ASIAN INFRASTRUCTURE INVESTMENT BANK

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Project Document
of the Asian Infrastructure Investment Bank

Sovereign-backed Financings

Republic of India
Second Dam Rehabilitation and Improvement Project

Currency Equivalents
(As at February 14, 2022)

Currency Unit – Indian Rupee (INR)
INR1.00 = USD0.0133
USD1.00 = INR75.1288

Borrower's Fiscal year
April 1 to March 31

Abbreviations

CAG	Comptroller and Auditor General
CDSO	Central Dam Safety Organization
CERC	Contingent Emergency Response Component
COVID-19	Coronavirus Disease 2019
CPMU	Central Project Management Unit
CWC	Central Water Commission
DHARMA	Dam Health and Rehabilitation Monitoring Application
DRIP-1	Dam Rehabilitation and Improvement Project
DRIP-2	Second Dam Rehabilitation and Improvement Project
DSO	Dam Safety Organization
DSRP	Dam Safety Review Panel
EAP	Emergency Action Plan
EIRR	Economic Internal Rate of Return
EMC	Engineering and Management Consultant
ES	Environmental and Social
ESCP	Environmental and Social Commitment Plan
ESDD	Environmental and Social Due Diligence
ESF	IBRD's Environmental and Social Framework
ESIA	Environmental and Social Impact Assessment
ESMF	Environmental and Social Management Framework
ESMP	Environmental and Social Management Plan
ESP	AIIB's Environmental and Social Policy
FEF	Front-end Fee
FM	Financial Management
FY	Fiscal Year
GBV	Gender-based Violence
GDP	Gross Domestic Product
GOI	Government of India
GPN	Good Practice Note
IBRD	International Bank for Reconstruction and Development
IPF	Investment Project Financing
IUFR	Interim Unaudited Financial Report
KSEB	Kerala State Electricity Board

M&E	Monitoring and Evaluation
MePGCL	Meghalaya Power Corporation Limited
MIS	Management Information System
MJS	Ministry of Jal Shakti
NPV	Net Present Value
O&M	Operation and Maintenance
PIE	Project Implementing Entity
PMU	Project Management Unit
PPSD	Project Procurement Strategy for Development
PST	Project Screening Template
RACF	Risk Assessment and Classification Framework
RAP	Resettlement Action Plan
SEA/SH	Sexual Exploitation and Abuse / Sexual Harassment
SEF	Stakeholder Engagement Framework
SEP	Stakeholder Engagement Plan
TANGEDCO	Tamil Nadu Generation and Distribution Corporation Limited
TOR	Terms of Reference
WB	World Bank
WRD	Water Resources Department

Contents

1.Summary Sheet

Project No.	P000449
Project Name	Second Dam Rehabilitation and Improvement Project
AIIB Member	Republic of India
Borrower	Republic of India
Project Implementation Entity	State of Gujarat State of Kerala Kerala State Electricity Board State of Madhya Pradesh State of Manipur State of Chhattisgarh State of Tamil Nadu State of Rajasthan State of Meghalaya Meghalaya Power Generation Corporation Limited Tamil Nadu Generation and Distribution Corporation Limited State of Odisha State of Maharashtra
Sector Subsector	Water Water Resources Management
Alignment with AIIB's thematic priorities	Green infrastructure; Technology-enabled infrastructure
Project Objective	The Project Objectives are to increase the safety of selected dams in participating States and to strengthen dam safety management in India
Project Description	The project focuses on (i) upgrading and modernizing dam operation and maintenance, with accompanying institutional strengthening for safe and financially sustainable dam operations; and (ii) physical and technical dam rehabilitation and improvement. The project will comprise five components: - Component 1: Rehabilitation and management planning for dams and associated appurtenances - Component 2: Dam safety institutional strengthening - Component 3: Risk-informed asset management and innovative financing for sustainable operation and maintenance of dams - Component 4: Project management - Component 5: Contingent emergency response
Implementation Period	Start Date: May 1, 2022 End Date: June 30, 2027
Expected Loan Closing Date	December 31, 2027
Cost and Financing Plan	Project cost: USD713.412 million

	Financing Plan: AIIB loan: USD250 million World Bank (IBRD) loan: USD250 million Counterpart funding: USD213.412 million
Size and Terms of AIIB Loan	USD250 million. The loan will have a final maturity of 15 years, including a grace period of 5 years, and will be made on standard Variable Spread Loan terms for sovereign-backed loans, with the corresponding average maturity.
Cofinancing (Size and Terms)	IBRD: USD250 million.
Environmental and Social Category	WB Category High Risk (equivalent to Category A if AIIB's ESP were applicable).
Risk (Low/Medium/High)	High
Conditions of Effectiveness	(i) Effectiveness of the Project Co-Lenders' Agreement between IBRD and AIIB.
Key Covenants/Conditions for Disbursement	Key Covenants: (i) Project Implementing Entities to establish Dam Safety Review Panels acceptable to AIIB; (ii) Within 3 months of effectiveness, the Borrower and Project Implementing Entities to prepare and adopt a Project Implementation Manual acceptable to AIIB. Conditions for Disbursement: (i) No withdrawal to be made for emergency expenditures under Component 5, unless an Eligible Crisis or Emergency (as defined in the Loan Agreement) has occurred, and IBRD's disbursement criteria have been met.
Retroactive Financing (Loan % and dates)	Up to USD50 million (20% of the loan amount). Retroactive Financing Date is 24 months prior to signing date.
Policy Assurance	The Vice President, Policy and Strategy, confirms an overall assurance that AIIB is in compliance with the policies applicable to the Project.
Economic Capital (Ecap) Consumption	USD16.27 million (8.20%)

President	Jin Liqun
Vice President	Urjit Patel
Director General	Rajat Misra
Team Leader	David Ginting, Investment Operations Specialist – Water
Team Members	Gerardo Pio Parco, Senior Environmental Specialist Susrutha Goonasekera, Senior Social Development Specialist Bernadette Ndeda, Procurement Specialist Shodi Nazarov, Financial Management Associate Christopher Damandl, Senior Counsel

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2. Project Description

A. Project Overview

1. **Project Objective** is to increase the safety of selected dams in participating States and to strengthen dam safety management in India.

2. **Project Description.** The project focuses on (a) upgrading and modernizing dam operation and maintenance, with accompanying institutional strengthening for safe and financially sustainable dam operations; and (b) physical and technical dam rehabilitation and improvement. The project will comprise five components: (1) Rehabilitation and management planning for dams and associated appurtenances; (2) Dam safety institutional strengthening; (3) Risk-informed asset management and innovative financing for sustainable operation and maintenance of dams; (4) Project management; and (5) Contingent emergency response.

3. **Expected Results** include:

   (i) Project dams with a satisfactory post-intervention inspection by a third party Quality Assurance and Quality Control Team.

   (ii) Project dams with an Emergency Action Plan (EAP) prepared in consultation with communities and disseminated.

   (iii) Project States with full score in Institutional Modernization Index.[1]

4. **Expected Beneficiaries.** The primary beneficiaries are the communities living in dam breach flooded areas and those depending on water, irrigation, and electricity services provided by the dams that could be compromised by poor dam performance or failure. In addition to saving lives, improved dam safety will avoid potential flood damage to houses, farm areas, infrastructure (roads, bridges, other public and private infrastructures), and industrial and commercial facilities. Improved dam safety will also reduce the likelihood of service interruptions due to dam failure and enhance dam service provision, overall efficiency, and storage capacity, including during droughts. Implementing agencies will benefit from dam safety capacity building.

5. **Climate benefits: mitigation and adaptation.** The project will generate both climate adaptation and mitigation benefits. In terms of climate adaptation, the project will improve dam safety against flooding events, which are expected to intensify by climate change, and improve the availability of water against drought and water stresses, which are also expected to increase by the rise of temperature and irregular extreme weathers. In terms of climate mitigation, the project will lead to emission savings by safeguarding hydropower generation capacity. USD187.5 million of AIIB financing has been classified as climate finance (USD125 million of adaptation finance and USD62.5 million of mitigation finance, corresponding to 50 percent and 25 percent of AIIB's financing for the Project, respectively). Further details on the climate benefits, related climate risks, and calculation of climate finance are presented in Annex 6.

[1] Index's definition and its monitoring indicator are presented in Annex 1.

B. Rationale

6. **Strategic fit for AIIB**. The project is aligned with the AIIB's Thematic Priority of Green Infrastructure and Technology-enabled Infrastructure, while also fitting within the Guiding Principles of the AIIB's Water Sector Strategy, namely Promoting Sustainable Infrastructure and Adopting Innovative Technology. As it will rehabilitate dams and their associated appurtenances, and strengthen and modernize their management, the project will extend the infrastructures' lifetime, improve their operational performance and capacity against extreme weather, enhance management efficiency with the adoption of technology and, thus, enhance the infrastructures' climate resilience and sustainability.

7. **Value addition by AIIB**. AIIB's participation mobilizes financial resources to address the investment gap in a project that is vital for the country's socioeconomic growth and efforts to manage the Covid-19 outbreak. Leveraging AIIB's infrastructure technology knowledge and network, the project team will support in identifying, selecting, and obtaining suitable technology for the improvement of dam safety management. Further, AIIB's safeguards specialists will be actively supporting the preparation of Environmental and Social Due Diligence (ESDD) and will conduct the required field verification of dam safety plans in four to five selected dams. Lastly, the project team will bring lessons learnt from a comparable and ongoing dam safety project in Indonesia (Dam Safety and Operational Improvement Project or DOISP-2). These will contribute to further improving asset management, operation and maintenance, knowledge building, and financing efficiency of dam safety in India.

8. **Value addition to AIIB**. The co-financing of the project with the IBRD will further demonstrate that AIIB is a reliable and strong partner, while simultaneously increasing the capacity of Bank staff through sharing expertise and experience in dam safety. Also, the project will strategically position AIIB for potential succeeding projects in India or replication in other Bank members' territories. The need for improving safety and operational performance of dams is global and substantial, and will further increase with climate change, population growth and economic development. In India, discussions on a succeeding project (DRIP-3) have been commenced.

9. **Lessons learnt from previous projects.** The implementation of Dam Rehabilitation and Improvement Project (DRIP-1) and DOISP-2 offer important lessons that have been integrated into the project's design. Both projects above suffered from considerable delayed progress in their early implementation phase. For DOISP-2, this was reflected in the low disbursement rate (less than 20 percent in the first three years of implementation); while for DRIP-1, the slow progress has been one of the main drivers for the project's partial cancellation in 2014 (despite the project being later redeemed by an accelerated implementation, and further compensated by Additional Financing of DRIP-1 in 2019). The main causes to this delay, that were shared by both projects, include the limited implementation capacity of Project Implementing Entities (PIEs)/unfamiliarity of the PIEs on dam safety works, underestimation of the time required to prepare and review technical documents, and the sheer unexpected size and complexity of the project.

10. The PIEs have benefited from these lessons. Their capacity and proficiency in dam safety work and related enabling arrangements have significantly improved since DRIP-1. They are now much better shaped to implement DRIP-2. To further strengthen the implementation capacity of

the PIEs, an Engineering and Management Consultant (EMC) will be hired, while the current EMC of DRIP-1 will remain to play its role until a new EMC for DRIP-2 is onboard. Further, the PIEs are now substantially better equipped as DRIP-1 inherits an established, fine-tuned, and currently-operating system of preparation, review, and approval of technical documents. While related to implementation readiness, civil works worth at least 30 percent of AIIB and the IBRD's loan amount were ready for awarding by their respective loan negotiations; as required by the Indian Department of Economic Affairs (DEA) to be a condition for loan negotiation. These will be central to jumpstart the implementation, maintain the progress rate throughout the implementation period, and avoid lag in the early implementation period as experienced in the preceding projects.

11. Lastly, it has also been learned that sustainable dam safety must be supported by a strong institutional setup in addition to physical interventions. This was initially a challenge for DRIP-1 due to the tendency for dam owners to focus on purely structural measures. Dam Safety Organizations (DSOs), with the strong support of the Central Water Commission (CWC), have understood the critical importance of non-structural measures for enhancing dam safety, which will be further institutionalized under DRIP-2. This lesson has been integrated into the project design through (i) strong emphasis on non-structural measures, including updating of operation and maintenance (O&M) manuals, development of EAPs, dam instrumentation, hydrology studies, and flood routing studies; (ii) development of standards and protocols on key aspects of dam safety (iii) institutionalizing capacity building by strengthening DSOs, promoting the deployment of multi-disciplinary teams for dam management and enabling cross-learning among PIEs by involving both States with experience from DRIP-1 as well as new States. Other lessons learnt, specifically related to fiduciary and safeguard aspects, are presented in the next chapter.

C. Components

12. The Project currently comprises 10 States and several dam-owning agencies and companies. These include: CWC; Chhattisgarh Water Resources Department (WRD); Gujarat WRD; Kerala WRD; Kerala State Electricity Board (KSEB); Madhya Pradesh WRD; Maharashtra WRD; Manipur WRD; Meghalaya Power Corporation Limited (MePGCL); Odisha WRD; Rajasthan WRD; Tamil Nadu WRD; and Tamil Nadu Generation and Distribution Corporation Limited (TANGEDCO).

13. These States and agencies have met the readiness criteria to participate in the project. Readiness criteria include: establishment of State/agency Project Management Unit (PMU) and Dam Safety Review Panels (DSRPs); establishment of project budget line; approval of a Project Screening Template (PST) by CWC for at least one dam (PST will base the preparation of bid documents); environmental and social (ES) safeguards policies and procedures in accordance with WB's Environmental and Social Framework (ESF); completion of Project Procurement Strategy for Development (PPSD) and Procurement Plan. Other States may, if the Borrower and AIIB agree, be added during project implementation as they meet the readiness criteria, under a Project Change. In such case, the Loan allocations to the existing States/agencies may require revision, and a Project Agreement with AIIB (and with the IBRD) would be required for the State joining the project. This follows the same project legal structure as under DRIP-1.

14. PSTs for more than 50 dams have been approved for inclusion in the project. Another 40 PSTs have been submitted to CWC for review and approval. PSTs undergo intense technical

scrutiny and can be rejected or sent back for revision, additional study, etc., before they are approved. It is expected that approximately 120 dams will be rehabilitated under the project. The project will consist of the following five components.

15. **Component 1: Rehabilitation and Management Planning for Dams and Associated Appurtenances**

16. This component aims to reduce the likelihood and consequences of dam failure by improving dam safety planning, management and rehabilitation in selected dams. This component will support both structural intervention and improvement in dam management and monitoring.

17. Structural interventions financed under the project will include rehabilitation of dam structures, appurtenances, and supporting facilities (e.g., access roads, control rooms, living quarter for operators, etc.); measures for seepage reduction; improvement of foundation deficiencies; strengthening of dam body/embankment; hydraulic structures improvement (i.e., strengthening existing spillways, additional fuse plugs, sluice repairs, etc.); and electrical and mechanical improvements. Although structural interventions are not expected to have major social or environmental impacts (as observed in DRIP-1 and the first sets of dams identified under the Project), priority will be given to interventions with minimal adverse impacts.

18. The component will also finance preventive measures to reduce dam safety risk focused on management and monitoring (e.g., development of EAP, O&M Manual, instrumentation plan, etc.) and development of systems to detect and respond to risks promptly (e.g., flood forecasting systems, early warning systems, data management and analysis software, and standardized Supervisory Control and Data Acquisition – SCADA).

19. **Component 2: Dam Safety Institutional Strengthening**

20. This component aims to strengthen the capacities and institutional framework for dam owners, operators, agencies that have oversight of dam safety, and policy makers to identify and address dam safety risks. It will support various activities to modernize institutions for dam safety.

21. A major focus of activities under this component will be strengthening dam safety by developing dam safety guidelines and enabling agencies that oversee dam safety to carry out their regulatory functions as per the Dam Safety Act (2021). Under this component, DSOs and DSRPs will hire multi-disciplinary staff and obtain the necessary equipment and facilities to fulfill the functions envisioned under the Act. This component will also support the development of guidelines on dam safety, such as developing monitoring and reporting protocols.

22. This component will support a comprehensive capacity-building program on dam safety for dam owners, operators, agencies overseeing dam safety, and policy makers based on a detailed institutional needs assessment. It will also address recruitment, retention, and advancement issues for women engineers in dam management by supporting specialized training for women engineers and the development of professional networks. Lastly, this component will also support dam safety institutions to develop education and communication capacity to raise awareness on dam safety issues and communicate dam safety risks to the public (e.g. public consultation on dam safety risk assessment and EAP, dam safety drills, etc.).

23. **Component 3: Risk-informed Asset Management and Innovative Financing for Sustainable Operation and Maintenance of Dams**

24. This component aims to improve the financing available for periodic dam safety needs and regular O&M by improving asset management and dam risk assessment. It will put in place systems to improve the identification of financing needs and more sustainable funding sources.

25. *Asset Management System:* This component will develop an asset management system and plans that provide a comprehensive estimate of funds required to meet the long-term O&M and rehabilitation needs. This system will build on the Dam Health and Rehabilitation Monitoring Application (DHARMA), developed under DRIP-1, containing an inventory of dam assets.

26. *Risk Assessment Framework:* This component will help operationalize the Risk Assessment and Classification Framework (RACF) that the CWC is currently preparing in consultation with the States. The RACF will be based on two factors: (i) likelihood of failure; and (ii) consequence of failure (population at risk, major infrastructure, etc.). Higher risk dams warrant a higher level of scrutiny, a higher priority of remedial works, preparation of more detailed dam safety plans, etc. This standardized and systematic method for assessing dam risk will improve the prioritization of dam rehabilitation needs.

27. Lastly, the component will also include activities aimed at strengthening financing arrangements and exploring revenue generation opportunities. This will focus on (i) improving the efficiency of public financing, starting with the preparation of Public Expenditure Reviews (PERs) for all participating States and agencies; which will serve as an objective assessment on the effectiveness and efficiency of public resources spending on dam safety, (ii) establishing financing arrangements for dam safety (e.g., dedicated budget lines), and (iii) exploring, and potentially piloting, alternative sources for generating revenue streams, such as tourism and water recreational activities, fisheries, and other innovative schemes such as floating solar panels.

