



**ASIAN INFRASTRUCTURE  
INVESTMENT BANK**

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**Project Document  
of the Asian Infrastructure Investment Bank  
Sovereign-Backed Financing  
Republic of India  
West Bengal Major Irrigation and Flood Management Project**

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### **Currency Equivalents**

(As of October 31, 2019)

Currency Unit: Indian Rupee (INR)

INR1.00 = USD0.014

USD1.00 = INR70.985

### **Borrower's Fiscal year**

Apr. 1 - Mar. 31

### **Abbreviations**

AIIB	Asian Infrastructure Investment Bank
BP	Bank Procedure
CAG	Comptroller and Auditor General of India
CWC	Central Water Commission
DDO	Drawing and Disbursing Officer
DEA	Department of Economic Affairs
DPIU	District Project Implementation Unit
DPMU	District Project Management Unit
DRIP	Dam Rehabilitation and Improvement Project
DSRP	Dam Safety Review Panel
DVC	Damodar Valley Corporation
DVCA	Damodar Valley Command Area
EAP	Emergency Action Plan
E&S	Environmental and Social
EIRR	Economic Internal Rate of Return
ENPV	Economic Net Present Value
EPP	Emergency Preparedness Plan
ESMP	Environmental and Social Management Plan
ESIA	Environmental and Social Impact Assessment
ESMF	Environmental and Social Management Framework
GDP	Gross Domestic Product
GRM	Grievance Redressal Mechanism
GRS	Grievance Redress Service
GST	Goods and Services Tax
ha	hectare
IBRD	International Bank for Reconstruction and Development
IC	Investment Committee
ICR	Implementation Completion Report
IFMIS	Integrated Financial Management System

IMF	International Monetary Fund
ISPs	Irrigation Service Providers
IWD	Irrigation and Waterways Department
KPI	key performance indicator
MDB	Multilateral Development Bank
M&E	Monitoring and Evaluation
MIS	Management Information System
NHP	National Hydrology Project
O&M	Operation and Maintenance
OP	Operational Policy
PD	Project Director
PIM	Project Implementation Manual
PLC	Programmable Logic Controller
PMC	Project Management Consultant
PPM	Project-affected People's Mechanism
PPP	Policy on Prohibited Practices
SWID	State Water Investigation Directorate
SPMU	State Project Management Unit
PT	Project Team
RAP	Resettlement Action Plan
RPF	Resettlement Planning Framework
RRI	River Research Institute
SCADA	Supervisory Control and Data Acquisition
SLTSC	State Level Technical Steering Committee
SoJ	State of Jharkhand
SoWB	State of West Bengal
TOR	Terms of Reference
WB	World Bank
WRIDD	Water Resources Investigation &Development Department

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## 1. Summary Sheet

### Republic of India West Bengal Major Irrigation and Flood Management Project

Project No.	000054
Borrower	Republic of India
Project Implementing Entity	State of West Bengal (SoWB), and its entities
Sector	Water
Subsector	Irrigation, Flood Protection
Project Objective	The objective of the project is to improve irrigation service delivery, strengthen flood risk management and improve climate change resilience in the project area.
Project Description	The project is to develop and strengthen the irrigation management and delivery systems, modernize and rehabilitate main, branch, distributary, minor, and sub-minor canals, and invest in structural measures to reduce flooding in the project area. The Project comprises the following components: <ul style="list-style-type: none"> <li>- Component A: Irrigation Management</li> <li>- Component B: Modernization of Irrigation Infrastructure</li> <li>- Component C: Flood Management</li> <li>- Component D: Project Management</li> </ul>
Implementation Period	Start Date: March 2020 End Date: November 2025
Expected Loan Closing	March 31, 2026
Cost and Financing Plan	Project cost: USD413.8 million <u>Financing Plan:</u> AIIB loan: USD145 million World Bank (IBRD) loan: USD145 million SoWB: USD123.8 million
Size and Terms of AIIB Loan	USD145 million, a US Dollar denominated, commitment linked variable spread loan based on the six-month LIBOR, with the front-end fee to be capitalized, and level repayment amortization profile. A final maturity of 23.5 years, include a 6 years grace period, with an average repayment maturity of 14.82 years.
Cofinancing	World Bank (IBRD): USD145 million
Environmental and Social Category	B
Risk (Low/Medium/High)	High
Conditions for Effectiveness	(1) Preparation of a Project Implementation Manual by SoWB in the form and substance satisfactory to the Bank. (2) The effectiveness of the IBRD's loan agreement. (3) The

	effectiveness of the Project co-financing agreement between IBRD and AIIB.
Key Covenants	<ol style="list-style-type: none"> <li>1. No later than six (6) months after the Effective Date, the Borrower shall cause the DVC to undertake a study, under Terms of Reference satisfactory to the WB, to develop flood forecasting models in the area downstream of Durgapur barrage on the Damodar river.</li> <li>2. No later than six (6) months after the Effective Date, an independent dam safety review panel of experts (DSRP) shall be appointed for each of the Project Dams to perform periodic inspections. Critical dam safety measures recommended by DSRP shall be implemented timely.</li> <li>3. No later than twelve (12) months after the Effective Date, an Emergency Preparedness Plan for the Project Dams shall be prepared, taking into account the recommendations of its relevant DSRP, all in form and substance satisfactory to WB.</li> <li>4. No later than twelve (12) months after Effective Date, an O&amp;M Plan for the Project Dams shall be prepared, taking into account the recommendations of the DSRP, all in form and substance satisfactory to the WB and thereafter implement such plan in a manner satisfactory to the WB.</li> </ol>
Policy Assurance	The Vice President, Policy and Strategy, confirms an overall assurance that the Bank is in compliance with the policies applicable to the project.

