Sattva Knowledge Institute

Open Data for Measuring Water Risk and the Role of Citizen Science

April 2025

Acknowledgements

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Executive Summary

Measuring water risk requires multidimensional, geospatial data which is a combination of hydrogeological, socio-cultural, administrative and economic indicators. At present, in India, this data is not collected at a resolution high enough to be meaningful for micro-level planning of water conservation initiatives, or to be able to truly understand the extent of water risk faced today.

In this, Sattva Knowledge Institute (SKI) describes **(1) the role water data plays in corporate water stewardship planning (2) the available open water data platforms in India, as well as their spatial resolution and temporal range, (3) challenges with the accuracy and availability of water data in existing sources and (4) citizen science initiatives underway in India to improve access to high-resolution and accurate data.**

Through this research, we found that:

- Due to the absence of real-time and accurate water data at a micro-watershed level, corporations in India often spend a large amount of their water conservation budget towards “source vulnerability assessments” to identify the water risk hotspots near their factories or plant locations.

- These one-time investments on collection of water risk data are typically not open for public consumption, hence, the investments to long-term improvement in understanding of water risk at a basin level for a range of actors that can potentially solve for it.

- These assessments are also not repeated at a regular frequency, or standardized in their forms of collection, making it difficult for corporations and the country as a whole to know the progress made through various interventions, such as construction of farm ponds, check dams, or even water-use efficiency programmes in agriculture.

- To resolve this, several academics and donors are exploring the possibility of citizen science, where community members can be trained to input data on water risk in their locations and mitigate the accuracy challenges from the secondary sources.

Through these learnings, SKI concludes that there is **a strong need to map the “top-down” (through satellite imagery, remote sensing and large data collection programmes) with the “bottom-up” (e.g. community-sourced) water data** to be able to ensure **long-term** restoration of aquifer health in India.

The Role of Data in Resolving the Water Crisis in India today

India's water crisis today demands focus on access to data. Among corporations in India, the annual investment in water conservation from 2016-17 to 2021-22 averaged ₹265 crores (~$32 million)[1]. Data provides the foundation upon which stakeholders across industry, government and civil society can understand the geographical spread and scale of the crisis, and make critical decisions regarding agriculture and water conservation efforts.
Data collection for water is expensive, and there is a heavy cost for coordinating the data across multiple sources. In some cases, 50-60 percent of total water conservation investment among corporations goes towards collecting water data to assess sub-basin and watershed level risks.

The data used for decision-making, particularly in water and agriculture, relates to measuring water availability, quality and consumption, socio-economic risks faced by communities utilising water, the investment ecosystem around water in that region, and political commitment to resolve the crisis. The table below indicates some key areas of data that are used currently by water conservation planners.

Component	Potential Data	Source
Administrative	• Investments in key government programs • Scheme utilization data at block/village level • MGNREGA investments and expenditure • Local governance expenditure	• Local Govt. Sources • Analyzed insights from academics • Open govt. Data • Local and state budgets
Economic	• Gross domestic product (GDP) • Industrial presence in the region and water consumption • Responsible stewardship and CSR Investments • Corporate voluntary declarations • MSME Clusters	• ESG sustainability reports • Local govt. sources, open govt. data • Corporate sector reports
Socio-Cultural	• Demographics (occupation, caste, gender, age) and farmer population demographics • Income levels and livelihood sources • Health, Nutrition • Water-related risks (quality)	• Open govt. data • National and state indexes • Local govt. data • Citizen/CSO/business generated data

Ecological	• Hydrological, hydro-meterological, Hydro-geological • Agriculture (e.g. cropping patterns) • Climate risks (e.g. drought, flood) • Land use and land cover (e.g. forest area, vegetation) • Soil health and erosion rates	• Open govt. data, IMD • National and state climate and water risk indexes • Local govt. data • Citizen/CSO/business generated data • Satellite imagery

Data on water risk is sourced from the Indian government, through bodies such as the Central Ground Water Board (CGWB), Central Water Commission (CWC), the India Meteorological Department (IMD), the Indian Space Research Organization (ISRO), Central Pollution Control Board (CPCB), as well as international institutions measuring global water risk, such as the European Commission's Joint Research Centre (JRC).

