



National River Conservation Directorate
Ministry of Jal Shakti,
Department of Water Resources,
River Development & Ganga Rejuvenation
Government of India

Hydrologic Data Collection

Periyar

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Hydrologic Data Collection

Periyar River Basin



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National River Conservation Directorate (NRC D)

The National River Conservation Directorate, functioning under the Department of Water Resources, River Development & Ganga Rejuvenation, and Ministry of Jal Shakti providing financial assistance to the State Government for conservation of rivers under the Centrally Sponsored Schemes of ‘National River Conservation Plan (NRCP)’. National River Conservation Plan to the State Governments/ local bodies to set up infrastructure for pollution abatement of rivers in identified polluted river stretches based on proposals received from the State Governments/ local bodies.

www.nrcd.nic.in

Centres for Periyar River Basin Management Studies (cPeriyar)

The Centre for Periyar River Basin Management Studies (cPeriyar) is a Brain Trust dedicated to River Science and River Basin Management. Established in 2024 by IIT Palakkad and NIT Calicut, under the supervision of cGanga at IIT Kanpur, the center serves as a knowledge wing of the National River Conservation Directorate (NRC D). cPeriyar is committed to restoring and conserving the Periyar River and its resources through the collation of information and knowledge, research and development, planning, monitoring, education, advocacy, and stakeholder engagement.

www.cPeriyar.org

Centre for Ganga River Basin Management and Studies (cGanga)

cGanga is a think tank formed under the aegis of NMCG, and one of its stated objectives is to make India a world leader in river and water science. The Centre is headquartered at IIT Kanpur and has representation from most leading science and technological institutes of the country. cGanga’s mandate is to serve as think-tank in implementation and dynamic evolution of Ganga River Basin Management Plan (GRBMP) prepared by the Consortium of 7 IITs. In addition to this, it is also responsible for introducing new technologies, innovations, and solutions into India.

www.cganga.org

Acknowledgment

Undertaken as part of the CAMP (Condition Assessment and Management of the Periyar River Basin) Project, this study was conducted by IIT Palakkad with supervision from cGanga at IIT Kanpur and submitted to National River Conservation Directorate (NRC D) in 2024. We gratefully acknowledge the efforts of the cPeriyar team at IIT Palakkad for their dedicated work in collecting and sorting hydrologic data for this report. We also extend our sincere thanks to all individuals and organizations who contributed valuable information and support throughout the course of this project.

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PREFACE

In an era of accelerating environmental change, understanding and protecting our rivers has become more crucial than ever. The Periyar River often referred to as “Lifeline of Kerala”, sustains diverse ecosystems, countless communities, and plays a pivotal role in the ecological and economic fabric of the state.

The Centre for Periyar River Basin Management and Studies (cPeriyar), established in 2024 by IIT Palakkad and NIT Calicut, under the supervision of cGanga at IIT Kanpur, serves as a knowledge wing for the National River Conservation Directorate (NRCD), Ministry of Jal Shakti, Government of India. This initiative is aligned with the national mission to apply basin-level approaches in river rejuvenation and natural resource management. Hydrologic data is vital for understanding the flow dynamics, seasonal variability, and overall health of a river basin. The systematic collection, organization, and interpretation of such data are essential for effective basin management and informed decision-making. This dataset, compiled as part of the CAMP (Condition Assessment and Management of the Periyar River Basin) project, represents one of the most comprehensive efforts to date in mapping and documenting the hydrologic characteristics of the region. Parameters such as rainfall, discharge, groundwater levels, evapotranspiration, water quality and sediment data have been collated from all available sources, ensuring a robust and multidimensional dataset.

The significance of this data extends far beyond the scope of this study. It provides a scientific basis for developing water management strategies, flood forecasting models, drought resilience planning, and sustainable allocation of water resources. Researchers, planners, policymakers, and regulatory agencies will find this data invaluable for future studies related to climate change impact assessment, hydrologic modelling, water quality management, and river restoration efforts.

We hope this dataset adds value to future interdisciplinary research and collaborative efforts aimed at safeguarding the Periyar river basin, while also supporting informed decision-making by stakeholders such as local governments, environmental organizations, and water resource authorities.

Centres for Periyar River Basin Management and Studies (cPeriyar)
IIT Palakkad & NIT Calicut

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INTRODUCTION

Hydrologic data is fundamental to understanding the behaviour of river systems and the interaction between water, land, and climate. It provides critical insights into water availability, variability, and trends that influence both ecological health and human activities. The Periyar river basin is characterized by diverse topography, climatic conditions, land use patterns, and anthropogenic pressures. Effective management of such a complex system requires detailed and reliable data on various hydrologic parameters including streamflow (discharge), rainfall, evapotranspiration, groundwater levels and quality, surface water quality, sediment data etc.