President	Jin Liqun
Vice President, CIO	D.J. Pandian
Director General, Investment Operations	Supee Teravaninthorn
Manager	Gregory Liu
Team Leader	Sing Cho, Senior Investment Operations Specialist - Water
Team Members	<p>Guoping Zhang, Senior Investment Operations Specialist</p> <p>David Ginting, Young Professional</p> <p>Jessana A. Yanuario, Finance Officer</p> <p>Julius Thaler, Senior Counsel</p> <p>Yogesh Malla, Financial Management Specialist</p> <p>Somnath Basu, Senior Social Development Specialist</p> <p>Abhijit Sen Gupta, Senior Economist</p> <p>Xiaowei Guo, Senior Procurement Specialist</p> <p>Zhixi Zhu, Environment Specialist</p> <p>Yige Zhang, Project Assistant</p>

## 2. Project Description

### A. Rationale

1. **Country Priority.** Agriculture is the largest consumer of India's water. Water is critical in enhancing agricultural productivity, thus expansion of irrigation has been a key strategy in the development of agriculture in the country. However, increasing competition for water between industry, domestic use and agriculture has highlighted the need to plan and manage water across sectors and on a river basin basis. As urban and other demands increase, less water is likely to be available for irrigation. Reforming the water sector represents the biggest challenge for agriculture and other water-intensive sectors of the economy. The sector needs a fundamental shift in water management.

2. India has invested considerably in the development of large dams, storage structures and canal networks to meet its water and agricultural needs, particularly to improve production of food grains, pulses, oilseeds and vegetables. This is evident in the huge increase in budgetary allocation for irrigation in the 12th Five-Year Plan compared to the 11th Five-Year Plan. These infrastructure investments have helped achieve food and water security but in many areas with inadequate surface water, the increasing use of water for irrigation and a growing population has led to higher and potentially unsustainable extraction of ground water to meet irrigation and domestic needs. India needs to adopt a growth path that uses water more efficiently, increases productivity and generates jobs (boost income) in rural areas. Ways to radically enhance the productivity of irrigation include piped conveyance, better on-farm management of water, and use of more efficient delivery mechanisms such as micro-irrigation. Better management, rather than wasteful use of groundwater, is also needed. Incentives to pump less water such as levying electricity charges or community monitoring have not succeeded beyond sporadic initiatives.

3. The country is also facing the potential threat of climate change, which may have complex implications on water availability, and amplify challenges. Changes in patterns and intensity of rainfall and glacial melt result in altered river flows, changes in ground water recharge, more intense floods, severe droughts in many parts of the country, salt water intrusion in coastal aquifers, and water quality issues. Food security, livelihoods, and public health are at stake. Access to safe water has a direct bearing on productivity and health of human and animal populations. The public health implications of unsafe water are enormous and unacceptable.

4. **State Priority.** West Bengal is one of the largest states in India. It comprises about three percent of India's land mass and eight percent of the population, with a population density of about 900 per square kilometers (km<sup>2</sup>). Almost 70 percent of its population live in rural areas, most of whom depend on agriculture. West Bengal is one of India's less developed states, with 20 percent of the population living below the poverty line, most of whom live in rural areas and are engaged in agriculture.

5. Agriculture makes up of almost 20 percent of the state economy and accounts for about half of employment in the state. West Bengal is one of the most important food producing states in India, producing nearly 20 percent of the rice and 33 percent of the potato output. Economic growth, poverty reduction and employment creation depend to a large extent on agricultural growth. Agriculture is not possible during the non-monsoon season without adequate irrigation.

However, the investment in irrigation infrastructure in West Bengal has not kept pace with needs of agriculture in recent years to support efficient irrigation service delivery, affecting agricultural productivity and leading to over-extraction of groundwater. Investment in irrigation is thus seen as key to increasing the number of cropping, improving sustainability, and raising productivity and incomes in the rural areas.

6. West Bengal lies in the cyclone zone. The state will need to improve resiliency in its infrastructure and to manage the impact of heavy rains. West Bengal has 37,660 km<sup>2</sup> of flood-prone area out of a total geographical area of 88,752 km<sup>2</sup>. An analysis of the floods that occurred over the last 41 years shows that the state has faced severe floods in all but five years. The total devastated area exceeded 20,000 km<sup>2</sup> in four of those years and the major floods (inundated areas ranging between 2,000 to 10,000 km<sup>2</sup>) have occurred on 10 occasions. In view of its geographical location at the tail end of the Ganga Basin, the problem of flooding and poor drainage in the state is acute.

7. The Damodar Valley Command Area (DVCA) is an irrigation scheme that is located downstream of Durgapur on the Damodar River in the districts of East and West Bardhaman, Howrah, Bankura and Hooghly. The irrigation scheme covers 393,964 hectares (ha) and provides an important source of livelihood for 2.68 million people. The DVCA is 60 years old, and its irrigation canal system is in urgent need of modernization. Key challenges include degradation of infrastructure and inadequate irrigation management, including poor quality of service delivery, inefficient irrigation and absence of a monitoring system. Because of the degradation of the system, surface water no longer reaches the middle and tail parts of the canal network. Out of the 41 blocks covered by the DVCA irrigation network, 23 blocks do not receive irrigation water in Rabi season (Dec. 25 to Feb. 5), 19 blocks in the Boro season (Jan. 25 to April 30) and three blocks even in the Kharif season (July 25 to Oct. 31). Of the 1,700 canal regulatory structures, almost half are severely or moderately damaged. Tail end farmers are compelled to abstract groundwater, which increases the costs of cultivation and undermines the sustainability of the scheme.

8. In DVCA, groundwater has traditionally been drawn from shallow aquifers (to about 20 meters [m] deep) with centrifugal pumps. Overuse of this source has forced farmers to increase the number of deeper wells with submersible pumps. Between 2005 and 2017, the number of semi-critical blocks increased from five to 19 (out of a total of 41 blocks)<sup>1</sup>. Out of 40 monitoring wells in 40 different blocks in the DVCA, 23 wells showed depletion of groundwater of more than 3 meters from 2001 to 2016.