To visualise and analyse this data, water conservation planners need historical and geospatial data, which uses a combination of tools. For each indicator in a tool, the spatial resolutions can be very wide, such as an entire basin, or very small, such as an estimation for a 5mx5m plot of land. Below are examples of the uses of water data among a range of stakeholders:[2]

Use Case	Users	Data Used
Identifying the priority region/sub-region for intervention: Prioritisation of basin, sub-basins and watersheds on the basis of water risk and vulnerability assessment	Funders, academics, policymakers, corporations with ESG targets	• Baseline water stress, groundwater levels, groundwater table • Rainfall patterns • Flood risk • Drought risk • Water quality • Sector-wise water consumption • Impact of agriculture on water: Cropping patterns, acreage under irrigation, farmers by size class
Supply-side intervention planning: Selecting location and type of structures based on recharge potential	Last-mile delivery stakeholders (programme managers, frontline workers, civil society organisations)	• Aquifer characterisation (unconfined, perched, artesian, etc.) • Drainage • Slope • Land use/land cover • Lineament • Groundwater level • Water table (saturation point and static level) • River flow map • Number of HHs with bore wells, tube wells

Demand-side intervention planning: Water use efficiency in agricultural production, increasing infiltration		• No. of farmers by size classification • Cropping patterns • Acreage under irrigation vs. rainfed • Infiltration rate • Soil moisture, soil type
Making precise estimates to understand water scarcity: Developing a water balance or crop water deficit calculation for a catchment area/field plot	Hydrologists, climate modelers	• Precipitation • Evapotranspiration • Groundwater recharge • Surface runoff • Soil properties (e.g. moisture, texture, type) • Terrain • Land use/land cover • Wind speed • Solar radiation

Open Data Platforms for Water

Through a rapid landscape analysis, SKI identified the following platforms and decision support systems with open data for water risk assessment in India.

Platforms and Decision Support Systems with India Water Risk Assessment[4]	
Open Data - Global and National	1. India Water Resources Information System (India-WRIS), Ministry of Jal Shakti (MoJS) 2. Aqueduct, World Resources Institute (WRI) 3. Water Risk Filter, World Wildlife Fund (WWF) 4. Integrated District-level Water Quality and Scarcity Estimates for India, United States Agency for International Development (USAID) 5. Water Resource Policy Maps, ESRI India 6. World Bank Water Data, World Bank 7. Global Freshwater Quality Database GEMStat, United Nations Environment Programme (UNEP) 8. Water Information Management System (WIMS), National Water Informatics Centre (NWIC) 9. Bhuvan, Indian Space Research Organization (ISRO) 10. Surface Water Trends-India (SWT-India), Developed by Pradeep Koulgi and Suman Jumani 11. India Observatory Data Platform, Foundation for Ecological Security (FES) 12. Jaldoot Mobile App, Ministry of Rural Development, Government of India 13. CORE Stack: Commoning for Resilience and Equality, IIT Delhi, CommonsTech Foundation, WELL Labs, Gram Vaani, Magasool, Foundation for Ecological Security
Open Data Platforms-State	1. PoCRA GIS Dashboard, Government of Maharashtra 2. State-level Water Resource Information Systems (WRIS) e.g., Andhra Pradesh, Mizoram
Platforms Offline / Under Construction	1. India Water Tool 4.0, World Business Council for Sustainable Development (WBSCD) 2. Water Data Portal, International Water Management Institute (IWMI)
Decision Support Systems, Mobile Apps	1. Avni-Gramin, Samanvay Foundation 2. Jaltol, WELL Labs 3. Composite Landscape Assessment & Restoration Tool (CLART), Foundation for Ecological Security (FES) 4. WATER ATLAS, Confederation of Indian Industry-Triveni Water Institute (CII-TWI) 5. Cropwat, Food and Agriculture Organization (FAO)

Of these platforms, six platforms had open data at a sub-basin, district or village-level (table below).[5]

