigation, have been instrumental in sustaining agricultural production. Important Minor Irrigation investments/

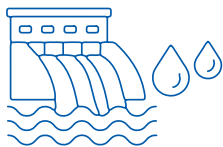
schemes are as follows:

- i. **Dug-well:** These are open wells and their depth depends upon the location and thickness of the aquifer. It is generally desirable that the depth of the well should be atleast 2 to 3 m below the summer water level. The diameter of the dug well depends on the hydro-geological characteristics of the formations. In hard rock areas, generally, the diameter is large and is in the range of 5 m to 6 m which permits storage of water in the wells. While in the alluvial areas the diameter is in the range of 2.5 to 4.0 m.
- ii. **Bore well :** Bore wells are constructed in hard rock formations by means of drilling. These wells are constructed to tap groundwater occurring at relatively deeper layers under semi-confined to confined conditions. The diameter of the bore wells is generally 150mm and the depth ranges from 50m to about 100m bgl. Due to depletion in water levels the traditional dug wells are being replaced by bore wells. Also, the construction of bore well is economical and less time consuming when compared to dug wells. They are also sustainable during summer season as they tap deeper aquifer and hence farmers prefer construction of bore wells over dug wells.
- iii. **Tubewells:** These wells are generally constructed in alluvial areas where the formation are soft and collapsing in nature.. To prevent collapsing of the wells, the entire well is cased with GI or PVC casing. Against the water

bearing zones, perforated pipes or well screen is installed with gravel pack on its outside to prevent entry of fine sand and allow the groundwater into the well. While shallow tube wells are constructed by individual farmers, the deep tube wells which encounter multiple aquifers are normally constructed for higher discharges and meeting larger water requirement for a group of farmers/ society. The diameter of shallow tube wells is generally 150mm and the depth generally ranges from 50m to about 150m. In deep tube wells, the diameter ranges from 200mm to 300mm and the depth is generally more than 150 m. Both the bore wells and tube wells are installed with submersible pump sets for pumping water for agricultural usage.

- iv. **Filter point :** Filter point is a type of tube well and is constructed in areas where the water level is very shallow like coastal plains, river courses, command areas, etc. The diameter of the filter point is generally 100mm and depth ranges from 15 m to 25 m. Filter points are constructed manually by hand drilling and hence the cost is low and may be about ₹6000 to ₹7000.
- v. **Infiltration wells :** Infiltration wells are open dug-wells constructed in the bed of seasonal rivers/streams to draw sub surface water. The top portion of the well is closed to prevent entry of sand when the river flows.

The diameter of these wells is generally in the range of 3m to 6m and the depth depends on the thickness of sand bed. A



large number of lift irrigation schemes have been installed on infiltration wells.

- vi. **Lift irrigation Schemes** : Lift irrigation schemes are of different types depending on the command area and the type of lifting devices. There are small lift irrigation schemes constructed by individuals where simply a pump set and pipeline of required length and diameter to convey water upto the highest point in the command area is required. Big lift irrigation schemes are implemented by a group of farmers/ cooperative societies/ irrigation department having large command area which require Head works(intake well, intake pipe, jack well/sump well and pump house), Rising main and Delivery chamber, Distribution system and Pump sets(Centrifugal/ VT pump/Submersible).
- vii. **Pump sets** : Based on the type of power used for operating the pumps, they can be broadly classified as (a) Electric pump sets (Centrifugal/VT pump/Submersible), (b)Diesel pump sets, (c)Solar pump sets, (d)Wind mills.
- viii. **Micro-irrigation** : The term “micro-irrigation” describes a type of irrigation systems that applies water to the plants through small devices known as emitters. These devices deliver water onto the soil surface very near the plant or below the soil surface directly into the plant root zone. The emission of water may be thru’ different devices as per type of soil, crop, daily crop water requirement. Micro Irrigation system

are of two types –drip and Sprinkler systems.

- **Drip Irrigation** : Drip irrigation can also be called as trickle irrigation since water is applied to the plant at the root zone, drop by drop. Since the water is applied directly to the root zone of the plants, the water requirement for irrigation is considerably less than that of conventional irrigation methods. Further, conveyance losses are totally absent resulting in saving of considerable quantity of water. The water use efficiency is considerably high in the drip irrigation system.
- **Sprinkler Irrigation System** : Sprinkler irrigation method distributes water to crops by spraying it over the crop area like a natural rainfall. The water under pressure flows through perforations or nozzles and sprays over the area. The pressure is provided by a pump of suitable capacity and horsepower. With careful selection of nozzle sizes, operating pressure and spacing, the actual water required for maintaining the soil moisture at field capacity is applied uniformly at a rate to suit the infiltration rate of soil thereby obtaining efficient water application. The sprinkler irrigation system substantially reduces the use of water and the crop productivity also increases. The important advantages of drip irrigation are (a)Conservation of water, (b)saving in energy, (c) soil conservation, (d) increase in crop yield, (e) Saving in fertilizer. The limitation of the system is the higher

initial investment and the problem of clogging of the system which requires proper maintenance.

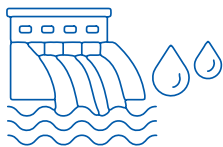
10.2 Irrigation Through Canal

In the case of canal water, the creation of a large public irrigation system constituted the main thrust of public expenditure on irrigation under the planned development of India. Yet, there is a large gap between India's irrigation potential creation (IPC) and its utilisation (IPU), mainly through major and medium irrigation (MMI) projects since long and it has stubbornly increased over time, especially since the 1980s. This means under-achievement of the planned targets, low returns on large investments and the farmers facing continued scarcity of irrigation water. Government initiatives such as the Pradhan Mantri Krishi Sinchayee Yojana aim to monitor and implement irrigation projects more effectively. NABARD has played an active role in this initiative, providing loans for irrigation projects and contributing significantly through the Rural Infrastructure Development Fund (RIDF).

10.3 Tank Irrigation in India

Ponds are traditional water-harvesting structures central to India's settlement patterns. Historically, these ponds were managed by local communities, ensuring equitable water distribution. However, the significance of these community-managed ponds has declined with the advent of large-scale irrigation projects. As a result, water scarcity has become

a pressing issue, leading to reduced crop yields, shifts in cropping patterns, environmental degradation, rural-urban migration, increased reliance on monsoons, groundwater depletion, and adverse effects on livelihoods. Farm ponds offer several benefits. They capture and store rainwater during the monsoon, providing a crucial resource for irrigation during dry periods and reducing groundwater reliance. By allowing rainwater to permeate the ground, farm ponds contribute to groundwater recharge, sustaining borewells and other wells during water-scarce months. Consistent water availability enables farmers to diversify crops and experiment with high-value, water-intensive varieties, increasing income and food security. Farm ponds also act as buffers against climate change, helping farmers cope with droughts and water scarcity. The stored water serves livestock for consumption and bathing, promoting the health and well-being of farm animals. Additionally, some farmers use farm ponds for fish farming, creating an additional income source and a protein-rich food supply. Farm ponds play a crucial role in mitigating water scarcity, promoting sustainable agricultural practices, and enhancing climate resilience. With growing awareness and government support, farm ponds are becoming crucial to farming practices in India. In 2017-2018, the Space Application Centre of India mapped 231,195 water bodies and wetlands, covering 15.98 million, accounting for 4.86% of India's total geographical area. Two-thirds of these water bodies are ponds and tanks, contributing 11.4% of the mapped area.

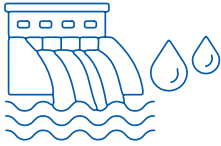


Aquaculture ponds occupy 2.7% of this area. Ponds and tanks are more prevalent in the plateau and desert regions than in the Himalayan and Indo-Gangetic plains, highlighting their significance in water-scarce areas. Southern India has a high concentration of ponds and tanks, with Andhra Pradesh having 22,255, Tamil Nadu 21,501, Maharashtra 19,816, Karnataka 13,347, and Telangana 11,638. Government initiatives and the revival of

traditional water-harvesting structures like ponds are vital for enhancing crop diversity, climate resilience, and overall agricultural productivity. Key government initiatives aimed at addressing water scarcity and promoting sustainable agriculture include Pradhan Mantri Krishi Sinchayee Yojana (PMKSY), Har Khet Ko Pani, Per Drop More Crop, National Mission for Sustainable Agriculture (NMSA), and Atal Bhujal Yojana



11 Drinking Water Supply



Water supply for drinking purpose has been accorded top most priority in water allocation and its various uses, but major utilization is for irrigation purpose. As on 2011-12, Ultimate Irrigation Potential (UIP) estimated for the country is 139.89 Mha, out of which the assessed potential through major and medium irrigation projects is 58.47 Mha. Besides this, an additional irrigation potential of about 35 Mha can be created by inter basin transfer of water from surplus to deficit basins. The Irrigation Potential Created (IPC) in the country, which stood at 12.9 Mha in 1951, has risen to 113.53 Mha by end of XI plan period. Reassessment of UIP, IPC & IPU of the country, project wise for MMI projects, and source wise i.e. Surface and Groundwater, for MI projects has been taken up for updating this data and are under progress.

In order to appropriately address the present and future water and food security Government of India has been implementing various measures. The following thrust/priority areas, for further water resources development, have been identified by the Government.

- Improving the overall water use efficiency in irrigation and drinking water supply system;
- Adoption of piped distribution system in place of open canal system to reduce the conveyance water loss
- Command area development by implementing more micro irrigation system and participatory irrigation management;
- Flood management and erosion control using new tools and

techniques;

- Protection from coastal erosion by creation of proper coastal data collection and management network;
- Dam safety, dam rehabilitation and performance improvement;
- Repair, Renovation and Restoration of existing water bodies use for irrigation, drinking water supply, cultural activities, etc;
- Construction of more minor irrigation structures to achieve the goal of Appropriate regulation and improvement in management of groundwater;
- Increasing the groundwater availability by various Groundwater recharge techniques;
- Inter basin transfer of river water by inter-linking of rivers;
- Improving the rural drinking water supply system and sanitation;

NABARD has been thriving for sustainable development of water resources of the country, by directly and indirectly contributing in achieving the objectives of these thrust/priority areas.

The Government of India has prioritized safe and accessible drinking water through the Jal Jeevan Mission (JJM), launched in 2019 to provide functional household tap connections to every rural household by 2024. This mission focuses on universal coverage, ensuring water quality, sustainable water management, and community participation. Budgetary allocations reflect the importance

of these goals, with the Department of Drinking Water and Sanitation receiving ₹59,790.44 crore in 2022-23, which increased to ₹77,390.68 crore in 2024-25. These funds have fueled significant progress, providing tap water connections to over 11 crore households, boosting coverage by 57% since JJM's inception. Four states—Goa, Gujarat, Telangana, and Haryana—along with three Union Territories have achieved 100% household coverage. Despite these strides, challenges persist, including water scarcity, contamination, and infrastructure gaps. The government aims to address these issues by expanding water supply systems, promoting conservation practices like rainwater harvesting, and empowering local communities for sustainable water management. Through strategic investments and community engagement, the mission envisions a future where every Indian household has access to safe drinking water, bolstering public health and quality of life. Project Nirmal Jal, an all-women FPO initiative supported by NabFoundation, aims to establish a reverse osmosis ultraviolet filtration plant in the water-stressed Husnapur region of Wardha district, Maharashtra, to provide 1,000 litres per hour of drinkable water. The project will be executed in partnership with toyaM Technologies India Private Limited. Water will be sourced from a nearby well, and a unique card-based water delivery system will facilitate self-collection and

home delivery to both domestic and commercial clients. Additionally, water dispensing systems and electric vehicles for transportation will be powered by solar energy.