9. The Lower Damodar basin area is historically flood-prone. Some 33,500 ha of the cropped area and 461,000 people are affected by floods annually on average. The major causes of floods, waterlogging and drainage congestion in the project area - include inadequate utilization of flood storage potential in the five dams in Jharkhand, river bed siltation, unauthorized construction of bunds across channels and rivers to augment the water availability during Boro season and the tidal effect at the outfall of the channels and rivers.

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<sup>1</sup> A semi-critical block is a block where the ground water table has on average been declining by over 0.20m per year over a five-year period.

10. **Institutional Context.** DVCA is managed by the Irrigation and Waterways Department (IWD) of the State of West Bengal (SoWB). IWD supplies water up to the field outlets (*chaks*). After the field outlets, beneficiaries organized in Chak committees distribute, manage and maintain water. Distribution infrastructure is generally absent within chaks and water flows from plot to plot. Surface water for irrigation is supplied from five dams located in the adjacent state of Jharkhand, and the Durgapur Barrage located in West Bengal. Four of the five dams (Konar, Maithon, Panchet, and Tilaya) in Jharkhand are managed by the Damodar Valley Corporation (DVC)<sup>2</sup>, while the fifth dam, Tenughat, is managed by the State of Jharkhand (SoJ). The Durgapur Barrage is operated and managed by IWD.

11. IWD also provides some levels of protection against floods, alleviates drainage congestion, arrests erosion, and maintains internal navigation channels and natural waterways in the state.

12. **Strategic Fit for AIIB.** The project fits into and supports the West Bengal State Action Plan for Climate Change, which has a strong focus on water resources management. The State of West Bengal has been implementing the World Bank (WB)-financed Accelerated Development of Minor Irrigation Project since 2012, which aims to enhance agriculture production of small and marginal farmers. The project will seek synergy with the WB project, contributing to long-term water sector reforms and improving irrigation efficiency in West Bengal. The project will enable the government to improve the transparency of the budget allocation and in turn the long-term sustainable operations and maintenance (O&M) by outsourcing O&M services to irrigation service providers (ISPs). Commercializing operation and maintenance of irrigation infrastructure is expected to make irrigation a more attractive proposition for private sector participation. Therefore, the project is well-aligned with the Bank's mandate to promote social and economic development through investment in irrigation infrastructure. It meets the Bank's key strategic investment priorities, particularly related to sustainable infrastructure.

13. **Value Addition by AIIB.** AIIB's participation mobilizes financial resources to fill the investment gap in a project that is vital for the country's socioeconomic growth. Besides providing substantial technical advice for the feasibility study, the AIIB team also provided the experience of good practices in agriculture and water resource development and management from other countries. For example, in the most water-scarce provinces in the Northern region of China, innovative measures are implemented to reduce water withdrawal for irrigated agriculture and groundwater over-abstraction. Farmers are also given incentives to lower agricultural production costs and increase agricultural yield and value and improve water use efficiency. Exposure study tours to China will be planned to facilitate IWD's peer learning from China's experience, which would help improve water resources management.

14. **Value Addition to AIIB.** The joint co-financing of the project with the WB demonstrates that the Bank is a reliable and strong partner, while also increasing the capacity of Bank staff through sharing of expertise and knowledge in the irrigation and flood management sector. The

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<sup>2</sup> The DVC is a statutory corporation constituted under the Damodar Valley Corporation Act, 1948 and is owned by the SoJ, SoWB, and the Government of India (through the Central Water Commission). DVC is committed to the socio-economic development of the Damodar Valley by carrying out its mandate of flood control, power supply, irrigation, water supply management and soil conservation in the command area.

project is the Bank's first water resources project to bring in performance-based irrigation operations through the recruitment of ISPs for O&M of the irrigation infrastructure to ensure long-term sustainability. It will help open a new and potentially important business line with many future opportunities in the Bank's member countries.

## **B. Project Objective and Expected Results**

15. **Project Objective.** The objective of the project is to improve irrigation service delivery, strengthen flood risk management and improve climate change resilience in the project area.

16. **Expected Results.** The core outcomes of the project will be measured through the following indicators:

- (i) To improve irrigation service delivery
  - a. Area provided with new/improved irrigation or drainage services.
  - b. Compliance with agreed water delivery schedule of the ISP's contract<sup>3</sup>.
  - c. Compliance with irrigation water supply from the main canal to the distributary canals<sup>4</sup>.
- (ii) To strengthen flood risk management
  - a. Rate of reduced flood depth at the monitoring points compared with equivalent flood depth for the period 1999-2017.
- (iii) To improve climate change resilience
  - a. Arrest in the rate of decline of groundwater levels in semi-critical blocks in each defined groundwater management area.
  - b. No deterioration of groundwater level trends in safe blocks in each defined groundwater management area.

A detailed results monitoring framework containing results indicators and monitoring and reporting arrangements is attached in Annex 1.

17. **Expected Beneficiaries.** The main project beneficiaries are farmer households, who will directly benefit from more reliable and efficient irrigation water supply and distribution and reduced flooding. This includes the 2.68 million people that will directly or indirectly benefit from the project. Another group of beneficiaries include the state and district irrigation management agencies and Chak committees.

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<sup>3</sup> A water delivery schedule will be agreed as part of the annual contract. The monitoring and evaluation consultant will monitor the performance of the ISPs.

<sup>4</sup> IWD and the ISP will sign annual bulk water delivery contracts that define the amount of water that will be delivered to the head of the distributary canal. The monitoring and evaluation consultant will monitor the compliance with the contract.

## C. Description and Components

18. **Overview.** The project objective will be achieved by: (i) improved irrigation management to improve service delivery, performance monitoring and irrigation efficiency evaluation and strengthen institutions; (ii) modernizing irrigation infrastructure by upgrading hydraulic assets at main, branch, distributary and minor canal levels; and (iii) strengthening flood risk management to reduce flooding in the downstream parts of the project area. Improving climate change resilience is integrated in each of these components. The project management component will support implementation activities in accordance with the project implementation manual (PIM).