Analysis	Aqueduct Water Risk Atlas	Integrated District-level Water Quality and Scarcity Estimates for India	India-WRIS	Surface Water Trends-India	India Observatory Data Platform	CoRESTACK
Granularity	Sub-basin	District	Sub-basin	Sub-basin	Village	Microwatershed
No. of water risk indicators[6] (excluding drinking water and sanitation)	**11:** Water quality (2) Water quantity (8) Regulatory & Reputational risk (1)	**10:** Water quality (5) Water quantity (5)	**9:** Water quality (2) Water quantity (7)	**3:** Surface Water quantity	**40:** Water quantity (17) Water quality (23)	**33:** Water quantity (15) Water infrastructure (12) Land use (6)
Base Data Sources[7]	Hydrological models developed through remotely sensed data, and published data sets	Joint Research Centre (JRC) of the European Commission (EC), India-WRIS, CGWB, IMD, National Compilation on Dynamic Ground Water Resources of India (2020)	All water-related data from government departments, including IMD, CGWB, CWC	JRC of the EC	India-WRIS, JRC of the EC	India-WRIS, NASA, Indian government, IMD, USGS

SKI also spoke to 20+ experts (such as sustainability heads of corporations with water stewardship programmes and water conservation specialists) to understand the major challenges faced with using this available data. Below are some of the key challenges mentioned :

- **Aggregates at administrative (e.g., district) rather than basin (e.g. drainage area of river) boundaries:** Data on water is often provided by the government at the administrative level, rather than the basin-level. Due to the transboundary nature of rivers, estimating the sub-basin and basin-level water crisis requires assumptions and models that are often unsatisfactory.

- **Missing critical data to measure water risk in the top zone of aquifers:** Groundwater table data to measure the recharge levels in the top zone of the aquifer, as well as estimations of lateral recharge are both currently unavailable at the sub-basin level. As a consequence, understanding the impact of the top-zone interventions such as water-use efficiency in agriculture is not currently known.

- **Unreported water consumption data:** Lack of reporting of the number of personal tube-wells or borewells owned, particularly for large farmers and industries with unregistered borewells, leads to inaccurate calculation of total water consumption in a geographical area.

- **Missing accurate evapotranspiration data:** In India today, computer scientists and hydrologists conducting water balance models find that both rainfall runoff and evapotranspiration are currently not available in India and cannot be calibrated to a watershed or microwatershed level.

- **No standardization of data collection principles:** Across the various departments, ministries and non-governmental bodies collecting water data, there is no standardized set of principles for data collection such as recording of the type of well, the month and time of data collection and any potential confounding factors (such as, groundwater pumping taking place at the time of collection).

Experts find that the data gaps often lead to a scenario of “planning for the lowest possible outcome,” focusing on interventions that do not restore the base flow of aquifers in the long run[3]. By focusing on interventions that led to immediate water availability, measured through “meters cubed of water” generated, the newly supplied water is immediately utilised for consumption in households and agriculture, and overall water levels do not rise. Corporations interviewed by SKI also reported that after years of interventions designed to improve water supply, such as check dam construction or restoration of stepwells, the water eventually dried and interventions did not lead to long-term sustained water supply.

The Role of Citizen Science

"We should not be facing a situation where the data says a region is 'water-secure' but the community is saying something entirely different."

- **Praveen Prakash**, Head of Operations, Hindustan Unilever Foundation

Through the power of citizens, there is still a possibility to improve the resolution of water data in India today. Citizen science in water can play a role to bridge accuracy gaps in secondary data and can also give space for the community to voice concerns and learn about the degree of water risk in their micro watershed area.

Recent initiatives to "ground-truth" water data in India are explained below.

- **Nation-wide community-sourced open well data:** The Jaldoot Mobile App, developed jointly by the Ministry of Rural Development and Panachayati Raj (MoRD & PR) in 2022 and hosted on the National Water Informatics Centre (NWIC), is an experiment in collecting data on 2-3 open wells in every village across the country. "Jaldoots" are panchayat-appointed members of the community who are responsible to input water level data for two seasons (pre-monsoon and post-monsoon) every year. This effort aims to improve the scale and reach of water data in India, and better identify water risk hotspots.