The hydrologic data catalogue presented in this report is a comprehensive and structured compilation of datasets critical for the assessment, planning, and integrated management of the Periyar river basin. Developed as part of the CAMP (Condition Assessment and Management of the Periyar River Basin) project, this catalogue brings together a wide range of data types from multiple sources, ensuring a holistic understanding of the basin's hydrological behaviour and related environmental parameters.

The datasets encompass essential variables such as streamflow (gauge discharge), rainfall, evapotranspiration, groundwater levels and quality, surface water quality, river cross-section profiles, basin shapefiles, sediment loads, and other key meteorological indicators.

Given the increasing frequency and intensity of extreme climatic events observed in the Periyar basin in recent years the availability of reliable and comprehensive hydrologic data is more critical than ever. This catalogue serves as a vital resource for developing and calibrating hydrologic and hydraulic models capable of simulating such extremes. Accurate modelling, in turn, enables improved flood forecasting, drought preparedness, reservoir operation planning, and long-term climate impact assessments. By supporting robust scenario analysis, the data presented here contributes to building climate resilience and informed decision-making for sustainable water resource management in the basin. By supporting evidence-based decision-making, hydrologic data enables planners, policymakers, and stakeholders to design adaptive, sustainable, and resilient river management strategies. In complex and sensitive basins like the Periyar, where human and ecological demands intersect, such data is indispensable for balancing development with conservation.

HYDROLOGIC DATA CATALOGUE

META DATASHEET

HYDROLOGIC DATA

CATEGORY I

GAUGE DISCHARGE DATA

Sl No	Discharge Station	Years		Missing data			
		From	To	Gauge %	Discharge %	WP & Radius	Velocity, Max Velocity & Area
1	Vettilappara Station Chalakkudy RB	01-01-2016	31-12-2021	0.22	0.8	Available from 2017	Available from 2016
2	Kalady	01-01-1978	31-12-2020	2.5	2.5	Available from 2018	Available from 2017
3	Mangalapuzha	01-01-1970	31-12-2020	6.4	57.2	Available from March 2018	
4	Marthandavarma	01-01-1980	31-12-2020	6.1	49	Available from 2018	
5	Neeleshwaram	16-03-1971	11-07-2022	3.8	8.24	No data available	
6	Vandiperiyar	01-06-2000	11-07-2022	9.42	21.54	No data available	

REMARKS

Vettilappara Station (Chalakkudy RB):

- Gauge measured in m; discharge measured in cumecs.
- Recorded 3 readings per day
- Discharge is observed values

Kalady:

- Gauge measured in m; discharge measured in cumecs.

- Recorded 3 readings per day
- Data is missing for year 1994
- Discharge is observed values for 1995-1997,2000-2002,2017-2020
- Discharge is computed for 1978-1993, 1998-1999

Marthandavarma:

- Gauge measured in m; discharge measured in cumecs.
- Recorded 3 readings per day
- Discharge is observed values for 1994-1998,2000-2002,2015
- Discharge is computed for 1980-1993, 1999,2003-2014

Mangalapuzha:

- Gauge measured in m; discharge measured in cumecs.
- Recorded 3 readings per day
- Discharge is observed values for 1996,2000-2002
- Discharge is computed for 1970-1993,1997,1999,2003-2010,2011-2015
- Data is Missing for years 1974,1994,1995,1998

Neeleshwaram:

- Gauge measured in m; discharge measured in cumecs.
- Single reading is recorded per day
- Zero of gauge is (-3)
- River point and flow report of neeleshwaram (CWC) downloaded on 19-09-2024

Vandiperiyar:

- Gauge measured in m; discharge measured in cumecs.
- Single reading is recorded per day
- Zero of gauge is (789)
- River point and flow report of neeleshwaram (CWC) downloaded on 19-09-2024

Location Details of CWC Stations in Periyar Basin

River Point Name	Latitude	Longitude
Vandiperiyar	9.57333333	77.09055556
Neeleeswaram	10.18333333	76.49555556