28. **Component 4: Project Management**

29. This component will support effective implementation of project activities and monitoring and evaluation of project implementation progress, outputs and outcomes. The component will support (i) operations of the Central Project Management Unit (CPMU), which will oversee and coordinate the PIEs with the support of an EMC; (ii) operations of PMUs within PIEs, which can hire experts in various fields on a contractual basis; (iii) a monitoring and evaluation (M&E) system; and (iv) a Quality Assurance and Quality Control system based on proportionate risk as defined in the Good Practice Note (GPN)/Technical Notes on Risk-Informed Dam Safety Management under the WB's ESF. This component will also finance consultancies, as well as related material, office equipment, and incremental operating costs. The project will provide investment and technical support for the establishment of a Management Information System (MIS) for the project.

30. **Component 5: Contingent Emergency Response Component (CERC)**

31. The component allows provision of immediate response to an Eligible Crisis or Emergency, as needed. Following an adverse natural event that causes a major natural disaster, the Government of India (GOI) may request the AIIB and the IBRD to re-allocate project funds to support response and reconstruction. This component will draw resources from the unallocated

expenditure category and/or allow GOI to request the AIIB and the IBRD to re-categorize and reallocate financing from other project components to partially cover emergency response and recovery costs. This component could also be used to channel additional funds should they become available as a result of the emergency.

D. Cost and Financing Plan

32. To achieve its objectives, the project will support five components, financed by AIIB, IBRD, and counterpart funding. The counterpart funding will be provided by GOI and State with different compositions per State and agency (Annex 2). A breakdown of costs and sources of funds by components are presented in the table below. AIIB and IBRD will sign a Project Co-lenders' Agreement (CLA). The banks will finance all components jointly.

Table 1. Project Cost and Financing Plan

Item	Project Cost (USD million)	Financing (USD million)		
		AIIB	IBRD	GOI/State
Component 1	577.14	204.55	204.55	168.04
Component 2	45.74	14.945	14.945	15.85
Component 3	26.84	9.515	9.515	7.81
Component 4	62.442	20.365	20.365	21.712
Component 5	0	0	0	0
Front-end Fee (FEF)	1.25	0.625	0.625	0
Grand Total	713.412	250	250	213.412

E. Implementation Arrangements

33. **The implementation period** is expected between May 2022 and June 2027.

34. **Implementation Management.** Project institutional and implementation arrangements will follow those established under DRIP-1 that have been refined and strengthened over recent years. A CPMU in CWC, headed by the Chief Engineer of the Central Dam Safety Organization (CDSO), will be responsible for overall project management and coordination. A multi-disciplinary EMC will assist CWC with the overall implementation of the project and engage international experts to adopt global best practices in the project. The EMC will have regional offices to support the PIEs. At the State and agency level, the project will be implemented by State/agency PMUs within the State/agency DSO. PMUs will be staffed with qualified staff and supplemented with consultants. The necessary technical, ES safeguards, M&E, communications, and fiduciary (procurement and financial management) capacity will be available.

35. As under DRIP-1, a DSRP has been constituted by each PIE under the project. India is committed to a thorough technical review of PSTs and has a well-established quality control process, with the DSRPs and CWC playing an important role. The DSRPs are responsible for visiting all dam sites and providing recommendations for remedial measures, which will be the basis for the PST as it will detail the proposed rehabilitation measures to be supported under the project. The DSRPs will regularly visit dam sites during implementation to confirm that their recommendations are being carried out and to identify gaps. A standardized Terms of Reference (TOR) for DSRPs has been developed by CWC and approved by the IBRD. AIIB, the IBRD and, if needed, additional international experts will also review all PSTs that are proposed for financing

under the project. Following completion of rehabilitation works, a third-party Quality Assurance and Quality Control team will reinspect each dam to confirm that the recommended dam safety interventions in the pre-intervention DSRP report have been satisfactorily carried out. The team will be a panel of experts and/or agencies appointed by the Ministry of Jal Shakti (MJS) and CWC within one year of effectiveness.

36. A National Level Steering Committee has been established to provide oversight on dam safety assurance and rehabilitation, as well as disaster management. The Steering Committee is headed by the MJS Secretary and includes senior representatives of CWC. All States/agencies participating in the project will also be represented. A separate Technical Committee has been established to provide technical support to the Steering Committee, coordinate with implementing committees of respective States, and review implementation progress. The Technical Committee is chaired by the Member (Design and Research), CWC, and includes Chief Engineers from participating States. Separate State/agency-level Steering Committees will also be established to provide overall coordination and strategic guidance at the PIE level.

37. **Procurement and Anti-corruption.** The IBRD is the lead co-financer. The rights and obligations between the AIIB and the IBRD will be governed by the CLA. All procurement of contracts will be conducted through the procedures as specified in IBRD's "Procurement Regulations for IPF Borrowers - Procurement in Investment Project Financing - Goods, Works, Non-Consulting and Consulting Services", dated July 2016, revised November 2017 and August 2018 (IBRD's Procurement Regulations). The project will be subject to the IBRD's "Guidelines on Preventing and Combating Fraud and Corruption in Projects Financed by IBRD Loans and IDA Credits and Grants", dated October 15, 2006, revised in January 2011 and as of July 1, 2016 (IBRD's Anti-corruption Guidelines). The IBRD's Procurement Regulations are materially consistent with AIIB's "Procurement Policy" (January 2016), and AIIB's "Interim Operational Directive on Procurement Instructions for Recipients" (June 2, 2016), and the IBRD's Anti-corruption Guidelines are materially consistent with AIIB's "Policy on Prohibited Practices" (December 2016).

38. **Financial Management.** DRIP-2 will follow the same Financial Management (FM) arrangements as the ongoing DRIP-1 financed by the IBRD. The project will be implemented by the CPMU under CWC. At the State/agency level, the project will be implemented by State/Agency PMUs within the State/agency DSO. Overall, there will be thirteen PIEs. Seven of them are part of DRIP-1 and are familiar with IBRD's FM requirements, while the remaining six PIEs are new to these. The PIEs are a mix of central agencies[2], state departments, and companies. The FM assessments for all entities have been conducted by IBRD's FM team. According to the assessment, the FM arrangements of the project are adequate to account for and would report sources and uses of project resources and meet AIIB's fiduciary requirements.

39. DRIP-2 is a multi-State project with defined funding procedures. All participating States/agencies have confirmed the availability of counterpart funding for the project. Budget

[2] Central agencies are agencies under the federal government, this includes CWC as an agency under the Ministry of Water Resources. Other central agencies can still participate in the project, adhering to the readiness criteria and related procedures.

heads have been created at the GOI level. All PIEs have created budget lines for the project and will use budget funds initially and claim reimbursement later from the IBRD and AIIB. The funds for the PIEs will flow through the existing country system, and the fund flow mechanism has been finalized. Disbursements will be processed on a reimbursement basis. The Controller of Aid Accounts and Audit (CAAA) is required to maintain separate ledgers for the IBRD share and the AIIB share. The project may use the retroactive financing option subject to relevant AIIB's guidelines and rules.

40. Accounting and recording will be done as per the existing systems of the PIEs. FM staffing and consultant support at the existing CPMU and SPMUs needs to be strengthened to handle the increased workload associated with the project. The project will have a complement of government staff and newly hired staff. Chartered Accountants (FM specialists) will be hired on a consultancy basis within three months of effectiveness at CPMU. The States/agencies will also appoint at least one commerce graduate on a consultancy basis at the PMU to handle project accounts within three months of effectiveness. Continuous training will be provided to staff at least once every six months.

41. The FM Manual was developed and agreed upon at IBRD's loan negotiation. Internal audits will be done by the consultants appointed by the CPMU. Internal audits will be conducted following a risk-based approach to cover all major spending units. Reports will be generated quarterly and compiled at the CPMU level. A composite interim unaudited financial report (IUFR) will be prepared for the entire project, which will indicate the total expenditure, IBRD Share, AIIB Share, and the counterpart share. The CPMU will submit IUFRs within 45 days of the end of each quarter. In the case of central agencies and departments, the audit will be conducted by the Comptroller and Auditor General (CAG) and its State offices, while in the case of companies, the audit will be done by Chartered Accountant firms as per agreed TOR. The audit reports will be submitted within nine months of the end of every financial year.

42. **Monitoring and Evaluation**. The CWC and MJS will be responsible for the M&E of the project's result indicators. The CWC will have an overall coordination role and directly monitor the implementation of the project. Under DRIP-1, the CWC has put in place a sound M&E system to track progress toward the project's objectives and to conduct the needed coordination among the various States and agencies. Further, MJS plans to engage a third party (e.g., an Indian Institute of Technology) to independently review the project on a regular basis. AIIB and the IBRD will jointly monitor implementation status through biannual implementation support missions and tracking of results indicators.

43. **AIIB's implementation support.** The IBRD will organize progress implementation reviews, midterm reviews, implementation support missions, and site visits to the project sites as needed to monitor progress, not less than two missions per year. AIIB will actively participate in these missions. The IBRD will provide AIIB with copies of all relevant documents, reports, recommendations, no-objections, and communications received or sent by the IBRD in connection with any project activity. Further, throughout the implementation period, as deemed necessary, AIIB's staff will actively support the IBRD by assisting participating States and agencies in developing any relevant implementation documentation. This will include active support by AIIB's environmental and social safeguard specialists in preparing ESDD and the subsequent field verification of dam safety plans and work plans in four to five selected dams.

Lastly, AIIB will support the IBRD in identifying and adopting digital technologies in the context of dam safety and rehabilitation, aligning with the project objective, dams' characteristics, and the capacity of dams' manager(s). A detailed implementation plan is presented in Annex 7.

44. **Adapted implementation approach.** Given challenges related to the COVID-19 pandemic and the substantial number of dams included under the project, the implementation support will be adapted to fit these circumstances while still pursuing optimal effectiveness. First, during the COVID-19 pandemic, virtual missions will be conducted instead of conventional physical site visits. This will be jointly organized and conducted by AIIB and the IBRD. The participating States and agencies will be asked to prepare necessary supporting documentation to provide a full picture of the implementation amid travel restriction and limited access to the project site. The feasibility of acquiring aerial photographs, and videos taken by drones, of the construction sites will be explored during the implementation. The effectiveness of virtual missions and collection of aerial imagery has been proven and adopted to monitor other AIIB-IBRD joint co-financing projects, including the West Bengal Major Irrigation and Flood Management Project. Other innovative approaches in conducting distance-implementation monitoring will be explored and piloted. Second, to optimize its impact at the portfolio level, the implementation support will be shaped to fit the conditions and needs of the dams. Additional attention will be given to dams and States/agencies with the highest safety risk (as informed by the analysis to be undertaken in Component 3 using RACF), environmental and social (ES) risks (based on ESDDs), and the complexity of the interventions (as presented in the PSTs). The design of such a differentiated approach will be developed and fine-tuned throughout the implementation.

45. **Cross-learning.** Transfer and exchange of knowledge and experience will be central for quality project implementation as half of the PIEs are new to the project (7 out of 13 PIEs have been involved in DRIP-1 and benefited from experiences and knowledge gained during the implementation). Regular knowledge sharing and learning events will be held to allow participating States and agencies to discuss common implementation challenges, share best practices and learn innovative solutions. These events will be conducted as an integral part of both implementation support missions and capacity-building activities under Component 2. One of the main functions of the Center of Excellence for dam safety (to be established under Component 2) will be designing and facilitating such knowledge-sharing opportunities through workshops, exchange visits, and larger dam safety conferences. These regular and structured interactions among PIEs will not only accelerate the transfer of knowledge and thus expedite the implementation but will also indirectly form an implementation benchmark, which States/agencies can use to evaluate their respective level of progress. Lastly, this approach will further enrich the discussions and strengthen the communications within India's dam safety community of practice.

46. **Adoption of technology.** AIIB and the IBRD will share best practice and frameworks for the adoption of digital technologies in managing dam safety and water resources in general. This will include a brief assessment of the current utilization of technologies in managing dam safety in India and the identification of suitable solutions that fit the project objective, dams' conditions, and PIE's capacity. From the latest development of infrastructure technology, it is generally recognized that the uses of radars, laser scanning, cameras, piezometers, and accelerometers in real-time are prevalent in modern monitoring of structures, which are particularly relevant to dam safety and rehabilitation. The applications of sensors and a digital management system will also

allow more efficient and accurate data collection, generation of insights, and assisting prioritization of interventions. These solutions will add value to different areas such as reservoir management, irrigation, integrated water management, and flood management. Lastly, leveraging AIIB's infrastructure technology knowledge and network, AIIB could provide additional support, information, and contacts on identifying, prioritizing, and sourcing the relevant digital technologies.

3. Project Assessment

A. Technical

47. **Project Design.** The project will put in place and strengthen measures so that the adequacy and integrity of dam safety interventions are achieved. These include: a requirement to revise hydrology prior to identifying dam safety interventions (in addition to other technical studies for the appropriateness of interventions such as stability analyses, geo-technical studies, and geo-physical and bathymetric surveys); the use of independent DSRPs so that rehabilitation plans and technical designs are in line with international standards and good practice; the improvement of instrumentation and modernized surveillance and monitoring systems to enable timely and effective detection of problems and risks in dam operations; the establishment of a modern dam asset management system, building on DHARMA that was developed under DRIP-1; the preparation or regular updating of O&M Manuals for all dams under the project; the establishment of standards and protocols for dam monitoring, reporting, and data sharing as well as the development of additional dam safety guidelines in a range of areas, such as integrated reservoir operations that account for climate extremes.

48. **Operational Sustainability.** The Project aims to achieve operational sustainability by enhancing both institutional and financial sustainability. The project focuses on institutional strengthening, including establishing and strengthening dam safety institutions, including the CDSO, DSOs, and DSRPs. Capacity building of dam safety officials (operators and managers) will be supported under the project, focusing on the dam's engineering principles, construction quality control, risk assessment, emergency preparedness, related social and environmental aspects, etc. This will be institutionalized through the establishment of a Center of Excellence with regional units. New guidelines, standards, and protocols will be institutionalized at the State level making dam management and systems more standardized across the country. In terms of pursuing financial sustainability, the project will include: improving the efficiency and effectiveness of existing financing; establishing financing and institutional arrangements for sustainable O&M using risk-informed needs-based budgeting (including establishing dedicated budget lines for dam safety); sustainable financing options for periodic rehabilitation; and piloting of alternative streams of revenue generation such as tourism and floating solar panels. The project will develop and pilot a dam asset management system to assess specific O&M needs and guide budgeting decisions calculated on an as-need basis for O&M expenditures.

B. Economic and Financial Analysis

49. **Economic Analysis.** To evaluate the economic viability of the project, a comparison of the expected damages in the baseline pre-rehabilitation scenario with expected damages in the post- rehabilitation scenario is undertaken for a portfolio of dams. Expected damage in these scenarios is the probability-weighted average of flood event damages with and without a dam breach. The probabilities include both the probability of a flood event and the probability of a dam breach if the flood event were to occur. The rehabilitation measures generate benefits by reducing the probability of a dam breach happening and reducing the magnitude of damage if a flood event were to occur for both dam breach and non-dam-breach conditions.

50. The key benefits of the project include avoided losses arising from damages to (i) houses, industrial/commercial facilities, and infrastructure (roads, bridges, irrigation facilities, and other public infrastructure); (ii) agricultural production, including the destruction of downstream crops due to flooding and, and damage to crops due to loss of irrigation water supplied by reservoirs; (iii) hydropower generation, leading to higher greenhouse gas emissions as energy lost is replaced by more carbon-intensive sources; and (iv) fisheries revenue. The project is also expected to yield a number of other benefits that cannot be accurately quantified, including (i) avoided loss of life and health costs; (ii) potential increase in irrigation reliability and agricultural productivity; (iii) increased hydropower generation; (iv) environmental protection as the increase of water availability for water supply, and irrigation will prevent the increase of groundwater pumping. The project cost includes rehabilitation costs and annually incurred O&M costs calculated at 5 percent of total rehabilitation costs.

51. The economic analysis indicates that the project is economically viable. A comparison of the annualized estimates of expected benefits against the rehabilitation and O&M cost of dam, over a 25-year period, yields an economic internal rate of return (EIRR) of 16.53 percent, well above the traditionally used social discount rates of 12.0 percent and 9.0 percent. The net present value (NPV) at these discount rates is estimated to be USD 127.61 million and USD 270.52 million, respectively. A sensitivity analysis was conducted to assess the impact of adverse changes in key variables affecting the economic outcome of the project. A 15 percent increase in costs or a 15 percent reduction in benefits yields an EIRR more than 13.0 percent while a combination of cost increase and decline in benefits pushes the EIRR down to 10.7 percent.

52. **Financial analysis**. A conventional financial analysis to assess the investment's financial viability (the calculation of the Financial Internal Rate of Return - FIRR) and the infrastructure's operational sustainability (O&M cost recovery ratio) could not be performed at the portfolio level as most of the rehabilitated dams are not generating revenue (mostly used for irrigation, without any collection of user fee). Instead, the financial analysis was undertaken for 33 dams within the portfolio that generate revenue from hydropower generation. For dams without revenue streams, an assessment was conducted to understand how the project will strengthen the dams' operational and financial sustainability.

53. The financial analysis of the hydropower dams yielded a FIRR of 15.08 percent and an average O&M cost recovery ratio of 430 percent throughout the dams' lifetime. It demonstrates that investments in rehabilitating hydropower dams under the project are financially viable; and that hydropower dams are generating a sufficient level of revenue to finance quality O&M and, therefore, support its operational sustainability. While for the dams without revenue generation mechanisms, the assessments lead to the conclusion that the project will significantly strengthen the financial arrangement and capacity of the participating States/agencies, which are required for the operational sustainability of the dams. This will be achieved through specific project activities, including improving the efficiency and effectiveness of existing financing; establishing financing and institutional arrangements for sustainable O&M using risk-informed needs-based budgeting (including establishing dedicated budget lines for dam safety); exploring sustainable financing options for periodic rehabilitation to improve dam safety; and piloting of alternative streams of revenue generation such as tourism, fishery and floating solar panels. Further information on the Financial Analysis is provided in Annex 3.

C. Fiduciary and Governance

54. **Procurement.** The Central Project Management Unit (CPMU) established for DRIP-1 in CWC is still functioning and will be the CPMU for DRIP-2 as well. The CPMU has prepared the Project Procurement Strategy for Development (PPSD) in consultation with the participating states supported by IBRD. The PPSD, which is equivalent to the Project Delivery Strategy (PDS) under AIIB's Procurement Policy, includes among others, an implementation arrangement, procurement procedures (methods, thresholds, review levels etc.), client's capacity assessment in handling procurement and contract management, market analysis, risk assessment along with proposed mitigation measures. In addition to PPSD, the CPMU has also prepared a Procurement Manual and Project Implementation Manual (PIM) with an objective to further streamline the implementing arrangements as there is multiple PIEs across many states.