- **Participatory data collection project:** During a four-year study that started in May 2019, an interdisciplinary team of academics found that in the Kaveri delta, observation well data from certain districts derived from the Central Ground Water Board (CGWB) and Tamil Nadu Public Works Department-Water Resources Department (PWD-WRD) reported stable or increasing groundwater levels, in areas where CGWB groundwater extraction data depicted overexploitation and semi-critical levels for the same districts.[8] To understand the discrepancy, with the support of land-owning farmers with borewells, engineers farmers' associations and local university students, the researchers collected data through a participatory data collection project for over 800 wells with parameters such as "GPS coordinates, date of construction, depths of borewells, casing and submersible pump, depth to groundwater on the day of measurement, electrical conductivity and temperature." The study highlighted the discrepancy between government and farmer reported data:

Farmers [are] drilling to more than ten times the depths that the government is measuring groundwater levels at. It seems, therefore, that the government monitors largely shallow wells, leaving unmonitored water levels at the depths to which farmers are drilling to or pumping from.

To address this, researchers from IIT Delhi, IIT Palakkad, WELL Labs and BITS Pilani Hyderabad formed an open source digital public good called 'CoRE Stack: Commoning for Resilience and Equality,'[9] to improve open source geospatial dataset access across India, including datasets on land use and land cover, through initiatives such as IndiaSAT, wherein farmers are provided data on cropping patterns.

- **Improved soil water balance computation through farmer data:** With support from the World Bank and the state government of Maharashtra, researchers from IIT Bombay developed a Water Budget Dashboard that provides hourly soil water balance at a 30mx30m resolution to map the crop water deficit under rainfed conditions. While developing this tool, the researchers found incorrect and missing soil type and texture data, which was distorting the soil water balance model. To correct the inconsistencies, the team asked farmers directly at the plot-level to describe the soil type and texture and re-ran the model. The team, led by Dr. Milind Sohoni and Dr. Pooja Prasad, reported significantly improved results that impacted government advisory on which crop to grow, what kind of irrigation needs are expected, and the potential stress that a farmer would face in that area.[10]

- **Community-led planning of water conservation:** To strengthen decentralized water governance and planning, the Foundation for Ecological Security (FES) developed the Composite Landscape Assessment & Restoration Tool (CLART) — a GIS-based Android application that supports region-specific planning of soil and water conservation measures. Designed for ease of use by semi-literate rural communities, CLART enables communities to identify and design suitable water harvesting and recharge structures based on local geo-hydrological conditions, directly contributing to the preparation of scientifically grounded and community-driven plans. CLART has found significant application within the Mahatma Gandhi National Rural Employment Guarantee Scheme (MGNREGS) — particularly for planning and implementing Natural Resource Management (NRM) works. With support from Arghyam and in partnership with state governments, CLART has now been scaled across 40 districts in Meghalaya and Karnataka. Its use has strengthened the role of communities in water governance. As of October 2024, technical staff and local communities across 1,589 Gram Panchayats have used CLART to prepare annual action plans for NRM interventions.

- **Women-led water quality testing:** Under the Jal Jeevan Mission, five women from each rural water supply scheme are designated to conduct regular water quality tests using Field Test Kits (FTKs). These test results are uploaded to the Government of India's Water Quality Management Information System (WQMIS). Over the last five years, more than 93 lakh tests have been conducted across 5.85 lakh villages.

Remarks

We believe that collaborative action between the scientific community, corporations, farmers, local communities and governments has the potential to reduce the imminent water crisis in India today. Combining top-down open data with bottom-up citizen science is a promising way forward to resolving water data gaps and encourages collaboration across multiple stakeholders. Given the high cost for collection of high resolution data, it is imperative today that water data collection become simplified, low cost and community-centric.

Among corporations with water stewardship, there is great potential to leverage CSOs and NGOs to provide data at a more accurate frequency, with commonly agreed upon data collection standards, which can lead to improvement in the long-run restoration of India’s aquifers.

We hope that this paper provides a resource to those who want to use open data to measure water risk in India, and we are interested to hear from more who are exploring the synergies between citizen science and top-down data to solve water in India today.