19. **Component A: Irrigation Management.** This component will improve the management of the DVCA irrigation scheme. Subcomponents include: (i) development of a management information system (MIS) consisting of various modules related to administrative functioning, irrigation operations and decision support system supported by a supervisory control and data acquisition (SCADA) system at the main canal level;; an irrigation efficiency evaluation system to monitor the quantity and timeliness of delivery of water, farmers' feedback through a mobile app, and grievance redressal; (ii) improvement in the quality of service delivery through introduction of performance-based irrigation operation of selected distribution canals ( including minor & sub-minor canals) , by engaging ISPs. The ISPs will maintain and operate the canals and appurtenant structures within their scope, provide irrigation water to farmers and farmer groups and promote water use efficiency measures including micro irrigation, and would be paid by the IWD on the extent of area actually irrigated. (iii) management of aquifers through establishing a groundwater monitoring system and a groundwater database on groundwater use, levels and quality; hiring an Expert Groundwater Study Consultant to assist WRIDD to prepare and implement a Groundwater Action Plan; (iv) strengthening the capacity of IWD staff and ISPs, to improve the quality of service delivery including supporting IWD to prepare separate financial reports of the accounts of different irrigation schemes in West Bengal; and the transformation of the River Research Institute (RRI) into a university-affiliated center of excellence, and (v) improvement works in sectors closely associated with irrigation, including support for diversified cropping; demonstrations to promote water conservation and promotion of pressurized micro-irrigation (see sub-Component B.2); capacity strengthening of farmers and farmer producers' organizations, construction of pack houses, support for value chains, and promotion of pisciculture.

20. **Component B: Modernization of Irrigation Infrastructure.** This component will invest in the modernization of irrigation infrastructure at main, branch, distributary and minor canal levels. Subcomponents include: (i) modernization and rehabilitation of the Right and Left Bank main canals and branch canals; and (ii) modernization and rehabilitation of distributary canals, minor canals, and sub-minor canals.

21. **Component C: Flood Management.** This component will invest in structural measures to reduce flooding in the project area<sup>5</sup>, including increasing the conveyance capacity of the

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<sup>5</sup> The nonstructural measures for flood management in the project area are covered under the World Bank-funded National Hydrology Project, including monitoring, preparation of an emergency preparedness plan, establishment of an early flood warning system, hydrological studies and capacity strengthening.

Mundeswari River, construction, rehabilitation and improvement of embankments, selected desilting of the river, implementation of small improvements and modifications to the Amta Channel left bank, improvement of several sluice gates and desiltation of local tertiary drainage channels to facilitate more rapid evacuation of flood water. The component will also include construction of fall-board shutters at three locations across the Mundeswari River and Amta channels, and implementation of the recommendations of the Dam Safety Review Panel related to the Durgapur Barrage.

22. **Component D: Project Management.** This component will strengthen IWD's and the State Project Management Unit's (SPMU) capacity for project management including, inter alia. procurement and financial management, Monitoring and Evaluation (M&E), and environmental and social safeguards management and communication. A Project Management Consultant (PMC) will be recruited to support implementation of the Project. The component will also support a communication campaign to inform stakeholders on the importance of water use efficiency.

#### D. Cost and Financing Plan

23. Table 1 sets out the total cost and the financing plan.

**Table 1: Project Cost and Financing Plan**

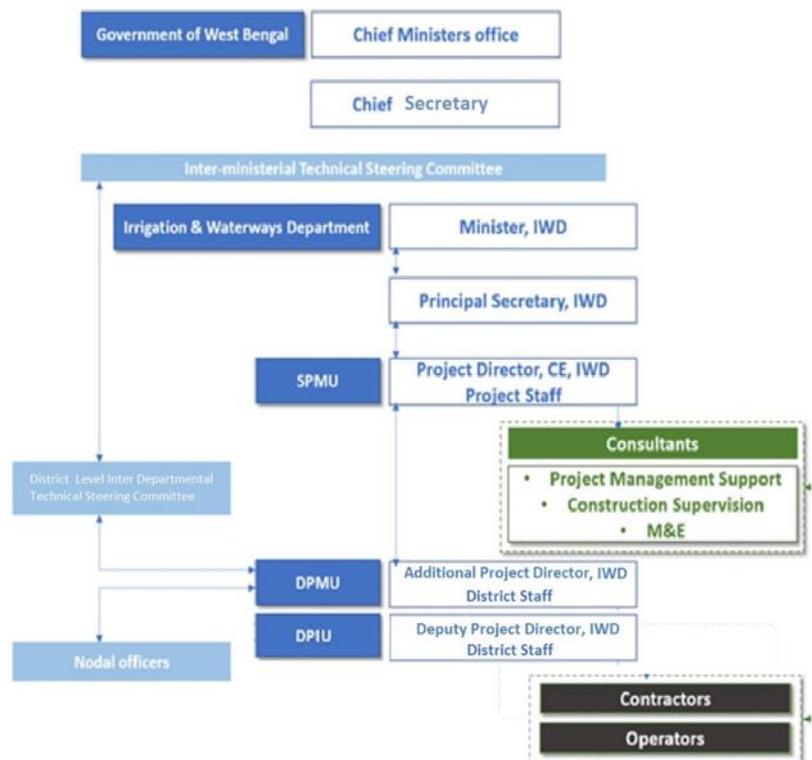
Item	Project Cost (USD m)	Financing (USD m and percent)		
		AiIB	IBRD	SoWB
Component A: Irrigation Management	21.1	7.4 (35%)	7.4 (35%)	6.3 (30%)
Component B: Modernization of Irrigation Infrastructure	186.5	65.3 (35%)	65.3 (35%)	55.9 (30%)
Component C: Flood Management	188.7	66.1 (35%)	66.1 (35%)	56.5 (30%)
Component D: Project Management	16.7	5.8 (35%)	5.8 (35%)	5.1 (30%)
Front End Fees	0.8	0.4	0.4	0.0
Grand Total	413.8	145 (35%)	145 (35%)	123.8 (30%)

#### E. Implementation Arrangements

24. **Implementation Period.** The project is expected to be implemented from March 2020 to November 2025.

