

# "A Systematic Review of the Ecological Significance of Nathsagar Wetland and Challenges in its Ramsar Designation"

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## **Abstract:**

The Nathsagar Wetland, formed by the impoundment of the Godavari River at the Jayakwadi Dam, represents one of the largest and most ecologically vital freshwater ecosystems in the semi-arid Marathwada region of Maharashtra. Despite its designation as the Jayakwadi Bird Sanctuary and its documented role as a critical wintering ground for over 230 species of migratory avifauna, the site has yet to receive international recognition under the Ramsar Convention.

This paper provides a comprehensive review of five years of multi-disciplinary research, spanning from 2021 to 2026, focusing on the wetland's biodiversity, water chemistry, and the socio-political barriers to its conservation. A primary focus of this review is the administrative journey of the Ramsar proposal file initiated by the Maharashtra State Wildlife Department. We analyze the technical justifications provided in the proposal—including the presence of globally threatened species and unique hydrological functions—against the backdrop of persistent "administrative delay" and local anthropogenic stressors such as agricultural encroachment and industrial runoff.

The study concludes that while the biological criteria for a Ramsar Site are indisputably met, the lack of integrated management and delayed administrative processing remain the primary hurdles. This review serves as a call to action for policy-makers to expedite the designation to ensure the long-term sustainability of this "Lifeline of Marathwada."

**Keywords:** Wetland Conservation; Ramsar Convention; Nathsagar Reservoir; Avian Biodiversity; Anthropogenic Stress; Marathwada Hydrology

## **1: Introduction:**

### 1.1 The Hydrological Backbone of Marathwada

The Godavari River, the largest river system in Peninsular India, undergoes a massive transformation at Paithan in the Chhatrapati Sambhajnagar district of Maharashtra. Here, the construction of the Jayakwadi Dam in 1976 created the Nathsagar Reservoir, a sprawling freshwater body with a surface area of approximately 350 km<sup>2</sup>. Originally engineered as a multi-purpose project to alleviate the chronic drought conditions of the Marathwada region, Nathsagar serves as the primary source for irrigation, industrial cooling, and drinking water for a population exceeding 1.5 million. However, over the last five decades, the reservoir has evolved beyond its industrial mandate, inadvertently becoming one of the most significant man-made wetland ecosystems in Central India.

### 1.2 Ecological Evolution: From Reservoir to Sanctuary

The shallow, nutrient-rich margins of Nathsagar, characterized by extensive mudflats and submerged aquatic vegetation, have created a niche habitat for diverse flora and fauna. In 1986, recognizing its burgeoning biodiversity, the Government of Maharashtra declared a portion of the reservoir as the Jayakwadi Bird Sanctuary.

The site serves as a vital node on the Central Asian Flyway (CAF). Annual census data, including the most recent Asian Waterbird Census (2025–2026), consistently record the arrival of over 230 avian species. High-profile migratory visitors such as the Greater Flamingo (*Phoenicopterus roseus*), Northern Shoveler (*Spatula clypeata*), and the Bar-headed Goose (*Anser indicus*) use the Nathsagar wetlands as a critical wintering and foraging ground. As noted by Dr. Dilip Yardi, a leading environmentalist who has studied the site for decades: "The aquatic ecosystem is so rich right now that it attracts around three lakh birds every year... birds come here for roosting, nesting, and basking from Central Asia, Europe, and Siberia."

### 1.3 The Ramsar Ambition: A Five-Year Administrative Odyssey

Despite its clear alignment with international conservation standards, Nathsagar's designation as a Ramsar Site (a Wetland of International Importance) remains an unfulfilled objective. Since 2020, the Maharashtra State Wildlife Department has been actively preparing and refining the proposal file for the Ramsar Secretariat.

This administrative journey has been marked by technical hurdles, including precise boundary demarcation and the reconciliation of "sanctuary" boundaries with "irrigation" land. The delay has drawn sharp criticism from conservationists who point to the rapid designation of smaller sites across India. Kishor Pathak, Honorary Wildlife Warden, emphasizes the necessity of this global tag: "The presence of flamingos in such large numbers... highlights its importance as an ideal wetland. Getting the Ramsar tag would pave the way for scientific methods to protect this rich biodiversity."

The "Ramsar File" represents more than just a title; it is a legal and financial instrument that would mandate the protection of the 56-hectare buffer zone currently threatened by human encroachment.

### 1.4 Emerging Threats and Anthropogenic Stress

As of 2026, the Nathsagar ecosystem faces a "Triple Threat":

1. Siltation: Reducing the live storage capacity and altering the depth of the wetland.
2. Pollution: Inflow of untreated sewage from Chhatrapati Sambhajnagar and chemical runoff from sugarcane belts.
3. Land Use Conflicts: The recent push for floating solar projects and agricultural encroachments.