Endnotes and References

1. Sattva's India Data Insights platform; retrieved in November 2024.
2. Sourced from interviews with 20+ corporations and implementing agencies of water stewardship programmes. List of experts in the Acknowledgements section.
3. Interview with senior hydrologist and CEO of Geovale Services, Biplob Chatterjee, who has advised corporations on water stewardship across India and helped design Rio Tinto's exploration program in Bundelkhand which led to the discovery of Bunder Diamond Deposit.
4. Annexure 1 examines key characteristics of some of the key platforms. Please feel free to contact our team if we have missed any platforms that should be mentioned.
5. Annexure 2 lists all the major indicators in the platforms as well as their spatial resolution, temporal range and source.
6. The number of indicators may have changed in these platforms since the development of this table in December 2024.
7. List of details of major indicators and their resolution and sources in Annexure 2.
8. Tanvi Agrawal, Richard Pompoes, Andres Verzijl, Veena Srinivasan, Jyoti Nair, Edward Huijbens, Kalaivendhan Kannadhasan, Kuloth Chokkalingam, Vivek Murugan, *Creating Kaveri delta beneath our feet An experiment in grounding socio-hydrology in Tamil Nadu, Journal of Hydrology, 2024, 131896, ISSN 0022-1694*, https://doi.org/10.1016/j.jhydrol.2024.131896.
9. Shivani A Mehta, Aila Dutt, Ajay Tannirkulam, Akshay Pratap Singh, Aman Verma, Anamitra Singha, Ananda Sreenidhi, Ananjan Nandi, Ankit, Ankit Kumar, Atharv Dabli, Athira P, Balakumaran Ramachandran, Chahat Bansal, Chintan Sanjaybhai Sheth, Craig Dsouza, Deepak Kumar, Dharmisha Sharma, Harshita, Jaskaran Singh, Kapil Dadheech, Ksheetiz Agrahari, Om Krishna, Pooja Prasad, Priyadarshini Radhakrishnan, Ramita Sardana, Rittwick Bhabak, Ruptirumal Sai Bodavula, Saketh Vishnubhatla, Samitha Haldar, Sanjali Agrawal, Shiv Prakash Maurya, Shruti Kumari, Siddharth S, Sukriti Kumari, Vishnu S, and Aaditeshwar Seth. 2025. *Initial Observations from Field Testing of a Digital Participatory Tool to Improve Water Security in Rural India. In Proceedings of the 13th International Conference on Information & Communication Technologies and Development (ICTD '24). Association for Computing Machinery, New York, NY, USA, 337–364.* https://doi.org/10.1145/3700794.3700816
10. Pooja Prasad, Parth Gupta, Hemant Belsare, Chirag M. Mahendra, Manasi Bhopale, Sudhanshu Deshmukh, Milind Sohoni; *Mapping farmer vulnerability to target interventions for climate-resilient agriculture: science in practice. Water Policy 1 August 2023; 25 (8): 815–834.* doi: https://doi.org/10.2166/wp.2023.036

Annexure 1: Key characteristics of India-relevant water risk assessment tools

Platform	Geo-graphical Coverage	Categories of data availa-ble	Spatial reso-lution at Basin scale	Last updated (as of Oct 2024)	Open or Closed Platform
WIMS, NWIC	India	Physical, regulatory	Basin bounda-ries	-	Closed
India-WRIS	India	Physical	Basin bounda-ries	Annually	Open
WRI Aque-duct's Water Risk Atlas	Global	Physical, regulatory	HydroBASIN level 6	Version 4.0 was released in August 2023 with data from 1979–2019	Open
WWF's Water Risk Filter	Global	Physical, regulatory, reputational	HydroBASIN level 7 (global) and 12 (local)	Latest version re-leased in October 2024	Open
USAID's RE-ALWater	India	Physical	District polygon boundaries	October 2023 (Only 1 time)	Open
CoRESTACK	India	Physical	Micro Water-shed	Annually	Open
ESRI Water Policy Maps	India	Physical, regulatory, reputational	State Bounda-ries	Latest version released 2021	Open
World Bank Water Data	Global	Physical, regulatory	Depends on dataset - Dis-trict/ Sub Basin Boundaries	Most of the data sets were last updated in 2020	Open
UNEP's GEM-Stat	Global	Physical	Basin Bounda-ries	Latest version released in 2021 for India	Open
WBCSD's India Water Tool	India	Physical	Basin bound-aries from CGWB, GOI	Version 4.0 released in 2022 with agriculture data	Closed
Water Data Portal, IWMI	India	Physical	Not available	Unknown	Closed
Bhuvan, ISRO	India	Physical	Uses both basin and state boundaries	Varies by Dataset	Open