HYDROLOGIC DATA**CATEGORY II****RAINFALL DATA**

SI No	Rain gauge Station	From	To	Missing Data	Remarks
1	Chinnar	14-09-2000	21-12-2022	None	
2	Boothathankettu Station	01-01-2019	31-12-2023	None	
3	Keerampara	06-04-2000	31-12-2023	0.32%	
4	Aluva	01-07-1967	31-12-2023	0.2%	
5	Kumili	01-03-2000	31-12-2023	None	Jan to May 1974 is available
6	Mathilakam	01-01-2000	31-12-2023	0.03%	
7	Nedumkandam	01-03-2000	31-12-2023	0.4%	
8	Neriyamangalam	01-01-1995	31-12-2023	0.09%	
9	Painavu	01-01-2007	31-12-2023	0.3%	Sept-2001 is available
10	Vandanmedu	01-09-2000	31-12-2023	0.72%	

SI No.	Station	District	Station type	Latitude	Longitude
1	Chinnar estate	Idukki	SRG	9.68889	77.0311
2	Boothathankettu	Ernakulam	SRG&AWS	10.1592	76.6164
3	Keerampara	Ernakulam	SRG	10.15	76.75
4	Aluva	Ernakulam	SRG	10.0847	76.3047
5	Kumili	Idukki	SRG	9.60444	77.1742
6	Mathilakam	Thrissur	SRG	10.2952	76.1676
7	Nedumkandam	Idukki	SRG	9.83352	77.1594
8	Neriyamangalam	Ernakulam	SRG	10.0914	76.6883
9	Painavu	Idukki	FCS&AWS	9.882	76.926
10	Vandanmedu	Idukki	SRG	9.72217	77.1522

REMARKS

Data Received from IDR B

HYDROLOGIC DATA	
CATEGORY III	EVAPOTRANSPIRATION DATA

District	Frequency	Duration	Missing	Downloaded from India WRIS on 24/09/24
Ernakulam	Daily	2018-07-24 to 2024-09-09	None	
Thrissur	Daily	2018-07-24 to 2024-09-09		
Idukki	Daily	2018-07-24 to 2024-09-09		

REMARKS

Data downloaded from India WRIS Website on 24/09/24

HYDROLOGIC DATA	
CATEGORY IV	GROUND WATER QUALITY DATA

SI No	District	No of locations	Years	Parameters	Source
1	Ernakulam	25-76, 18 common	2012 to 2019	Electrical conductivity, pH, Total hardness, Ca, Mg, Cl, F, NO ₃	CGWB, TVM
2	Thrissur	20-41, 17 common			
3	Idukki	29-56, 26 common			
4	Kottayam	25-54			
5	Pathanamthitta	16-55			
6	Alappuzha	23-61			

SI No	Districts	Year	Parameters	Source
1	All districts	2021	Fe, Mn	CGWB, TVM
2	Thrissur, Ernakulam, Idukki, Alappuzha, Kottayam, Pathanamthitta	2022	pH, Electrical Conductivity, Total Hardness, CO ₃ , HCO ₃ , SO ₄ , Cl, NO ₃ , F, Ca, Mg, Na, K	
3	Thrissur, Ernakulam, Idukki, Alappuzha, Kottayam, Pathanamthitta	2023	pH, Electrical Conductivity, Total Hardness, Total Dissolved Solids, CO ₃ , HCO ₃ , Cl, SO ₄ , NO ₃ , F, Ca, Mg, Na, K, U, Fe, Cd, Mn	

REMARKS

Shared by CGWB Trivandrum

No data available for 2020

HYDROLOGIC DATA

CATEGORY V

GROUND WATER LEVEL DATA

SI No.	Basin	No of locations	Frequency	Year
1	Periyar	120	Quarterly	2013 to 2023
2	Chalakudi	14		
3	Manimala	53		
4	Minachil	60		
5	Muvattupuzha	141		
6	Pamba	59		
7	Pambar	3		

REMARKS

Readings taken during January, April, August and November

Data missing for some year

HYDROLOGIC DATA**CATEGORY VI****SURFACE WATER QUALITY DATA**

Station & Code	Year	Parameters
Neeleshwaram - KS000F3 Latitude : 10°11'00" Longitude : 76°30'00"	2013-2023	Physical, chemical, biological/bacterial, trace or toxic, chemical indices
Vandiperiyar - KS000U1 Latitude : 09°34'30" Longitude : 77°05'30"		

REMARKS

Water Quality Seasonal Average (flood, winter, summer) for water years 2004 to 2022 is available.

Data provided by CWC

Parameters included in the collected data are listed below

1. Physical Parameters

- Q (cumec) - Discharge or flow rate of water (cubic meters per second).
- EC_FLD (µmho/cm) - Field electrical conductivity (a measure of water's ability to conduct electricity, indicating the level of dissolved salts).
- EC_GEN (µmho/cm) - General electrical conductivity, often measured in the lab.
- pH_FLD (pH units) - pH of water in the field (acidity or alkalinity).
- pH_GEN (pH units) - pH of water as measured in the laboratory.
- TDS (mg/L) - Total dissolved solids (concentration of dissolved substances in water).
- Temp (°C) - Temperature of the water (degrees Celsius).