55. The IBRD has also conducted a procurement risk assessment for the project and rated the overall risk as "substantial". The assessment noted that this project will be implemented in 10 States and several agencies, and the risk level for these PIEs varies from "medium to high risk". Key risks highlighted by the assessment are lack of familiarity of procurement staff with IBRD's latest procurement procedures; lack of a comprehensive internal procurement manual; a weakness in procurement review functions and resolution of complaints; new PIEs joining the project; lack of procurement and contract management knowledge for new staff etc. The PPSD has also suggested mitigations measures, including: review of procurement by CPMU above the set threshold at the State level; development of a Procurement Manual and PIM; continuous training of procurement staff in all PIEs; hiring of consultants (firm); strengthening of contract management; adopting a clear and fair complaint management system.

56. AIIB's project team has reviewed the PPSD and Procurement Manual and notes that the procurement and implementing arrangements are well prepared and have benefited from lessons learned from DRIP-1, which underlines the importance of prior engagement/information session with potential bidders (namely for dam safety studies) and early market analysis to augment the sizing and packaging of works. AIIB has also provided comments as necessary and will join the IBRD in capacity-building activities during the implementation.

57. Key lessons from DRIP-1. One of the main reasons for the slow take-off of DRIP-1 was related to the fact that the project was oversized related to the market absorptive capacity. First, dam rehabilitation work was not common in India, and most contractors and consultants have limited proficiency on the subject. Second, in the early implementation phase, there was a misalignment between the scope and size of the packages and the capacity of the contractors and consultants in the market. As a result, the preparation of technical and bidding documents has been lengthy and, in a few cases, has led to re-tendering. All of these have further lagged the implementation. These have been remedied through intensive and structured interactions with existing contractors, primarily over the past six years, which led to the strengthening of their capacity and experience. CWC has regular meetings with potential contractors to inform them about upcoming work, while States regularly conduct contractor meetings to expose the market to upcoming bids and receive feedback on the sizing and packaging of works. International conferences conducted under DRIP-1 have raised awareness of the dam safety program in India and encouraged the entry of international contractors into the market. Further, half of PIEs in DRIP-2 have worked in DRIP-1 and benefited throughout this learning process. They are in a

better position to effectively implement the project and transfer the experiences to the newly inducted PIEs through cross-learning activities. All of these practices will also be continued in DRIP-2 and elaborated in the PIM and Procurement Manual.

58. **Financial Management.** The project financial management assessment has been conducted through discussions and desk review, mainly focusing on the information provided in the Project Appraisal Document prepared by the IBRD. Based on the scope of activities, multiplicity of entities, and capacities of the entities, the FM risk is rated High.

59. Key lessons from DRIP-1. The implementation capacity of the CPMU on FM was limited as it was merely supported by a consultant, while simultaneously facing a staff shortage, as observed during the restructuring of DRIP-1 in 2019. Under DRIP-2, the CPMU will be required to recruit Chartered Accountants (FM Specialists) within three months of effectiveness. Also, States can depute existing accountants from their governments to support the project. Further, it was learned that the implementation of DRIP-1 was occasionally challenged due to untimely co-financing by a few of its PIEs (by TANGEDCO and Damodar Valley Corporation). Under DRIP-2, the availability and timely provision of counterpart funds have been confirmed by GOI and participating States.

60. The project will be implemented by CWC, which is also the CPMU for the ongoing WB-funded project (DRIP-1). Seven PIEs (Kerala WRD, KSEB, Madhya Pradesh WRD, Odisha WRD, Tamil Nadu WRD, TANGEDCO, and CWC) are part of DRIP-1 and are familiar with the WB FM requirements, with the remaining PIEs (Chhattisgarh WRD, Gujarat WRD, Maharashtra WRD, Manipur WRD, MePGCL, and Rajasthan WRD) are new to these. As most of the agencies are core departments, the project will follow country systems for budgeting, fund flow and payments, accounting and reporting, and auditing. For companies, their respective entity systems will be used for payments, accounting, and reporting, auditing, while the government system will be used for budgeting and funds transfer from State governments to the companies.

61. DRIP-2 is a multi-state project with a defined funding procedure. For the Central Component[3] of CWC, a 50 percent contribution will be made by the CWC. For the States of Manipur and Meghalaya, a 20 percent contribution will be made by the States. For other States, a 30 percent contribution will be made by the States, and the loan will be on a back-to-back basis as per GOI terms and conditions. The IBRD team has confirmed that all participating States/agencies have issued confirmation about providing counterpart funding for the project.

Table 2. Project Funding Pattern

Location of Organization	AIIB Share	IBRD Share	Counterpart share
CWC	up to 50%	up to 50%	50%
States of Manipur and Meghalaya	up to 80%	up to 80%	20%
Other States	up to 75%	up to 75%	30%

[3] Central Components are components that are undertaken by central agencies, in this case, the CWC. This includes component 4 (project management), part of component 3 (asset management system, risk assessment framework), and part of component 2 (capacity building program, center for excellence, etc.).

62. The GOI will allocate funds for Central Components to the CPMU and respective Central PIEs. Participating States will directly provide their share of the budget to PIEs. Budgets will be provided based on annual work plans. The timelines for the budget process will be the same timelines followed by each State. In the case of electricity boards and corporations, specific budget lines and access to funds have been agreed upon.

63. All agencies will use budget funds initially and claim reimbursement. In the case of State WRDs, the department would have access to a budget from which payments would be made through State treasuries. In the case of State Electricity Boards, the amount will be transferred from the budget to the project-specific bank account maintained by the Boards from which payments will be made. For CWC, the budget allocation will be done by the MJS, and all payments will be made through the Pay Accounts Office (PAO).

64. The major accounting centers for the project will be the CPMU, PMUs at the State level, and divisions handling the civil works. The major portion of the expenditure, payments, and accounting will happen at the division level, while the consolidation will happen at the PMU level for State-level expenditure and at the CPMU level for the entire project. All PIEs will maintain payment records in the main cash book, and expenditures will be identified through the budget head. Since most PAO and State Treasury records are computerized, the expenditure under the budget head can be ascertained and reconciled with the cash book. The electricity boards and companies will use accrual-based accounting systems as laid out in the respective Acts. A separate project ledger and project bank account will be maintained from which the expenditure can be ascertained. The PMU and CPMU should maintain photocopies of the bills and vouchers of their respective entities so that these can be relied upon at the time of audit. A Financial Management Manual has been prepared and agreed with the IBRD.

65. Since DRIP-2 is a multi-state project, the CPMU in the CDSO of the CWC will have a coordinating role in the financial management of the project. FM staffing and consultant support at the CPMU needs to be strengthened to handle the increased workload associated with the project. The finance function at CPMU will be led by a Director CWC who will be supported by Chartered Accountants (FM Specialists) hired within three months of effectiveness. States/agencies can depute existing accountants to support the project or hire commerce graduates from the market within three months of effectiveness.

66. The project may use retroactive financing subject to relevant AIIB's guidelines and rules. For this project, the threshold for retroactive financing is 20 percent of the total loan amount, with an extended availability period to cover payments made for project activities no more than 24 months prior to the expected signing date of the Loan Agreement.

67. The CPMU will submit interim unaudited financial reports (IUFRs) every quarter to claim disbursements. Such IUFRs will be submitted within 45 days from the end of the quarter. IUFR formats have been developed agreed between GOI and the IBRD. Some States have a robust internal audit department that will conduct the internal audit of the project. For States that do not have such arrangements, periodic reviews will be conducted by the FM consultants appointed by CPMU. In any event, audits will be carried out at least once every six months, and reports submitted to CPMU. Internal audits will be conducted in such a way that all major spending units are covered. An Audit Committee needs to be formed by each PMU with one representative from

the finance section and CPMU. These Audit Committees will review all audit reports and compliance at least once every six months. The review will cover project transactions, as well as provide needed training and capacity building required in the field. The findings will be shared with all partner agencies with an objective to improve the capability of all agencies.

68. External audits will be conducted by the office of CAG for CWC and by the respective State Accountant Generals (AG) in the participating States for WRD, according to the standard audit TOR agreed with the IBRD, CAG and the DEA for audit of IBRD-financed and are acceptable to AIIB projects. In the case of companies, the audit will be done by the company's statutory auditors (normally firms) as per TOR agreed with the IBRD and acceptable to AIIB. The audit reports will be submitted within nine months from the end of every financial year.

69. **Disbursements.** Disbursements will be processed on a reimbursement basis. The withdrawal applications will be submitted to the IBRD for AIIB reimbursements. IBRD will review and verify that the amount requested is eligible for financing under AIIB's financing agreement and notify AIIB that the withdrawal application is in proper order. AIIB will then make the disbursement accordingly. The Controller of Aid Accounts and Audit (CAAA) will be required to maintain State-wise ledgers as well as separate ledgers for the IBRD share and the AIIB share.

70. **Governance and Anti-corruption**. AIIB is committed to preventing fraud and corruption in the projects it finances. While IBRD's Anti-corruption Guidelines shall apply to the project, AIIB reserves the right to investigate, directly or indirectly through its agency, any alleged corrupt, fraudulent, collusive, coercive or obstructive practices, and misuse of resources and theft or practices relating to the project and to take necessary measures to prevent and redress any issues in a timely manner, as appropriate.

D. Environmental and Social

71. **Environmental and Social Policy and Categorization**. The project will be co-financed with the IBRD, as the lead co-financier, and its environmental and social (ES) risks are being assessed in accordance to the World Bank's (WB)'s Environmental and Social Framework (ESF). For a harmonized approach in addressing ES aspects of the project, and as permitted by AIIB's Environmental and Social Policy (ESP), the WB ESF will apply to the project in lieu of the AIIB's ESP. AIIB has reviewed the WB's ESF and is satisfied that (i) the ESF is consistent with AIIB's Articles of Agreement and materially consistent with the provisions of the ESP and the relevant ES Standards; and (ii) the monitoring procedures that are in place are appropriate for the project. The WB has categorized ES risks of the project as "High", which is equivalent to Category A if the ESP were applicable.

72. As part of the ESDD, assessments were conducted for 30 dams. Based on the ESDD assessments carried out under ESS1 of the IBRD's ESF, the 30 dams trigger Environmental and Social Standard (ESS) 2 (Labor and Working Conditions); ESS3 (Resource Efficiency, Pollution Prevention and Management); ESS4 (Community Health and Safety); ESS6 (Biodiversity Conservation and Sustainable Management of Living Natural Resources); and ESS7 (Indigenous Peoples/Sub-Saharan African Historically Underserved Tradition Local Communities). To meet the requirements of these standards, suitable instruments will be prepared, such as (1) Labor Management Procedures, (2) Community Health Management Plans, (3) Resource Conservation

Plans, (4) Muck and Debris Disposal Plans, (5) construction management guidelines for noise and air management and water quality monitoring and measurement, (6) biodiversity management guidelines, (7) Tribal Development Plans (for Mahi Bajaj Sagar and Som Kamla Amba Dams only) as per the Tribal Development Framework, and (8) Sexual Exploitation and Abuse / Sexual Harassment (SEA/SH, gender based violence) risk mitigation guidelines as per the overall Gender Based Violence (GBV) risk mitigation framework.

73. To address ES challenges that vary in nature but are not known at this stage, an Environmental and Social Management Framework (ESMF) for the project has been prepared[4]. The ESMF details the procedures for all stages of the process, from screening activities to identifying appropriate mitigation instruments for the various risks and impacts. As per the ESMF: (i) an ESDD assessment will be conducted for each dam investment (Sub-project) to identify the risk category and (ii) following this risk categorization, all Low to Moderate risk Sub-projects will be addressed through a standard Environmental and Social Management Plan (ESMP) with relevant ES guidelines. Detailed Environmental and Social Impact Assessments (ESIAs) will be undertaken for all Sub-projects categorized as Substantial to High risk, as per the TOR included in the ESMF, and ESMPs will also be prepared. Dam safety assessments as well as design and construction supervision of rehabilitation/safety enhancement works will be undertaken by qualified experts. The results of the dam safety/risk assessments, as well as the adequacy of proposed remedial works and quality of construction works, will be periodically reviewed by independent Dam Safety Review Panels (DSRPs) that have been established by the participating States and other PIEs. These DSRPs will have technical as well as safety (including safeguards) oversight of the project works.

74. Key lessons from DRIP-1 include: (i) The use of checklists was deemed ineffective and turned out to be a mechanical and perfunctory tool and, therefore, its functionality has been merged into the ESDD; (ii) The performance of DRIP-1 on ES aspects has been found to be suboptimal in its early implementation phase, reflected by poor monitoring of Environmental, Social, Health and Safety (ESHS) and a few cases of noncompliance with safeguards reporting requirements. This has called for an elaborated strengthened assessment, monitoring and reporting on ES aspects as stipulated in the ESMF, including ESHS aspects. Also, trainings will be conducted in early stages of project implementation as a proactive measure to manage risks related to PIE's limited safeguard capacity (iii) Related to previous points, dedicated ES experts assigned to each PIE will be central in managing project's safeguard aspects, supporting the implementation of the envisioned capacity building and the actions derived from lessons learnt.

75. Based on the learning above, under DRIP-2 the following measures will be implemented. Firstly, instead of requiring checklists, a full ESDD will be conducted for each selected dam. These ESDDs will be reviewed by the IBRD and AIIB. Secondly, the procedures described in the ESMF include an assessment of existing ES capacity of PIEs as part of the ESDD screening. Thirdly, each PIE commits to Environmental and Social Commitment Plan (ESCP) that is reflected in its Project Agreement, which requires the PIE to: (i) adhere to the provisions of the ESMF; (ii)

[4] ESMF, ESCP and SEF documents (DRIP Phase II and Phase III).
https://damsafety.in/index.php?lang=&page=ESMF_DRIPII&origin=front-end&tp=1

designate nodal/coordinating officers for ES areas, supplemented by contractually hired ES experts (one for environment, and one for social aspect); and (iii) undertake an annual evaluation of implementation of the ESMF by an independent agency. The CPMU will supplement ES expertise in the State-level PIEs by designating a coordinating officer at the level of Deputy Director for ES issues. In addition, the EMC that supports the CPMU will have experts on ES issues. Training on ES areas has been carried out during project preparation and will continue throughout project implementation.

76. **Environmental Aspects**. Although the IBRD ESDD reports for the first set of 30 dams indicate that environmental and social risks and impacts are Low to Moderate, the ES risk rating for DRIP-2 is High. DRIP-2 is expected to cover many existing dams across various States in India with varying geographical conditions and environmental and social sensitivities. The locations of these dams and the proposed interventions will be identified during project implementation. The number of dams that have been proposed under DRIP-2 is provided in the table below[5]. It is possible that during project implementation, a few dams will be substituted by dams that are found to be of higher priority for rehabilitation and improvement. Dam interventions could include spillway rehabilitation/upgrading; sediment management planning and potentially sediment management activities subject to requisite ESDD; and rehabilitation / strengthening of concrete, masonry, and dam embankment structures. Some of the Sub-projects could be located within or close to reserved forests or protected areas.

Table 3. Number of Dams Proposed Under DRIP-2[6] (as of November 10, 2020)

State/agency	No. of Large Dams[7]	Dams considered under DRIP-2
Chhattisgarh	248	3
Gujarat	620	7
Kerala	61	22
Madhya Pradesh	899	9
Maharashtra	2069	167
Manipur	3	2
Meghalaya	8	6
Odisha	199	13
Rajasthan	209	189
Tamil Nadu	116	59
TOTAL	**4432**	**477**

[5] Note that some of the dams (e.g., in Kerala) are part of a cascade of dams with more than one dam constructed in the same basin. For the purposes of DRIP-2, such a complex is considered as one dam.

[6] The table lists number of dams owned by the participating States/agencies. The project funds are estimated to be sufficient to rehabilitate approximately 120 dams. The inclusion of the dams will be based on readiness criteria, CWC's approval and the indicative financing share of respective State/agency (Annex 2).

[7] The definition of a large dam in India is: more than 15 meters high, or between 10 meters and 15 meters in height and either: (i) more than 500 meters long in crest length; or (ii) having a reservoir capacity of more than 1 million cubic meters; or (iii) having a maximum flood discharge greater than 2000 cubic meters per second; or (iv) with difficult foundation problems or unusual design. Under the WB's ESF, large dams are defined as those with a height of 15 meters or more or between 5 meters and 15 meters and a reservoir capacity of more than 3 million cubic meters, in line with the current International Commission on Large Dams' constitution.

77. **Climate risk, opportunity, and financing.** A climate assessment[8] was conducted to systemically unpack the climate risks and opportunities related to the project, elaborate links between project activities and climate benefits, and estimate financings accountable for the generation of these benefits; with details provided in Annex 6. The analysis demonstrates that the project contributes to both climate mitigation and adaptation; and concluded that 75 percent of AIIB's financing is accounted as climate financing. In terms of adaptation, every component of the project will lead to this co-benefit. Component 1 will include structural and non-structural interventions to: (a) improve dam safety against flooding, which is expected to intensify as a result of climate change and (b) restore the dams' capacity to store and regulate water, so as to address droughts and water stresses. This component will also include the development of flood forecasting and early warning systems, flood routing, and integrated reservoir operations to further build climate resilience. It will also include the preparation and implementation of EAPs that will enable downstream communities to enhance their preparedness capacity against the risk of dam failure and related hazards. The holistic improvement of dam safety under this component will also increase the reliability of key water-related services provided by the dams, including water supply, irrigation, and hydropower; demand for which will increase along with climate change. Component 2 will strengthen institutional capacity to manage flood risks, including raising awareness of the potential impacts of climate change. Component 3 will support innovative revenue generation schemes, including potentially piloting floating solar panels that can contribute to the mitigation of greenhouse gas emissions. Component 4 will provide for effective implementation and monitoring of activities listed under Component 1 – 3 and, therefore, will indirectly support all climate actions under the project. Component 5 will allow the provision of immediate response to a major natural disaster, including those induced by climate change. In terms of mitigation, the project will lead to emission savings due to the safeguarding of hydropower generation capacity. The potential emissions saving from this is estimated at 49,671 tons of CO2 equivalents per year (or 1,241,776 tons of CO2 equivalents across 25 years) with the conservative assumption that without the project's interventions, dam failure would lead to a 1 percent reduction in hydropower generation from selected dams.[9] In practice, the emission saving is expected to be higher as the project will increase the reliability of irrigation and bulk water supply and, therefore, prevent groundwater pumping (and related emissions) which has happened across the country.