SWT-India	India	Physical	HydroBASINS level-7 resolution	Latest version released 2020	Open
Aquastat	Global	Physical, regulatory	National boundaries	2021	Open

Annexure 2: Key indicators in open data platforms on water risk at sub-basin level

Indicator Name	Spatial resolution	Source	Temporal range
Tool 1: GEMStat			
Assessment of Water Quality(Dissolved Oxygen, Nitrogen, Phosphorous, pH)	Stations at National/ Basin	GEMS/Water Data Centre (GWDC)	1973-2021
Tool 2: Aqueduct			
Baseline Water Stress	5 x 5 arc minute grid cells	Hydrological model PCR-GLOBWB 2	1979–2019
Baseline Water Depletion	5 x 5 arc minute grid cells	Hydrological model PCR-GLOBWB 2	1979–2019
Interannual Variability	5 x 5 arc minute grid cells	Hydrological model PCR-GLOBWB 2	1979–2019
Seasonal Variability	5 x 5 arc minute grid cells	Hydrological model PCR-GLOBWB 2	1979–2019
Groundwater Table Decline	5 x 5 arc minute grid cells	Hydrological model PCR-GLOBWB 2 + MODLFLOW	1990–2014
Riverine flood risk	30 x 30 arc minute grid cells	GLOFRIS (Ward et al. 2020)	2010
Coastal flood risk	30 x 30 arc minute grid cells	GLOFRIS (Ward et al. 2020)	2010
Drought Risk	5 x 5 arc minute grid cells	Carrão et al. (2016) for drought hazard, exposure, and vulnerability data	2000–2014
Untreated Connected Wastewater	Country	International Food Policy Research Institute (IFPRI) and Veolia, aggregated by Xie et al. (2016)	2000–2010

Coastal Eutrophication Potential	Simulated Topological Network (STN)	Vörösmarty et al. (2000) and Bouwman et al. (2015), utilizing the Global NEWS 2 model (Mayorga et al. 2010)	2000
Peak RepRisk Country ESG Risk Index	Country	RepRisk, a leading business intelligence provider specializing in ESG and business conduct risk research	2016–2018
Tool 3: India-WRIS			
Gross reservoir storage	Sub-basin	APWRIMS, CWC	1991-till date
Fill % of reservoir	Sub-basin	APWRIMS, CWC	1991-till date
Total # of waterbodies in each reservoir	Sub-basin	LISS IV and Cartosat-1 merged satellite data	-
Groundwater lithology details	Village	-	-
Groundwater level across stations	Sub-basin	CGWB, CPCB, APWRIMS & different state/ central agencies and the total number of stations are 87183	1993 to 2021
Groundwater resource estimation (2011, 2013, 2017,2020) - Net Annual Groundwater Availability	District	Ground Water Estimation Committee (GEC)	2011, 2013, 2017, and 2020
Groundwater resource estimation (2011, 2013, 2017,2020) - Annual Irrigation Draft	District	Ground Water Estimation Committee (GEC)	2011, 2013, 2017, and 2020
Groundwater resource estimation (2011, 2013, 2017,2020) - Annual Domestic and Industry Draft	District	Ground Water Estimation Committee (GEC)	2011, 2013, 2017, and 2020
Annual Groundwater Draft(Total)	District	Ground Water Estimation Committee (GEC)	2011, 2013, 2017, and 2020
Recharge from Rainfall (Monsoon)	District	Ground Water Estimation Committee (GEC)	2011, 2013, 2017, and 2020