2. Chemical Parameters

- Alk-Phen (mgCaCO₃/L) - Phenolphthalein alkalinity (related to the buffering capacity of water).

- ALK-TOT (mgCaCO₃/L) - Total alkalinity (buffering capacity of water, usually from bicarbonates, carbonates, and hydroxides).
- B (mg/L) - Boron concentration in water.
- Ca (mg/L) - Calcium concentration in water.
- Cl (mg/L) - Chloride concentration in water.
- CO₃ (mg/L) - Carbonate concentration.
- F (mg/L) - Fluoride concentration in water.
- Fe (mg/L) - Iron concentration in water.
- HCO₃ (mg/L) - Bicarbonate concentration in water.
- K (mg/L) - Potassium concentration in water.
- Mg (mg/L) - Magnesium concentration in water.
- Na (mg/L) - Sodium concentration in water.
- NH₃-N (mg N/L) - Ammonia nitrogen concentration (typically from organic matter breakdown).
- NO₂+NO₃ (mg N/L) - Nitrate and nitrite nitrogen concentration (a major nutrient and pollutant).
- NO₂-N (mg N/L) - Nitrite nitrogen concentration.
- NO₃-N (mg N/L) - Nitrate nitrogen concentration.
- o-PO₄-P (mg P/L) - Orthophosphate phosphorus concentration.
- P-Tot (mg P/L) - Total phosphorus concentration.
- SiO₂ (mg/L) - Silica concentration in water.
- SO₄ (mg/L) - Sulfate concentration.

3. Biological/Bacteriological Parameters

- BOD₃₋₂₇ (mg/L) - Biochemical oxygen demand after 3 days at 27°C (a measure of organic matter in water).
- COD (mg/L) - Chemical oxygen demand (another measure of organic matter).
- DO (mg/L) - Dissolved oxygen concentration (an indicator of water quality and biological health).
- DO_SAT% (%) - Percentage of dissolved oxygen saturation.
- FCol-MPN (MPN/100mL) - Fecal coliform bacteria count (measured in most probable number per 100 mL of water).
- Tcol-MPN (MPN/100mL) - Total coliform bacteria count.

4. Trace & Toxic Elements

- As (µg/L) - Arsenic concentration (toxic).
- Cd (µg/L) - Cadmium concentration (toxic).

- Cr ($\mu\text{g/L}$) - Chromium concentration (toxic).
- Cu ($\mu\text{g/L}$) - Copper concentration.
- Ni ($\mu\text{g/L}$) - Nickel concentration.
- Pb ($\mu\text{g/L}$) - Lead concentration (toxic).
- Zn ($\mu\text{g/L}$) - Zinc concentration.

5. Chemical Indices

- HAR_Ca (mgCaCO_3/L) - Hardness due to calcium concentration.
- HAR_Total (mgCaCO_3/L) - Total hardness (includes all hardness-causing substances).
- Na% (%) - Sodium percentage (calculated to evaluate water's sodium content).
- RSC (-) - Residual sodium carbonate (an indicator of water's potential to cause soil degradation).
- SAR (-) - Sodium adsorption ratio (evaluates the suitability of water for irrigation).

HYDROLOGIC DATA

CATEGORY VII

CROSS SECTION DATA

Station & Code	Year	Type of Data
Neeleshwaram- KS000F3	2000-2022	Reduced Distance, CGL, UGL, DGL
Vandiperiyar- KS000U1	2000-2022	Reduced Distance, CGL, UGL, DGL

REMARKS

Any cross-section record is identified by the station code and the date of the cross-section observation

The horizontal distance of the point from the common origin (also called the reduced distance or R.D.)