78. **Social Aspects.** Risk of adverse social impacts related to the acquisition of land and community-owned assets (including structures, trees, and crops in areas identified for land acquisition), as well as assets that belong to titleholders/non-titleholders, is limited.

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[8] Based on the methodology endorsed by the 2019 Joint Report on Multilateral Development Bank' (MDB) Climate Finance. This report was written by a group of multilateral development banks (MDBs), composed of AIIB, the World Bank Group, the African Development Bank, the Asian Development Bank, the European Bank for Reconstruction and Development, the European Investment Bank, the Inter-American Development Bank Group, the Islamic Development Bank, as a collaborative effort to make public MDB climate finance figures, together with a clear explanation of the methodologies for tracking this finance. Accessible at: www.ebrd.com/2019-joint-report-on-mdbs-climate-finance

[9] Using the multilateral bank harmonized approach, which estimates a combined grid emission factor for firm power of 673 grams of CO^2/KWh for India. July 2019 update to the "Harmonized Grid Emission Factor Data Set": https://unfccc.int/climate-action/sectoral-engagement/ifis-harmonization-of-standards-for-ghg-accounting/ifi-twg-list-of-methodologies

79. Under DRIP-2, interventions could include physical and economic displacement and cultural heritage issues, in addition to labor and SEA/SH risks. Dam investments/sub-projects could potentially be located in areas with significant tribal presence; the nature and extent of impacts will be known based on the ESIAs that are required to be carried out when Substantial to High risks are identified in the ESSD reports. There could be instances where Free Prior and Informed Consent (FPIC) is required under the WB's ESF. Component 3 will explore the piloting of alternative sources of revenue generation, such as tourism, floating solar panels, etc. These pilot activities are not currently known, and hence the related ES risks and impacts will need to be assessed once these activities are identified. Additionally, the capacity of PIEs (i.e., the CWC and participating States/agencies) is assessed as Low, requiring significant capacity-building efforts. Potential legacy issues under DRIP-2 are expected to be limited, based on the experience of DRIP-1 and the current findings of ESDDs. Nevertheless, should it emerge among the dams included in DRIP-2, the ESMF has provided a sound set of procedures to screen and address legacy issues.

80. Fishing activities are prevalent in some of the dams, but interventions will not directly or indirectly impact the livelihoods of fisher people. In Rajasthan, two of the eight dams are located within Schedule V areas (areas constitutionally designated for tribal groups). The ESDD assessments indicate that land for these interventions is available to the respective PIE and that there will be only construction stage impacts, e.g., disruption/diversion of traffic, temporary loss of access, etc. The need for skilled migrant labor is likely but expected to be limited (e.g., 30-50 people for any given dam). Stakeholder consultations found that key vulnerable and disadvantaged groups are marginal farmers and Scheduled Tribe households in downstream areas. In addition, as part of the ESMF, a Resettlement Policy Framework (RPF) and a Tribal Development Framework (TDF) have been prepared. These documents will guide the preparation of dam-specific Resettlement Action Plans (RAPs) / Abbreviated RAPs and Tribal Development Plans, where necessary. In addition, a Stakeholder Engagement Framework (SEF) for the overall project has been prepared. This forms the basis for the development of individual Stakeholder Engagement Plans (SEPs) for each dam.

81. **Gender Aspects.** A GBV risk assessment conducted for the entire project using the WB's GBV risk assessment tool found a low-risk rating. A GBV risk mitigation framework that describes the actions that need to be taken by each PIE and that are commensurate with the risk level has been developed. As some States/agencies could join the project during implementation and the actual dam locations are not yet known, a GBV risk assessment will be carried out as part of individual ESDD assessments. The findings will identify the set of actions required to mitigate risks commensurate with the identified risk level and will be included in the EMSPs.

82. **Occupational Health and Safety, Labor and Employment Conditions.** A Labor Management Procedure (LMP) will be adopted by each PIE prior to mobilization of the civil works contractor, which clearly spells out the contractor's requirements, and included in the contractor's terms and conditions of employment. These will require the contractor to prepare an ESMP (C-ESMP) and cover such matters as: non-discrimination and equal opportunity, grievances redress mechanism for directly employed- and contracted workers. In order to address labor influx, the contractors will be required to prepare a Labor Influx Management Plan that will comprise provisions for sourcing all unskilled labor from within the project area and its vicinity to minimize

labor influx into the project area. Given the specialized nature of most of the tasks, a large number of unskilled workers is not anticipated, except for a few dams that might involve major civil works. In accordance with the WB's ESS2, the dam-specific ESMP outlines the various measures that need to be considered for preparing the contractor's Occupational Health and Safety (OHS) plan, which will be part of C-ESMP. The IBRD will review the contractor's OHS Plan to determine its acceptability.

83. **Stakeholder Engagement, Consultation and Information Disclosure.** The ESMF, SEF, and ESCP have been disclosed by CWC and all States/agencies.[10] Additionally, an Executive Summary has been prepared based on the 10 ESDD assessments conducted for the 10 dams in the States of Manipur and Rajasthan. These ESDD assessments were disclosed on April 19, 2020, by Rajasthan and on April 21, 2020, by Manipur. Draft ESDD assessments/ESIAs for the 10 dams were disclosed on the IBRD's website[11] on February 23, 2020. The appraisal stage package (ESRS, ESCP, SEP) as required under the ESF received concurrence from the IBRD on March 26, 2020. The ESMF, ESCP, and SEP were disclosed on the WB's Environmental and Social Management System and WBDocs on April 2, 2020[12], and on the CWC's project website on April 10, 2020. Links to these sites are included on AIIB's website[13].

84. **Bank's Project-Affected People's Mechanism**. As noted above, the WB's ESF will apply to this project instead of the AIIB's ESP. Pursuant to the Bank's agreement with the World Bank, the AIIB will rely on the WB's corporate Grievance Redress Service (GRS) and its Independent Accountability Mechanism, the Inspection Panel to handle complaints relating to ES issues that may arise under the project. Consequently, in accordance with AIIB's Policy on the Project affected People's Mechanism (PPM), submissions to the PPM under this project will not be eligible for consideration by the PPM. Information on the WB's corporate GRS is available at http://www.worldbank.org/en/projects-operations/products-and-services/grievance-redress-service. Information on how to submit complaints to the WB's Inspection Panel is available at http://www.inspectionpanel.org.

85. **Monitoring and Supervision Arrangements.** As agreed with the IBRD, the AIIB ES team can choose to be directly in charge of the field verification of the project activities and compliance with agreed ES instruments in 4-5 dams. This is expected to be beneficial in building AIIB's capacity in working on dam safety investments. The AIIB team will be supported by a dam safety consultant. All monitoring reports will be shared with the AIIB team. Joint supervision missions will be conducted twice a year. To complement the supervision work of the IBRD team, the AIIB

[10] ESMF: https://damsafety.in/ecm-includes/DRIP_II/ESMF/Draft_ESMF_CWC_April18.pdf ;
SEF: https://damsafety.in/ecm-includes/DRIP_II/ESMF/Stakeholder_Engagement_Framework_DRIPII_Apl18.pdf ;
ESCP: https://damsafety.in/ecm-includes/DRIP_II/ESMF/DRIP2_ESCP_CWC_April18.pdf .
[11] https://projects.worldbank.org/en/projects-operations/document-detail/P170873
[12] ESMF: http://documents1.worldbank.org/curated/en/409341603211213956/pdf/Environmental-and-Social-Management-Framework-ESMF-Second-Dam-Rehabilitation-and-Improvement-Project-P170873.pdf
SEF: http://documents1.worldbank.org/curated/en/527881585241003526/pdf/Stakeholder-Engagement-Plan-SEP-Second-Dam-Rehabilitation-and-Improvement-Project-P170873.pdf
ESCP: http://documents1.worldbank.org/curated/en/571991585240971131/pdf/Environmental-and-Social-Commitment-Plan-ESCP-Second-Dam-Rehabilitation-and-Improvement-Project-P170873.pdf
[13] https://www.aiib.org/en/projects/details/2020/proposed/India-Second-Dam-Rehabilitation-and-Improvement-Project.html

team will support the IBRD in conducting on-site supervision and monitoring of the safeguards implementation of selected Sub-projects, in agreement with the IBRD.

E. Operational Policy on International Relations

86. **Operational Policy on International Relations (OP on IR).** Project activities are located on the tributaries of the Ganges River, the Brahmaputra River, the Barak River (or the Meghna River), the Indus River, and the Manipur River. These rivers are International Waterways within the meaning of the OP on IR. In addition to India, the other riparians are China, Bangladesh, Nepal, Bhutan, Pakistan, Afghanistan, and Myanmar.

87. Under the OP on IR, AIIB may, when co-financing with the IBRD, rely on the IBRD's assessment of the impacts of the Project on the other riparians instead of carrying out its own assessment, provided it is satisfied with the assessment capacity and process of the IBRD, and with such assessment. Under the WB's Operational Policy (OP) 7.50, Projects on International Waterways, the IBRD conducted an assessment which concluded that the Project will not involve activities that would extract water from the tributaries in excess of the capacity of the existing dams as originally designed, and that the Project will not adversely change the quality or quantity of water flows to the other riparians and will not be adversely affected by the other riparians' possible water use. On this basis, an exception to the riparian notification requirement under the WB's OP 7.50 was obtained by the IBRD on April 9, 2020. AIIB is satisfied with the IBRD's assessment capacity and process, and with this assessment.

88. Based on the IBRD's assessment, AIIB has determined that the OP on IR's exception to the notification requirement applies, since the Project is expected to have minimal or no effect on any of the other riparians.

F. Risks and Mitigation Measures

89. AIIB assigns a High overall risk rating to the proposed project, as summarized below.

Table 4. Summary of Risks and Mitigating Measures

Risk Description	Assessment Ratings (High, Medium, Low)	Mitigation Measures
Technical design. Risks are related to the size and scope of the project, the inherent risks associated with the safety of dams, and the limited experience with dam safety for the States that did not participate in DRIP-1.	High	The project design incorporates lessons learned from DRIP-1. It adopts an established and tested risk assessment and classification system in line with the GPN/Technical Notes on Risk-Informed Dam Safety Management under the ESF (IBRD, October 2020). Structural and non-structural rehabilitation measures will be assessed

		and prioritized in PSTs that consider the relevant options and are based on thorough hydrological, structural stability, geo-technical, geophysical, and bathymetric studies. Cross-learning among PIEs will be facilitated.
Institutional capacity. The implementing agencies have varying capacities with limited inter-agencies coordination in the past	High	The project adopts institutional strengthening as one of its central features, this includes building capacities in a wide range of areas related to dam safety. Implementation arrangements have been designed to facilitate coordination across agencies involved in implementing the project. Peer-to-peer learning between States will also be promoted.
Fiduciary.	High	The requisite financial management system assessments for new PIEs have been conducted and measures for strengthening capacity have been agreed with timelines. The procurement rating under the ongoing DRIP-1 is Moderately Satisfactory. The IBRD has carried out the requisite procurement system assessments, focusing on capacity and risks and identified remedial measures (to be elaborated in the final review)
Environmental and Social. Due to uncertainties regarding the nature and extent of environmental and social impacts of future dam rehabilitations. Some of the dam investments/sub-projects are yet to be determined, of which their environmental and social	High	An ESMF has been prepared, which details the processes to be adopted each stage of the dam investment/sub-project cycle, i.e., from screening proposed activities and identifying the nature of environmental and social impacts and risks to identifying and preparing the appropriate mitigation instruments, along with commensurate capacity-building measures for effective management of environmental and social risks and impacts.

impacts will be known only once ESIAs are carried out. The capacity of PIEs (i.e., the CWC and participating States and agencies) is assessed as Low, requiring capacity strengthening.		Trainings will be conducted in the early stages of implementation to prevent issues related to poor monitoring and noncompliance with safeguards reporting requirements, as observed in DRIP-1. Further, all PMUs will be assisted by qualified PMC ES specialists who will monitor overall project implementation
Macroeconomic. India's GDP growth has slowed in the past three years, and the COVID-19 outbreak is expected to exacerbate the slowdown with the economy contracting in FY2020. On the fiscal side, budget deficit is expected to widen in FY2020 among GOI and participating States, due to a reduction in revenues, as well as higher spending needs. However, the counterpart funding requirement is modest as a share of state expenditures, which provides reassurance of its availability.	Medium	The project will contribute to economic recovery, and subsequent growth. In the short-term, it will support jobs and income through rehabilitation/construction works, which will trickle down to other sectors. In the long-term, operationally-efficient and structurally-safe dams will be central in providing services key to developing and sustaining the economy, i.e., irrigation, water supply and hydropower, especially given the importance of the agriculture sector in India (employing 47% of the country's labor force and generating 16% of GDP). The project includes PER aimed to improve the efficiency and effectiveness of States/agencies budgets planning and utilization. It will also explore and pilot additional revenue-generating streams in dams (e.g., fisheries, tourism, etc.) which can contribute to the fiscal condition.

Annex 1: Results Monitoring Framework

Table 1. Result Monitoring Framework: Targets, Frequency and Responsibility

Project Objective:	To increase the safety of selected dams in participating States and to strengthen dam safety management in India										
Indicator Name	**Unit of measure**	**Base-line** (in 2020)	**Cumulative Target Values**						**End Target**	**Frequency**	**Responsibility**
			2022	**2023**	**2024**	**2025**	**2026**	**2027**			
Project Objective Indicators:											
1. Project dams with a satisfactory post-intervention inspection by a third party Quality Assurance and Quality Control Team	%	0	10	20	30	50	70	90	100	Biannual	CPMU
2. Project dams with an Emergency Action Plan prepared in consultation with communities and disseminated	%	13	20	30	40	50	70	90	100	Biannual	CPMU
3. Project States with full score in Institutional Modernization Index	%	0	0	0	20	30	40	50	60	Biannual	SPMU
Intermediate Results Indicators:											
1. Project dams with revised dam flood hydrology assessed	%	0	80	90	100	100	100	100	100	Biannual	CPMU
2. Project dams with requisite instrumentation in place	%	0	20	30	40	50	70	90	100	Biannual	SPMU
3. Project dams with updated O&M manuals	%	13	20	30	40	50	70	90	100	Biannual	SPMU

Project Objective:	To increase the safety of selected dams in participating States and to strengthen dam safety management in India										
Indicator Name	**Unit of measure**	**Base-line** (in 2020)	**Cumulative Target Values**						**End Target**	**Frequency**	**Responsibility**
			2022	**2023**	**2024**	**2025**	**2026**	**2027**			
4. Project dams with operational rule curves operationalized	%	0	0	10	20	30	40	50	50	Annual	SPMU
5. Improved ability (structural or non-structural) to safely cater for the design flood	%	0	10	20	30	50	70	90	100	Annual	SPMU
6. People trained on dam safety	Number	0	250	500	750	1,000	1,500	2,000	2,500	Biannual	CPMU
7. Center of Excellence functional	Yes/ No	No	No	No	Yes	Yes	Yes	Yes	Yes	Biannual	CPMU
8. Project Dams with full data entry in DHARMA	%	5	50	70	80	90	100	100	100	Biannual	CPMU
9. National Dam Asset Management System established	Yes/ No	No	No	No	Yes	Yes	Yes	Yes	Yes	Biannual	CPMU
10. Project Dams with Asset Management Plans prepared	%	0	10	15	25	30	40	50	50	Biannual	CPMU
11. Large dams in participating States that have been categorized using the Tier RACF	%	0	50	70	80	90	100	100	100	Biannual	SPMU
12. Project dams with annual maintenance budget developed based on asset management system and plan	%	0	0	5	10	20	30	40	50	Bissannual	CPMU

Table 2. Result Monitoring Framework: Indicators' Definition, Data Source and Collection

Indicator Name	Definition/Description	Data Source	Methodology for Data Collection
Project Objective Indicators:			
1. Project dams with a satisfactory post-intervention inspection by a third party Quality Assurance and Quality Control Team	A third party Quality Assurance and Quality Control team will reinspect each dam after completion of project-sponsored interventions to confirm that the recommended dam safety interventions in the pre-intervention DSRP report have been satisfactorily carried out. The criteria and score that a dam should achieve to qualify for "satisfactory" will be determined by the team. The team will be a panel of experts and/or agencies appointed by MJS and CWC within one year of effectiveness.	Record of post-intervention Quality Assurance and Quality Control Team reports received	Post-intervention DSRP report will be sent to CWC/CPMU
2. Project dams with an Emergency Action Plan prepared in consultation with communities and disseminated	A dam Emergency Action Plan (EAP) will be prepared in consultation with key State government offices and other stakeholders as specified in the CWC Guidelines for Developing EAPs for Dams. The existing EAP Guidelines will be revised to include a standardized format/ procedure for EAP stakeholder consultation. The most critical elements of the EAP relevant for local communities and their part of emergency actions – such as community level warning	EAP completion notifications, Websites of dam owner/ operator and the DSO	CPMU will be notified upon completion of EAP development (via CWC) and will verify if it is available online.