A project for developing climate-adaptive and resilient livelihood systems through sustainable agriculture, water conservation, diversification, and technology adoption has been undertaken in 51 villages across two districts of Maharashtra under NAFCC. This project involves the cultivation of jowar in 4,000 acres of land, followed by rabi jowar (1,000 acres) and finger millet (600 acres). A study on water productivity mapping of major Indian crops indicates that rice, wheat, and sugarcane consume 80% of the freshwater available in India, leading to highly inefficient, inequitable, and unsustainable use of water resources. Conversely, millets are hardy, low-cost, and climate and drought-resilient crops. Therefore, besides conserving biodiversity and water use, millet farming also supports the most vulnerable food growers, such as women and tribal, small, and marginal farmers. Most promotion and branding exercises around millet cultivation specifically target these growers. Incentivising millet cultivation among women and tribal farmers could help achieve not just national goals of millet output but also global goals related to sustainable agriculture, production, and consumption.



12 Hydro-Power

The importance of hydro power has a renewed emphasis due to the changing energy mix of India. Hydro power is critical in India's response to the challenge of meeting the energy needs of an aspiring population even as climate change issues are also addressed. Government of India has set an ambitious target for enhancement of non-fossil fuel Energy capacity to 500 GW by 2030 (as announced in the COP26 Summit in Glasgow by the Hon'ble Prime Minister of India). The commitment regarding non-fossil fuel capacity is proposed to be met mainly from installation of Solar and Wind power capacities, which are infirm sources of power, i.e. the generation from these sources varies significantly with the availability of wind and sunshine. With the increased share of intermittent Renewables in the energy mix of the country, the existing flexibility in Generation of power will not be sufficient to meet the balancing requirement in the electricity grid and the stable operation of Grid for ensuring 24x7 Power will require. Hydro Power, which has unique features like quick ramping, black start capability etc. The development of Hydro Power and the Hydro Pumped Storage projects is of paramount importance for achieving above goals. Hydro is clean, green, renewable, non-polluting and environmental friendly. Hydro projects improve quality of life in remote hilly and backward areas by benefits of electrification, industrialization & road/rail communication development. It provides escalation free & cheapest energy in long run. It has the ability for instantaneous starting, stopping and load variation, thereby ideally suited for

peaking and balancing operation and improves reliability of power system.

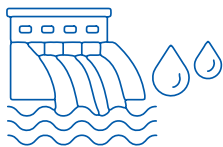
Storage projects increase lean season flows, provide flood control, navigation, irrigation and drinking water supply benefits etc. and thus help in the maximum utilization of scarce water resources. Projects like Hirakund & Bhakra Dam have increased Agriculture Productivity and have been behind the success of Green Revolution in India while the role of Tehri Dam in mitigating the 2013 Uttarakhand disaster floods is well known. Hydro projects also have a long useful life. Some projects like Bhakra are in operation for last 50 years, while some others like Pykara (59.2 MW) & Mettur Dam (50 MW) in Tamil Nadu, Pallivasal (37.5 MW) in Kerala and Sivasamudram (42 MW) in Karnataka etc., are in existence for more than 70-80 years now.

Table 12.1 : Installed Capacity of Hydro-Electric Stations: (31.03.2024)

Sector	Total	
	No.	MW
Central	43	15742.70
State	148	27254.45
Private	22	3931.00
Total	213	46928.15

In March 2019, Govt. of India approved number of measures for promoting hydro power sector, for realizing the Ultimate Hydropower Potential of 133410 MW. The details are as under:

- i) Declaring Large Hydro Power (LHPs) (> 25 MW projects) as Renewable Energy source.
- ii) Hydro Purchase Obligation (HPO) as a separate entity within Non-solar Renewable Purchase Obligation (RPO).



iii) Tariff rationalization measures for bringing down hydro power tariff.

iv) Budgetary Support for Flood Moderation/Storage Hydro Electric Projects (HEPs).

v.) The expenditure towards the idling cost leads to overall increase in the project cost. In order to bring down the same, Ministry issued an advisory to all CPSEs on 19.07.2022 for rationalization of manpower at stalled projects.

vi.) The design, construction and maintenance of the slopes is one of the major challenges during planning, construction and operation of Hydro Power projects. Generally, slope instabilities in hydro power projects are encountered during execution as well as operation. CEA issued Guidelines for Slope Stability in/around Hydro projects on 05.10.2023.

vii.) Contingent liabilities arising due to contractual disputes are not conducive

for financial health of the developer. To prevent this, MoP issued Guidelines on 18.03.2022 for early settlement of disputes and to minimize the arbitral claims/disputes in hydro sector

viii) Budgetary Support to Cost of Enabling Infrastructure, i.e. roads/bridges.

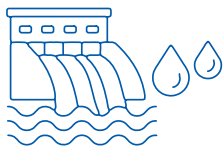
a. ₹ 1.5 crore per MW for projects upto 200 MW.

b. ₹ 1.0 crore per MW for projects above 200 MW.

As a result of these measures, the capital cost as well as the project tariff would be reduced in initial years which would improve project viability & saleability. The hydro power is being given its due importance given its niche role in the energy mix. The right framework in which viable projects required from the perspective of maintaining a stable grid and providing power at the time of the day it is required get selected for execution is being promoted.



13 Water Resources Management and Climate Change



Indian Agriculture is highly vulnerable to climate change with approximately 51 percent of cultivated areas under rainfed conditions. Climate change is causing significant shifts in weather patterns throughout the world and it is expected to impact agricultural production systems thereby posing major challenges to the livelihoods and food security to millions of people. As per the latest Inter Governmental Panel on Climate Change (IPCC) Assessment Report (AR-6), increase in rainfall, higher inter annual variability, intense and frequent heat waves, likely temperature increase by 1.5 to 4.0o C and rise in sea level by 300 mm could be the major challenges for sustainable agriculture in the coming years (IPCC, 2021). Agricultural production in India is becoming increasingly vulnerable to climate variability characterized by temperature rise and altered frequency, timing and magnitude of precipitation. One or other part of the country is experiencing frequent extreme weather events causing sizeable loss of yield and income to the farmers at micro scale and to the nation's economy at macroeconomic level. This necessitates accelerated research for developing resilient and smart technologies wherever feasible to combat climate change as well as their mainstreaming through adaptation mechanisms. Therefore, Government of India has accorded a high priority on research and development to cope with climate change in general and agriculture in particular. During the sessions of COP26 Climate Summit, Glasgow, Scotland

(2021), Government of India declared 5 commitments (Panchamrit) to deal with climate change. India, through its Nationally Determined Contributions (NDC) committed to become carbon neutral and achieve net zero emissions by the year 2070. India has identified agriculture as a sector for taking up adaptation as climate action.

13.1 United Nations Sustainable Development Goals (SDG)

The 2030 Agenda for Sustainable Development, adopted by all United Nations Member States in 2015, provides a shared blueprint for peace and prosperity for people and the planet, now and into the future. At its heart are the 17 Sustainable Development Goals (SDGs), which are an urgent call for action by all countries - developed and developing - in a global partnership. These 17 goals are further divided into 169 targets. These Goals recognize that ending poverty and other deprivations must go hand-in-hand with strategies that improve health and education, reduce inequality, and spur economic growth – all while tackling climate change and working to preserve our oceans and forests. Sustainable Development Goal 6 aims to “Ensure availability and sustainable management of water and sanitation for all”. The Goal 6 is further divided into 8 Targets. To measure the progress towards these Targets, each target has been further subdivided into Indicators. These Indicators are then reported country wise.

13.2 State Specific Action Plan (SSAP)

Under National Water Mission (NWM), State Specific Action Plans for Water Sector aligned with the State Action Plan on Climate Change to be prepared for all States and Union Territories (UT) (36 Nos.). A Steering and Technical Committees for State Specific Action Plan (SSAP) on Water was constituted in September 2020 having Chief Engineer, BPMO and Director, BP-III, respectively. The main responsibility of these committees is to examine and approve the SSAPs for States / UTs. Comments/ views / suggestions on Draft Status Report (DSR) of 21 States/UTs have been offered by BP-III. No. of meetings on DSR of Technical and Steering Committee held for 14 and 11 States/UTs, respectively.



14

**Major Schemes &
Programmes**

14.1 Pradhan Mantri Krishi Sinchayee Yojana (PMKSY)

PMKSY aims to provide assured irrigation to enhance incomes of small and marginal farmers. It was launched in 2015 to extend irrigation coverage by utilizing groundwater where sufficiently available. Key States covered under this are Assam, Arunachal Pradesh, Nagaland, Tripura, Manipur, Mizoram, Tamil Nadu, Gujarat, Uttar Pradesh, and Uttarakhand. Under the PMKSY-HKGP-GW scheme for utilizing groundwater for assured irrigation, 13 projects have been sanctioned in 10 states. As of March 2023, 29,695 wells constructed, 77,964 Ha command area created, and 67,285 marginal farmers have benefited.

PMKSY- Har Khet Ko Pani- Groundwater (PMKSY-HKGP-GW): It is a centrally sponsored scheme launched by Department of Water Resources, River Development and Ganga Rejuvenation, Ministry of Jal Shakti, which envisages to provide irrigation facility for Small and Marginal Farmers in areas having sufficient potential for future development of groundwater. The Scheme is being implemented with an objective to support goal of Hon'ble Prime Minister of India, for doubling the farmer incomes. The scheme was approved for 2015-20, but keeping in view various requirements to implement the scheme, guidelines were revised during May 2019 and scheme has been re-launched in July 2019. So far 13 projects have been implemented in 10 states namely Assam, Arunachal Pradesh, Gujarat, Nagaland, Manipur, Mizoram, Tripura, Tamil Nadu, Uttar Pradesh, Uttarakhand. The total cost of these 13 ongoing projects are ₹ 978.00 Crore and Central Assistance is ₹ 827.15 Crore. Out of 12 completed projects,

three projects have completed during the year 2022-23.

