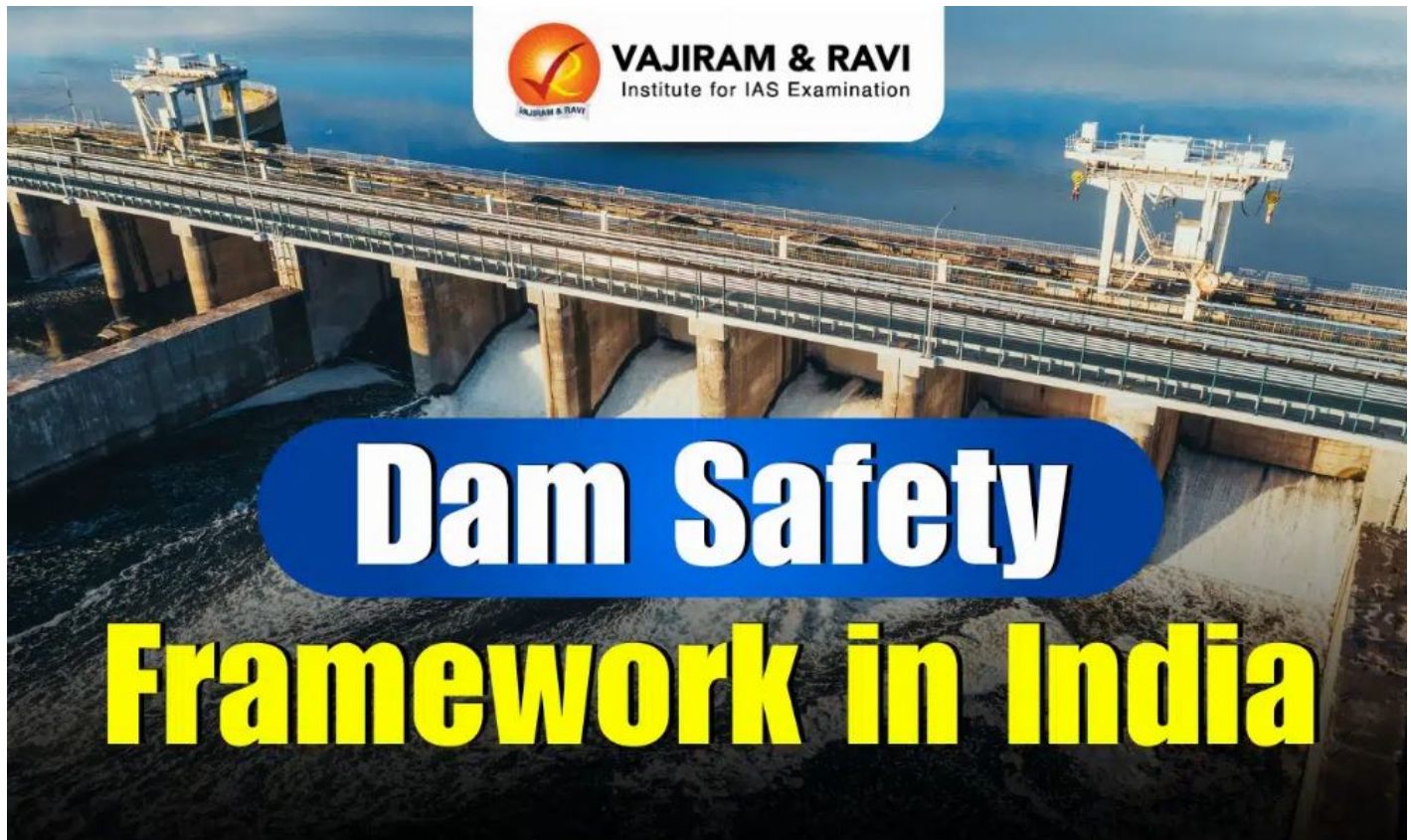


Dam Safety Framework in India, Status, Act, Challenges

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Dams are important for irrigation, hydropower generation, drinking water supply and flood control in India. They play a major role in supporting agriculture, water security and economic development.

However, **many dams in India are becoming old, while climate change and extreme rainfall events are increasing safety risks. To address these challenges, the government is strengthening the Dam Safety Framework in India** through the Dam Rehabilitation and Improvement Project (DIRP), the Dam Safety Act, 2021 and technology-driven monitoring systems. These measures aim to improve dam safety, rehabilitation and long-term resilience.

Status of Dams in India

India has the world's third-largest dam network after the United States and China.