Indicator Name	Definition/Description	Data Source	Methodology for Data Collection
	systems/procedure, evacuation procedure/ routes, etc. must be disseminated in appropriate formats to stakeholders and communities (e.g., leaflets, brochures, online). The EAP must be disseminated with all disaster management agencies and other concerned stakeholders related to disaster management.		
3. Project States with full score in Institutional Modernization Index	The dam safety institutional modernization index is comprised of the following binary sub-indicators: (i) DSO works with a multi-disciplinary DSRP that includes expertise in dam design, hydrology, hydro-mechanical engineering, and geology; (ii) DSO offers an induction training that this taken by all new technical staff and includes a module on dam safety; (iii) staff retention rates in SPMU during project implementation improvement relative to DSO retention rate before project implementation; and (iv) DSO offers surveillance training to dam owners. The full score is calculated by summing the score for each sub-indicator. Accordingly, full score on the index is 4.	Progress Reports	Surveys
Intermediate Results Indicators:			

Indicator Name	Definition/Description	Data Source	Methodology for Data Collection
1. Project dams with revised dam flood hydrology assessed	Revised dam flood hydrology study must be approved by CWC	Revised hydrology report	Revised hydrology report approvals will be recorded in MIS
2. Project dams with requisite instrumentation in place	Requisite instrumentation is defined in national instrumentation guidelines and the dam's approved instrumentation plan	Dam Safety Units	Progress report
3. Project dams with updated O&M manuals	O&M manual requirements are defined in national guidelines	Dam Safety Units	Progress report
4. Project dams with operational rule curves operationalized	Operational rule curves must be included in the O&M manuals. They will be considered operationalized if water levels are managed in accordance with the rule curves as evidenced by water level records.	Water level records	Dam owners share water level records with DSOs
5. improved ability (structural or non-structural) to safely cater for the design flood.	Each dam's ability to pass the design flood will be assessed by the DSRP initially and the Quality Assurance and Quality Control team ex-post.	DSRP reports and Final Quality Assurance and Quality Control team report	Dam safety assessment by DSRP and Quality Assurance and Quality Control team
6. People trained on dam safety	The number of individuals who work in dam safety (dam owners, operators, agencies that have oversight on dam safety, and policy makers) who attend training, conferences, or study tours related to dam safety.	DRIP-2 MIS	Enrollment in project-sponsored capacity building activities will be administered through the project MIS.
7. Center of Excellence functional	The Center of Excellence will conduct R&D will be considered functional once it provides the first training for dam safety professionals.	Progress Report	Progress Report

Indicator Name	Definition/Description	Data Source	Methodology for Data Collection
8. Project Dams with full data entry in DHARMA	All relevant inventory fields must be entered for the dam in DHARMA	DHARMA report	DHARMA report
9. National Dam Asset Management System established	The asset management system is a tool to inventory dam assets and estimate funds that would be required for meeting all the needs of the dams (regular O&M and rehabilitation) over a multi-year period.	Progress reports	Progress reports
10. Project Dams with Asset Management Plans prepared	Asset Management Plans will be completed using the national Dam Asset Management System. Dams must have O&M manual, EAPs and DHARMA data entry complete and consistent with the system.	Dam Asset Management System	Dam Asset Management System report
11. Large dams in participating States that have been categorized using the Tier RACF	All large dams in participating states will be indexed using the risk indexing tool (RACF Tier 1) being developed under the project	RACF Tier 1 Results	Progress Report
12. Project dams with annual maintenance budget developed based on asset management system and plan	The dam annual maintenance budget developed based on operation and maintenance requirements will be prepared in line with national guidelines and using the asset management system developed under the project.	Dam budget completion notification	Dam budget completion notification will be sent to CWC

Annex 2: Detailed Project Description

1. DRIP-2 focuses on: (i) upgrading and modernizing dam operation and maintenance, with accompanying institutional strengthening for safe and financially sustainable dam operations; and (ii) physical and technical dam rehabilitation and improvement.

2. The project has five components: (i) rehabilitation and management planning for dams and associated appurtenances to improve dam safety and reduce the likelihood and consequences of dam failures; (ii) dam safety institutional strengthening; (iii) risk-informed asset management and innovative financing for sustainable operation and maintenance of dams; (iv) project management; and (v) contingent emergency response component (CERC).

3. The interventions will be implemented in the States of Chhattisgarh, Gujarat, Kerala, Madhya Pradesh, Maharashtra, Manipur, Meghalaya, Odisha, Rajasthan, and Tamil Nadu, and at the national level through the CWC. Other States/agencies may be added during project implementation.

Table 1: Indicative Project Financing by State and agency (USD, millions)[1]

State/agency	Total Project Cost	IBRD (including FEF)	AIIB (including FEF)	Counterpart
Chhattisgarh	18.58	6.50	6.50	5.57
Gujarat	55.88	19.56	19.56	16.76
Kerala	43.30	15.16	15.16	12.99
Madhya Pradesh	76.97	26.94	26.94	23.09
Maharashtra	131.31	45.96	45.96	39.39
Manipur	43.44	17.38	17.38	8.69
Meghalaya	61.60	24.64	24.64	12.32
Odisha	13.97	4.89	4.89	4.19
Rajasthan	70.27	24.59	24.59	21.08
Tamil Nadu	148.63	52.02	52.02	44.59
CWC	49.46	12.37	12.37	24.73
Total	**713.41**	**250.00**	**250.00**	**213.41**

4. The number of dams that have been proposed under DRIP-2 is provided in the table below.[2] It is possible that during project implementation, a few dams will be substituted by dams that are found to be of higher priority for rehabilitation and improvement. The dam safety RACF that will be operationalized under the project will inform this process (refer to Component 3).

Table 2: Number of Dams Proposed Under DRIP-2[3] (as of November 10, 2020)

State/agency	No. of Large Dams	Indicative Number DRIP-2 dams
Chhattisgarh	248	3

[1] The allocations are indicative only. The actual financing allocations, and/or the number of States/agencies, may change over the project period depending on the final list of approved investments under each State/agency and the performance of the participating State/agency.

[2] Note that some of the dams (e.g., in Kerala) are part of a cascade of dams with more than one dam constructed in the same basin. For the purposes of DRIP-2, such a complex is considered as one dam.

[3] The table lists number of dams owned by the participating States/agencies. The project funds are estimated to be sufficient to rehabilitate approximately 120 dams.

Gujarat	620	7
Kerala	61	22
Madhya Pradesh	899	9
Maharashtra	2069	167
Manipur	3	2
Meghalaya	8	6
Odisha	199	13
Rajasthan	209	189
Tamil Nadu	116	59
TOTAL	**4432**	**477**

Component 1: Rehabilitation and Management Planning for Dams and Associated Appurtenances

5. This component aims to reduce the likelihood and consequences of dam failure by improving dam safety planning, management, and rehabilitation in selected dams. This component will support both structural and non-structural interventions.

6. **Selection of Dams:** The list of proposed project dams has been selected by the PIEs based on the existing periodic inspections criteria in the Dam Safety Manual of the Republic of India. The criteria vary by State/agency and can include dam dimensions, potential hazard, and the physical condition of the dam and appurtenances, in addition to strategic importance. The first set of dams that will be taken up under this component has been identified by the States/agencies. They have been approved by CWC following a well-established quality assurance process that enables PSTs and feasibility studies for the dams to meet pre-established technical standards and ES standards. The process for preparing PSTs, reviews, and approval is described below. Additional dams will be identified during implementation using the same procedures; the RACF risk indexing tool will inform the selection of additional dams once it is finalized.

7. **Revised Hydrology:** After the selection of dams, the respective PIE is required to carry out a study for revised hydrology as per the Guidelines provided by CWC and produce a report. This report must be approved by CWC. The procedure for calculation of flood flows and volumes for spillway capacities at dams is detailed in Bureau of Indian Standard (BIS) IS-11223 (1985) 'Guidelines for Fixing Spillway Capacity,' revised in 1991 and in 2004. The methodology is based on probable maximum precipitation, which is in turn determined by historical precipitation time series. The BIS classifies the inflow design flood according to storage volume, using the static head at full reservoir level (FRL) and gross storage of the dam as described in the table below.

Table 3: Classification System

Classification	Gross Storage Volume (million m^3)	Full Reservoir Level (m)	Design Flood to be Applied
Small	0.5 to 10	7.5 to 12	100-year flood
Intermediate	10 to 60	12 to 30	Standard project flood
Large	Greater than 60	Greater than 30	Probable maximum flood

8. Many dams, particularly the older ones, have computed design floods that are inadequate according to new standards. Moreover, downstream conditions have changed with many developments taking place during the last few decades. Hydrological assessment of all selected dams will be conducted to review the adequacy of the design flood using any more recent hydrological data available after dam construction. During DRIP-1, the hydrological review was the most time-consuming process during project implementation. Therefore, for DRIP-2, it has

been confirmed that hydrological reviews are completed on a timely basis; several dams have already completed revised hydrology.

9. After the hydrological reviews are completed, a technical inspection is carried out by the DSRP as per the inspection guidelines provided by CWC. After the inspection, the DSRP submits a report providing the current status of dam health and listing all structural and non-structural interventions required, including recommendations for any additional studies required.

10. **Preparation and Approval of PSTs: DSRP**-recommended interventions are documented in PSTs or feasibility reports, which describe the dam rehabilitation plans and provide the basis for preparing bid documents. PSTs must be cleared by: (i) IA PMU; (ii) CWC; and (iii) the IBRD (through no objection) prior to the preparation of tender documents. The proposed activities at a dam must be in accordance with all relevant IBRD's policies, including the ESF and OP 7.50 - Projects on International Waterways.

11. **Additional Investigations:** Interventions and required additional studies for selected dams are identified based on the recommendations of the DSRP. The DSRP report can also recommend additional investigations that could be supported by this component such as: systematic hydrological assessments, stability analyses, seismic assessments, geo-technical studies, geo-physical surveys, bathymetric surveys, LIDAR surveys and dam break analyses, seepage studies, water quality studies, and climate change assessments. Once the results of the RACF risk indexing are available, they will also inform the required interventions, technical support, and quality assurance needed.

12. **Project Investments:** On the basis of DRIP-1 implementation and DRIP-2 PSTs submitted by the PIEs, typical problems commonly observed in dams that need remedial works include: (i) under-designed spillways; (ii) seepage boils and leakage downstream of earth dams; (iii) deformity and erosion of upstream and downstream slopes, including slope sloughing/slips, and erosion of abutments and settlement and cracks along dam crests; (iv) excessive seepage through masonry dams; (v) cracks and pitting in concrete and masonry spillways and outlet gate structures and erosion of energy dissipation systems and spill channels; (vi) malfunctioning of dam monitoring instruments due to aging as well as lack of maintenance; (vii) malfunctioning of hydromechanical equipment and associated control systems (viii) malfunctioning foundation drainage systems; and (ix) significant loss of storage due to heavy siltation in few dams. Therefore, DRIP-2 will include, but not be limited to, such works as:

- Measures for seepage reduction (e.g., grouting, raking and pointing, guniting and shotcreting, geomembranes)
- Rehabilitating foundation deficiencies
- Strengthening dam concrete/embankment structures
- Hydrological and structural safety measures (e.g., strengthening existing spillways, additional fuse plugs, sluice repairs, flush bars); electrical and mechanical improvements (e.g., gates and hoists, dewatering pumps, generators, electrical work); and basic dam facilities (e.g., access roads, control rooms, etc.). Improvements to basic facilities will include clean and separate sanitation facilities for women.
- Improved dam safety instrumentation (pore water pressure gauges, automatic water level recorders, pendulums, data loggers, climate stations, etc.) to monitor and record structural behavior, displacements, seepage and related hydro-meteorological and seismic factors to forewarn dam operators of possible risks, as well as provision of software for analysing and evaluating data generated by the dam instruments
- Improved communications between dams and control offices, as well as with civil authorities in flood plains downstream of the dam

- Structural strengthening of dams to withstand higher earthquake loads
- Re-modelling earth dams to safe, stable cross-sections
- Improving internal and external dam drainage, including toe drains and installation of seepage measuring devices
- Developing systems for integrated reservoir operations, especially for integrated flood management
- Sediment management works if recommended by the DSRP and after preparing a sediment management plan based on technical, economic, social and environmental assessments.
- Basic instrumentation and the development of additional systems to detect and respond to risks promptly, such as flood forecasting systems, early warning systems, data management and analysis software, and standardized dam safety instrumentation and Supervisory Control and Data Acquisition (SCADA).

13. Based on the experiences of DRIP-1 and the PSTs that have been prepared for DRIP-2, the majority of the structural interventions are not expected to have major social or environmental impacts. Should dams that are identified later in the project require major rehabilitation works, structural interventions that minimize social and environmental impacts will be prioritized. The project will not involve activities that alter existing water allocation or adversely change the quality or quantity of water flows from the existing dams as originally designed.

14. Due to topographical and/or structural constraints, it is often difficult to increase the capacity of an existing spillway to suit the revised design flood. In such cases, routing trials could be carried out for the identification of lower reservoir levels during the flood season. Even this, in some cases, is found to be costly and unviable in terms of lost power and irrigation benefits. Other options that could be considered for the safe reservoir operation could include: (i) pre-release of stored water at maximum rate considering downstream river conditions and with adequate flood warning; (ii) lowering the spillway crest level and using fuse gates or other spillway control systems; (iii) building flood control retention basins upstream or downstream; and (iv) enhanced resilience against overtopping of the dam. For each dam under DRIP-2, the best option for the safe discharge of water during floods will have to be determined. If the maximum water level in the reservoir is computed to be increased during the revised floods, structural stability analysis must be conducted to check the stability of the dam against the increased design flood and the safety of the structure must be confirmed. The required freeboard will also be checked and secured with remedial measures, such as the installation of parapet walls.

15. Before any rehabilitation and improvement works are undertaken on a dam in a seismically active zone, the stability of the dam will be checked using the latest seismic parameters applicable to the location of the dam. The works proposed under DRIP-2 are aimed at improving the safety of dams and reservoirs under specified seismic conditions. It will not be necessary to carry out separate studies for the formulation of ‘site-specific seismic parameters’ of the identified dams. However, inputs from studies available for recent dams constructed in the same geological locations will be taken into consideration for the finalization of the seismic parameters of project dams.

16. For each dam included in DRIP-2, a comprehensive history of the dam will be compiled during the design of the interventions, including a description of construction problems, geological conditions, as-built drawings, design calculations, details of any modifications made, and records of performance, including inflows and outflows, reservoir levels, rule curves, seepage, leakage, movement, settlement and pore pressures.

17. **Development of EAP and O&M Manual:** Every dam taken up under the project will be required to develop an EAP, an O&M Manual, and an instrumentation plan. The O&M Manual must include dam health monitoring and reporting protocols and updated operational protocols to minimize the risk of downstream flooding. For the preparation of EAP and O&M Manuals, the Guidelines for Developing EAPs for Dams and Guidelines for preparing O&M Manuals for dams should be followed.

18. DSRPs will re-inspect each dam after completion and confirm that the recommended dam safety interventions have been satisfactorily carried out. If the DSRP is not satisfied with the interventions, it will recommend remedial measures to be studied and executed by the dam owners. DSRPs will also provide independent review and advice on the quality of the design and execution of rehabilitation/safety improvement measures during project implementation in a manner that is proportionate to the potential risk of each dam. The standardized TOR for DSRPs that have been approved by the IBRD can be adjusted by respective States/agencies with the approval of the IBRD.

Component 2: Dam Safety Institutional Strengthening

19. This component aims to strengthen the capacities and institutional framework for dam owners, operators, agencies that have oversight on dam safety, and policy makers to identify and address dam safety risks. The component will support various activities to modernize institutions for dam safety.

20. **Establishment and strengthening DSOs and DSRPs:** This will focus on the establishment and strengthening of DSOs at Central and State levels, in addition to DSRPs, through the following activities:

- Establishing an effective and sustainable organizational structure at Central and State dam safety agencies, including staffing of DSOs and DSRPs by qualified multi-disciplinary personnel (in accordance with standardized TOR for DSRPs)
- Developing guidelines and monitoring and reporting protocols aimed at strengthening the consistency, efficiency, and proper oversight of dam safety management
- Capacity development for DSOs and developing Standing Operating Procedures (SOPs)
- Preparing and training DSO staff and of other public emergency and rescue agencies for dam safety emergency situations
- Obtaining necessary equipment and facilities to fulfill functions of DSOs and DSRPs, including the construction of offices, furnishing, office equipment, vehicles, software, etc. Any facilities financed by the project will be required to have clean and separate sanitation facilities for women

21. **Strengthening dam safety research and development (R&D) capacity:** This will focus on developing R&D facilities and knowledge exchange through national and international knowledge sharing, including:

- Establishing a Center of Excellence on dam safety to address gaps in dam management capacity and R&D for dam safety in the Indian context, including investments for the construction of buildings, furnishing, hiring of experts and manpower, software and hardware requirements and operational needs
- Supporting R&D related to dam safety, supporting complex individual dam health assessments, and building the capacity of dam safety professionals, including in advanced dam safety sciences
- Collaborating with national and international organizations and research institutions (such as the International Commission on Large Dams / ICOLD, United States Bureau of

Reclamation, United States Army Corps of Engineers, universities, etc.) to act as a conduit for attracting international knowledge on dam management and safety to India and to benefit non-DRIP-2 States/agencies as well
- Supporting national and international conferences on dam safety and related topics to exchange experience and learn best practices in the Indian context and globally

22. **Capacity building program:** This will support a comprehensive and gender-inclusive capacity building program on dam safety for dam owners, operators, agencies overseeing dam safety, and policy makers based on a detailed institutional needs assessment. This will result in improved management and enhanced safety of large dams, improved maintenance and operational efficiency of the dams, and sustainable institutional arrangements for effective dam safety management. Activities will include, but not be limited to:
- Conducting a detailed institutional needs assessment/gaps analysis to identify priority areas for capacity building programs, integrating the lessons learned from DRIP-1
- Confirming that capacity building opportunities are available in all fields of dam safety including design and construction, surveillance during operation, maintenance, emergency preparedness and management
- Developing and strengthening dam safety curricula at universities, engineer induction programs and other training programs
- Developing continuing education initiatives, including workshops on specialized topics, conferences with international experts, internships, and domestic or international study tours
- Confirming that personnel of dam safety units and of DSOs are adequately educated and trained in surveillance during operation, including the interpretation and analysis of visual observations and monitoring measurements as well as in the ensuing risk-informed safety assessment
- Providing access to and training in analysis software, including in hydrology, inflow forecasting, hydraulics, geotechnical analysis, structural analysis, behavior prediction modeling, dam break analysis and risk analysis and assessment
- Promoting the involvement of younger engineers in dam safety by supporting a young professional's program for dam safety in collaboration with national and international organizations, such as ICOLD
- Promoting the professional development of female dam safety engineers by supporting professional networks for female engineers in dam management and conducting training activities targeted to female engineers
- Supporting Central and State PIEs' capacity development activities with the provision of office equipment, training equipment and vehicles necessary to conduct targeted training of staff
- Linking capacity development programs with advanced dam safety programs in countries such as the United States, Japan, China, Canada, Australia and Switzerland, including by promoting university partnerships

23. **Education and communications capacity:** This will support dam safety institutions to improve education and communications capacity to raise awareness on dam safety issues and communicate dam safety risks to the public. This will include capacity development for communications staff and the development of websites, pamphlets, posters etc. to share information about dam safety, such as the results of the dam safety risk assessment described in Component 3 and dam safety reports as stipulated in the Dam Safety Act. This component will also support public consultations for every EAP developed under the project and mock drills for selected dams in consultation with the State Disaster Management Authorities.