14.1.1 Pradhan Mantri Krishi Sinchayee Yojana (PMKSY) AIBP: Prioritization of 99 Projects:

- A large number of irrigation projects taken up under Accelerated Irrigation Benefits Programme (AIBP) after its launch in 1996-97 were languishing due to inadequate provision of funds. Consequently, large amount of funds spent on these projects were locked up and the benefits envisaged could not be achieved.
- A committee under the Chairmanship of Hon'ble Minister (WR), Chhattisgarh was constituted vide MoWR, RD & GR order dated 02.03.2016 to look into the issues related to implementation of PMKSY. The committee in consultation with States identified ninety-nine (99) ongoing irrigation projects under AIBP for completion in phases up to December, 2019. Out of these 99 priority projects, 53 projects have been reported completed and 23 projects have progress more than 90%.
- Pari-passu implementation of command area development works in the Commands of these projects is envisaged to ensure that the irrigation potential created may be utilized by the farmers.
- The arrangement of funds for Central Assistance (CA) was made through NABARD under Long Term Irrigation Fund (LTIF) as per year-wise requirements which would be paid back in 15 years' time. Further, the State Governments, if required, may also borrow funds from NABARD for the State share.
- In January, 2020, Ministry of Finance



conveyed the continuation of ongoing centrally sponsored scheme up to 31.03.2021.

- The Union Government approved continuation of PMKSY on 15.12.2021 for the period 2021-26 along with permission for inclusion of new major and medium projects under PMKSY-AIBP. Funding of Renuka and Lakhwar National Projects were also approved to be funded through PMKSY-AIBP.

- Funding arrangements for central assistance during 2021-26 has been approved through budgetary allocations whereas state share for balance priority projects (out of 99 projects identified during 2016-17) through long term irrigation fund (LTIF) with loan from NABARD.

- The progress of the projects in physical as well as financial terms is monitored through the field units of Central Water Commission.

- Social audit in 10% of the projects in each State after completion is contemplated.

14.1.2 Command Area Development and Water Management (CAD&WM) Programme Components

The activities covered under CAD&WM component of a Project are broadly categorized as 'Structural' and 'Non-Structural' interventions, as detailed below:

- Structural Intervention: includes survey, planning, design and execution of:
- On-Farm Development (OFD) works;
- Construction of field, intermediate & link drains;

During 12th Plan period, a Culturable Command Area (CCA) of 7.6 million ha

was been targeted with central assistance amount of ₹ 15,000 crores which was subsequently reduced to 3.6 million ha during mid-term appraisal. From 2015-16, the programme came under HKPP component of PMKSY with a target of 1.5 million ha. Subsequently, from 2016-17 onwards, the role of programme has been restricted to 99 prioritized AIBP projects, under which the target was 4.5 million hectares. Against this, the achievement till March, 2023 has been reported to be about 1.79 million hectares, with release of central assistance of ₹2954.46 crore during this period.

14.1.3 Implementation of PMKSY-AIBP (including CADWM) during 2021-26

- PMKSY-AIBP including CAD&WM has been approved for implementation with an outlay of ₹ 23,918 crores (central assistance) during 2021-26 for completion of 60 ongoing AIBP and 85 ongoing CAD&WM projects, along with financial assistance of new major and medium irrigation projects. Funding of National Projects, including Renuka and Lakhwar Projects, is also approved.

- Financial progress requirement is dropped for inclusion of a project under AIBP and only physical progress of 50% to be considered.

- Advanced stage (50% physical progress) criteria is relaxed for projects having command area of 50% or more in Drought Prone Area Programme (DPAP), Desert Development Programme (DDP), flood prone, Tribal area, Flood prone area, left wing extremism affected area, Koraput, Balangir and Kalahandi (KBK) region of Odisha, Vidarbha & Marathwada regions of Maharashtra and Bundelkhand region of Madhya Pradesh & Uttar Pradesh, as also

for Extension Renovation Modernisation (ERM) projects and also for States with net irrigation below national average.

- Reimbursement is allowed for due central assistance in subsequent years also.

- Project completion permitted with physical progress of 90% or more.

- Central Assistance of ₹ 20235.91 crore (AIBP: ₹ 17107.12 crore; CADWM: ₹ 3128.79 crore) has been provided for these projects from 2016-17 to 2023-24, out of which ₹ 1508.21 crore (AIBP: ₹ 1333.82 crore; CADWM: ₹ 174.39 crore) has been provided during the Year 2023-24. So far, 8 new MMI and 2 new National projects have been included under PMKSY AIBP.

14.1.4.1 Har khet Ko Paani : Surface Minor Irrigation (SMI) Schemes and Repair, Renovation & Restoration (RRR) of water Bodies

Under the SMI scheme, since 2015-16, 7,304 schemes are ongoing with an estimated cost of ₹ 15,506 crores. Under the RRR of Water Bodies scheme, since 2015-16, 3,075 schemes are ongoing with an estimated cost of ₹ 2,835 crores. In the approval by Government of India for continuation of the scheme during 2021-22 to 2025-26, 4.5 lakh hectare of minor irrigation using surface water is targeted through SMI and RRR of water bodies. Cost norm of development of irrigated land under SMI has been revised from ₹ 2.5 lakh to ₹ 4 lakhs per hectare. Inclusion criteria for RRR of water bodies has been revised in terms of size from minimum 5 hectares to 2 hectares (1 hectare for northeastern and Himalayan States) for rural areas, and from 2-10 hectare in urban areas to 1 hectare (0.5 hectare for north eastern and Himalayan States). Funding pattern for RRR of water bodies component has

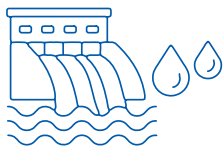
also been enhanced from 25% to 60% for nonspecial category regions. The outlay for SMI & RRR of water bodies scheme for implementation during 2021-26 is ₹ 4,580 crores.

14.1.4.2 Har khet Ko Paani : Groundwater Scheme (PMKSY-HKGP-GW)

PMKSY- Har Khet Ko Pani-Groundwater scheme, launched by DoWR, RD & GR envisages to provide irrigation facility for small and marginal farmers in areas having sufficient potential for future development of groundwater. During the year 2023, an amount of ₹ 29.71 crore has been released (01.01.2023 to 31.03.2024) to the projects in the States of Assam, Arunachal Pradesh, Gujarat, Manipur, Mizoram, Nagaland, Tripura, Tamil Nadu, Uttar Pradesh, and Uttarakhand towards central assistance and 550 wells have been constructed creating additional command area of 11305 Ha, benefitting 1309 small & marginal farmers.

14.1.5 Per Drop More Crop Component (PDMC):

Department of Agriculture & Farmers Welfare (DA&FW) is implementing Centrally Sponsored Scheme of Per Drop More Crop (PDMC) in the country from 2015-16. From the year 2015-16 to 2021-22, the PDMC was implemented as component of Pradhan Mantri Krishi Sinchayee Yojana (PMKSY). From the year 2022-23, the PDMC is being implemented under the Rashtriya Krishi Vikas Yojana (RKVY). PDMC focuses on enhancing water use efficiency at farm level through Micro Irrigation namely Drip and Sprinkler Irrigation Systems. Drip Irrigation irrigates root zone through emitters fitted on a lateral tube. In Sprinkler Irrigation, water is discharged



under pressure in the air through a set of nozzles attached to a network of pipes. The Micro Irrigation helps in water saving as well as reduced fertilizer usage through fertigation, labour expenses, and other input costs, while sustaining soil health and overall income enhancement of farmers.

Salient Features of PDMC Scheme:

The Government provides financial assistance @ 55% for small and marginal farmers and @ 45% for other farmers for installation of Drip and Sprinkler systems under the PMKSY- PDMC. Besides, some States provide additional incentives/ subsidy to farmers for encouraging installation of Micro Irrigation.

The Assistance for installation of Micro Irrigation systems is limited to 5 hectares per beneficiary with subsidy cycle of 7 years.

25% higher amounts have been taken into consideration while working out the unit cost for the North Eastern and Himalayan states, UTs of J&K and Ladakh and 15% higher for low penetration of Micro Irrigation States, namely, Bihar, Chhattisgarh, Goa, Punjab, Jharkhand, Odisha, Uttar Pradesh, West Bengal and Union Territories for larger adoption of systems by the farmers under the scheme.

An area of 78.47 lakh ha has been covered under Micro Irrigation in the country through PDMC from 2015-16 to 2022-23 which is 69% higher achievement as compared to the corresponding Pre-PDMC eight years period. Besides, an area of 4 lakh ha has been covered during 2023-24 (as on 31.12.23). Total area of 82.48 lakh ha has been covered under PDMC as on 31.12.23.

14.1.6 Irrigation Reforms: Smart Irrigation through Modernization of CADWM works (MCAD)

The Ministry is in the process of bringing irrigation reforms by modernization of CADWM component of PMKSY to make it more relevant in the current context. This smart irrigation scheme also envisages to transform the existing command (whether rainfed or gravity based) to a Pressurized Piped Irrigation Command (PPIC) by providing pressurized irrigation water from established canal source to farm gate below Minor (Tertiary) Level Network. This will make the entire canal command area as micro-irrigation ready for farmers by providing robust backend infrastructure for Surface Water. The Micro-Irrigation will shift to Surface Water and the dependency on the Groundwater will reduce. An ideal size of the cluster can be from 50 Ha up to 5000 Ha. Assuming average land holding of 1 Ha per farmer this will lead to a Water User Society [WUS] from 50 to 5000 farmers. The major areas of reforms under the proposed modernization are as:

- Institutional Changes by farmer education on Water User Society (WUS) and Micro-Irrigation (MI).
- Technology Changes by Pressurized Piped Irrigation Command (PPIC) with Internet of Things (IOT) based Smart irrigation on tertiary distribution system.
- Water Accounting & Monitoring by Geo mapping, App, MIS, water accounting with AI.
- On Farm Management by providing data to farmers for rational farm management plans, sensors, IMD data, eco system trainings to use agri

robots and drones.

- Develop WUS into an Economic Entity by handholding for five years and Irrigation Management Transfer (IMT) to the WUS for subsequent maintenance to its own funds.
- The overall benefits of the MCAD (Modernization of CADWM works) shall be many, related to water conservation, accounting, pricing, management and maintenance.
- **Irrigation as a Service (IaaS):** The MCAD Scheme envisages transformation of the construction contractors to Irrigation Service Providers (ISP), who will be responsible for on demand delivery of water at farm gate as per agreed service performance indicators. ISP will be accountable to WUS and WUS will be responsible for collecting charges towards operation and management of services. Long term performance-based service contracts will ensure commitment of ISP for the water use efficiency and sustainability of the infrastructure. Independent expert agency may be engaged to measure the service levels. Different PPP models will also be explored to de-risk the engagement for the private sector.

The MCAD Scheme has been appraised and recommended by the Cabinet for a total outlay of ₹ 1600 Crore for the period ending March 2026. The Ministry of Finance has recommended central outlay of ₹ 1100 Crore including ₹ 100 Crore of Central Component as Administrative & Other Expenses (A&OE). States will contribute ₹ 500 Cr. The projects will be sanctioned and executed during financial year 2025-26.