- The country currently has **6,628 specified dams, of which 6,545 are operational** while 83 are under construction.
- Together, these dams possess a gross water **storage capacity of nearly 330 billion cubic metres.**

- **Most dams in India are owned by state governments.** Around 98.5 per cent of dams, or nearly 6,448 dams, belong to state governments.
- Public Sector Undertakings own 49 dams, while private entities own 36 dams.
- **Maharashtra** possesses the **highest number of specified dams in the country**, followed by Madhya Pradesh, Gujarat, Chhattisgarh, Rajasthan, Karnataka and Odisha.
- **India's oldest functioning dam**, the historic **Kallanai, also known as the Grand Anicut**, has remained operational for nearly 2,000 years.

Ageing Dam Infrastructure

A large number of dams in India are becoming old:

- **Around 1,681 dams are more than 50 years old**, including 291 dams that are over 100 years old.
- In addition, **nearly 42 per cent of dams fall in the 25-50 year age group.**
- The ageing of dams has increased concerns related to structural deterioration, spillway inefficiency, sedimentation and disaster risks.
- **Climate change has further intensified the problem** by increasing the frequency of extreme rainfall events and hydrological variability.
- A study conducted by the **Central Water Commission** on 439 reservoirs found that **reservoirs have lost nearly 19 per cent of their gross storage capacity because of sedimentation.**
- The **average annual storage loss has been estimated at around 0.74 per cent.** These developments have made systematic dam rehabilitation and scientific safety management increasingly important.

Dam Rehabilitation and Improvement Project (DRIP)

To strengthen ageing dam infrastructure, the Government of India launched the **Dam Rehabilitation and Improvement Project.**

- It is one of the **world's largest dam rehabilitation programmes** and reflects India's shift towards a systematic and risk-based approach to dam safety management.
- The programme **focuses on improving the safety and operational performance of dams** through **structural repairs, spillway modernisation, installation of monitoring systems and institutional strengthening.**

DRIP Phase I (2012-2021)

- The **first phase of the Dam Rehabilitation and Improvement Project was launched in 2012** with support from the **World Bank.**
- The programme **covered 223 dams across seven states** namely Jharkhand, Karnataka, Kerala, Madhya Pradesh, Odisha, Tamil Nadu and Uttarakhand.
- **Design flood reviews, dam health inspections and rehabilitation planning** were completed for all 223 dams. **Rehabilitation works** were awarded for 144 dams.
- The programme also **focused on preparing Emergency Action Plans, strengthening technical expertise and improving maintenance practices.**

- An important achievement of the first phase was the **introduction of the Dam Health and Rehabilitation Monitoring Application**, which is a digital platform for inspection management, maintenance tracking and data-driven monitoring.
- The programme significantly **improved dam safety practices and institutional capacity**.

DRIP Phase II and III

- The second and third phases of the programme became operational in **October 2021**.
- Together, they **cover 736 dams across 19 states and three central agencies**, namely the Central Water Commission, the Bhakra Beas Management Board and the Damodar Valley Corporation.
- The total financial outlay of the programme is ₹10,211 crore.
- It is jointly financed by the World Bank and the **Asian Infrastructure Investment Bank**.
- Around ₹7,000 crore is financed through external loans while participating states and agencies contribute ₹3,211 crore.
- **Major dams undergoing rehabilitation under the programme include** the Bhakra Dam, Ranjit Sagar Dam, Nagarjuna Sagar Dam, Gandhi Sagar Dam and several others across the country.
- As of March 2025, rehabilitation proposals for 191 dams worth more than ₹5,053 crore had been approved. Major rehabilitation work had already been completed at 43 dams.
- The second and third phases **focus on rehabilitation of dams and associated structures, institutional strengthening, revenue generation for sustainable maintenance and effective project management**.

Dam Safety Act, 2021

A major institutional reform in India's dam safety governance came with the enactment of the **Dam Safety Act, 2021, which came into force on 30 December 2021**.

- The Act **provides a comprehensive legal framework for surveillance, inspection, operation and maintenance of specified dams across the country**.
- The **Act defines a specified dam as a dam above 15 metres in height or a dam between 10 and 15 metres** fulfilling prescribed technical conditions.
- The legislation transformed dam safety from an advisory mechanism into a legally enforceable framework with clearly defined obligations and timelines.
- The Act **created a four-tier institutional structure** comprising the National Committee on Dam Safety, the National Dam Safety Authority, State Committees on Dam Safety and State Dam Safety Organisations.
- The **National Committee on Dam Safety** acts as the apex policy-making body responsible for formulating dam safety standards and recommending regulations. Since its constitution in February 2022, it has played an important role in strengthening the regulatory framework for dam safety.
- The **National Dam Safety Authority** functions as the implementing and regulatory body responsible for ensuring compliance with national standards and policies.
- At the state level, all 31 dam-owning states have established **State Dam Safety Organisations** responsible for inspections, monitoring, surveillance and compliance.