The elevation with respect to the mean sea level for U/S gauge line (UGL)

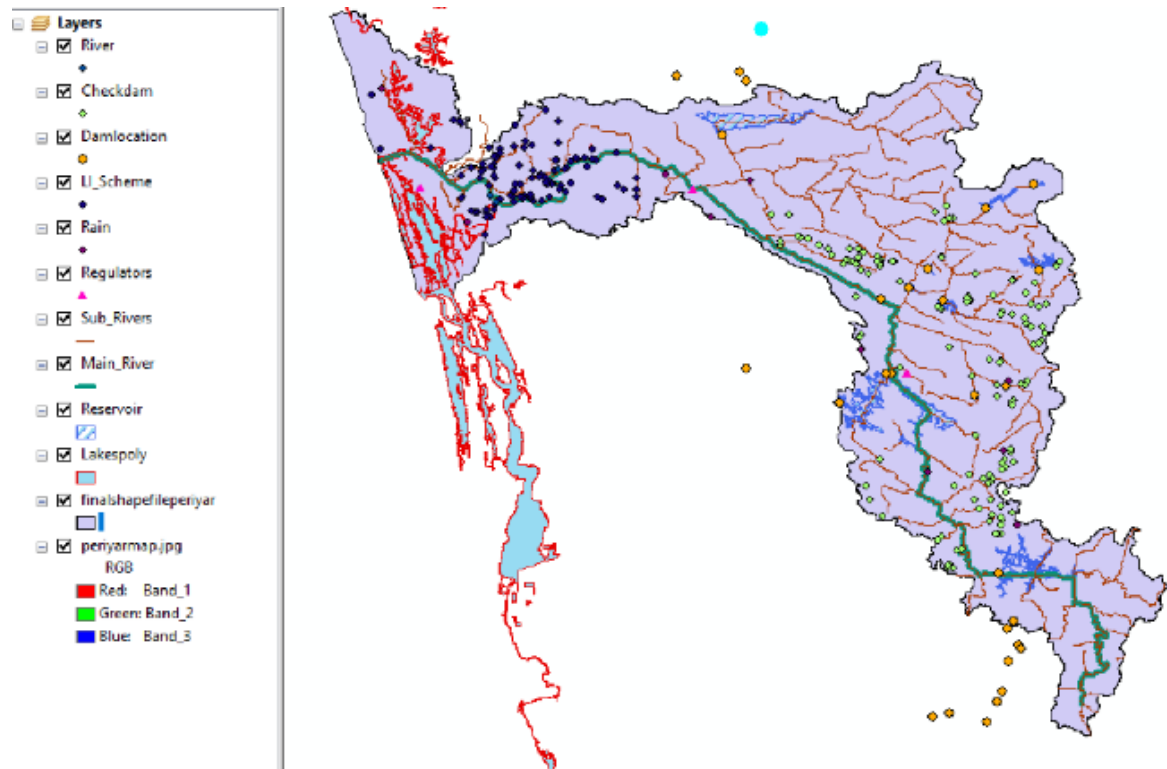
The elevation with respect to the mean sea level for Central gauge line (CGL)

The elevation with respect to the mean sea level for D/S gauge line (DGL)