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Major milestones	Time Frame
Completion of works under Pilot Projects of MCAD including transfer of Irrigation Management to Water User Society (WUS)	31 March 2026
Handholding of WUS (since inception of project) and O&M support for 5 years (starting from the transfer of Irrigation Management to WUS)	31 March 2031
National Program for MCAD	1 April 2026 onwards

14.2 Micro Irrigation Fund (MIF)

Micro Irrigation Fund (MIF) with corpus of ₹ 5000 crores have been created with National Bank for Agriculture and Rural Development (NABARD). The objective of the MIF is to facilitate the States in mobilising resources for expanding coverage of micro irrigation. The States



may access MIF for taking up special and innovative projects for expanding coverage of Micro Irrigation and also for incentive in micro irrigation beyond the provisions available under PDMC scheme to encourage farmers. Projects of Rs 4724.74 crore have been approved to the States and so far Rs 2812.24 crore has been disbursed to the States of Andhra Pradesh, Haryana, Gujarat, Punjab, Rajasthan and Tamil Nadu on reimbursement basis.

14.3 Irrigation Census Scheme

“Rationalization of Minor Irrigation Statistics (RMIS)” was launched in 1987-88 in the DoWR, RD & GR, MoJS, with 100% central assistance to the States/UTs. In 2017-18, the scheme was renamed as “Irrigation Census” and brought under the centrally sponsored umbrella scheme, “PMKSY and other schemes” to build up a comprehensive and reliable database in the Minor Irrigation (MI) sector for effective planning and policy making. The continuation of the Irrigation Census scheme for a period of 5 years from 2021-22 to 2025-26 has been approved with a total outlay of ₹237 crores for conducting 7th MI Census and 2nd Census of water bodies after completion of 6th MI Census and 1st Census of water bodies. Further, it is also proposed to conduct 1st census of Major and Medium Irrigation projects and 1st census of Springs also under ‘Irrigation Census’ scheme. 6th MI Census and 1st Census of Water Bodies has been completed successfully and reports of both the censuses have been uploaded on the website of the Ministry.

The 6th Minor Irrigation Census : The 6th Minor Irrigation Census (2017-18) aimed to create a national database for all water

bodies, collecting detailed information on various parameters such as irrigation sources, irrigation potential created (IPC), potential utilised, ownership, holding size, water lifting devices, energy sources, and the use of energy-conserving devices like sprinklers and drip irrigation. The census reported 23.14 million Minor Irrigation (MI) schemes across 695 districts and 6,47,394 villages, with 21.93 million (94.8%) being Groundwater (GW) schemes and 1.21 million (5.2%) Surface Water (SW) schemes. Dug wells accounted for the highest share, followed by shallow, medium, and deep tube wells. Uttar Pradesh had the largest number of MI schemes (17.2%), followed by Maharashtra (15.4%), Madhya Pradesh (9.9%), and Tamil Nadu (9.1%). Leading states in GW schemes included Uttar Pradesh, Maharashtra, Madhya Pradesh, Tamil Nadu, and Telangana, while Maharashtra, Karnataka, Telangana, Odisha, and Jharkhand led in SW schemes. A majority (96.6%) of MI schemes are privately owned, primarily by individual farmers or farmer groups, with small and marginal farmers (less than 2 ha of land) holding a major share. Around 60.2% of schemes have a single source of finance, mostly from farmers’ own savings, indicating a need for more financial support from institutions. Of 23.14 million MI schemes, 22.32 million (96.4%) have installed lifting devices, with submersible pumps being the most common. Electricity is the main energy source for 76% of these schemes, followed by diesel (22.2%). There has been an improvement in water use efficiency, with a decline in open channel usage and an increase in efficient water distribution systems like surface pipes, underground pipes, drip, and sprinklers.

1st Census of Water Bodies (2013) : The

1st Census of Water Bodies, conducted by the Ministry of Water Resources in 2013, aimed to document and assess the status of water bodies across India, creating a comprehensive database of ponds, lakes, tanks, reservoirs, and other water sources essential for irrigation, drinking water, and various uses. The Census identified approximately 2.4 million water bodies nationwide, with ponds comprising about 69% of the total. Tanks and wells were significant as well, particularly in southern states like Tamil Nadu, Karnataka, and Telangana, while lakes and reservoirs, though fewer, played a crucial role in large-scale water storage. West Bengal led in the number of water bodies, accounting for around 25% of the total, followed by Uttar Pradesh, Madhya Pradesh, Tamil Nadu, and Karnataka. The majority of these water bodies were used for irrigation (57.5%), with drinking water, fisheries, and recreation also prominent uses. However, many water bodies were in poor condition due to encroachment, pollution, and siltation, with urbanization and industrialization further contributing to their degradation. Encroachments for agricultural, residential, or commercial purposes were especially concerning. The Census highlighted the urgent need for conservation, advocating for community-based management, improved legal frameworks, and ecological restoration to preserve these vital resources for sustainable use.

14.4 Special Package for Completion of Irrigation Projects to Address Agrarian Distress in Vidarbha and Marathwada Region and Drought Prone Areas of Rest of Maharashtra

The approval of the above scheme was given on 18.07.2018. The proposal aims to provide special package of ₹ 3,831.41 crore as central assistance to complete 83 SMI and 8 MMI (Major & Medium Irrigation) projects benefitting 12 districts of Vidarbha, Marathwada and drought prone areas of rest of Maharashtra. So far 45 SMI and 1 MMI project have been completed. The scheme has been extended till March 2025 for completion of balance works.

14.5 National Mission for Clean Ganga (NMCG)

Government of India approved the Namami Gange Mission on 13th May 2015 as a comprehensive and integrated approach for Ganga river rejuvenation and its tributaries. The five main pillars of the program are Nirmal Ganga, Aviral Ganga, Jan Ganga, Gyan Ganga and Arth Ganga. The programme was subsequently extended up to 31st March 2026 with a budgetary outlay of ₹ 22,500 crores from April 2021 to March 2026. “Namami Gange” was launched with the aim of integrating previous and currently ongoing initiatives in holistic manner with a basin approach. It has been approved as a Central Sector Scheme in 2015 and includes diverse set of interventions such as pollution abatement measures to tackle different sources of pollution such as municipal sewage, industrial effluents, municipal solid waste, non-point sources



of pollution and interventions for improving ecological flows, biodiversity conservation, afforestation, improving amenities and sanitation at riverbanks, capacity building, research & monitoring, public awareness.

14.6 Groundwater Management and Regulation (GWMR) Scheme

Groundwater Management and Regulation scheme is a continuing Central Sector Scheme, which is being implemented since 2007-08 by Central Groundwater Board (CGWB). One of the major activities under the scheme is National Aquifer Mapping & Management (NAQUIM) Programme, under which it was targeted to cover approximately 25 lakh sq km of mappable area and it has been covered by 31st March 2023. In addition to above other activities like groundwater level & quality monitoring, assessment of dynamic groundwater resources, regulation and control of groundwater withdrawal, demonstrative recharge projects etc. are also being carried out. Further, in order to scale up the aquifer mapping and groundwater monitoring activities, CGWB is implementing a PIB approved project under which constructions of exploratory and observation wells, piezometers and installation of Digital Water Level Recorders (DWLRs) will be taken up on a national scale with an outlay of ₹ 805 Crore. Tendering activities for most part have been completed and work has been awarded for a value of ₹ 343 Crore.

14.7 Flood Forecasting

Central Water Commission (CWC) is providing flood forecasting services at 338

stations, of which 200 are level forecasting stations on major rivers and 138 are inflow forecasting stations on major dams/barrages. 5 new stations (1 Level and 4 Inflow) have started functioning during the year 2023. Flood Forecast operations cover the 20 major river systems in the country across 25 States and UTs. The States/UTs are provided promotional central financial assistance through Flood Management Programme (FMP) and River Management Activities & Works related to Border Areas (RMBA) schemes of Department, which have been merged into a single scheme titled FMBAP (Flood Management & Border Areas programme) which is under implementation.

14.8 National Projects

The Implementation of National Projects was approved in 2008 with central assistance to projects which meet the following criteria:

- International project where usage of water in India is required by a treaty or where planning and early completion of the project is necessary in the interest of the country.
- Inter-State projects which are dragging on due to non-resolution in inter-State issues relating to sharing of costs, rehabilitation, aspects of power production, etc., including river inter-linking projects

	Category	Central:State
A	Projects in North Eastern and Hilly States	90:10
B	Projects in other States	60:40

Sixteen projects have been declared as national projects so far. These projects

are: Gosikhurd Irrigation Project, Shahpurkandi Dam Project, Teesta Barrage Project, Saryu Nahar Pariyojna, Polavaram Irrigation Project, Lakhwar Multipurpose Project, Renuka Dam Project, Kishau Multipurpose Project, Ujh Multipurpose Project, Ken-Betwa Link Project, Kulsi Dam Project, Noa-Dihing Dam Project, Bursar Hydro Electric Project, Gyspa Hydro Electric Project, 2nd Ravi Vyas Link Project and Upper Siang Project. National projects are taken up for execution after the concerned States obtain techno-economic clearance, other statutory clearances and investment clearance.

14.8.1 Polavaram Irrigation Project, Andhra Pradesh:

Polavaram Irrigation Project is a multipurpose project on Godavari River near Ramayyapeta, Polavaram in West Godavari District, Andhra Pradesh. The project is located 42 Km upstream of Sir Arthur Cotton Barrage on Godavari River. Water from the project is proposed to meet the demands of irrigation, drinking water and power generation. The project envisages irrigation benefits to 4.0 lakh acres in East Godavari, Visakhapatnam districts under Left Main Canal and to 3.2 lakh acres in West Godavari, Krishna districts under Right Main Canal.

In addition to irrigation benefits, generation of Hydropower with installed capacity of 960 MW, water supply for industries in Visakhapatnam and drinking water supply to villages & towns are also envisaged under the project. Further, it is also proposed to release 15 TMC of stored water to downstream existing Sir Arthur Cotton Barrage in lean period and 80 TMC of stored water to be diverted to Krishna River through Right

Main Canal.

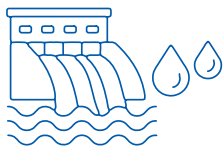
The project components include:

- i) Earth cum rock fill dam in Gap I on left bank of river
- ii) Earth cum rock fill dam in Gap II located in main flow channel of Godavari River
- iii) Concrete dam in Gap III
- iv) Spillway located on RB along with connecting approach channel and spill channel

An Ogee Type Concrete Spillway has been constructed on the right bank for passing of PMF of 50 lakh cusecs with FRL of the reservoir at EL. 45.72 m. The concrete dam comprises of 49 nos. of overflow blocks (including 10 nos. of river sluice blocks), 2 nos. of non-overflow blocks and 2 nos. of key blocks. Spillway with crest level at EL. 25.72m has 48 Nos. of Radial Gates of sizes 16m(W) x 20m(H) with hydraulic hoist arrangement for lifting. There is provision of 10 nos. of river sluices of sizes 2.1m(W) X 3m(H) in the over flow blocks for releasing 15 TMC of water to the downstream.