25. **Implementation Management.** IWD will implement the project. It has established a SPMU headed by a project director (PD) at the rank of chief engineer, who will be responsible for project implementation. The PD is supported by two additional PDs at the rank of superintending engineer, four deputy PDs at the rank of executive engineer, accounts officers and other support

staff. Nodal officers from the Agriculture, Agri-marketing, Horticulture and Water Resources Investigation and Development Department (WRIDD) have also been appointed as members of the SPMU. The nodal officers will liaise between the IWD and their respective departments. At the district level, two district project management units (DPMUs) have been established (one for Howrah and Hooghly districts, and one for Bankura and East and West Bardhaman districts) that are headed by additional PDs. The DPMUs have a skeleton staffing structure that will be strengthened during project implementation. Four district project implementation units (DPIUs) have been established that are headed by deputy PDs at the rank of executive engineer, located in the districts of Purba Bardhaman (including Paschim Bardhaman), Bankura, Hooghly and Howrah. A state level technical steering committee (SLTSC) headed by the chief secretary has been established and consists of the heads of all relevant departments. The SLTSC will review broad progress in implementing the project, coordinate between departments and provide guidance on policy matters (Figure 1).



**Figure 1: Implementation Arrangements**

26. **Institutional Capacity.** The overall management of the project including preparation and implementation lies with IWD. IWD is a first-time client and has not implemented investment projects supported by the WB or any other multilateral development Banks (MDBs). During project implementation, strengthening of capacities of the implementing agency will be carried out through recruitment of qualified and experienced specialists and consultants' services. A close and intensive engagement with stakeholders during the preparation has helped identify the gaps on different aspects and accordingly prepare a suitable capacity building and action plan to address those gaps.

27. **Monitoring and Evaluation.** The SPMU will provide overall coordination of project monitoring. A consultant will be recruited by the SPMU that will be responsible for M&E, including monitoring of project progress, project impact, and achievement of the project objective. The M&E consultant will set up a monitoring system for the project area that can be accessed online, collect data and undertake regular reporting. The monitoring system will be based on the agreed project outcome indicators and performance targets presented in the results monitoring framework.

28. **AIIB's Implementation Support.** The project will be jointly co-financed by the SoWB, the AIIB and the World Bank. Each party will finance the same contracts under the project in agreed proportions. WB procurement, financial management, disbursement and safeguard policies and standard documents will be followed. As the lead co-financier, the WB will lead the supervision of the project and administer the Bank's loan on behalf of the Bank, in accordance with the WB's applicable policies and procedures, and a Project Co-lenders' Agreement to be signed between the Bank and WB, in accordance with the Co-financing Framework Agreement. The WB staff will carry out progress implementation reviews, midterm review and project evaluation missions and site visits to the project sites as needed, to monitor progress, not less than two missions per year. AIIB will participate in these missions with the WB to monitor the project implementation. Adequate resources will be provided to match the frequency of the WB's implementation support visits.

29. **Procurement.** The WB will take the lead role and cooperate with the Bank team for procurement implementation in accordance with the Co-financing Framework Agreement between the World Bank and AIIB. All goods, works, non-consulting services, and consulting services required for the project and to be financed under the project shall be procured in accordance with the World Bank's Procurement Regulations for Investment Project Financing Borrowers dated July 2016, revised November 2017 and August 2018, which are materially consistent with the AIIB Procurement Policy, and the provisions of the Loan Agreement. The SPMU will have overall responsibility for most of the procurement under the project. The identified other line departments (Agriculture, Horticulture, and WRIDD) shall carry out procurement for activities not exceeding one percent of the total project procurement. As per the World Bank's requirement, a Project Procurement Strategy for Development (similar to the Bank's Project Delivery Strategy) has been prepared with the applicable procurement arrangement including a procurement plan for the initial 18 months. The works and goods procurement will be carried out for: (i) *structural interventions* including but not limited to desilting, improvement and strengthening of flood embankments, rehabilitation and modernization of irrigation canals and drainage channels; installation of a data monitoring system; and remodeling of hydraulic structures, etc.; and (ii) *nonstructural interventions* including development of a GIS-based MIS, aquifer management, and capacity strengthening, etc. The consulting services will be procured for strengthening project management and improving irrigation service delivery, etc. All procurement above INR500,000 (USD7,000) is generally executed by SPMU through e-procurement except consulting services<sup>6</sup>. IWD, apart from its own procurement will utilize its DPMUs to undertake

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<sup>6</sup> The West Bengal state e-procurement portal does not support consultancy assignments, and therefore all consultancy procurements will be done manually.

procurement for other line departments due to their limited capacities to undertake procurement following WB's guidelines and regulations. However, as an exception, WRIDD, which has sufficient exposure to the Bank norms, will undertake its own procurement. The World Bank's online tool Systematic Tracking of Exchanges in Procurement will be used to monitor the procurement progress. The procurement method, prior review, post review and the supervision plan have been prepared by the World Bank and are acceptable to the Bank (refer to paragraph 41 for the procurement assessment).

30. **Financial Management.** An annual budget for the project expenditures will be prepared by the IWD, in accordance with the Annual Work Plan and in consultation with the State Finance Department each year. Budget funds will flow through multiple lines budget heads. The PD will issue authorizations to designated Drawing and Disbursing Officers (DDOs) at the SPMU, DPMUs, and DPIUs to process and make direct electronic payments to consultants, contractual staff, suppliers, contractors and others. All project expenditures will be pre-financed by the state budget, and reimbursement from World Bank and AIIB will be made through the Ministry of Finance on a quarterly basis. No designated account is therefore required for the project (refer to paragraph 43 for the financial management assessment).