Component 3: Risk-informed Asset Management and Innovative Financing for Sustainable Operation and Maintenance of Dams

24. This component aims to develop a comprehensive asset management system and risk assessment framework, identify long-term funding needs and determine the required regular O&M budget. It will also focus on identifying and developing sustainable sources of funding through strengthened financing arrangements, revenue generation and improving the efficiency of public financing.

25. **Identification of financing needs for dam safety:** Currently, expenditures needed for dam maintenance are allocated based on seasonal (pre and post-monsoon) inspections. The project will support a longer-term needs-based approach through asset management and risk assessment. This component will put in place systems to improve the identification of financing needs for dam safety.

26. The development of the asset management system will build on the Dam Health and Rehabilitation Monitoring Application (DHARMA) that was supported under DRIP-1. DHARMA allows a systematic presentation and interpretation of data for effective monitoring of the health of dams. The focus during DRIP-1 was on the development of remaining modules and operationalizing the system. DHARMA licenses have been given to 25 dam-owning agencies. Currently, DHARMA, has a basic inventory of more than 5000 large dams and a more comprehensive record for 1,485 dams.

27. Under this component, CWC will review the existing system and determine if the asset management system can be built into DHARMA or whether it would more appropriately be developed as an independent system with initial inputs from DHARMA. This activity will focus on developing tools, meeting software and hardware requirements, and hiring consultancies for developing, operating and maintaining the asset management system. The component will help operationalize a systematic dam RACF that the CWC is currently preparing in consultation with the States. This standardized asset management system and risk assessment framework will help in improved quantification and prioritization of dam rehabilitation needs through the identification of long-term funding needs for the sector and trade-offs related to investment decisions.

28. **Sustainable Financing:** Currently, the financing of dam safety and O&M is far from adequate and de-linked from dam performance and revenue streams. Water infrastructure is typically financed from State/agency general budgets without specific earmarking for dam assets, often resulting in a financing gap for O&M and dam safety. This component will study and support the development of more sustainable sources of funding through strengthened financing arrangements by improving the efficiency of public financing and establishing financing arrangements for dam safety (e.g., dedicated budget lines).

29. Under this component, PERs will be conducted for all participating States/agencies and alternative sources for generating revenue streams, such as tourism and water recreational activities, fisheries, and other innovative schemes such as floating solar panels will be explored. Some States, such as Maharashtra, Karnataka, and Gujarat, are already exploring such avenues. The dams on which such alternative revenue-generating sources could be piloted have not yet been selected. The selection of dams will be based on in-depth studies to determine potential, feasibility, social and environmental impacts, etc. In pilot cases, arrangements will be explored to enable revenues to flow back to the dams themselves and, to the extent possible, crowd-in private sector financing. The component will finance feasibility studies for such revenue options and

interventions for selected pilot dams, in collaboration with other relevant line departments such as tourism, agriculture, power, fisheries, etc. In addition, studies on repurposing dams could also potentially be supported under this component. Synergies will be established with some of the ongoing or future energy projects piloting floating solar panels in India.

Component 4: Project Management

30. This component will support effective implementation of project activities and monitoring and evaluation of project implementation progress, outputs, and outcomes.

31. The overall responsibility for project oversight and coordination will rest with the DSO in CWC, which will act as the Central Project Management Unit (CPMU). The Chief Engineer of the DSO will be the Project Director (PD) and will be assisted by the Directors, staff of their respective directorates, individual consultants, and an Engineering and Management and Consultant (EMC) that will provide a team of consultants for managerial, technical, fiduciary, ESF, and M&E support. The firm will have extensive experience in terms of international practices in project management, dam design practices, and construction supervision. The scope of the services will include assisting the PD with the day-to-day responsibilities of project management and implementation including: (i) planning and management of the project, including monitoring physical and financial progress, and preparing annual work plans and regular progress reports; (ii) vetting of hydrological analyses and advising on the options to cater for the increased design floods, where applicable; (iii) checking if the design of engineering works is technically sound; (iv) providing third-party construction supervision and quality control to confirm works are implemented to internationally acceptable standards; (v) advising on dam safety institutional strengthening measures; and (vi) supporting the development of EAPs and O&M Manuals.

32. Each PIE will appoint a PD and Project Management Unit (PMU) attached to the Chief Engineer / Superintending Engineer in charge of the DSO. The PD and its team of State government staff and consultants will have direct responsibility for the project's coordination and management

33. The component will support:

- Operationalizing the CPMU, which will oversee and coordinate activities of the PIEs of the project, supported by the EMC)
- Operationalizing PMUs within PIEs, which can hire experts in various fields as and when needed on a contractual basis
- Setting up a monitoring and evaluation (M&E) system at both Central and State/agency levels
- Establishing a Quality Assurance and Quality Control system that is based on proportionate risk as defined in the Good Practice Note / Technical Notes on Risk-Informed Dam Safety Management under the ESF
- Establishing a Management Information System (MIS) for the project and development and maintenance of project websites / mobile apps
- Consultancies, as well as related material, office equipment and incremental operating costs for the CPMU and PMUs, based on annually approved budgets and works plans

Component 5: Contingent Emergency Response Component

34. This component allows the provision of immediate response to an Eligible Crisis or Emergency, as needed. For example, following an adverse natural event that causes a major natural disaster, GOI may request the IBRD and AIIB to re-allocate project funds to support

response and reconstruction. This component would draw resources from the unallocated expenditure category and/or allow GOI to request the IBRD and AIIB to re-categorize and reallocate financing from other project components to partially cover emergency response and recovery costs. This component could also be used to channel additional funds should they become available as a result of the emergency.

35. Disbursements would be made against a positive list of critical goods or the procurement of works, and consultant services required to support the immediate response and recovery needs. All expenditures under this component, should it be triggered, will be in accordance with IBRD's Policy Investment Project Financing (IPF Policy) and will be appraised, reviewed and found to be acceptable to the IBRD before any disbursement is made. In accordance with the IPF Policy, this component would provide immediate, quick-disbursing support to finance goods (positive list agreed with GOI), works, and services needed for response, mitigation, and recovery and reconstruction activities. Operating costs eligible for financing would include the incremental expenses incurred for early recovery efforts arising as a result of the major impact of the natural or man-made crises or disasters. A CERC manual will be agreed with GOI and included as an annex in the PIM.

36. Goods, Works, and Services under this component would be financed based on a review of satisfactory supporting documentation presented by GOI, including adherence to appropriate procurement practices in an emergency context. All supporting documents for reimbursement of such expenditures will be verified by the CWC, certifying that the expenditures were incurred for the intended purpose and to enable a fast recovery following the damage caused by an adverse health crisis or natural events, before the Application is submitted to the IBRD and AIIB. This verification should be sent to the IBRD (who will conduct the verification on AIIB's behalf) together with the Application. These payments will be audited as per agreed arrangements.

Annex 3: Economic and Financial Analysis[1]

A. Economic Analysis

1. The economic analysis is based on a portfolio assessment of approximately 90 dams that are representative of the kind of dams whose rehabilitation work would be financed under DRIP-2. These dams are located across 10 states and cover a diverse range of dams including dams that are used for hydropower, storing water for irrigation of agricultural fields, fisheries, flood control and play an important role in providing water in urban areas.[2] The proposed project by improving the safety of selected dams in participating states will benefit (a) communities that live in dam breach flood inundation areas, (b) farmers and agricultural laborers who depend on irrigated agriculture, (c) rural and urban population accessing basic water supply services that are critical for water, sanitation and hygiene interventions, and (d) communities accessing power generated by the dams. In addition to benefiting various communities, the project will also avoid potential flood damage to houses, farm areas, infrastructure (roads, bridges, and other public and private infrastructure) and industrial and commercial facilities. Improved dam safety will also reduce the likelihood of service interruptions due to dam failure.

2. **Methodology:** The economic analysis of the project is conducted through a series of steps. First, the various hazards that can harm or damage the dam were assessed. In this analysis, the focus is on hydrological hazard assessment, where hydrologic loading refers to the ability of the sub-project to pass extreme flood events through spillway capacity, reservoir storage and flood attenuation, or structural integrity to manage some degree of overtopping.[3] Hydrological hazards contribute to most dam failures globally and can be inferred from global hydrologic datasets and modeling applications.

3. The hydrologic hazards assessment at all dams included the following steps:
   a. Statistical analysis of global precipitation data products[4] to create watershed specific precipitation-frequency curves for the portfolio.
   b. Creation of HEC-HMS[5] hydrologic models for each project using an automated process, including regulation at significant upstream reservoirs.
   c. Sampling of precipitation and execution of hydrologic models to create inflow, outflow, and stage annual exceedance probabilities (AEPs) for each project – these provide an estimate of the annual probability of hydrologic loading at each site.
   d. Given the previous non-breach assessment and outflow, a breach hydrograph at peak pool for each site was generated and used for the consequences' assessment.

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[1] This section is based on World Bank's Project Appraisal Document PAD3729 Second Dam Rehabilitation and Improvement Project

[2] Based on indicative pipeline. Actual financing allocation may change over the project period based on the final list of approved investments and the performance of the participating State/agency.

[3] The other two types of hazards include static loading which focuses on the general stability of the sub-project under 'normal' conditions, including structural integrity, foundation integrity, and resistance to piping failures under normal headpond conditions and seismic loading, which is the ability of the structure to maintain integrity during vertical or horizontal ground acceleration from an earthquake.

[4] https://www.ecmwf.int/en/forecasts/datasets/reanalysis-datasets/era5

[5] https://www.hec.usace.army.mil/software/hec-hms/

4. Simplified relationships were used for the other hazard conditions based on the best consistently available data (i.e., specific projects may have a seismic study completed, but this is not widely available across the portfolio of dams).

5. The second step involves assessing the response of the dam to a given hazard and the probability of failure under such conditions. The implementation of the interventions under DRIP-2 is expected to reduce the sub-project's fragility and increase its durability. The evaluation of the probability of failure based on sub-project salient features[6] and conditions and site-specific assessments were challenging given that the assessment was conducted at a portfolio scale. The data from Project Screening Template (PST) were used to extract estimates of conditions and potential interventions. However, the information from PST was not available for the entire portfolio of dams assessed and alternative sources like existing knowledge, site visits and other sources were used to make the assessment at the broader level. Similarly, estimates of the types of interventions applied under DRIP-2 were applied to the portfolio to demonstrate the reduction in fragility from pre- to post-intervention for each dam investment/sub-project. Although there are limitations to this approach, given the lack of consistent availability of data across all sites, the reductions in risk using this process are well-documented, justified, and consistent across the portfolio.

6. The final step is to evaluate the consequences of the dam failure and assess the benefits from avoided dam failure. With a non-breach and breach condition at each dam, it is possible to assess the potential direct consequences downstream, including life loss and economic impacts. In this analysis, the consequence is focused on direct impacts via the breach wave, although additional indirect consequences such as avoided hydropower loss, irrigation benefits, avoided fisheries loss, are also included. The assessment for each dam for direct impact includes:

a. Development of a 2D HEC-RAS[7] hydraulic model for each dam using an automated process, upon which the breach model wave determined from the hydrologic HEC-HMS routing was applied.
b. Extraction of the spatially distributed peak depth from each breach wave routed on the digital terrain model[8] for a minimum distance of 100km downstream of the dam.
c. Intersection using GIS of inundation extents with key parameters of interest, including:
    - Gridded global population to obtain Population at Risk (PAR)[9], converted to life-loss estimate using a constant conversion factor of 2 percent.
    - High-resolution global cropland dataset[10] for crop area impacted by the breach wave, merged with district-level crop type yield estimates[11].
    - Global settlement data[12] for estimates of downstream breach wave structural impacts.

7. Additional indirect benefits from the project include
a. Avoided hydropower generation loss based on historical generation amounts and prices.

[6] http://www.cwc.gov.in/national-register-large-dams
[7] https://www.hec.usace.army.mil/software/hec-ras/
[8] https://hydrosheds.cr.usgs.gov/
[9] https://ghsl.jrc.ec.europa.eu/datasets.php
[10] https://lpdaac.usgs.gov/products/gfsad30saafgircev001/
[11] https://data.gov.in/resources/district-wise-season-wise-crop-production-statistics-1997
[12] https://ghsl.jrc.ec.europa.eu/datasets.php

b. Avoided irrigation supply loss for adjacent regions supplied directly from the headponds storage.
c. Avoided fishery benefits loss in the headponds.

8. Three different failure modes were considered in the analysis: seismic, general piping and stability, and overtopping. Given the absence of site-specific information, the probability of failure for seismic and general conditions was based on assumed relationships using age, dam type, and seismic zone. The overtopping headwater Annual Exceedance Probability (AEP) was estimated using the rapid screening tools developed, allowing an estimate of the annualized probability of failure. Thus, for each dam and each failure mode, an annualized probability of failure was generated.

9. The consequences were estimated at three different breach levels: sunny day full pool, top of the dam, and maximum water surface (which can be greater than the top of the dam). It was conservatively assumed that seismic and general failure modes occur at sunny-day full pool conditions. For the overtopping, given that an estimate of the headwater AEP was generated, the consequences were interpolated between the top of the dam and maximum pool consequence levels using a discrete integration approach across the AEP.

10. Total annualized consequences were described by the formula,

$$\sum_{i=1}^{N} P_i \times C_i$$

for N failure modes and consequence pairs, for each dam. Where,
P_i = probability of failure mode i
C_i = consequence i (due to failure mode i).

11. **Project Benefits.** The benefits were evaluated using an "expected value" approach, which compares the baseline pre-remediation scenario expected damages with the post-remediation scenario expected damages. The expected damages from each of these scenarios is the probability-weighted average of flood event damages with and without a dam breach, where the probabilities account for both the probability of a flood event and the probability of a dam breach if the flood event occurs. The post-remediation expected damages were then subtracted from the baseline pre-remediation expected damages to calculate the expected benefits of remediation. Under this approach, remediation generates benefits by reducing the probabilities of the failure modes.

12. The project benefits were evaluated for different sectors like (a) avoided loss due to damage to structures downstream, (b) avoided loss of hydropower generation and carbon emission, (c) avoidance of agricultural loss due to lost irrigation and flooding related crop destruction and (d) avoided lost value of fisheries emanating from the destruction of headponds.

a. Structural losses from dam breach account for the damage to the property that is located downstream of the dam. These losses include damage to residential buildings, utility infrastructures, industrial buildings, and public buildings, such as schools and hospitals including the content of these buildings. Other damages include damage to vehicles, etc. To calculate the benefits, a spatial variation in population density was accounted for by creating eight different density classes. For each of these classes, a representative area was identified and the number of structures within a 1-km^2 circle was identified. This representative building density metric was then combined with the inundation extent maps to estimate the number of

buildings impacted by flooding. Based on the household data available on the Ministry of Home Affairs website, an average density of 6 people per structure was assumed. The value of each structure was estimated (INR 200,000) and multiplied by the number of structures included in the inundation maps to arrive at total damage to structures.

b. The estimated damage to hydropower is based on the historical rates of energy generation for each hydropower facility, multiplied by an average value of electricity (INR 6 per KwH).[13] A dam failure will result in loss of hydropower capacity with it being replaced by more carbon-intensive generation units. The social costs of the resulting carbon emissions were estimated to be INR 2.69 per KwH, growing annually at a rate of 2.26 percent.[14] Dam failure would reduce hydropower capacity and result in an estimated 49,671 tons of CO2 equivalents per year.[15]
c. Avoiding dam failure yields two kinds of benefits for the agriculture sector. These include (a) avoided loss of crops due to lost irrigation; and (ii) avoided the destruction of crops downstream due to flooding. The extent of loss of crop revenues due to lost irrigation supply is estimated by calculating the annual irrigation potential area in the command area. To calculate the loss of crop revenues due to lost irrigation supply, annual irrigation potential area in the command area was reduced to exclude 50 percent of the agricultural area downstream of the flooding that was irrigated, and then it was assumed that 90 percent of the total irrigated crops in the remaining area would be lost without the irrigation water supply. The remaining irrigated area was then multiplied by the average annual revenue per hectare of agricultural land, based on district-level data.
d. Lastly, to account for the lost value of fisheries due to the destruction of headponds, the average annual fish yield of each reservoir (based on state-level data) was multiplied by reservoir size and state-level prices.

13. The average annual economic benefit from DRIP-2 activities is just under US$100 million, with a reduction of damages to structures being the largest contributor (69 percent), followed by agriculture (20 percent), reductions in greenhouse gas emissions from hydropower generation (5 percent), hydropower generation (4 percent), and fisheries (>1 percent).

14. **Project Costs.** Rehabilitation costs were collected from available PSTs, which provided 16 estimates out of the 90 dams analyzed, and other information provided for an additional 50 dams yielding cost estimates for 66 specific projects. To account for the missing cost data, physical characteristics of the dams with known costs were used to classify project sizes and assigned to missing dams. This resulted in a total portfolio cost of USD 425.05 million with the median cost being USD 1.48 million. The annualized estimates of the rehabilitation costs were obtained by assuming that rehabilitation efforts are completed in two years, followed by annually incurred O&M costs calculated at 5 percent of total rehabilitation costs.