14.9 National Hydrology Project (NHP)

NHP with support from the World Bank, envisages establishing a system for timely and reliable water resources data acquisition, storage, collation and management. It has pan-India coverage with 48 Implementing Agencies (IAs) (including 9 from Central Government, 3 from River Basin Organisations, 36 from States/UTs). It will also provide tools and systems for informed decision making for water resources assessment, planning and management. The National Hydrology project has been approved with an outlay of ₹ 3,679.77



crores as a Central Sector Scheme with 100% grant to State Governments and Central Implementing Agencies. The project has a duration of 8 years from 2016-17 to 2023-24, However, Department of Expenditure has granted conditional extension upto September 2025 within the same allocation.

14.10 Dam Rehabilitation and Improvement Project (DRIP)

DRIP is an externally aided project with financial assistance from the World Bank, targeting rehabilitation of some of the selected dams of the country along with accompanying institutional strengthening component. DRIP (Phase-I) World Bank assisted Dam Rehabilitation and Improvement Project was initiated in April 2012, with an objective to improve safety and operational performance of selected dams along with institutional strengthening with system wide management approach. 223 dams located in seven States i.e. Kerala,

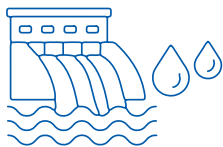
Madhya Pradesh, Odisha, Tamil Nadu, Karnataka, Jharkhand and Uttarakhand were taken up for rehabilitation measures for improving safety and operational performances of these dams.

DRIP: (Phase-II & III): Based on the success of DRIP Phase-I, Ministry of Jal Shakti initiated another externally funded scheme, DRIP Phase-II and Phase-III. The scheme has provision for rehabilitation of 736 dams located in 19 States (Andhra Pradesh, Chhattisgarh, Goa, Gujarat, Jharkhand, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Manipur, Meghalaya, Odisha, Punjab, Rajasthan, Tamil Nadu, Telangana, Uttar Pradesh, Uttarakhand, West Bengal) and 3 Central Agencies (Central Water Commission, Bhakra Beas Management Board and Damodar Valley Corporation). It is a State Sector Scheme having central component, with duration of 10 years, to be implemented in two Phases i.e. Phase-II and Phase-III, each of six years duration with an overlap of two years.



15

Participatory Irrigation Management (PIM)



National Water Policy stresses participatory approach in water resources management. It has been recognized that participation of beneficiaries will help greatly in the optimal upkeep of irrigation system and effective utilization of irrigation water. The participation of farmers in the management of irrigation would include transfer responsibility for operation & maintenance and also collection of water charges to the water users' association (WUA) in their respective jurisdiction. One-time functional grant @₹ 1,200/-per hectare, to be shared by the Centre, State as well as farmers in the ratio of 45:45:10 respectively, is being paid to outlet level water users associations as incentive, the interest from which is to be used for maintenance. Apart from this, an amount of ₹ 3.00 lakh (60%-Central: 40%-State) is being provided to each WUA as one-time infrastructure grant.

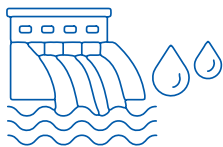
Recognizing the need for sound legal frame work for PIM in the country, in 1998 a model act was circulated to be adopted by the States legislatures for enacting new irrigation Acts amending existing irrigation Acts. At present, there are 18 States that have either enacted a new Act or modified their existing Act to fulfil the objective of the PIM. About 93,000 WUAs, covering an area of 17.84 million hectares, have been formed in India.

Strengthening of PIM is being aimed as part of the CAD&WM program. Under CAD&WM for the 99 prioritized projects during 2016-22, 14,685 WUAs were targeted to be created under the ongoing 88 projects, out of which 9,272 WUAs have been formed, and about 2,900 WUAs the CAD assets have also been transferred to respective WUAs.



16

**Inter Linking of
Rivers under NPP**



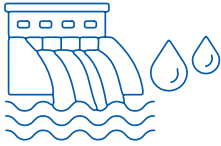
NPP (National Perspective Plan) was formulated to address the issue of water scarcity and to optimize water resources through the interlinking of rivers, facilitating irrigation, drinking water supply and flood control. After concerted efforts taken by the Ministry of Jal Shakti, a tripartite Memorandum of Agreement (MoA) for the implementation of the Ken-Betwa link project was signed on

22.03.2021 amongst the Union of India, the Government of Madhya Pradesh, and the Government of Uttar Pradesh in a virtual event in the presence of Hon'ble Prime Minister of India. The MoU for preparation of DPR and implementation of the Modified Parbati-Kalisindh-Chambal link benefitting the States of Rajasthan and Madhya Pradesh was signed on 28.01.2024.



17

**National
Infrastructure
Pipeline (NIP)**



The National Infrastructure Pipeline (NIP) for FY 2019-25 aims to improve project preparation and attract investments into infrastructure. To draw up the NIP, a high-level task force was constituted under the chairmanship of the secretary of the Department of Economic Affairs (DEA), and the Ministry of Finance. The Final Report on National Infrastructure Pipeline for FY 20-25 of the Task Force was released by the Union Minister for Finance & Corporate Affairs, on 29th April, 2020.

The Final Report of the Task Force projected total infrastructure investment of ₹111 lakh crore from FY 2019-20 to FY 2024-25, including ₹ 8.94 lakh crore in irrigation (water and sanitation) Sector. The meeting of the Committee of Secretaries held on 5th March 2020 advised line Ministries/Departments

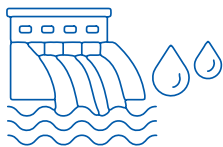
to monitor the implementation of NIP projects and take up key reforms to accomplish the target of infrastructure investments in the next five years.

For monitoring of National Infrastructure Pipeline (NIP) Projects, an Inter-Ministerial Steering Committee (IMSC) of DoWR,RD&GR, Ministry of Jal Shakti has been formed under the Chairmanship of Secretary, DoWR,RD&GR. A list of NIP water resources projects comprising of Irrigation/Flood Control Projects from various State Governments was compiled. Projects under AIBP, CADWM, NMCG are also a part of these NIP Projects. Now, the NIP list is comprised of total 569 (as is being reflected in the portal @ indiainvestmentgrid.gov.in) projects. Out of which, 475 Projects are of State NIP Projects and rest 94 are Central NIP Projects.



18

Water Conservation Initiatives



Efficient management of water resources is crucial, especially given the over-extraction of groundwater and delayed completion of canal irrigation projects. Groundwater depletion is exacerbated by subsidised power supply for agriculture, leading to inefficient water use. With an annual groundwater draft of 253 BCM, India is now the largest groundwater user in the world. However, this increase in groundwater irrigation coverage has been at the cost of negative externality associated with continuous groundwater depletion in large areas. Since the power supply to agriculture is heavily subsidised, especially in states like Punjab, Rajasthan, Tamil Nadu, and Maharashtra, farmers rarely feel the actual operating cost of groundwater extraction. This results in negligence in realising the scarcity value of groundwater, which in turn leads to inefficient management of a crucial resource. Farmers need to realign their cropping pattern considering the economic value of groundwater. Policy-makers should also consider the economic value of a particular region's groundwater extraction and aquifer characteristics before announcing perverse power subsidies causing depletion (or decline) in groundwater resources.

Projects like the Jal Shakti Abhiyan and Atal Bhujal Yojana focus on water conservation and sustainable groundwater management. NABARD supports these initiatives through financial assistance and developmental support. Efforts include community-led groundwater management and convergence of activities to enhance

water security. Atal Bhujal Yojana is being implemented in water-stressed Gram Panchayats (GPs) of 229 administrative Blocks/Talukas in 80 districts of 7 states: Haryana, Gujarat, Karnataka, Madhya Pradesh, Maharashtra, Rajasthan, and Uttar Pradesh for five years from 01.04.2020. The scheme aims at community-led sustainable groundwater management through convergence of activities.

18.1 Atal Bhujal Yojana (ATAL JAL)

Atal Bhujal Yojana (ATAL JAL) has been implemented since April 2020 in 8,213 water-stressed Gram Panchayats of 229 administrative blocks/ Talukas in 80 districts of seven States, viz. Gujarat, Haryana, Karnataka, Madhya Pradesh, Maharashtra, Rajasthan and Uttar Pradesh for five years. The selected States account for about 37% of the total number of water-stressed (over-exploited, critical and semi-critical) blocks in India. The components of the scheme are :

- Institutional Strengthening & Capacity Building component (₹ 1,400 crore) for strengthening institutional arrangements by providing a strong database, scientific approach and community participation in the States to enable them to sustainably manage their groundwater resources.
- Incentive Component (₹ 4,600 crore) for incentivizing the States for convergence amongst various schemes of the Central and State Governments and achievement of pre-defined results as a measure

of improved groundwater management and consequent improvement in groundwater scenario.

The States shall use the allocation of funds under the Institutional Strengthening Component for improve their institutional framework for groundwater management through activities such as engagement of domain experts & District Implementation Partners (DIPs), procurement of equipment, up-gradation of laboratories and capacity-building activities.

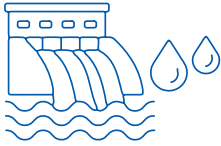
Funds under the Incentive Component shall be disbursed to the States on achievement of pre-defined targets, namely i) public disclosure of groundwater-related information and reports, ii) preparation of community-led Water Security Plans (WSPs), iii) public financing of approved Water Security Plans through convergence of ongoing/new schemes, iv) adoption of practices for efficient water use and v) improvement in groundwater conditions, evidenced by arrest in the decline of water levels in observation wells. The incentives shall be used by the States for interventions that improve the sustainability of groundwater resources.

The scheme is expected to result in multiple benefits, including improvements in the sustainability of groundwater resources in target areas, ii) positive contributions to the sustainability component of Jal Jeevan Mission, and to the goal of doubling farmers' income, mainly through convergence among various ongoing schemes and iii) Inculcation of behavioural changes

in the community to foster improved groundwater management. The participatory approach envisaged under this scheme is crucial for addressing groundwater challenges in the long run.

18.2 Managing Scarce Water Resources in Rainfed Areas

Water is fundamental to the sustenance of all forms of life on the earth. With the increasing population, socioeconomic shifts, and changes in consumption patterns, the demand for water continues to rise. This presents significant challenges for nations in effectively managing their water resources within the constraints of available supply. While it is crucial for nations to meet the water needs of their people and economy, they must also ensure that its water resources are managed efficiently and judiciously. Rainfed agriculture is complex, diverse and risk prone characterized by low levels of productivity and low input usage. Rainfed areas if managed properly have the potential to contribute a larger share in the overall production of food grains in the country. In view of this, the Government of India has accorded very high priority to the holistic and sustainable development of rainfed areas through efficient use of water management at farm level and appropriate farming systems etc. In this context, the Per Drop More Crop Component (PDMC) and Rainfed Area Development (RAD) component of the National Mission for Sustainable Agriculture (NMSA) is being implemented. Besides, a dedicated Micro Irrigation Fund (MIF) has been instituted



with NABARD with a corpus of ₹ 5000 crores for expanding coverage of Micro Irrigation which has been proposed to be doubled to 10000 crores.