Environmentalist Yash Netke warns that current developments must be scrutinized under the Wetland (Conservation and Management) Rules, 2017:

"Authorities must comply with the Wetland Rules... which prohibit interventions of a permanent nature in a major wetland like the Jayakwadi dam."

### 1.5 Scope and Objectives of the Review

This paper aims to synthesize the fragmented research conducted on Nathsagar over the last decade. By reviewing hydrological data, avian census reports, and the legislative history of the Ramsar proposal, this study seeks to:

- Validate Nathsagar's standing against the nine Ramsar Criteria.
- Analyze the impact of human-induced stressors on the wetland's health.
- Provide a roadmap for the Wildlife Department to overcome the final administrative hurdles in the "Ramsar File" process.

## 2: Review of Literature:

### 2.1 The Avian Pulse: Decades of Feathered Guests

For local naturalists, the Nathsagar wetland isn't just a "data point"—it's a living lung. Dr. Dilip Yardi (2011, 2022) and Dr. Madhavrao Chitale have long been the human faces of this research. Their longitudinal studies confirm that while the reservoir was built for steel and sugar (industry and agriculture), the birds claimed it for survival.

Recent research by Aman Ghutke (2022) and collaborators from Dr. B.A.M. University has brought a modern lens to this, using the "World Lake Vision" framework. They've documented how the reservoir has become a "Siberian Colony" in the heart of Maharashtra. Unlike the rigid academic papers of the past, these recent studies emphasize that the birds are the best "bio-indicators" we have. If the Flamingos don't show up, something is wrong with the water, not just the weather.

### 2.2 The Chemical Stagnation: What the Water Tells Us

The literature on water quality has shifted from simple "pH testing" to a more concerned tone regarding Eutrophication. Researchers like Rahul Mahamuni (2023) have highlighted a significant management contradiction: the very water that gives life to the crops around Paithan is being returned to the reservoir laced with nitrates and phosphates.

A human reading of these papers reveals a recurring "recurring concern in literature" regarding the Siltation of the dam. Wikipedia and local WRD reports (2025) note that nearly 30-31% of the dam's capacity is now just mud and silt. For a researcher, this isn't just a number; it means the "shallows" where birds feed are disappearing, turning into hard land that invites human encroachment.

### 2.3 The "Ramsar" Paper Trail: An Administrative Ghost

If you look through the forest department archives from 2020 to 2026, there is a specific kind of literature—the "Proposal File." It's a collection of maps, bird counts, and justifications that have been sitting on desks for over five years.

Sunil Limaye (2022) and other wildlife officials have documented the technical "why" of the Ramsar status, but the review of this literature shows a gap between Science and Will. While sites like Lonar or Thane Creek moved fast, the Nathsagar file appears to be a "Review of Delays." Scholars like Sharma and Yadav (2021) have pointed out that the "policy gap" in Indian wetland conservation often leaves sites like Jayakwadi in a legal grey zone—protected on paper as a sanctuary, but neglected in terms of international funding.

### 2.4 Anthropogenic Pressure: The Human Footprint

The most recent "grey literature" (webinars, local reports, and 2025 impact studies) focuses on the Triple Threat:

- The 56-Hectare Encroachment: Academic surveys by local sociology and environmental departments show that as the water recedes, farmers move in. It's a human struggle for land that creates a "declining habitat conditions" for the birds.
- The Solar Debate: 2025 saw a surge in "Impact Assessment" literature regarding floating solar panels on Nathsagar. Researchers like Yash Netke argue that this isn't just "green energy"—it's a permanent change to a migratory flyway.
- Urban Sewage: Studies on the North-East fringes of the reservoir show that the growth of Chhatrapati Sambhajanagar is directly reflected in the high BOD (Biochemical Oxygen Demand) levels of the reservoir's inlet.

"The following table synthesizes the environmental stressors identified in recent academic and governmental surveys." Table No. 2.1 Monitoring the "Triple Threat": Environmental Status (2020–2026).

Factor	Observed Impact	Researcher Reference	Status
Siltation	~11% loss in live storage capacity	CWC (2020/25)	 Critical
Eutrophication	High Nitrate/Phosphate from runoff	Mahamuni (2023)	 Warning
Encroachment	56 hectares of buffer zone utilized	News Archives (2025)	 Critical
Sewage Inflow	High BOD levels at urban inlets	Aware (2025)	 Moderate

### 3: Methodology:

The review followed a structured systematic review framework adapted from PRISMA guidelines for environmental synthesis studies.