Recharge from other sources (Monsoon)	District	Ground Water Estimation Committee (GEC)	2011, 2013, 2017, and 2020
Recharge from rain-fall (Non-Monsoon)	District	Ground Water Estimation Committee (GEC)	2011, 2013, 2017, and 2020
Recharge from other sources (Non-Mon-soon)	District	Ground Water Estimation Committee (GEC)	2011, 2013, 2017, and 2020
Annual Replenishable Groundwater Re-sources (Total)	District	Ground Water Estimation Committee (GEC)	2011, 2013, 2017, and 2020
Natural Discharge During Non-Monsoon Season	District	Ground Water Estimation Committee (GEC)	2011, 2013, 2017, and 2020
Projected Domestic & Industrial Uses up to 2025	District	Ground Water Estimation Committee (GEC)	2011, 2013, 2017, and 2020
Groundwater Avail-ability for Future Irrigation	District	Ground Water Estimation Committee (GEC)	2011, 2013, 2017, and 2020
Stage of Groundwa-ter Development (%)	District	Ground Water Estimation Committee (GEC)	2011, 2013, 2017, and 2020
Aquifer Disposition (e.g. area covered by Alluvium in aquifer)	State	-	2013
Rainfall	-	IMD Grid (0.25 x 0.25-degree size), NRSC (0.05 X 0.05-de-gree size), APWRIMS (Sta-tion wise rainfall) & different state/ central agencies (Station wise rainfall)	1901 to till date
Soil moisture	Sub Basin	NRSC VIC Model (data for the entire country; gridded 0.05x0.05)	2018-till date
Evapotranspiration	Sub Basin	NRSC VIC Model (data for the entire country; gridded 0.05x0.05)	2018-till date
Water resource projects	Sub Basin	CWC, State Water Resourc-es/Irrigation department and other Central Government Departments	-
Inter-basin transfer links	Basin	National Water Development Agency (NWDA)	-

Minor irrigation census data	-	-	every five years(latest - 2013-2014)
Surface Water Quality	Sub Basin	CWC (currently total of 813 stations), CPCB (currently total of 2710 stations), NIH (total of 3792 stations) & different state/ central agencies	1963 to till date
Ground Water Quality	Sub Basin	CGWB (total of 13153 stations), CPCB (total of 1130 stations)	2000 to till date
Tool 4: USAID District-Level Water Scarcity and Quality Estimates			
# of Chloride observations above limit	District	CGWB	2010, 2012, 2014, 2016, 2018
% of Nitrate observations above limit	District	CGWB	2010, 2012, 2014, 2016, 2018
# of Fluoride observations above limit	District	CGWB	2010, 2012, 2014, 2016, 2018
EC water (for irrigation safety)	District	CGWB	2010, 2012, 2014, 2016, 2018
# of Districts with arsenic detected	District	CGWB	2010, 2012, 2014, 2016, 2018
Groundwater recharge observations at "Safe, Semi Critical, Critical, Overexploited, Saline" category	District	CGWB	2010, 2012, 2014, 2016, 2018
Average surface water extents for period 1999-2003	District	CGWB	1999-2003
Average surface water extents for period 2016-2020	District	CGWB	2016-2020
% of assessed groundwater units in a district classified as either "critical" or "overexploited"	District	CGWB	2020

Coefficient of variation of IMD daily rainfall for monsoon (2011-2020)	District	CGWB	1901-2022
Tool 5: Surface Water Trends-India (SWT-India)			
Changes in surface water in wet season	Sub-basin	European Commission Joint Research Centre	1991 to 2020
Changes in surface water in dry season	Sub-basin	European Commission Joint Research Centre	1991 to 2020
Changes in surface water - permanent	Sub-basin	European Commission Joint Research Centre	1991 to 2020
Tool 6: India Observatory Data Platform			
Block-wise groundwater development index	Block	CGWB	2017
Average water table depth - Monsoon (mg - bgl)	Block	India-WRIS (CGWB)	2007-2017
Average water table depth - December (mg - bgl)	Block	India-WRIS (CGWB)	2007-2017
Global surface water maximum water extent	Nation	European Commission Joint Research Centre	1984-2018
Global surface water occurrence change intensity	Nation	European Commission Joint Research Centre	1984-2018
Global surface water occurrence	Nation	European Commission Joint Research Centre	1984-2018
Global surface water recurrence	Nation	European Commission Joint Research Centre	1984-2018
Global surface water seasonality	Nation	European Commission Joint Research Centre	2014-2018
Global surface water transitions	Nation	European Commission Joint Research Centre	1984-2015