18.3 Master Plan for Artificial Recharge to Groundwater in India

CGWB has prepared a conceptual document on “Master Plan for Artificial Recharge to Groundwater in India” in 2020 to work out the feasibility of various structures for the different terrain conditions of the country and estimated costs, providing a broad outline of the project and expected investments which include artificial recharge in both rural and urban areas. A total 14175144 number of structures at an estimated cost of Rs 1.33 lakh Cr have been envisaged for rainwater harvesting and artificial recharge in the country.

One district in each state has been identified for the implementation of Master Plan for Artificial Recharge-2020 on pilot basis. The implementation of Master Plan for Artificial recharge has been initiated in 20 States and 03 UT which are Arunachal Pradesh, Bihar, Chhattisgarh, Delhi, Gujarat, Haryana, Himachal Pradesh, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Odisha,

Punjab, Rajasthan, Sikkim, Tamil Nadu, Tripura, Uttar Pradesh, Uttarakhand, West Bengal, UT of Andaman and Nicobar, Chandigarh, Ladakh.

District Recharge Plan Maps:

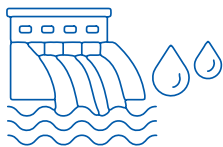
It has been decided to prepare “District Recharge Plans” for the 255 water stressed district of the country which were identified during Jal Shakti Abhiyan (JSA) 2019 and the same need to be shared to the State Govt dept/implementing agencies and District authorities. The District Recharge Plan will be prepared on 1:50,000 and printable on A0 size. The District Recharge Plan will comprise of the following layers.

- Admin Boundary.
- Location of villages.
- Watershed Boundary.
- Drainage layer with water bodies.
- Major Aquifer units.
- Important location with base layer (major roads).
- Area suitable for Artificial Recharge.
- Area suitable for different artificial recharge structures.
- Tentative location of the artificial recharge structures.



19

Regulation and Control of Groundwater Extraction



Central Groundwater Authority, constituted under Section 3 (3) of the Environment (Protection) Act, 1986 has been regulating groundwater development in the country. The Authority regulates in 19 States/ UTs and 15 States/ UTs have their own Acts. The Authority issues 'No Objection Certificate' for groundwater abstraction.

Ministry of Jal Shakti notified the revised guidelines on 24.09.2020 and for regulation and control of groundwater development in the country. These guidelines have Pan India applicability. Further the guidelines has been amended on 29.03.2023 The salient features of guidelines are as follows:

- The seeking NOC is exempted for individual domestic consumers (in both rural and urban areas) drawing groundwater for drinking/ domestic use, Rural drinking water supply schemes, Armed Forces and Central Armed Police Forces Establishments, Agricultural users and Micro and Small Enterprises drawing < 10 KLD of groundwater, All industries/ mining projects/ infrastructure projects drawing groundwater only for drinking/ domestic purposes up to 5 Cum /day in all assessment units, Residential Apartments and Group Housing Societies: (a) For drinking water and domestic uses, drawing groundwater upto 20 m³/day subject to the conditions mentioned in Para 2.0 of the guidelines. (b) Dwelling units for Economically Weaker Sections (EWS) under Government schemes.
- No new industries except those

MSMEs based on groundwater are permitted in Over-exploited assessment units.

- Expansion of existing industries, except MSMEs located in Over-exploited assessment units involving an increase in the quantum of groundwater abstraction is not permitted.
- Industries drawing >100 KLD of groundwater in OE, Critical and Semi-critical assessment units are required to submit impact assessment reports along with the application.
- Industries drawing > 100 KLD of groundwater in OE, Critical, and Semi-critical assessment units are required to conduct biennial (once in two years) water audits and reduce fresh groundwater consumption by 20% over the next three years.
- No NOC is granted for groundwater extraction for water parks, theme parks, and amusement parks in OE assessment units. Commercial infrastructure projects requiring groundwater for drinking /domestic use shall also be covered under this category. Further, the Indicative list of location-specific Infrastructure projects is as per Annexure VI of the guidelines.
- All groundwater users seeking NOC are required to pay groundwater abstraction charges in Critical, Semi-critical and Safe assessment units and groundwater restoration charges in OE assessment units. The charges so collected are to be utilized by States/ UTs on specific water

conservation measures and specific supply/ demand side interventions.

- No charges are to be paid by users drawing saline groundwater.
- Users drawing groundwater illegally are liable to pay Environmental Compensation.
- Penal provision has been kept to ensure compliance with various conditions of NOC.
- Bulk water suppliers have also been brought into the ambit of NOC.
- Installation of Sewage Treatment Plants is mandatory for all new residential apartments/ Group

Housing Societies where the groundwater requirement is more than 20 m³/day. STP-treated water is to be used by such users for flushing, green belts, etc.

- All users seeking NOC are required to install tamper-proof flow meters along with telemetry on all the groundwater abstraction structures.
- In over-exploited assessment units, the use of groundwater for construction activity is permitted only if no treated sewage water is available within a 10 km radius of the site



20 NABARD's Financial Contributions

NABARD's financial support has been pivotal in various water resource projects.

20.1. Rural Infrastructure Development Fund (RIDF)

NABARD's financial support has been crucial in various water resource projects. The GOI established RIDF in FY1996 to address the shortfall in priority sector lending by commercial banks for incomplete irrigation projects. Over the past 28 years, the scope of RIDF has expanded to include 39 activities related to rural infrastructure. During FY2024 (RIDF Tranche XXIX), NABARD received an allocation of ₹40,474.6 crore under RIDF (2.4% increase over FY2023) and sanctioned ₹50,115.5 crore towards financing rural projects in agriculture and related activities, irrigation, social sector, and rural connectivity. As on 31 March 2024, RIDF has resulted in creation of irrigation potential of 422.2 lakh ha besides providing drinking water facilities in remote rural areas.

20.2. Long-Term Irrigation Fund (LTIF)

LTIF was announced in the Union Budget FY2017 to fast-track the completion of 99 identified medium and major irrigation projects across 18 states. NABARD provided loans towards both the central and state shares for these projects, with 13 states executing agreements to avail funding. From FY2022 onwards, LTIF has supported 60 ongoing Accelerated Irrigation Benefit Programme (AIBP) projects and 85 major/medium irrigation projects under the Command Area Development and Water Management

(CAD&WM) Programme. The projects are expected to create an additional 6.8 million ha of irrigation potential. As on 31 March 2024, 58 projects have been completed and 25.2 lakh ha irrigation potential has been achieved.

20.3. Support for Jeevan Mission and PM-Kusum Yojana

The Jal Jeevan Mission, besides aiming to provide tap connections for all households, has also enhanced the focus on holistic management of local water resources, where local panchayats are expected to play a key role. Mission Amrit Sarovar aimed at developing/rejuvenating 75 amrit sarovars (ponds) in each district, totalling to about 50,000 ponds in the country. Going beyond the initial target, as of December 2023, 1.1 lakh sites were identified and work was completed in 68,187 sites.² NABARD supported state shares of flagship GOI schemes by sanctioning projects worth ₹4,734 crore under the Jal Jeevan Mission and ₹1,752 crore under the PM-Kusum Yojana from RIDF Tranche XXVIII.

20.4. Climate Change Mitigation

NABARD is the national implementing entity for the Adaptation Fund under the United Nations Framework Convention on Climate Change (UNFCCC) and National Adaptation Fund for Climate Change, and the Direct Access Entity (DAE) for the Green Climate Fund (GCF) under the UNFCCC. In this role, NABARD has been channelling funds for a variety of interventions to mitigate the effects



of climate change. As on 31 March 2024, there are 40 climate change projects at different stages of completion with a total financial assistance of ₹1,971.56 crore.

20.5. NABARD Infrastructure Development Assistance (NIDA)

NIDA has created a profound socioeconomic impact by facilitating access to improved sanitation and assured water supply. The infrastructure created under NIDA has had a wide-ranging impact, from reducing child malnutrition and mortality to improving female enrolment ratios in schools. It has been instrumental in achieving targets under SDG 6 (clean water and sanitation). Cumulative term loan sanctioned for irrigation stands at ₹31,498 crore (40%) and ₹9,786 crore (12%) for drinking water projects.

20.6. SBM-Grameen and PMAY-Gramin

Under Swachh Bharat Mission (SBM)-Grameen, NABARD supported universal sanitation and clean water access in rural areas by extending loans to the National Centre for Drinking Water, Sanitation & Quality. By 31 March 2020, ₹15,000 crore was sanctioned, and ₹12,298.2 crore was disbursed, enhancing water and sanitation infrastructure. As on 31 March 2024, NABARD has exposure of ₹12,298 crore under SBM-G. The Pradhan Mantri Awaas Yojana (PMAY)-Gramin also facilitated the provision of safe drinking water in rural housing. From FY2018 to FY2021, loans worth ₹61,975 crore were