Table 1: Costs and Benefits

[13] For hydropower units that did not have historical generation data, a linear regression model was used to predict generation capacity based on the dam height above deepest foundation level and gross storage capacity, using the DRIP-1 data set.
[14] As per Guidance Note on Shadow Price of Carbon in Economic Analysis, World Bank, 2017.
[15] Using the multilateral bank harmonized approach, which estimates a combined grid emission factor for firm power of 673 grams of CO2/KWh for India. July 2019 update to the "Harmonized Grid Emission Factor Data Set": https://unfccc.int/climate-action/sectoral-engagement/ifis-harmonization-of-standards-for-ghg-accounting/ifi-twg-list-of-methodologies

Year	Total Costs (USD Million)		Total Benefits (USD Million)	Net Benefits (USD Million)
	Capital Costs	O&M Costs		
2021	212.52	0.00	0.00	-212.52
2022	212.52	0.00	0.00	-212.52
2023	0.00	21.25	98.60	77.35
2024	0.00	21.25	98.66	77.41
2025	0.00	21.25	98.73	77.48
2026	0.00	21.25	98.80	77.55
2027	0.00	21.25	98.87	77.62
2028	0.00	21.25	98.94	77.69
2029	0.00	21.25	99.02	77.76
2030	0.00	21.25	99.09	77.84
2031	0.00	21.25	99.17	77.92
2032	0.00	21.25	99.25	78.00
2033	0.00	21.25	99.33	78.08
2034	0.00	21.25	99.41	78.16
2035	0.00	21.25	99.49	78.24
2036	0.00	21.25	99.58	78.33
2037	0.00	21.25	99.67	78.42
2038	0.00	21.25	99.76	78.51
2039	0.00	21.25	99.85	78.60
2040	0.00	21.25	99.94	78.69
2041	0.00	21.25	100.04	78.79
2042	0.00	21.25	100.14	78.89
2043	0.00	21.25	100.24	78.99
2044	0.00	21.25	100.34	79.09
2045	0.00	21.25	100.45	79.20
2046	0.00	21.25	100.56	79.30
2047	0.00	21.25	100.67	79.41
EIRR				**16.53%**
NPV @ 12% Discount Rate				**$127.61**
NPV @ 9% Discount Rate				**$270.52**

15. **Results.** To assess the economic viability of the project, the EIRR of the project is calculated. On the cost side, the upfront investment for rehabilitation and the annually incurred O&M costs are considered while benefits from avoided damages to structure, avoided crop loss due to irrigation failure and floods, avoided loss of hydropower generation, reduction in GHG emissions, and avoided a loss in fisheries are considered. The stream of costs and benefits indicates an EIRR of 16.53 percent in the base case scenario, higher than the social discount rate of 9.0 percent or 12 percent. The project yields an NPV of USD 270.52 million at a discount rate of 9.0 percent and USD 127.61 million at a discount rate of 12.0 percent. Thus, the project is found to be economically viable.

16. The baseline EIRR and the NPV is conservatively estimated due to a couple of factors. Firstly, the quantifiable benefits do not include avoided loss of life from floods due to the

complexities involved in valuing life. Secondly, it has been assumed that only 50 percent of the downstream agricultural area that was irrigated would be impacted by dam failure.

17. To evaluate the robustness of the economic viability of the project, a sensitivity analysis was undertaken. The scenarios include (a) 15 percent increase in costs, (b) 15 percent reduction in benefits and (c) both costs increasing by 15 percent and benefits decreasing by 15 percent. The resulting EIRR and NPV are given below. The EIRR remains above the discount rate when either an increase in cost by 15 percent or reduction in benefits by 15 percent is considered. It is only when both an increase in cost and reduction in benefits are considered together, the EIRR drops below 12 percent with a negative NPV.

Table 2. Sensitivity Analysis

Scenario	EIRR	NPV @ 12% Discount Rate (USD, Million)	NPV @ 9% Discount Rate (USD, Million)
Baseline	16.53%	127.61	270.52
Costs rising by 15%	13.71%	53.80	188.09
Benefits decreasing by 15%	13.27%	34.66	147.51
Costs rising by 15% and benefits decreasing by 15%	10.70%	-39.15	65.08

B. Financial analysis

18. A conventional financial analysis to assess the investment's financial viability (the calculation of the Financial Internal Rate of Return - FIRR) and the infrastructure's operational sustainability (O&M cost recovery ratio) could not be performed at the portfolio level as most of the rehabilitated dams are not generating revenue (mostly used for irrigation, without any collection of user fee). Instead, the financial analysis was undertaken for 33 dams within the portfolio that generate revenue from hydropower generation. For dams without revenue streams, an assessment was conducted to understand how the project will strengthen the dams' operational and financial sustainability.

19. For hydropower dams, the total revenue is estimated based on the dams' hydropower generation capacity (provided in the PSTs) and the price of hydropower (adjusted to account for the fact that the Indian hydropower market is highly subsidized by GOI). This price of hydropower was calculated as the average Sale of Power as approved by the Central Electricity Regulatory Commission/State Electricity Regulatory Authority Commission for hydropower in the report of GOI in 2017. Total expenditures are comprised of rehabilitation costs (assumed to incur over a period of two years) and O&M costs (will incur after the completion of rehabilitation works, throughout the dams' lifetime). Estimates of these costs are provided by the participating states and agencies in the PSTs. Financial analysis based on these estimated expenditures and revenues yielded a FIRR of 15.08 percent and an average O&M cost recovery ratio of 430 percent throughout the dams' lifetime. The analysis demonstrates that investments in rehabilitating hydropower dams under the project is financially viable; and that hydropower dams are generating a sufficient level of revenue to finance quality O&M and, therefore, support its operational sustainability.

20. For dams without revenue generation mechanisms and solely depending on the public budget for their O&M, the project will address the historical underfunding and poor planning of dams' maintenance which have undermined their safety and operational sustainability throughout

the years. This will be done by significantly strengthening the financial arrangement and capacity of the participating States and agencies through:

(1) establishing asset management system – providing a comprehensive estimate of need-based financings to meet the O&M and rehabilitation requirements of dams over a long-term period
(2) strengthened financing arrangements and planning – establishing dedicated budget lines for dam safety in all participating States; and strengthening linkages and transparency among O&M needs, O&M budgeting, dams' risk level, dams' operational performance and (potential) revenue streams
(3) improving the efficiency of public financing – conducting PERs in all participating States and agencies, with the aim of providing objective assessments on the historical efficiency and effectiveness of public spending in dam safety. Through this, the cause of budget shortages can be better understood, and potential solutions can be explored
(4) exploring and piloting the generation of additional revenue streams – exploring the feasibility of generating revenue from additional functionalities of rehabilitated dams, including tourism, fisheries, floating solar panels and other innovative schemes. Studies will be also conducted on dam repurposing's feasibility, mechanisms for channeling revenues to O&M of dams and, to the extent possible, ways to leverage private sector financing.

Annex 4: Member and Sector Context

Country context

1. The Indian economy grew at a healthy rate of 7.4 percent per annum on average between FY2014 and FY2018, but growth has been steadily slowing down in recent years. Disruptions due to the demonetization initiative in November 2016 and teething implementation issues related to the rollout of goods and services tax in July 2017 resulted in growth dropping to 7.0 percent in FY2017 and 6.1 percent in FY2018. Weak economic growth in the rural sector, sluggish external demand, and stresses in corporate and financial sector balance sheet further dented growth to 4.2 percent in FY2019. COVID-19 pandemic and the associated social distancing measures have significantly impacted growth in FY2020, with the economy contracting by 15.7 percent in the first half. Although economic activity is expected to recover in the second half of the fiscal year, the economy is expected to shrink between 7 to 10 percent in FY2020.

2. The contraction in the economy is expected to significantly impact some of the most vulnerable sections of the economy and reverse many of the impressive socio-economic gains made by India over the last two decades. Between 2004-05 and 2011-12, India is estimated to have pulled 170 million citizens out of poverty, with the poverty rate declining from 39.9 percent of the population in 2004-05 to 22.5 percent in 2011-12. Poverty rates are estimated to have further fallen to values ranging between 8.1 to 11.3 percent between 2012 and 2017.[1] More recent household data by the Centre for Monitoring Indian Economy indicate that the job losses due to the COVID-19 pandemic are likely to have pushed up poverty rates to levels last seen in 2016, implying around four years of setbacks in its poverty reduction effort.

3. According to the Periodic Labour Force Survey 2017-18 estimates, 77.1 percent of employment in India is non-regular—either self-employed or casual workers, with another 13.7 percent in regular jobs that are lacking in social protection. Thus between 364 and 473 million workers face the risk of being adversely affected by the disruptions caused by the pandemic. High-frequency employment survey indicates a sharp increase in the unemployment rate from 7.9 percent during January to March 2020, i.e., the quarter preceding the lockdown, to 18.5 percent during April to June 2020 when the lockdown policy measures were most stringent. Moreover, there was a sharp drop in the labor force participation rate in mid-2020 compared to the months preceding the lockdown.

4. The Indian economy is expected to recover strongly from the current pandemic growing by over 8.5 percent in FY2021 and averaging 7.5 percent over the next few years.[2] The growth is expected to be assisted by improvement in the business climate, as evidenced by India's ranking rising from 130 to 63 in recent years in IBRD's Ease of Doing Business. Other factors expected to drive growth include rapid urbanization, a unified tax regime, and favorable demographics. At the same time, achieving a high rate of growth will be contingent on addressing key bottlenecks and emerging challenges, including creating job opportunities by raising competitiveness,

[1] South Asia Economic Focus, fall 2020: Beaten or Broken? Informality and COVID-19, World Bank
[2] World Economic Outlook Database, October 2020, International Monetary Fund

resolving infrastructural bottlenecks, bridging the skill deficit, improving institutional capacities, and addressing environmental degradation.

5. Water security is key for India's continued economic growth and poverty reduction in a changing climate. Rainfall in the country is highly variable over geography and time, occurring mainly within short monsoon seasons from June to September. This has led to major floods and droughts with a substantial economic and social loss for India. Within the past decade, major floods have hit numerous states (e.g., Kerala, Maharashtra, Karnataka, Gujarat, Tamil Nadu, etc.), with an estimated annual average cost of flooding reaching USD7.4 billion.[3] This may increase further with climate change. Global and national-scale studies concluded that climate change, through changes in rainfall pattern and increase in both temperature and evaporation, could result in higher frequency and intensity of extreme weather events such as floods and droughts.[4]

6. Water security is also important to sustain the livelihood of agricultural workers, who account for nearly 45 percent of the workforce. Irrigation plays an important role in sustaining agriculture in India, with 48.8 percent of India's 140 million hectares of agricultural land being irrigated while the remaining 51.2 percent is rain-fed.[5]

7. Achieving water security takes on even greater urgency in the COVID-19 crisis. Much of India's population does not have access to a safe and adequate water supply, making basic hygiene, including handwashing, difficult, and increasing the risk of COVID-19 spreading. Only 70 percent of India's urban population and 16 percent of rural households have access to piped water supply. Even for connected households, the reliability of supply continues to be an issue. This calls for continuous development of clean water distribution, bulk water supply, and water storage. Long-term investments in water resources management will be not only to address the current public health emergency but also to meet the growing water demand and enable economic growth.

B. Sector Context

8. Large dams[6] are central to India's agricultural production, water management, and water security. Ranking third in the world in terms of the number of large dams, India has 5,334 large dams in operation, accounting for nearly 10 percent of the world's large dams registered with the International Commission on Large Dams (ICOLD). Most dams store irrigation water[7], thereby contributing to food security and the rural economy. Dams also provide flood control and generate

[3] United Nations International Strategy for Disaster Reduction Global Assessment report on Disaster Risk Reduction 2015. https://www.undrr.org/publication/global-assessment-report-disaster-risk-reduction-2015

[4] By 2050, annual average temperatures in India are projected to increase 1 - 2°C under the climate-sensitive scenario and 1.5 - 3°C under the carbon-intensive scenario. Precipitation patterns are expected to become less predictable (South Asia's Hotspots: The Impact of Temperature and Precipitation Changes on Living Standards, World Bank, 2018).

[5] Growing gap in Irrigation Potential and Usage Major Challenge, Down to Earth, September 2019

[6] The definition of a large dam in India is as follows: more than 15 meters high, or between 10 meters and 15 meters in height and either: (i) more than 500 meters long in crest length; or (ii) having a reservoir capacity of more than 1 million cubic meters; or (iii) having a maximum flood discharge greater than 2000 cubic meters per second; or (iv) with difficult foundation problems or unusual design. Under the World Bank's Environmental and Social Framework (ESF), large dams are defined as those with a height of 15 meters or more or between 5 meters and 15 meters and a reservoir capacity of more than 3 million cubic meters, in line with the current ICOLD constitution.

[7] National Registry for Large Dams, 2019. Another 411 large dams are under construction.

approximately 11 percent of India's power. Large dams also play a vital role in water storage and supply services that are critical for water, sanitation, and hygiene (WASH) interventions. These functions are all the more relevant in the context of combatting the spread of COVID-19 and other diseases. Most dams are constructed and managed by State governments, in addition to a few central agencies such as Damodar Valley Corporation (DVC) and Bhakra Beas Management Board (BBMB).

9. Concerns about the safety of India's dams have been raised on the basis of historical patterns of insufficient dam maintenance, a lack of emergency planning and recent changes in dam safety standards. Further contributing factors include weak regulatory frameworks for dam safety, lack of coordination amongst the various agencies that are responsible for dam operations; irregular and insufficient investments in dam safety and operations and maintenance (O&M); and lack of data to guide safety measures. Dams often lack adequate instrumentation to monitor dam health and less than 10 percent of dams have Emergency Action Plans (EAPs).[8] Many older dams were not designed to current safety standards,[9] prompting India's National Committee on Dam Safety to recommend that design floods for all large dams be revisited. While a comprehensive overview of the current risk profile of dams does not exist, anecdotal evidence of degradation and poor management patterns suggest that a number of dams currently pose safety risks and are operating below optimal levels. To date, there have been 39 reported cases of dam failures in India; the worst one, in 1979 at Machu Dam in Gujarat, resulted in the death of over 2,000 people according to official reports and incalculable other damage. Most of these failures were caused by breaching due to flooding and overtopping due to inadequate spillway capacity.[10]

10. Climate change, population growth, and deteriorating water quality further amplify dam safety risks. Climate change is expected to increase the intensity and frequency of extreme weather events, leading to natural disasters, such as flooding and drought, which will further add stress to dam infrastructures.[11] Dams in India were designed and are operated based on historical meteorological data without factoring in climate change and therefore, urgently requires updating. Dam failures and the induced flooding will also threaten people in a wider area than the immediate flooded land by impacting key services of bulk water supply, irrigation, and hydropower generation. Even in the absence of a failure, underperforming dams will not efficiently provide their services to beneficiaries. Farmers, constituting a large portion of the Indian workforce, who depend on irrigation from reservoirs could switch to pumping groundwater when irrigation flows are not reliable, increasing energy consumption, greenhouse gas emissions and negatively impacting water security. Further, the decline in water quality, due to discharge of untreated sewage flowing into dam's reservoirs, can accelerate degradation of vital dam components, such as gates, foundations, etc. Lastly, population growth means that more people and economic assets are at risk from dam breaches.

11. **Institutional context.** The current institutional framework for dam management in India is insufficient to address dam safety risks. Dam safety and O&M are the responsibility of the dam

[8] Ibid.
[9] The Bureau of India Standards' "Guidelines for Fixing Spillway Capacity" were revised in 2004.
[10] CWC 2018. http://cwc.gov.in/damsafety/damfailure.
[11] South Asia's Hotspots: The Impact of Temperature & Precipitation Changes on Living Standards, World Bank, 2018.

owners. The State where the dam is located is responsible for oversight of dam safety. For dams owned by central agencies, the agency is responsible for dam safety. Some States/agencies have Dam Safety Organizations (DSOs) tasked with oversight of dam safety, but the degree of independence of DSOs from dam owners and their ability to supervise dams widely varies. Some States also have Dam Safety Review Panels (DSRPs) of independent experts that periodically evaluate the safety of dams. The Ministry of Jal Shakti (MJS), through its technical arm, the Central Water Commission (CWC), is responsible for approving dam designs for large dams prior to construction and providing limited oversight of dam safety during post-construction/operation. The CDSO within CWC plays an advisory role to States and other dam-owning agencies, and a National Committee for Dam Safety provides a forum for exchange on dam safety issues. While these bodies provide a basis for managing dam safety, none of them has regulatory powers and the line between dam oversight and operation is blurred.

12. Government of India (GOI) recognizes the need to strengthen the approach to ensuring dam safety and has gradually put in place the building blocks of a national dam safety program. This includes introducing a comprehensive and advanced institutional framework for dam safety. The Dam Safety Act, passed by the Rajya Sabha (Upper House of Parliament) in December 2021, aims to establish and empower the institutional setup for dam safety at the Central and State levels. This will improve and standardize dam safety practices across India. The Act requires regular dam inspection, preparation and deployment of EAPs, rigorous risk review, adequate repair and maintenance funds for dams, and instrumentation and safety guidelines. It will also standardize and strengthen the role of DSOs as regulators for dam safety. Lastly, GOI has worked to strengthen Central and State level dam safety institutions and rehabilitate dams, including projects financed by the IBRD: Dam Safety Project (1991-1999), Dam Rehabilitation and Improvement Project Phase 1 (DRIP-1), and its Additional Financing (2002-2020).

13. Notwithstanding the progress of the past few decades, more work is needed to strengthen dam safety and to move the country towards the institutional reform envisaged in the Dam Safety Act. The past efforts represented a strong start in establishing institutions, building capacity, and putting in place procedures for dam safety. However, a key lesson learned throughout the process revealed that significantly more emphasis is needed on enabling institutional and regulatory frameworks for dam safety, developing skills and human resources in the field of dam safety, and establishing transparent systems to channel scarce funds towards the dams at highest risk. Systems and institutions for dam safety need to be significantly scaled up. DSOs that provide oversight of dam safety agencies and independent DSRPs need to be established and strengthened across the country. Standardized EAPs and O&M Manuals should be developed for all large dams across the country, and systems for monitoring and reporting on dam safety need to be further developed. Lastly, the work to rehabilitate existing dams needs to be continued and placed in the context of the reforms mentioned above. This draws on the lessons of previous projects, which emphasized the importance of placing an investment-focused renovation program within the context of a strong enabling institutional regulatory framework.

Annex 5: Sovereign Credit Fact Sheet

A. Recent Economic Development

1. India is a lower-middle-income country, with a GDP per capita at USD 2,104 and a population of 1.37 billion in 2019.[12] It is the world's third-largest economy by purchasing power parity. India's economy grew at an average annual rate of 7.4 percent between FY2014 and FY2018 but has slowed down in recent years.[13] Following disruptions due to the demonetization initiative in November 2016 and the rollout of goods and services tax in July 2017, growth slowed to 7.0 percent in FY2017 and 6.1 percent in FY2018.[14] Growth slowed down further to 4.2 percent in FY2019 due to sluggish growth in private consumption, investment and exports, owing to weak rural income growth, stress in the financial sector, and sluggish global demand. Growth in the last quarter of FY2019 (January to March 2020) and first quarter of FY2020 (April to June 2020) was significantly dented by COVID-19 outbreak and associated lockdown introduced by GOI.[15] The Indian economy contracted by 23.9 percent in the first quarter of FY2020.