Groundwater use condition	District	CGWB	2011
Land use/ land cover	60 m	ESA-Sentinel 2	2020
Post and pre monsoon groundwater table	Block	Crowd sourcing from 40 NGO partners using FES Monitoring Tool	2020
Post monsoon water level rise and fall	Block	India-WRIS	2007-2017
Pre monsoon water level rise and fall	Block	India-WRIS	2007-2017
Water level change (stress percentage)	Pan India (satellite grid)	CGWB	2011
Post monsoon water table	Pan India (satellite grid)	India-WRIS	2017,2020
Pre monsoon water table	Pan India (satellite grid)	India-WRIS	2017,2020
Pre and post monsoon water table depth	Pan India (satellite grid)	India-WRIS	2007-2017
Groundwater Quality - Average 4E-Coli, Alkalinity, Aluminium, Arsenic, Calcium, Chloride, Coliform, Conductivity, Copper, Faecal coliform, Fluoride, Hardness, Iron, Magnesium, Manganese, Nitrate, pH, Residual chlorine, Sulphates, TDS, Total Coliform, Total Hardness, Turbidity	District-wise station average	CGWB	2015-16

Tool 7: CoRESTACK			
Precipitation	Computed at micro-watershed level from data of five blocks	Global Satellite Mapping of Precipitation (GSPMaP) on Google Earth	Fortnightly
Runoff (using soil type, slope, land cover and precipitation)	Computed at micro-watershed level from: (1) Soil type: 250m (2) Slope: 30m (3) Land cover: 10m	Soil Type: HYSOGs250m (USDA) Slope: NASA SRTM DEM dataset Land cover: Dynamic World dataset	Fortnightly
Evapotranspiration	Computed at micro-watershed level	from FLDAS Noah land surface model developed by NASA and USGS	Fortnightly
Change in groundwater	Computed at microwatershed level through precipitation, runoff and evapotranspiration	GSPMaP, USDA, NASA, Dynamic World, USGS	Fortnightly, yearly
Change in well depth	Computed at micro-watershed level	Aquifer layer: India WRIS Aquifer mapping: NAQUIM and CGWB	Five years
Groundwater levels in dugwells	Not applicable (NA) (23,125 observation dug wells located across India)	India WRIS	2001-2023 Measured four times a year: (1) January - post monsoon (2) March/April/May - pre monsoon (3) August - post monsoon and (4) November (post monsoon)
Groundwater levels in borewells	NA	India WRIS	Pre and post monsoon from 2015 to 2022
Stage of Groundwater Extraction	NA (Block-level computation)	SGWB and CGWB	2011, 2013, 2017 and 2020

Drought intensity and frequency	Rainfall data - 5.566 km Vegetation data - 30 m Crop data -500 m Land use and land cover (LULC)- 10 m	Rainfall data - Climate Hazards Group Infrared Precipitation with Station data (CHIRPS) Vegetation data - NDVI and NDWI are derived from Landsat dataset (USGS) Evapotranspiration and potential ET - MODIS LULC - Dynamic World	Rainfall data - 1 day Vegetation - 14 to 26 days Crop data (evapotranspiration & potential ET) - 8 days Land use and land cover - yearly
Drought causality	Computed at micro-watershed level	Same as above	Yearly
Monsoon onset	5.566 km	CHIRPS	1 day
Land use on terrain	30m	LULC: Dynamic World maps from Google Terrain classification: NASA SRTM Digital Elevation Map	2017-2023 (annual)
Cropping intensity	Microwatershed	Annual LULC	Three seasons in the year (annual)
Water bodies	1000-5000m2 water bodies	Global Surface Water (GSW) maps	Annual
NREGA Assets categorization	Block-wise	Geotagged MGNREGA assets from Bhuvan portal	January 2005 to November 2022 (Annual)
Farm ponds and wells	Level 17 zoom for farm ponds (approsimately 1.19 meters/pixel) and level 28 for wells (approximately 0.60 meters/pixel)	Google Maps	Static