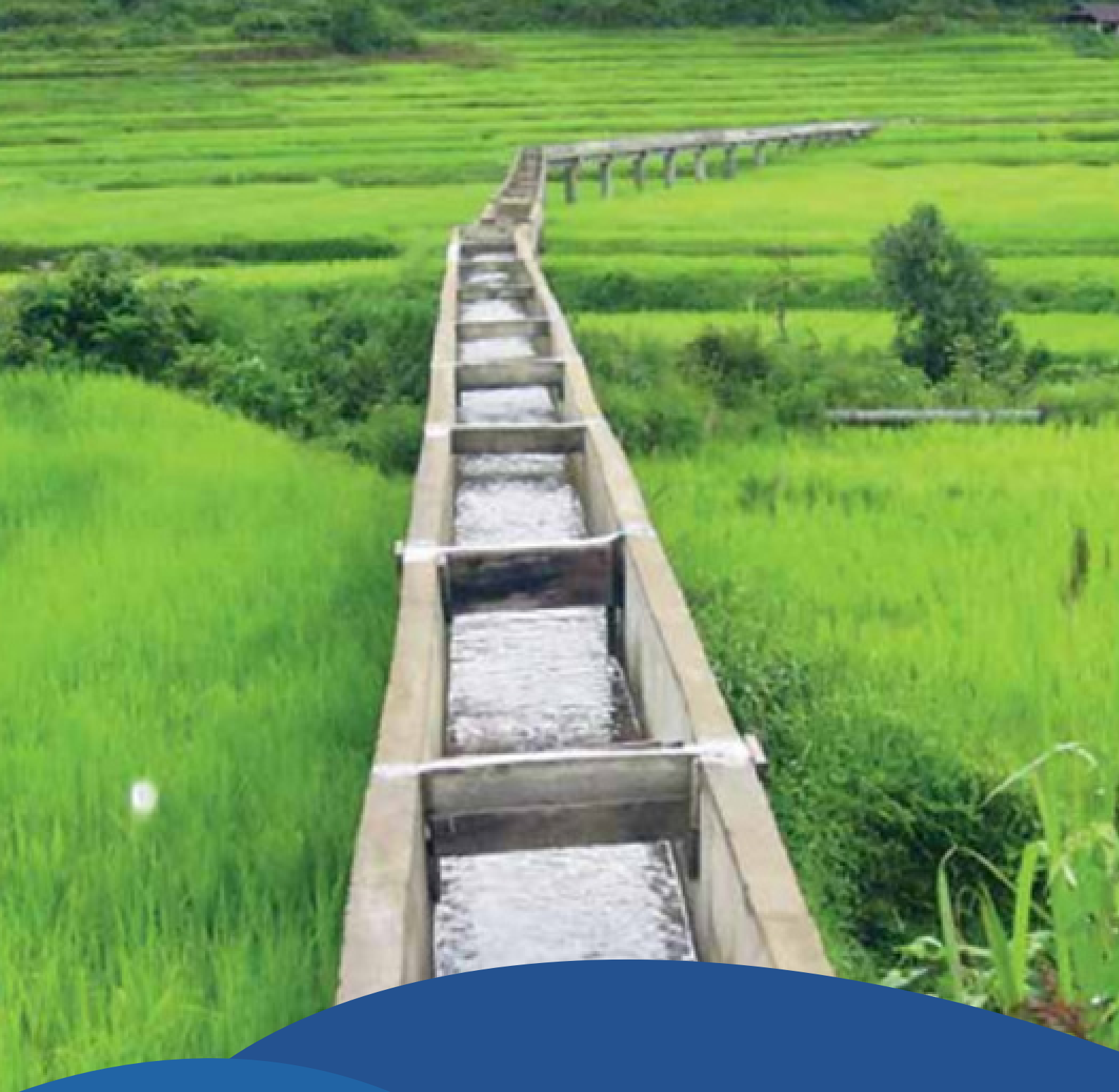
sanctioned, with ₹48,819 crore disbursed, aiding the construction of 1.8 crore houses by 31 March 2022. As on 31 March 2024, NABARD has loans outstanding of ₹48,819 crore under PMAY-G.

20.7. Scheme for WASH Activities

To provide clean water, sanitation, and hygienic conditions to rural and semi-urban areas and thereby protect human health during outbreaks of infectious diseases, NABARD introduced a scheme under which concessional refinance was available to banks and eligible financial institutions for water, sanitation, and hygiene (WASH) activities. The cumulative disbursement under the scheme till 31 March 2023 was ₹92.1 crore. NABSAMRUDDHI Finance Limited (NSFL) a subsidiary company of NABARD has disbursed, cumulatively, around ₹350 crore of water, sanitation, and hygiene (WASH) loans through 32 partners. Sanction during FY2024 amounted to ₹191 crore. NSFL has been able to reach out to more than 3 lakh ultimate beneficiaries in 25 states and 2 UTs cumulatively through NBFCs, NBFC-MFIs, and other institutional clients.

20.8. Recognition

For its contribution to WASH financing, Nabsmruddhi was awarded the Sa-Dhan Water.org 'Water and Sanitation Financing Award, 2022' under the category 'Capital Providers.'



21 Constraints in Irrigation Sector



Various constraints in boosting credit flow to water resources sector relate to two main aspects of project financing viz., (a) technical, and (b) financial/credit, which are described hereunder:

21.1 Related to Technical Aspects

21.1.1 Surface Water Projects

Reservoir & Tank Irrigation

1. Inadequate annual provisions, in general, for O & M public grants leading to deterioration of both headworks and distribution network (disnet).
2. Distribution channels beyond sluice opening could not be completed in a number of tanks due to fund constraints, land acquisition, and project-affected people (PAP) issue, besides delay in obtaining Forest, PWD, and Railway clearances;
3. The foreshore lands of tanks have been encroached upon by farmers for cultivation making construction/repairs difficult;
4. The supply channels of old tanks have been silted and the desilting works are not covered under the programme;
5. Non-execution of OFD (up to 1.5 cusec outlets), more particularly in large MI tanks;
6. Concurrent design changes leading to cost and time overruns;
7. Effective submergence exceeding the limit with respect to Irrigated Command Area (ICA); and

Cooperative Lift Irrigation

1. Flouting of WLPs issued by Irrigation Department (ID) by growing perennial crops, mostly sugarcane in lieu of seasonal crops during Khariff and Rabi seasons, e.g. Sugar Factory (SF) sponsored projects;
2. Over designing of headworks and disnet to suit unauthorized / non-permissible use of higher percentage of "Irrigated Command Area" (ICA) for perennial crops like sugarcane than what is allowed by the Water Lifting Permissions (WLPs), mostly in case of Sugar Factory (SF) sponsored projects;
3. Non-observance of sanctioned technical norms/parameters; often, project execution is halfway through before applying for loan / refinance by LI Societies through Primary Banks / Branches;
4. Inadequate availability of water at the source point in river, streams etc., due to unauthorized tapping by similar such structures in the upstream;
5. Non availability of adequate and continuous voltage leading to under and/or over irrigation with associated problems including reduced crop yields or crop failures; and
6. Other associated problems, e.g., leakages, pipe damages etc., affecting irrigation schedule under cooperative Lift Irrigation Scheme (LIS) leading to post commissioning sickness / failure of LIS.

21.1.2 Groundwater Projects

1. Large scale well failure of both open wells and bore wells in hard rock areas due to absence / inadequate technical guidance from State Groundwater Departments (SGDs) for siting of well source, besides non availability of groundwater worthy maps on user friendly scales (1:5000 or 1:10000) especially for use by program implementing banks / branches;
2. Large number of blocks coming under Over-exploited and Critical categories with depleted water levels, where free flow of institutional credit is often not available;
3. Potential for construction of open wells and bore wells in hard rock areas declining due to drought conditions and falling water levels;
4. Selection and installation of higher HP electric and diesel pump sets than what is required as per prevailing hydro-geological conditions of the area and that too not conforming to IS norms for Complete Pumping System (CPS); thus leading to overdrawal and groundwater mining, besides higher consumption of electric power and diesel fuel;
5. Non observance of spacing criteria under privately constructed wells due to absence of State Groundwater Legislation;
6. Sluggish energisation resulting into widening of gaps between potential created and utilized, besides undependable and erratic power supply causing shortfalls in

achievement of productivity targets; and

7. Sizable number of small and marginal farmers were not having access to credit because of fragmented land holdings.

21.2 Financial /Credit Related Issues

1. Lesser Central / State resource availability for new works. Most of these works are grounded by State PRIs / Rural Development Department;
2. Poor performance of lift irrigation schemes due to non repayment of bank loans and poor O & M during post construction stage by Groups and Cooperatives;
3. Delay in loan appraisal due to cumbersome procedure and documentation insisted by banks;
4. Unsatisfactory recovery position of banks leading to reduced lending eligibility. besides, in some major States SCARDBs have become weak due to mounting NPAs necessitating rehabilitation / adoption of reform packages;
5. Delay in sanction and release of subsidy;
6. Relatively high cost of micro irrigation systems;
7. Diversification to other activities like Farm Mechanization, Non-farm Sector and Other Priority Sector and contribution to Rural Infrastructure Development Fund (RIDF) instead of direct lending to individuals or group



of farmers; and

8. Inadequate land records.

21.3 Possible Strategies/ Solutions for Boosting Institutional Credit for Water Resources Development

NABARD will have to play a crucial role as an apex refinancing agency in steering various policies and programs with suitable modifications so as to help boost the ground-level credit disbursement in minor irrigation activities, especially groundwater schemes, to meet the country's increasing food demand. The various initiatives proposed to be undertaken are described hereunder:

21.3.1 Credit Planning Initiatives

- Conducting investment-specific studies, along with monitoring and evaluation, to assess real-world challenges and opportunities, identify constraints, and develop actionable solutions.
- For harnessing the untapped groundwater potential, it is proposed to formulate banking plans and area development projects for dug wells, shallow tubewells / bore wells, medium deep tube-wells, agriculture pump sets (diesel / electric), underground pipelines, etc., under individual and group financing in groundwater resource-rich states / districts. Towards achieving this objective, adequate credit flow for minor irrigation sector has to be ensured. Among the rural financial institutions, traditionally, State

Cooperative Agriculture and Rural Development Banks (SCARDBs) are the major purveyors of credit for minor irrigation investments. In the recent years, the financial health of many of these banks has deteriorated. Some are having acute recovery problems and they are not in a position to augment their resources through refinance from NABARD due to default. As a result, the disbursements made by SCARDBs under minor irrigation investments have declined, as reflected by the declining drawals of refinance from NABARD. Commercial Banks have generally been reluctant to finance agriculture in general due to a large number of small borrowing accounts. The RRBs are having a tendency to deploy their funds in investments rather than disbursement of credit for agriculture. These agencies have to be sensitized to play a greater role in agricultural development, especially minor irrigation activities. The short-term cooperative credit structure with a large presence in rural areas has so far not evinced keen interest in funding the term investments in agriculture, though they have the financial strengths to assume a larger role in many states. However, their experience in financing minor irrigation investments is limited. Through proper sensitization of these banks and upgrading their appraisal skills, a greater involvement of these banks can be ensured in minor irrigation investments.

- With the creation of substantial

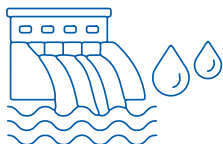
additional surface water irrigation potential through RIDF intervention, the impact in terms of rejuvenation of groundwater in the downstream of the newly created reservoir projects, activation of well fields in their canal command areas, besides availability of a small committed share of their back/reservoir water for development through lift irrigation schemes, may have to be planned through formulation of reservoir / command specific banking plans under institutional lending program. All these credit interventions would be possible only when the respective state governments annually allocate funds for operation and maintenance of these newly created irrigation structures;

- Enhancing credit support to micro irrigation systems with simultaneous reduction in the quantum of subsidy in phased manner. Formulation and vigorous implementation of state wise / district wise banking plans with emphasis on large scale adoption by states like Himachal Pradesh, Jammu and Kashmir and Northeastern states where the coverages under horticulture crops have grown over the years but are lagging in adoption of micro irrigation system, is necessary. Similarly, states like Punjab, Haryana and Uttar Pradesh who are agriculturally advanced but slow in adoption of micro irrigation system; and states facing frequent droughts e.g., Madhya Pradesh, Gujarat, Rajasthan and Orissa should be the focused areas for promotion

and popularization of micro irrigation.