This study employs a Mixed-Method Systematic Review approach, integrating quantitative environmental data with a qualitative analysis of administrative policy. The methodology is designed to evaluate Nathsagar’s eligibility for Ramsar status while identifying the bottlenecks in the designation process.

#### 3.1 Data Collection Sources

To ensure a comprehensive review, data was synthesized from four primary streams:

- Peer-Reviewed Literature: Academic databases (ResearchGate, Semantic Scholar, Google Scholar) were searched for keywords including "Jayakwadi Water Quality," "Nathsagar Biodiversity," and "Godavari Basin Hydrology" from 2015 to 2026.
- Government & Grey Literature: Official reports from the Maharashtra State Wildlife Department, Central Water Commission (CWC) sedimentation surveys, and Asian Waterbird Census (AWC) annual counts.
- Geospatial Data: Analysis of remote sensing imagery (Sentinel-2 and Landsat-8) to track changes in water spread areas and encroachment on the 56-hectare buffer zone.
- Narrative Tracking: Review of local news archives and official statements to reconstruct the timeline of the "Ramsar File" from its inception to its current 2026 status.

#### 3.2 Evaluation Parameters

The research evaluates the wetland’s health based on three critical pillars:

##### A. Physicochemical Analysis (The "Pulse" of the Water)

We analyzed documented trends in the following parameters to assess habitat suitability:

- Nutrient Loading: Nitrate (NO<sub>3</sub>) and Phosphate (PO<sub>4</sub>) levels to measure agricultural runoff.
- Organic Stress: Biological Oxygen Demand (BOD) and Dissolved Oxygen (DO) to evaluate urban sewage impact.
- Siltation Indices: Reviewing CWC data on the loss of live storage capacity due to sedimentation.

### B. Avian Diversity (The Biological "Indicators")

Using the AWC methodology, the study reviews:

- Species Richness: Total number of recorded migratory and resident species.
- Population Thresholds: Specifically checking if any species meets the Ramsar 1% Criterion (supporting 1% of a species' global/regional population).

### C. Ramsar Eligibility Mapping

The core of the methodology involves mapping the collected data against the Nine Ramsar Criteria.

Example: If census data shows >20,000 waterbirds, the site fulfills Criterion 5.

### 3.3 Administrative Process Analysis

We conducted a Process Trace Analysis of the Ramsar proposal file. This involved:

- Identifying the specific stages of the proposal (State Level Approval → National Wetland Committee → Ramsar Secretariat).
- Documenting "Stop-Points" where the file was returned for technical queries (e.g., boundary disputes between Irrigation and Forest departments).

### 3.4 Spatial Analysis (GIS Framework)

The study utilizes the Normalized Difference Water Index (NDWI) to delineate the wetland's boundaries. By overlaying land-use maps from 2015 and 2025, we quantified the rate of "buffer zone shrinkage" caused by human intervention.

## 4: Results and Discussion:

### 4.1 Fulfillment of Ramsar Criteria (The Scientific Verdict)

"Nathsagar's eligibility is not merely anecdotal; it is substantiated by global standards as shown in Table 4.1."

Ramsar Criterion	Requirement	Nathsagar Evidence	Requirement Met?
Criterion 4	Supports species at critical life stages	Key wintering ground for CAF birds	Yes
Criterion 5	Regularly supports >20,000	Consistent counts of >1.5	Yes

	birds	lakh	
Criterion 6	Supports 1% of a species population	>1% of Greater Flamingo population	Yes
Criterion 9	Supports 1% of non-avian animal species	Rich diversity of endemic fish species	Potential

Table No. 4.1 Ramsar Criteria Fulfilment Checklist

Our review of the Asian Waterbird Census (2020–2026) and hydrological surveys confirms that Nathsgar is not just a local reservoir; it is a global asset. The data shows that the site comfortably meets at least four of the nine Ramsar criteria:

- Criterion 5 (>20,000 Waterbirds): Nathsgar consistently supports between 1.5 to 3 lakh birds annually.
- Criterion 6 (1% Population): It supports over 1% of the biogeographic population of the Greater Flamingo and Bar-headed Goose.
- Criterion 4 (Critical Life Stages): It serves as a vital refuge during the peak winter months for the Central Asian Flyway.

#### 4.2 The "Sinking" Reservoir: Siltation and Storage

The results of the Central Water Commission (2025) and remote sensing studies (Sentinel-2) reveal a grim reality. The reservoir has lost approximately 10.5% to 11% of its gross capacity to siltation since 1976.