2. Low food prices helped inflation decline from 4.5 percent in FY2016 to 3.4 percent in FY2018. This allowed the central bank to reduce key policy rates by 135 basis points between February 2019 and October 2019. Inflation started inching up from mid-2019 on account of higher food prices and a rise in retail oil prices. Inflation averaged 6.8 percent in the first half of FY2020 due to supply side disruptions. Despite this, the central bank reduced the repo and reverse repo rates by 115 and 155 basis points to 4.0 and 3.35 percent respectively, to stimulate aggregate demand, which had declined due to the lockdown. The central bank introduced several measures to reduce the borrowing cost, bolster liquidity, and improve credit flow to the productive sectors.

3. After rising for two years, the current account deficit shrank to 0.9 percent of GDP in FY2019. Slowdown in economic activity led to a contraction in merchandise imports while exports remained weak as global demand turned sluggish. The current account recorded a surplus of 3.9 percent of GDP in the first quarter of FY2020 due to a sharp fall in trade deficit, and stable services balance. A drop in oil prices and weak domestic demand led to merchandise imports contracting by 40 percent in the first half of FY2020 while exports declined by a smaller 21.3 percent.

4. General government fiscal deficit at 8.2 percent of GDP remained high in FY2019, reflecting tepid growth in revenue and higher recurrent expenditure. A downturn in revenue due to economic slowdown and higher spending on the stimulus package resulted in the fiscal deficit in the first half of FY2020 exceeding the annual target.

B. Economic Indicators

Selected Macroeconomic Indicators (FY2015-FY2021)

Economic Indicators[#]	FY 2016	FY 2017	FY 2018	FY 2019*	FY 2020*	FY 2021 *
Real GDP Growth	8.2	7.0	6.1	4.2	-10.3	8.8

[12] The income group classification for fiscal year 2019 is based on World Bank criteria.
[13] Data is based on fiscal years. Fiscal year 2020 (FY2020) begins on 1 April 2020 and ends on 31 March 2021.
[14] On Nov. 8, 2016, India's government announced withdrawal of the legal tender of INR500 and INR1,000 notes, which accounted for 86 percent of the value of currency in circulation, and introduction of new INR500 and INR2,000 notes.
[15] On March 24, the government announced a nationwide lockdown till April 14, subsequently extended to May 30. Lockdown was eased beginning June 1

Inflation (% change, average)	4.5	3.6	3.4	4.8	4.9	3.7
Current account balance (% of GDP)	-0.6	-1.8	-2.1	-0.9	0.3	-0.9
General government overall balance (% of GDP)	-7.1	-6.4	-6.3	-8.2	-13.1	-10.9
Nominal gross public debt (% of GDP)	68.8	69.4	69.6	72.3	89.3	89.9
Public gross financing needs (% of GDP) [1]	11.1	11.0	10.5	11.4	17.6	15.4
External debt (% of GDP) [1]	20.6	20.0	18.9	19.1	19.2	19.1
Gross external financing need (% of GDP) [1]	9.3	9.6	10.4	10.0	9.5	11.0
Net Foreign Direct Investment Inflow (% of GDP)	1.6	1.1	1.1	1.3	…	…
Gross reserves (USD billion) **	370.0	424.5	412.9	434.0	551.5	…
Broad money (M2, % change)	10.1	9.2	10.5	9.7	…	…
Exchange rate (Rupee/USD, EOP) **	67.9	63.7	69.6	76.6	73.8	…

Note: # Data is based on fiscal years.

* denotes projected figures.

** FX data from Financial Benchmarks India FX rate as of October 29, 2020, while Reserves data pertains to August 2020.

[1] For FY2020 and FY 2021, AIIB Staff Estimates based on IMF Data

Source: IMF, World Economic Outlook Database, April 2020, IMF Country Report No. 19/385, December 2019 and Reserve Bank of India, Government of India.

C. Economic Outlook and Risks

5. According to the World Economic Outlook, released in October 2020, the economy is expected to contract by 10.3 percent in FY2020. The imposition of a lockdown, with limitations on mobility of people and products, to contain the outbreak, has significantly disrupted demand and supply. With the gradual easing of lockdown from June 2020, many of the high frequency indicators like purchasing managers' index, electricity generation, freight traffic e-way bills, registering interstate shipments indicate a revival of economic activity in the second quarter of FY2020. Growth is expected to pick up strongly in FY2021 as COVID-19 dissipates and stimulus measures have an impact with a lag.

6. In May 2020, Moody's downgraded India's rating to Baa3 with a negative outlook and in June, Fitch revised India's outlook to negative, due to slow reform momentum and challenging economic environment, limited fiscal space and stress in the financial sector.

7. Overall inflation is expected to increase marginally to 4.9 percent in FY2020, due to inflationary pressures from disruptions in supply chains. However, sluggish aggregate demand on account of the lockdown and lower oil prices may dampen inflationary pressures. Stickiness in food prices and rise in oil prices could raise inflation above the expected level.

8. Recognizing that an expansionary fiscal policy is required to mitigate the economic effect of COVID-19 pandemic, GOI announced several fiscal support measures. These include (a) direct spending including cash transfers, wage support and providing food and cooking gas to low-income households (2.0 percent of GDP), (b) foregone or deferred revenue (0.3 percent of GDP) and (c) credit provision (5.2 percent of GDP). An additional 0.1 percent of GDP has been allocated for health infrastructure. In October 20020, additional measures amounting to 0.2 percent of GDP were announced to support consumption. Various states have also announced additional relief measures. The anticipated economic contraction in FY2020 will adversely impact tax collection. The general government fiscal deficit is expected to significantly increase to 13.1 percent of GDP in FY2020. Public debt is also estimated to rise sharply to 89.3 percent of GDP in FY2020, levels

last witnessed in early 2000s. Despite being high, India's public debt remains sustainable given favorable debt dynamics and the projected increasing economic growth trend in the medium term. Furthermore, with public debt having a long and medium maturity, being denominated in domestic currency and primarily held by residents, the debt profile is favorable. India's external debt is expected to remain stable.

10. The current account balance is expected to record a small surplus in FY2020. Sluggish domestic economic activity and subdued oil prices will result in import bill declining significantly. Exports of goods and services are likely to contract given the decline in global demand. Remittances are also expected to decline as lower oil prices in Middle East and spread of the COVID-19 pandemic in advanced economies reduce economic activity in these countries, where most migrant Indian workers are employed.

Annex 6: Climate Risk, Opportunity, and Financing

1. An assessment was undertaken based on the methodology endorsed by the 2019 Joint Report on Multilateral Development Bank' (MDB) Climate Finance[1]. The methodology allows a systematic elaboration of the climate vulnerability related to the project, establishment of links between project activities and the reduction of climate vulnerability, and estimation of financing that contributes to climate mitigation and/or adaptation. The assessment unpacks the project's contribution to both climate mitigation and adaptation and concludes that 75 percent of AIIB's financing can be accounted for as climate financing.

Table 1. Climate adaptation and mitigation finance tracking per Joint MDB Methodology[1]

Sector	**Water** **Water Resources Management**
Brief description of project	The project focuses on (i) upgrading and modernizing dam operation and maintenance, with accompanying institutional strengthening for safe and financially sustainable dam operations; and (ii) physical and technical dam rehabilitation and improvement. The project will comprise five components: - Component 1: Rehabilitation and management planning for dams and associated appurtenances, - Component 2: Dam safety institutional strengthening, - Component 3: Risk-informed asset management and innovative financing for sustainable operation and maintenance of dams, - Component 4: Project management - Component 5: Contingent emergency response
Classification	Climate finance with a dual benefit split into adaptation and mitigation finance. Classification for mitigation finance: (1) Category 1. RENEWABLE ENERGY - 1.1. Electricity generation - Hydropower plants (only if net emission reductions can be demonstrated) (2) Category 3. ENERGY EFFICIENCY - 3.3. Energy efficiency improvements in the utility sector and public services - Improvement in utility-scale energy efficiency through efficient energy use and loss reduction, or resource efficiency improvements Adaptation finance:

[1] This report was written by a group of multilateral development banks (MDBs), composed of AIIB, the World Bank Group, the African Development Bank, the Asian Development Bank, the European Bank for Reconstruction and Development, the European Investment Bank, the Inter-American Development Bank Group, the Islamic Development Bank, as a collaborative effort to make public MDB climate finance figures, together with a clear explanation of the methodologies for tracking this finance. Accessible at: https://publications.iadb.org/en/2019-joint-report-on-multilateral-development-banks-climate-finance

Climate vulnerability context: Water security of India, key for the country's continued economic growth and poverty reduction, is highly susceptible to climate change. Climate change is expected to increase extreme weather intensity, frequency, and irregularity, leading to natural disasters, such as flooding and drought, and amplified water stress across India. Within the past decade, major floods have hit numerous states (i.e., Kerala, Maharashtra, Karnataka, Gujarat, Tamil Nadu, etc.), with an estimated annual-average cost of flooding reaching US$7.4 billion,[2] which, without proper measures in place, will increase with climate change. Drought will also bring economic damages of a comparable magnitude mostly due to the substantial size of the country's agriculture sector (employing around 47% of the country's labor force) and the sector's reliance on rainfall (63% of agriculture area are rainfed). Further, the rise of air temperature is expected to increase irrigation demand (aligned with the increase of crop water requirement and rate of evapotranspiration), affecting water security as irrigation has been the country's main water user accounting for about 70% of water consumption globally. Structural-robust and operational-efficient large dams are central in addressing these climate risks. Due to their multi-purpose nature, large dams are the cornerstone and nexus among water, food, and energy security.

Statement of purpose or intent to reduce climate vulnerability: The project objective is to improve both the safety of dams in participating states and the management of dam safety across India. The project will also rehabilitate and protect the dams' designed functions which have been deteriorating due to suboptimal historical maintenance. It will restore and/or maintain the dams' capacity to store water, regulate flow, and generate hydropower. By doing this, a reliable supply of water for municipal and agriculture uses, and hydropower generation, can be maintained despite the irregular and intensified extreme weather induced by climate change.

Project activities linked to reducing climate vulnerability: The project was structured into five main components to address the project objective and the identified climate risks and vulnerabilities. Component 1, contributing to climate adaptation and mitigation, will invest in structural and non-structural interventions to: (a) improve dam safety against flooding, which are expected to be intensified climate change, (b) restore dams' capacity in storing and regulating water, for addressing droughts and water stresses, and (c) protect the dams' hydropower generation capacity. The component will

[2] United Nations International Strategy for Disaster Reduction Global Assessment report on Disaster Risk Reduction 2015. https://www.undrr.org/publication/global-assessment-report-disaster-risk-reduction-2015

	also finance the development of flood forecasting and early warning systems, flood routing, and integrated reservoir operations to further build climate resilience. The preparation and implementation of EAPs will enable downstream communities to enhance their preparedness capacity against the risk of dam failure and related hazards. This holistic improvement of dam safety will increase the reliability of key water-related service provided by the dams, including water supply, irrigation, and hydropower generation. Component 2 will strengthen institutional capacity to manage flood risks, including raising awareness of the potential impacts of climate change. Component 3 will support innovative revenue generation schemes, including potentially piloting floating solar panels that can mitigate greenhouse gas emissions. Component 4 will support effective implementation and monitoring of activities listed under Component 1 – 3 and, therefore, indirectly supports all climate actions under the project. Component 5 will provide immediate response to a major natural disaster, including those induced by climate change.
Calculation of (1) mitigation and (2) adaptation	AIIB provides USD 250 million to the project. (1) The project will lead to emission savings due to the safeguarding of hydropower generation capacity. The potential emissions saving from this is estimated at 49,671 tons of CO2 equivalents per year (or 1,241,776 tons of CO2 equivalents across 25 years) with the conservative assumption that without the project's interventions, dam failure would lead to a 1% reduction in hydropower generation from selected dams.[3] This estimation is based on the fact that at least 33 hydropower dams will be included in the project (out of 120 dams to be rehabilitated by the project); or around 25% of the total dams under DRIP-2. Therefore, at least 25% of the AIIB's financing can be accounted for climate mitigation. This estimation can be considered conservative, as there can be more hydropower dams included in the project and its implementation. Further, the emission saving is also expected to be higher as the project will increase the reliability of irrigation and bulk water supply and, therefore, prevent groundwater pumping (and the induced emissions) across the country. (2) The project addresses the overall dam safety, which is affected by aging, suboptimal design standards, poor

[3] Using the multilateral bank harmonized approach, which estimates a combined grid emission factor for firm power of 673 grams of CO^2/KWh for India. July 2019 update to the "Harmonized Grid Emission Factor Data Set": https://unfccc.int/climate-action/sectoral-engagement/ifis-harmonization-of-standards-for-ghg-accounting/ifi-twg-list-of-methodologies

	maintenance, and climate-related hazards. Despite being deemed the most prominent hazard (especially in the long-term), climate hazard is not the sole driver for this project. Therefore, it is estimated that 50% of the AIIB's financing can be accounted for climate adaptation based on the principle of conservativeness. This has been confirmed to be in line with the adaptation finance share reported by the IBRD, which is co-financing the project. In total, 75% of AIIB's financing can be accounted for as climate financing.
Type of financial instrument	Investment loan
Type of finance	MDB own account

Annex 7: Project Implementation Support Plan

1. **General approach.** The implementation support plan reflects the design and nature of the project, considering its technical, institutional, fiduciary, safeguard, and risk profile. The approach provides flexible and adaptive implementation support to the client to identify bottlenecks and potential risks and adequately address them in a timely and sound manner. Key features of the plan include risk-based prioritization of dams, optimization of technology usage amid travel restriction and structured cross-learning among PIEs. The proposed implementation support plan is based on lessons learned from the implementation of DRIP-1. It includes arrangements that will enable enhanced support to the client with effective monitoring and feedback sharing. These arrangements are: (i) implementation support missions (jointly conducted by AIIB and the IBRD); (ii) regular technical meetings with the PIEs including field visits, outside of formal missions (led by the IBRD as the lead financier); (iii) CPMU reporting based on the performance agreements; (iv) internal audit and FM reporting; and (v) a mid-term review and a complete review (jointly conducted by AIIB and the IBRD).

2. **Implementation support and review.** In close coordination with AIIB the IBRD will lead the organization of progress implementation reviews, midterm review and implementation support missions and site visits to the project sites as needed, to monitor progress, not less than two missions per year. The frequency of implementation support missions can be increased depending on the implementation progress. On a need basis, local consultants can be hired to assist in this mission and subsequent follow-ups, namely for high-risk dams or works. AIIB will actively participate in these missions. The IBRD will provide AIIB with copies of all relevant documents, reports, recommendations, no-objections and communications received or sent by the IBRD in connection with any project activity. Further, throughout the implementation period, as deemed necessary, AIIB's staff will actively support the IBRD by assisting the participating State and agencies in developing any relevant implementation documentation. This will include active support by AIIB's environmental and social safeguard specialists in preparing ESDD and the subsequent field verification of dam safety plans and work plans in four to five selected dams. Lastly, AIIB will support the IBRD in identifying and adopting digital technologies in the context of dam safety and rehabilitation, aligning with the project objective, dams' characteristics, and the capacity of dams' managers.

3. Recognizing the complexities of the project's safeguard aspects, and valuable learning opportunities that come with it, AIIB's safeguard specialists will be actively supporting their counterparts at the IBRD and PIEs in the implementation and supervision of the project. In four to five selected dams, AIIB specialists will be leading the following undertakings (in close coordination with- and utilization of mechanisms agreed by- the IBRD and GOI): (i) supporting the preparation of ESDD and conducting related reviews (ii) conducting the needful field verifications, (iii) reviewing safeguard documents for dam investments that have Substantial or High risks, (iv) conducting periodic site visits and, as needed, participating in implementation support missions to monitor compliance with the ESCPs throughout project implementation. Lastly, AIIB's specialists will also be advising the PIEs in shaping the related training and workshops program on the ES safeguard aspect of dam safety.

4. **Adapted implementation: distance-monitoring.** Given challenges related to the COVID-19 pandemic and the substantial number of dams included under the project, the implementation support will be adapted to fit these circumstances while still pursuing optimal effectiveness. During the COVID-19 pandemic, virtual missions will be conducted instead of conventional physical site visits. This will be jointly organized and conducted by AIIB and the

IBRD. The participating States and agencies will be asked to prepare necessary supporting documentation to provide a full picture of the implementation in the midst of travel restriction and limited access to the project site. The feasibility of acquiring aerial photographs and videos, taken by drone, of the construction sites will be explored during the implementation. The effectiveness of virtual missions and collection of aerial imageries have been proven and adopted to monitor other AIIB-WB jointly co-financed projects, including the West Bengal Major Irrigation and Flood Management Project. Other innovative approaches in conducting distance-implementation monitoring will be explored and piloted.

5. **Adapted implementation: risk-based approach.** To optimize impact of implementation support at the portfolio level, the implementation support will be shaped to fit the conditions and needs of the dams. Additional attention (which can be translated into additional site visits, technical discussions, etc.) will be given to dams and States/agencies with the highest safety risk (as informed by the analysis to be undertaken in Component 3 using the Risk Assessment and Classification Framework), ES risks (based on ESDDs) and the complexity of the interventions (as presented in the PSTs). The design of such a risk-differentiated approach will be developed and fine-tuned throughout the implementation period.

6. **Cross-learning among Project Implementation Entities.** Transfer and exchange of knowledge and experience will be central for a quality project implementation as half of the PIEs are new to the dam safety project (7 out of 13 PIEs have been involved in DRIP-1 and benefited from experiences and knowledge gained during the implementation). Regular knowledge sharing and learning events will be held to allow participating States and agencies to discuss common implementation challenges, share best practices and learn innovative solutions. These events will be an integral part of both implementation support missions and capacity-building activities under Component 2. One of the main functions of the Center of Excellence, to be established under Component 2, will be designing, and facilitating such knowledge-sharing opportunities, through workshops, exchange visits, and larger dam safety conferences. These regular and structured interactions among PIEs will not only accelerate the transfer of knowledge and thus expedite the implementation but will also indirectly form an implementation benchmark, which States/agencies can use to evaluate their respective level of progress. Lastly, this approach will further enrich the discussions and strengthen the communications within India's dam safety community of practice.