31. **Fund Flow and Disbursements.** Proceeds from the AIIB loan will be disbursed using the reimbursement method, supported by an interim unaudited financial report providing the actual expenditures incurred for the previous quarter, and cumulative to-date expenditures. Disbursements will be made in US dollars, at the prevailing spot rate at the time of disbursement. The Borrower will absorb the foreign exchange risk. Disbursements of the AIIB loan will be administered by the WB in accordance with the Co-financing Framework, 2018 and the Co-lenders' Agreement for the project. The SPMU through the Office of the Controller of Aid and Accounts, will submit separate applications for withdrawal from AIIB loan to WB, on a quarterly basis, for its review. Upon instructions from WB together with a copy of the withdrawal application, AIIB will disburse the funds from the loan account. Upon receipt of funds, the Office of Controller of Aids and Accounts will transfer the funds to SoWB in accordance with the country's standard Center-State Mechanism for Additional Central Assistance. Advance method of disbursement is not envisioned for the project given the complexity of the implementation arrangements but will be confirmed during loan negotiations. Retroactive finance will be applied for this project. The date of eligible expenditures and the amount of retroactive financing will be determined according to the Bank policy and as specified in the loan agreement.

### 3. Project Assessment

#### A. Technical

32. **Project Design.** A feasibility study of the modernization of the irrigation system and improvement of flood management was completed during project preparation by an international consultant. The feasibility study consultant carried out detailed analysis on several key aspects including: water balance, flood modelling, irrigation system, and SCADA system. Based on the results of these analyses, various interventions have been designed and adopted for

implementation. Detailed designs have been prepared for infrastructure investments, and contracts for flood protection works representing 30 percent of the total project budget have been prepared and are ready for award in keeping with the Government of India readiness criteria.

33. The Project design has taken some of the lessons learned from the implementation of the ongoing West Bengal Accelerated Development of Minor Irrigation Project (P105311). These include: (i) adopting a more balanced approach between “last mile” and “first mile” service delivery needs to improve the overall viability of irrigation, and strengthening the capacities of Water Users Group to improve irrigation performance and improving the quality of irrigation services to these Committees, (ii) providing incentives to improve irrigation efficiency by paying ISPs for operation and managing of irrigation canals to deliver the water more equitably across the DVCA catchment, and (iii) by outsourcing O&M to ensure that the full cost of O&M is paid for through the state public budget.

34. **Flood Mitigation.** The Lower Damodar area in the districts of Hooghly and Howrah experiences flood problems almost every year and frequently faces devastating damages from high floods. The feasibility study consultant has carried out a detailed flood modelling study with options to reduce flooding. One- and two-dimensional mathematical models were used to study the scope of reduced flooding. Although flooding cannot be eliminated altogether, there will be substantial reduction in the duration as well as extent of inundation by revitalizing critical channels and rivers, improving existing embankments, remodeling of existing structures and constructing new interventions across the rivers and channels.

35. **Irrigation Modernization.** The design of the main and branch canal modernization is based on an irrigation modernization assessment that was conducted during project preparation to optimize the type and location of the hydraulic infrastructure to facilitate service delivery. A modernization component of a SCADA system will be introduced. The water levels in the canal system will be managed in a more reliable manner.

36. **Operational Sustainability.** The project supports transformation toward sustainable irrigation service delivery by addressing three fundamental areas, i.e., accountability, transparency and financial sustainability. These will be addressed through improved information, accountability and transparency in the management of service delivery through improved MIS and the introduction of service standards and asset management systems. The infrastructure will be designed to address the challenges of irrigation service provision related to staffing levels, skills and costs. An irrigation assessment has identified the type and location of the hydraulic infrastructure that is most appropriate to promote management reforms and best suited to improve irrigation service delivery. More cost-effective technologies for performance monitoring will be introduced. Training in the use and management of these new technologies will be provided. Finally, with the introduction of asset management systems, the functioning and condition of the system will be continuously monitored. Global experience suggests that attempts to recover irrigation service fees from users must start with a significant improvement of the quality of these services, and with an increased capacity to pay. The project will continue to depend on irrigation service funding from the government budget. This will be done by outsourcing on a performance basis, service delivery to ISPs to ensure adequate funding for services while improving service

delivery, transparency and accountability. Improved quality of irrigation services will also help improve farmer incomes. Therefore, through outsourcing the O&M services to performance-based ISPs, the long-term O&M of the project will be ensured, and performance and output will be verified in more transparent way for public budget allocation, which will contribute in the medium-term to operational sustainability.

37. **Performance-based Irrigation Operation.** IWD will outsource the O&M of selected distributary and minor canals (serving on average 10,000 hectares) to ISPs. The ISPs will sign two contracts with IWD: (i) a multiyear framework contract that lays down the broad principles; and (ii) annual water supply and bulk water delivery contracts that are based on the amount of water available in the upstream reservoirs in that particular year. They will also sign on a voluntary basis separate service delivery contracts for promoting micro-irrigation. ISPs will be paid by IWD on per hectare basis. The amount of the payment per hectare by IWD will be determined through competitive bidding. The compliance with a water delivery schedule that will be agreed as part of the annual contract will be used as a Key Performance Indicator (KPI) of the ISPs and project objective indicator. The M&E consultant will be responsible for monitoring the performance of the ISPs including the key result indicators.

38. The proposed longer-than-normal project implementation period (i.e., six years) will allow the ISPs model to be tested and become fully operational. The investment in IWD's capacity building under the project will strengthen the institutional basis for continued sustainability of the facilities and services set up under the project. By competitive outsourcing of O&M service to ISPs, the real costs of O&M will be verified, and an asset management plan will be used to account for the resources required for adequate maintenance. This will support the commitment of IWD to O&M outsourcing in the medium to long term and ensure that O&M outsourcing becomes an integral part of irrigation services in West Bengal.

## **B. Economic and Financial Analysis**

39. **Economic Analysis.** A cost-benefit analysis was carried out to assess the economic viability of the project by comparing "with-project", and "without-project" scenarios. The main benefits included in the analysis are: (i) reduced flood damages (on cultivated crops, houses and public properties), (ii) reduced income loss due to less disturbance by flooding (reduced productivity loss due to shorter inundation period and smaller inundated area), and (iii) energy savings due to reduced groundwater pumping. The main cost items include construction costs and O&M costs, both of which were converted into economic costs using a standard conversion factor.