"The different storage zones of the Jayakwadi reservoir are silting up rapidly... reduced live storage is expected to be available around 100 MCM by the year 2060-70 if current rates persist." (Source: IJSART Research, 2020/updated 2025)

#### 4.3 Anthropogenic Stressors: The Solar and Sewage Debate

The discussion must address the most recent conflict of 2025-2026: the proposed Floating Solar Power Project. While the state pushes for "Green Energy," researchers and local advocates see it as a "potential ecological risk." As Yash Netke, an environmentalist recently noted in his plea to the irrigation department:

"Authorities must comply with the Wetland Rules 2017, which prohibit interventions of a permanent nature... it is premature to go ahead with the floating solar project until the judicial verdict on wetland protection is out."

Furthermore, the Water Quality Index (WQI) consistently drops to "Poor" or "Unfit" near the urban inlets. This isn't just a chemical change; it's a sensory one for the people of Paithan who witness the "blackening" of the edges of their holy Nathsgar.

#### 4.4 The "Ramsar File" Paradox

The most striking result of this review is the Administrative Gap. While other sites like Lonar Lake were fast-tracked, the Nathsgar proposal has been "under consideration" for over five years. Kishor Pathak, Honorary Wildlife Warden,

captures the sentiment of the local scientific community perfectly: "While administrative delay by the local authorities is already taking a toll on the flora and fauna... the state-level authorities are also snubbing the Jayakwadi sanctuary by ignoring it for the Ramsar tag."

"When compared to other designated sites in the region, the scale of Nathsagar biodiversity is significantly higher, highlighting a clear administrative disparity."

Parameter	Nathsagar (Proposed)	Nandur Madhmeshwar	Lonar Lake
Total Area	~35,000 Hectares	~600 Hectares	~427 Hectares
Avg. Bird Count	1,50,000 – 3,00,000	30,000 – 40,000	20,000 – 30,000
Key Species	Greater Flamingo, Bar-headed Goose	Cranes, Raptors	Migratory Ducks
Status	Pending (5+ years)	Designated (2020)	Designated (2020)
Primary Stressor	Siltation & Encroachment	Tourism	Salinity Changes

Table No. 4.2 Comparative Analysis: Nathsagar vs. Existing Ramsar Sites.

## 5: Conclusion and Suggestions:

### 5.1 Conclusion: The Price of Procrastination

The Nathsagar wetland stands at a paradoxical crossroads in 2026. While it remains a thriving ecological sanctuary, hosting over 230 species of birds and acting as a vital carbon sink, its official status is trapped in a extended administrative delay. This review concludes that Nathsagar has met the Ramsar Criteria—specifically Criteria 4, 5, and 6—for over twenty years.

The primary threat to Nathsagar is not a lack of biodiversity, but "administrative delay." As summarized by Kishor Pathak: "While administrative delay by the local authorities is already taking a toll... the state-level authorities are also snubbing the Jayakwadi sanctuary by ignoring it for the Ramsar tag."

If the Ramsar designation is not secured by 2027, the increasing pressures of siltation (now exceeding 11% of total capacity), urban sewage inflow, and the encroachment on the 56-hectare buffer zone may cause an irreversible collapse of the very habitat that draws migratory guests from across the globe.

### 5.2 Suggestions: A Roadmap to 2027

To bridge the gap between "Sanctuary" and "Ramsar Site," the following measures are proposed:

### 1. Expedite the "Ramsar File"

The Maharashtra State Wildlife Department must establish a Special Task Force to resolve the boundary disputes between the Irrigation Department and Forest Department. The proposal should be refiled with the MoEFCC immediately, using the 2025-2026 Asian Waterbird Census data as a fresh justification.

### 2. Implement "Wise Use" Management

Under the Ramsar Convention's "Wise Use" principle, the state should:

- Prohibit Permanent Interventions: Halt proposals for floating solar projects until a comprehensive Environmental Impact Assessment (EIA) specific to migratory paths is completed.
- Establish Riparian Buffers: Restore the 56-hectare encroached area with native vegetation to act as a natural filter for agricultural runoff.

### 3. Integrated Pollution Control

Chhatrapati Sambhajnagar Municipal Corporation must prioritize the completion of Sewage Treatment Plants (STPs) at all inlet points. As researchers have noted, the "blackening" of the reservoir edges is a direct threat to the bottom-feeding avian species.

### 4. Real-Time Monitoring

Establish a Digital Observatory at Nathsagar using GIS and IoT sensors to monitor water quality (DO, BOD, Nitrates) and siltation levels in real-time. This "Smart Wetland" approach will provide the data-backed evidence needed to sustain its international status.

### 5. Community-Led Conservation

Transition from a "top-down" sanctuary model to a "community-led" one. Training local youth from Paithan as professional bird guides and conservationists will create a socio-economic shield around the wetland.

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