HYDROLOGIC DATA

CATEGORY VIII

PERIYAR BASIN DATA

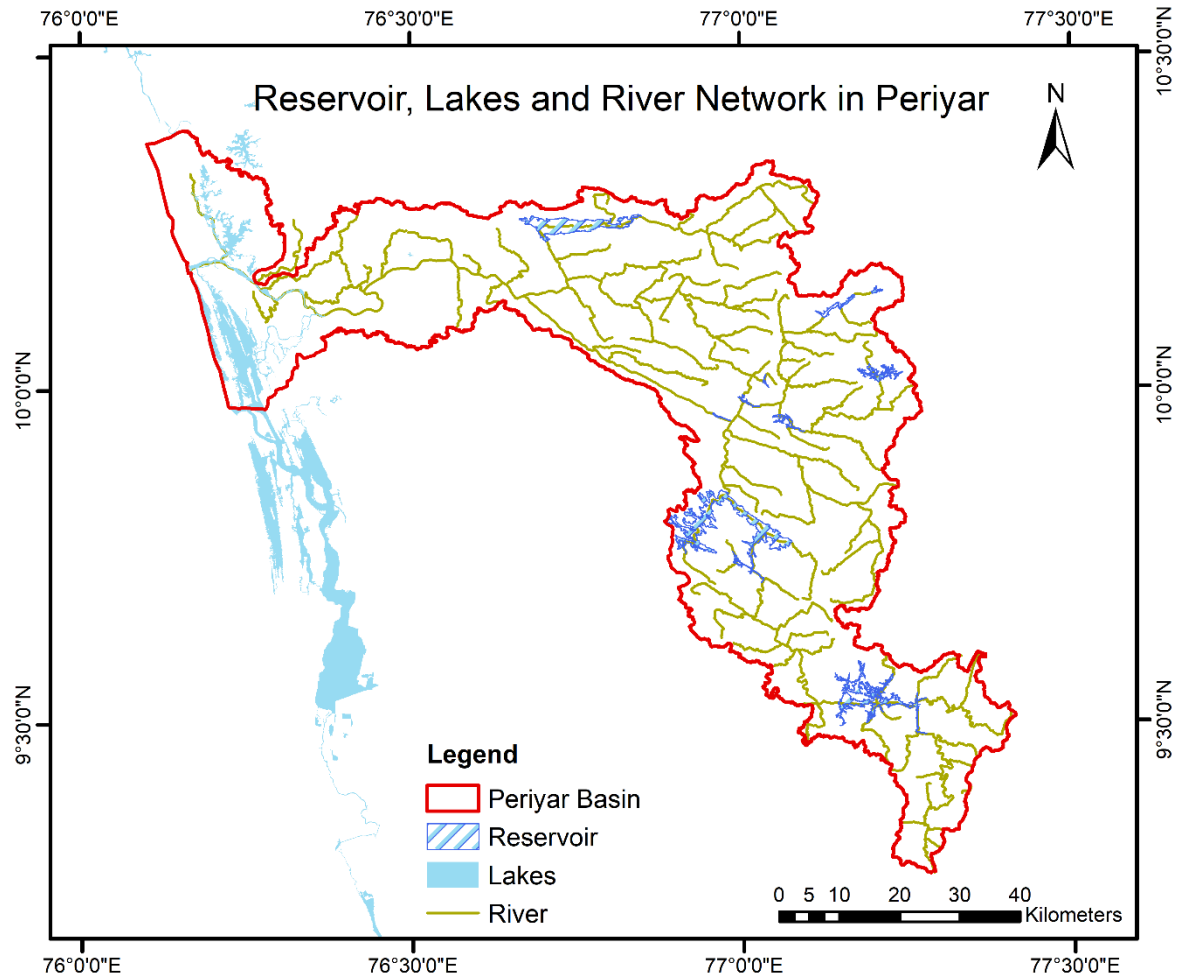


REMARKS

Shapefiles Received from IDRB

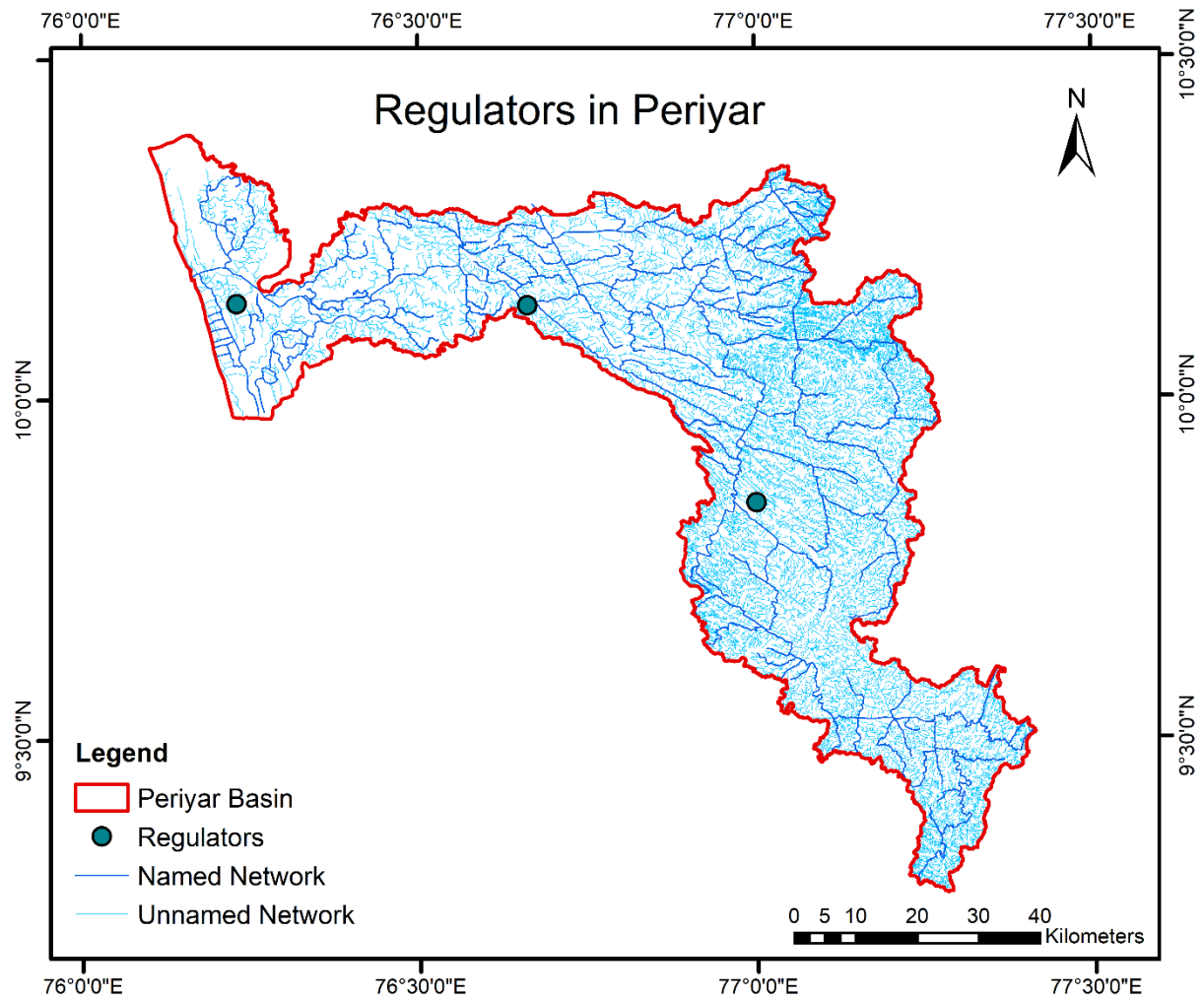
- Rivers Network
- Reservoirs
- Lakes
- Location of Dams
- Check dams
- Regulators
- Rain Gauge Stations
- Lift irrigation schemes