In states where adoption of micro irrigation is in advanced stage e.g., Maharashtra, Tamil Nadu, Karnataka, Andhra Pradesh and Kerala, efforts will have to be intensified to enhance the coverage in various fruit and cash crops with strong support from the state governments;

- Encourage small lift irrigation schemes (up to 40 Ha) for individuals / groups, medium lift irrigation schemes (up to 250 Ha) in cooperative sector and big lift irrigation schemes (up to 500 Ha) in cooperative sector on selective basis with preference to Sugar Factory sponsored schemes;
- Encourage low lift point schemes involving least engineering (3-5 HP electric, diesel and petrol start kerosene driven pump sets with 200 - 300 m length / 4 Kg per sq cm pressure class RPVC pipes) through formulation of area development plans exclusively for tribal and hilly areas based on identified surface stream potential available upto February - March;
- Promoting rain water harvesting through large scale financing of farm pond, weir, check dam schemes especially in hard rock areas (central and southern peninsular India) where groundwater is in a state of depleted conditions. Similar efforts also may have to be made in drought prone areas especially in the plateau areas of Rajasthan, Madhya Pradesh, Gujarat and Orissa.
- Encourage drainage development



schemes coupled with conjunctive use of surface water and groundwater especially in canal commands to avoid water logging in areas beset with:

- a. Shallow water table conditions (e.g., Punjab, Uttar Pradesh and parts of Rajasthan and Maharashtra);
- b. Surface runoff stagnation (e.g., Andhra Pradesh, Haryana, Gujarat, Kerala, Orissa, Punjab, Tamil Nadu, Uttar Pradesh and W.B.); and
- c. Saline / alkaline lands (e.g., Punjab, Haryana and parts of U.P.);

This would require enhanced public sector funding towards the development and maintenance of main and intermediate drainage systems besides all other on-farm development (OFD) works under the Command Area Development Program (CADP) run by Central / State Governments. In addition, better integration of the engineering, agriculture and extension functions in managing the system is needed.

- Encourage schemes for construction of new tanks, renovation and modernisation of existing tanks to restore lost potential, especially in the tribal and hilly districts of states like Madhya Pradesh, Maharashtra, Andhra Pradesh, Tamil Nadu, Orissa and Karnataka with people's participation and NGOs;
- Encourage groundwater recharge schemes with the help of State Groundwater Departments / State

Minor Irrigation Departments in areas where water levels are persistently declining for sustenance of wells facing partial and /or complete failures e.g., Maharashtra, Rajasthan, Saurashtra in Gujarat, Tamil Nadu, Karnataka and Andhra Pradesh;

- Encourage large scale reuse of treated waters for irrigation under guidance from Central and State Pollution Control Boards; and
- Besides, steps should be taken to protect groundwater resources from pollution.

21.3.2 Financial Initiatives

- Continue existing refinance quantum of the bank loan depending upon the category of borrower, agency and region;
- Keeping in view the significance of minor irrigation as an important input for accelerated growth in agriculture and food grains production, NABARD has given priority to extending refinance for lending under the sector by various agencies.
- Existing norms of drawl of refinance for wells, pump sets, and small lift irrigation schemes under automatic refinance to continue in white/safe areas, whereas for larger investment outlays, formulation of area development projects and banking plans for prior sanction by NABARD may have to be accelerated in resource-rich groundwater worthy areas both in hard rock and alluvial formations;
- In the case of irrigation schemes like

drip and sprinkler schemes where there is a subsidy component, banks may extend credit after assessing the overall viability of the schemes and NABARD would extend refinance based on bank loans;

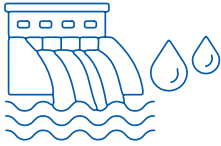
- Promoting innovative schemes with the help of state governments e.g., creation of “Private Groundwater Markets” in water-logged and salt-affected command areas, especially in hard rock areas beset with excessive use of groundwater for growing cash crops like sugarcane, banana etc., for the benefit of adjoining non-command areas; and
- Promoting commercial agriculture and contract farming in identified groundwater sanctuaries on a pilot basis as direct or co-financing activity.

21.3.3 Developmental Initiatives

- Continue promotional program of conducting district-level minor irrigation workshops by NABARD every year – to sensitize representatives of SGDs, SEBs, District Panchayat, Participating Banks, LDMS, NGOs, farmers, and other concerned agencies to boost ground-level credit disbursement, especially in over-exploited and critical areas.
- Organizing workshops/seminars to create awareness about energy conservation through efficient pumping systems – to promote understanding of energy-saving measures in irrigation practices.
- Promoting environmental and

ecological awareness – by educating on judicious groundwater use to prevent over-exploitation and addressing concerns such as seawater intrusion in coastal areas due to an avoidable interface between seawater and fresh water.

- Promoting watershed development programs – in semi-critical, critical, over-exploited, and drought-prone areas to improve groundwater conditions by effectively detecting surface runoff.
- Encouraging and supporting artificial groundwater recharge, rainwater harvesting, and watershed development activities – to maximize in-situ water retention and minimize surface runoff, especially in semi-critical, critical, over-exploited, and drought-prone areas.
- Promoting water users’ associations (WUAs) and participatory irrigation management (PIM) – to facilitate efficient turnover of irrigation projects, optimize water use, and improve equity in water distribution.
- Refining guidelines for estimating crop water requirements – for different crops across various agro-climatic regions/sub-regions to promote efficient water use in irrigation.
- Extending credit support for the rectification of defective/inefficient pump sets – to ensure that farmers have access to functional, efficient pumping systems.
- Promoting non-conventional energy resources and irrigation methods



– such as solar, wind, and treadle pumps to support sustainable irrigation

21.3.4 Model Bankable projects on Water Resources

- As part of its promotional initiatives and to facilitate enhanced credit flow for water resources sector, NABARD has brought out the following model schemes in the past:
 1. Sprinkler Irrigation
 2. Shallow Tube wells
 3. Drip Irrigation
 4. Dug-wells in Hard Rock areas
 5. Integrated Project on Micro Irrigation Scheme

6. Dug Wells
7. Pump Sets
8. Small Lift

These model schemes have served as the first point of reference for promoting water resources projects in India and provided an effective tool for increasing the credit to agriculture. These model schemes are being updated with the latest techno-economic parameters. Apart from these model schemes, the Model Scheme on Solar Photovoltaic Pumping System (for farmers without pumpsets) is included in the NABARD website (www.nabard.org).



22 Functional Areas of Water Resources Expertise of NABARD



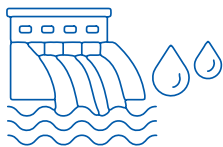
A gist of the major functional areas of Water Resources expertise available in NABARD is furnished below.

- Providing Consultancy Services through NABCONS
- Appraisal of hi-tech and innovative projects
- Technical guidance in appraising proposals under various funds of NABARD
- Providing technical support for conduct of Ex Post Evaluation studies
- Suggesting improvements in technical input of Potential Linked Credit Plans (PLPs)
- Regular updation of viability and bankability of small farm investments supported under Automatic Refinance Facility (ARF) through preparation of farm models
- Conducting Sectoral/ Scheme Specific/ Investment Specific studies
- Formulation and publication of model schemes for the benefit of banks/farmers
- Preparation of area development schemes/ co-financing schemes
- Involving in the planning process for development of Water Resources activities by closely following the similar programmes of GoI and various other institutions related to the development of Water Resources sector
- Holding meetings with state horticulture departments/ commodity boards to chalk out strategies for sector development
- Capacity building of bank officials on development of Water Resources activities
- Serving as resource persons for the trainings/workshops organized by Bankers Institute of Rural Development (BIRD), National Bank Staff College (NBSC), Training Centres of Banks, etc.
- Organising/participating in seminars/ symposia on various sub-sectors of Water Resources
- Supporting R & D activities for improvement of production, productivity, and quality of Water Resources activities
- Development of Database on Water Resources sector
- Keeping abreast with research highlights of various research organisations in India related to the Water Resources sector
- Guidance to farmers/entrepreneurs in selecting new technologies
- Encouraging technology transfer through innovative schemes
- Popularising initiatives such as Groundwater Recharge, Rainwater Harvesting, etc.



23

Conclusion



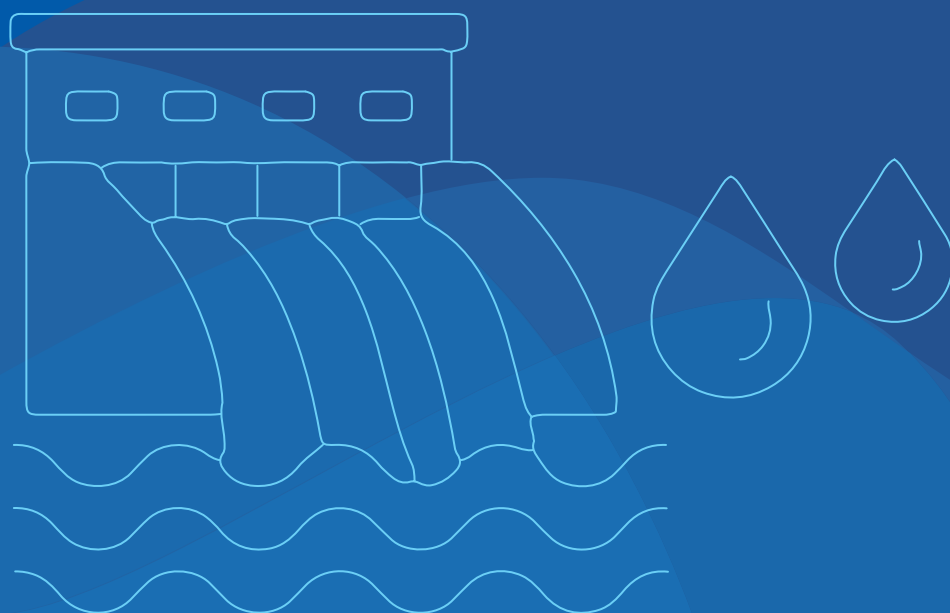
The current status of water resources in India highlights both immense challenges and critical opportunities for sustainable growth. Irrigation, primarily through minor irrigation schemes, has proven vital in enhancing agricultural productivity and supporting farmers' livelihoods. With smaller capital requirements and efficient water use, these schemes are crucial in diverse terrains and contribute significantly to the nation's agricultural output. However, addressing the over-extraction of groundwater and enhancing the efficiency of irrigation systems remain essential for long-term water security. Government initiatives and community-led water conservation and management efforts are crucial for sustaining India's agricultural and economic growth. As water demand rises across agriculture, industry, drinking water supply, and domestic sectors, and with mounting

pressures from climate change, managing this vital resource is essential for economic resilience, food security, and energy production. Strategies like Participatory Irrigation Management (PIM) and the strengthening of Water Users Associations (WUAs) are essential for fostering local ownership and efficient water use in agriculture. Furthermore, recognizing the multiple uses of water spanning agricultural needs, industrial processes, drinking water supply, and hydro-power generation can support a holistic approach to resource allocation. As a financial institution dedicated to agricultural development and rural prosperity, NABARD plays a pivotal role by investing in advanced irrigation technologies, conservation initiatives, and essential water infrastructure. In doing so, NABARD helps foster sustainable rural development and prosperity, securing a resilient future for India's rural landscape.



Notes

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National Sectoral Paper

Water Resources Development



Farm Sector Development Department
National Bank for Agriculture and Rural Development

Mumbai

National Sectoral Paper on Water Resources Development