- The Act mandates several safety measures including **regular inspections, instrumentation systems, inflow forecasting, risk assessment studies, Emergency Action Plans, integrated reservoir operations and early warning systems.**
- It also requires dam owners to allocate adequate funds for maintenance and repairs.
- The legislation also includes provisions related to offences and penalties. **Any obstruction or refusal to comply with directions issued under the Act can result in imprisonment, fines or both.**
- If **negligence leads to loss of lives or creates imminent danger, punishment may extend to two years of imprisonment.**

Digital Monitoring and Technological Reforms

Technology has become a central pillar of India's evolving dam safety framework.

- The **Dam Health and Rehabilitation Monitoring Application** now hosts data related to all 6,628 specified dams in the country. It enables *digital inspection records, maintenance tracking and safety assessments.*
- Authorities conduct nearly 13,000 dam inspections annually, and the records are maintained digitally through the platform.
- **Rapid Risk Screening exercises using web-based assessment tools** have been completed for 5,553 dams **to identify vulnerabilities and prioritise rehabilitation.**
- The government is also strengthening **hydro-meteorological stations, seismological stations, instrumentation systems and early warning mechanisms for real-time monitoring and disaster preparedness.**
- **20 regulations under the Dam Safety Act** have already been published in the Official Gazette to standardise dam safety practices across the country.

Capacity Building and Research

India is also investing in **technical expertise and scientific research** to improve dam resilience and risk management.

- The **National Centre for Earthquake Safety of Dams** is being established at the Malaviya National Institute of Technology Jaipur.
- **Specialised Centres of Excellence on dam safety** are being developed at the Indian Institute of Technology Roorkee and the Indian Institute of Science Bengaluru.

These institutions focus on seismic hazard mapping, reservoir sedimentation studies, advanced rehabilitation technologies, material testing and comprehensive risk assessment.

- In addition, **Master of Technology programmes on dam safety** have been introduced at the Indian Institute of Technology Roorkee and the Indian Institute of Science Bengaluru since the academic session 2021-22.

Responsibilities of Dam Owners

The **Dam Safety Act** places **significant responsibilities on dam owners**, including central governments, state governments, public sector undertakings, private companies and local authorities.

- Dam owners are required to establish dedicated dam safety units, conduct pre-monsoon and post-monsoon inspections, prepare Emergency Action Plans, allocate maintenance funds and undertake periodic safety evaluations.
- The Act also mandates installation of instrumentation systems, establishment of hydro-meteorological stations and implementation of early warning systems.
- Under the inspection framework introduced in April 2024, dams are classified into three categories based on their risk levels.
 - Category I dams indicate critical deficiencies requiring urgent intervention.
 - Category II includes dams with major deficiencies requiring prompt corrective action.
 - Category III covers dams with minor or no deficiencies.

According to post-monsoon inspections conducted in 2025, three dams were categorised under Category I and 188 dams under Category II.

Challenges in India's Dam Safety Framework

Despite major reforms, several challenges continue to affect dam safety in India.

- A large number of dams were constructed several decades ago using **engineering standards that may not adequately address present-day climatic and hydrological conditions**.
- **Climate change** is increasing the frequency of extreme rainfall events, thereby placing additional stress on ageing infrastructure.
- **Sedimentation continues** to reduce reservoir capacity and affects irrigation as well as hydropower generation.
- **Financial constraints** also create difficulties for states in undertaking large-scale rehabilitation work.
- **Institutional coordination** among multiple agencies **remains another challenge**.
- In several regions, **disaster preparedness mechanisms and community awareness regarding dam-related risks are still inadequate**.

Way Forward

India must adopt a lifecycle-based approach towards dam management with greater emphasis on resilience, safety and sustainability.

- **Structural audits and scientific risk assessments** should be conducted regularly.
- **Real-time monitoring systems, artificial intelligence, remote sensing and Geographic Information Systems** should be integrated into dam management practices.
- There is also a need to **strengthen coordination among states**, improve evacuation planning and enhance public awareness regarding disaster preparedness.
- **Capacity building and advanced research** in seismic safety, reservoir sedimentation and rehabilitation technologies must continue to receive policy attention.

These reforms can significantly improve infrastructure resilience, reduce disaster risks and ensure the long-term sustainability of critical water resources that support agriculture, industry and urban development across the country.

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