Reservoir, Lakes and River network in Periyar basin



- Shapefiles of Vembanadu lake, kodungalloor lake, Udayamandal Canals and Waterways in Periyar
- Main River and Sub river Network
- 62 Named Rivers in Periyar
- Reservoir shapefiles of Kundala, Mattupetty, Idukki, Idamalayar, Kallarkutty, Anayirangal, Sengulam, Mullaperiyar, Ponmudi and Lowerperiyar (pambla)

Regulators in Periyar



Details of Regulators in Basin

Sl No	Name	Location	District	Latitude	Longitude
1	Cross bar across Mariapuram thodu near Myladoor Padasekharam	Mariyapuram	Idukki	9.846333	77.000361
2	Bhoothathankettu Barrage	Kuttampuzha	Ernakulam	10.1373	76.6617
3	Manjummel Regulator Cum Bridge	Paravoor Municipality	Ernakulam	10.1405	76.2305

HYDROLOGIC DATA**CATEGORY IX****SEDIMENT DATA**

Station & Code	Year	Data
Neeleshwaram- KS000F3 Latitude :10°11'00" Longitude:76°30'00"	1990-2023	Gauge, Discharge, Sediment concentration (coarse, medium, sand-silt, fine and total)
Vandiperiyar- KS000U1 Latitude:09°34'30" Longitude:77°05'30"		none

REMARKS

Sediment particles in water bodies are classified based on their size into categories such as coarse, sand, silt, fine, and medium.
Data provided by CWC

HYDROLOGIC DATA**CATEGORY X****MET DATA**

Station & Code	Year	Type of Data
Neeleshwaram-KS000F3	June 2012 to May 2023	Atmospheric Temperature(°C), Wind Direction, Wind Velocity, Evaporation, Humidity, Rainfall
Vandiperiyar-KS000U1		

Applications of Collected Data

The hydrologic datasets compiled here have diverse applications in Periyar river basin management, modelling, and environmental assessment. Each dataset contributes to specific domains of hydrologic, hydraulic, ecological, and climate-related studies

- **Discharge** (or streamflow) data is used in hydrological modelling to assess the movement of water in rivers, streams, and other water bodies. Gauge-discharge data is often used in hydrologic models (like HEC-HMS, SWAT, or MIKE 11) and hydraulic models (like HEC-RAS) to simulate flow dynamics in rivers and streams. Discharge data is required in flood prediction and management, sediment transport and erosion modelling, climate change and land use impact studies, E-Flow assessment, landslide assessment mapping etc.
- **Rainfall data** is fundamental in hydrologic modelling as it is the primary input to many hydrological processes. It is used in Estimation of runoff, flood forecasting and management, landslide assessment mapping, hydrologic budgets (to establish water balance models) etc.
- **Sediment data** is required for erosion modelling, to understand sediment transport in river basin, water quality studies, preparation of sediment budget etc.
- **Groundwater level data** is crucial in hydrological studies and models as it provides valuable insights into the behaviour of underground water resources. Required in analysis of ground water exploitation status, hydrological and water balance modelling, flood and drought assessment, landslide assessment mapping, climate change impact assessment etc.
- **Evapotranspiration data-** Evapotranspiration represents a major component of the hydrologic cycle. Its applications include, water balance modelling, irrigation planning and agricultural water demand estimation, hydrologic and climate modelling, drought monitoring etc.
- **Water quality data-** Required in physio-chemical and biological studies, hydrologic modelling, hydrologic impact studies, pollution mapping etc.
- **Cross section data-** Hydraulic modelling (e.g., HEC-RAS) for flow depth and velocity estimation, floodplain mapping and inundation modelling, river engineering and infrastructure planning (bridges, culverts, embankments), sediment transport and channel stability studies