40. The overall results of the economic analysis indicated that the project is economically viable, with an Economic Internal Rate of Return (EIRR) of 20.5 percent with corresponding Economic Net Present Value (ENPV) of INR 1,643 crores (USD 230 million), based on a 12 percent discount rate. A sensitivity analysis was performed with respect to cost overrun and decrease in the project benefits. The sensitivity analysis shows that the EIRR is sensitive to a decrease in the projects benefits but remains well above 12 percent in all scenarios (refer to Annex 3 for the details of the economic analysis).

41. **Financial Analysis.** The SoWB recognizes that the project beneficiaries (mostly farmers) are generally poor and has adopted the policy that irrigation and flood management investment and O&M costs should be covered by the public budget, and that recovery of O&M costs from the beneficiaries is a medium to long term objective. Therefore, conventional financial analysis (calculating the financial internal rate of return) was not performed for the project. A public expenditure review that was conducted during the project preparation shows that the overall budget allocation to IWD from the SoWB has been steadily increasing for the past six years. However, historically, the allocated resources have not been sufficient to achieve sound O&M practices and prevent deterioration of DVCA assets. Through outsourcing O&M services to performance-based ISPs, the long-term O&M of the project will be ensured through the transparent allocation of state budget funding for verified O&M outputs. Also, strengthening of institutional capacities and modernization of information systems, as key components of the project, will be central in further monitoring the performance of the ISPs and benchmarking them against agreed outputs, thus improving the overall sustainability of the infrastructure.

### C. Fiduciary and Governance

42. **Procurement.** The WB carried out a procurement capacity assessment of IWD and other line departments that will implement the project. The procurement capacity assessment shows that the capacity of IWD and all the other line departments is limited except WRIDD which is presently implementing a WB-financed project. Since procurement for other entities except WRIDD will also be undertaken by the IWD, the capacity and internal control systems of IWD will need to be strengthened. In addition, as the project involves some new and innovative aspects, such as the recruitment of ISPs for the O&M of irrigation infrastructure, there may be challenges related to capacity to manage and execute these contracts. Apart from delays in the procurement process, weak contract management and disputes are potential problem areas. The procurement risk is rated High before mitigation. Measures to improve the procurement capacity and reduce the procurement risk have been proposed, including: (i) establishment of a Procurement Cell in the SPMU comprising of a dedicated Additional PD (APD), Deputy PD (DPD) and at least two Assistant PDs supported by two Procurement Specialists to be engaged through the Project Management Consultant (PMC) (ii) conducting procurement training for all staff of SPMU and line departments; (iii) developing a procurement manual as part of PIM; and (iv) using the WB's Systematic Tracking of Exchanges in Procurement to monitor procurement processes and governance, etc. The Project Procurement Strategy for Development has been prepared under the WB's procurement policy and is satisfactory to the Bank.

43. **Financial Management.** A financial management assessment of the project was conducted by the World Bank in accordance with its Operational Policy (OP) / Bank Procedure (BP) 10 and the World Bank Directive on Financial Management Manual for World Bank Financed Investment Operations (February 2017). Based on its assessment, the overall financial management risk profile is moderate. Since IWD is one of the departments of SoWB, the internal control system, particularly the financial rules and procedures laid down in the State Financial Rules and the Central Public Works Accounts Code (for accounting and reporting procedures) are applicable to the project. The accounting responsibility of the project lies with the SPMU and the designated DDOs across the state and is reported on the state's online Integrated Financial

Management System (IFMS). Based on the IFMS quarterly reports of compiled expenditures against the budget line, supplemented by copies of the monthly financial reports submitted by the DPMUs/DPIUs, IWD will prepare on a quarterly basis, a statement of sources and uses of funds, reflecting activity-wise expenditures (for the quarter/year/project to date). The annual Statement of Sources and Uses of Funds prepared by IWD will be audited by the state office of the Comptroller and Auditor General of India (CAG). The audit report will be submitted to the World Bank and AIIB within six months of the close of each financial year. The CAG audit of the project financial statements will be in line with the agreed standard terms of reference (TOR) for World Bank-financed projects.

44. **Governance and Anticorruption.** The project will be subject to WB's Guidelines on Preventing and Combating Fraud and Corruption in Projects Financed by IBRD Loans and IDA Credits and Grants," dated July 1, 2016 (Anti-Corruption Guidelines). To the extent that the WB's Anti-corruption Guidelines are similar to the Bank's PPP, the WB's Anti-Corruption Guidelines will apply to the project activities financed in whole or in part by the proceeds of the proposed Bank and WB Loans. Detailed requirements are specified in the Loan Agreement and will also be included in the Co-Lenders' Agreement and the project tender documents. Project implementation will be monitored regularly by Bank staff in coordination with the WB. The Bank reserves the right to investigate, directly or indirectly through its agents, any alleged non-harmonized Prohibited Practices relating to the project, including "theft" and "misuse of resources", and to take necessary measures to prevent and redress any issues in a timely manner, as appropriate.

45. **Reporting and Monitoring.** The Project implementation progress will be monitored through regular implementation support missions conducted by the World Bank/AIIB and the SoWB. M&E consultant's findings will provide feedback during these missions, and progress reports will be prepared immediately preceding the implementation support missions. The final Beneficiary Implementation Completion Report (ICR) will be submitted to the WB/AIIB three months before the project's closing date. A separate ICR will be prepared by the WB/AIIB no later than six months after the project's closing date.