Data Gaps

Discharge data for the Periyar river basin was obtained from the Irrigation Design and Research Board (IDRB) for three gauging stations located within the basin. However, a significant portion of the data is incomplete. Approximately 50% of the discharge data is missing for two of the stations, limiting the continuity and reliability of long-term flow analysis. Additionally, for two CWC stations Vandiperiyar and Neeleshwaram (downloaded from IWRIS), nearly 20% of the discharge data are missing for Vandiperiyar.

Evapotranspiration (ET) is a key component of the hydrologic cycle, influencing both water availability and watershed behaviour. However, for the Periyar river basin, evapotranspiration data was available only from the year 2018 onward, limiting the temporal scope of analysis. The lack of long-term ET data hinders comprehensive water balance studies and the evaluation of climate-driven changes in basin-scale evapotranspiration patterns.

Despite being critical component of the hydrologic cycle, infiltration data was not available for the basin. The absence of infiltration data limits accurate assessment of surface water–groundwater interactions and effective rainfall estimation. Infiltration is vital for determining runoff, recharge potential, and soil moisture some of critical inputs for hydrologic modelling, water balance studies, and flood prediction. Without measured rates, the precision of these analyses remains constrained.

Sediment data availability for the Periyar basin is severely limited. Data was available only for Neeleswaram (GDSQ) station across the entire basin. The absence of sediment monitoring data from upstream and midstream locations hinders comprehensive understanding of erosion-prone zones, sediment yield, and deposition patterns. This limitation impacts the accuracy of reservoir siltation studies, river morphology assessments, and sediment-related modelling.

The water quality data received for the Periyar basin spans multiple years; however, there is inconsistency in both the number and spatial distribution of monitoring stations across different years. Only a few stations are consistently present in all datasets, making temporal comparison and trend analysis difficult. This lack of clarity in monitoring locations limits the ability to assess long-term water quality changes at specific sites and affects the reliability of basin-wide water quality assessments. Consistent and spatially representative data collection is essential for effective pollution tracking, source identification, and environmental management.

The assessment of available hydrologic data for the Periyar basin reveals several critical gaps that limit the depth and accuracy of basin-scale analysis.

Summary

The compilation of hydrologic data presented in this report forms a crucial foundation for the scientific assessment and sustainable management of the Periyar basin. In this report, diverse datasets including discharge, rainfall, groundwater levels and quality, surface water parameters, evapotranspiration, sediment, and meteorological variables have been systematically collected, organized, and catalogued. The comprehensive nature of this dataset enables integrated analysis of hydrologic processes and supports key applications such as water balance modelling, flood forecasting, drought assessment, water quality evaluation, sediment transport studies, and climate resilience planning.

While the report provides a valuable dataset for basin-scale studies and modelling, it also reveals significant data gaps particularly in discharge records, sediment data, evapotranspiration time series, and the consistency of water quality stations over time. These limitations underline the need for strengthening long-term monitoring networks and enhancing data availability across spatial and temporal scales. These limitations highlight the urgent need for improving monitoring infrastructure, standardizing data collection protocols, and fostering data-sharing mechanisms across departments such as IDRB, KWA, KSEB, CWC, and KSPCB. Establishing high-frequency monitoring stations equipped with automatic sensors and telemetry systems can greatly enhance the spatial and temporal resolution of future data.

Furthermore, the increasing incidence of extreme climatic events in the Periyar basin, such as the devastating Kerala floods of 2018 and recurring high-intensity rainfall events, underscores the importance of building a resilient, data-driven river basin management framework. Real-time hydrologic data is vital for early warning systems, adaptive reservoir operations, and disaster risk reduction.

Looking ahead, this data catalogue is envisioned as a reference repository to support interdisciplinary research, decision-support systems, river basin modelling, and evidence-based policy formulation. It will aid researchers, water resource planners, environmental regulators, and other stakeholders in making informed decisions that balance ecological integrity, human needs, and climate adaptation within the Periyar river basin.



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