#### **D. Environmental and Social and Operational Policy on International Relations**

46. **Environmental and Social Policy and Categorization.** The Project will be co-financed with the World Bank (WB), and AIIB has agreed with the WB that the Environmental and Social Safeguard Policies and related procedures of the WB (WB Safeguard Policies) will apply to this project. AIIB is satisfied that: (i) the WB Safeguard Policies are consistent with the Bank's Articles of Agreement and materially consistent with the provisions of the Bank's Environmental and Social Policy and relevant Environmental and Social Standards, and (ii) that appropriate monitoring procedures are in place for the project.

47. At the concept stage, the project was assigned Category A. The project has been downgraded to Category B during project preparation for the following reasons:

- (i) The number of project-affected people anticipated at the concept stage was high, but it was reduced significantly as the project design has been changed to minimize its E&S impacts.
- (ii) The impacts on natural habitats were less significant as no Ramsar sites have been identified within or in the vicinity of the project area.
- (iii) The impact assessment verified that no religious or other physical cultural property sites are associated with the proposed investments.

48. The joint AIIB and WB due diligence process for environmental and social aspects during project preparation has resulted in the triggering of WB's Environmental and Social Safeguard Policies on Environmental Assessment (OP/BP 4.01), Natural Habitats (OP/BP 4.04), Pest Management (OP/BP 4.09), Physical Cultural Resources (OP/BP 4.11), Indigenous Peoples (OP/BP 4.10), Involuntary Resettlement (OP/BP 4.12), and Safety of Dams (OP/BP 4.37).

49. An environmental and social management framework (ESMF) and an environmental and social impact assessment (ESIA) accompanied by an environmental and social management plan (ESMP) have been prepared to meet requirements in OP/BP4.01. An ESMF was first prepared, which spells out the procedures for undertaking the ESIA and preparing the ESMP. The ESMF includes a Resettlement Policy Framework (RPF), which specifies the procedures, probable impacts, eligibility, entitlements, and other measures to be followed in the event of resettlement and/or land acquisition. The ESMF will also provide guidance on the preparation of applicable instrument(s) when the activities for the rehabilitation of the Durgapur Barrage are identified. The ESIA focused broadly on construction-related environmental safeguards and issues related to displacement of encroachers and/or squatters in the embankment of the flood management and irrigation segments. OP/BP 4.04 on Natural Habitats was triggered since it was envisaged that the rehabilitation of canals and desilting of certain reaches of the primary rivers of this area will have potential impacts on the natural ecosystem. However, activities involving significant conversion or degradation of critical natural habitats will not be financed under the project. Subsequent assessments indicated that the impacts of the project on natural habitats are limited. The ESIA includes an integrated pest management plan, which is based on potentially induced impacts of increased fertilizer and pesticide use due to improved agricultural intensification and diversification. There are no physical cultural resources found in the project activity sites. However, the ESMP includes provisions for dealing with any "Chance Finds" of archaeological, paleontological, and historical significance.

50. OP/BP 4.10 on Indigenous Peoples is applicable since all five project districts have Scheduled Tribes<sup>7</sup>. A tribal people's plan has been prepared as part of the ESIA to address interventions in areas inhabited by tribal people. The project envisages temporary relocation of squatters during the rehabilitation of irrigation canals and flood embankments. A resettlement action plan (RAP) has been prepared for the project. Preparation of site-specific RAPs are required for every parcel of land that would require displacement of encroachers and/or squatters.

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<sup>7</sup> The Scheduled Tribes are officially designated groups of historically disadvantaged people in India.

The site-specific RAPs have been prepared for the civil works contracts that are undergoing bidding process.

51. **Dam Safety.** The fluvial system in the project area is fed by five upstream dams located in the adjacent state of Jharkhand (Konar, Maithon, Panchet, Tenughat, and Tilaiya) and the Durgapur Barrage, located in West Bengal. Four of the five dams in Jharkhand are managed by DVC, except the Tenughat dam which is managed by the State of Jharkhand, while the Durgapur Barrage is managed by the IWD. OP/BP 4.37 - Safety of Dams has therefore been triggered. The World Bank conducted due diligence on the condition of the dams and prepared an action plan to meet the requirements of OP/BP 4.37. Under this action plan: (i) a Dam Safety Review Panel (DSRP) will be established for each of the five project dams and Durgapur barrage; and (ii) (a) each DRSP will perform periodic inspections and safety assessments and prepare a report of the condition of the dam, and the recommended dam safety measures; (b) a copy of each report will be provided to the World Bank (and shared with AIB); and (c) critical dam safety measures recommended by DRSPs will be implemented in a timely manner. In addition, the action plan also recommended the preparation of: (i) a study by DVC to develop flood forecasting models in the area downstream of Durgapur barrage on the Damodar river in order to improve the reservoir operations and enhance flood management; (ii) an Emergency Preparedness Plan (EPP) for each of the five dams; and (iii) O&M manuals for each of the five dams. This action plan is reflected in dated covenants in the loan agreement reflecting the government's commitment to complete these activities to the satisfaction of the WB. GOI is currently implementing two WB-supported projects, i.e. the National Hydrology Project (NHP) and the Dam Rehabilitation and Improvement Project (DRIP). The flood forecasting study required as part of the action plan will be carried under NHP, while the EPP and O&M plans for three dams owned by DVC (Konar, Maithon, Panchet Dams) are being prepared as part of DRIP activities.

52. **Environmental Aspects.** The project is expected to reinforce surface and ground water conservation as well as reduce flooding. However, temporary adverse environmental impacts are expected during construction, particularly carting and disposal of desilted materials, construction debris, demolition waste and clearing of vegetation and aquatic weeds. Special attention is given to community health and safety issues, issues related to labor camps, disruption to traffic, and interruption in irrigation supply, etc. A detailed account of all environmental risks and mitigation measures is provided in the ESMP. The ESMP also includes a capacity building plan, a monitoring plan and budget, and describes the roles and responsibilities of the key institutions for its implementation.

53. **Social Aspects.** There are 2,637 structures in the project location and these structures belong to 2,253 households. Out of 2,637 structures, 1,076 are residential houses, 788 are residential combined with commercial units and 773 are shops. The residential households are predominantly encroachers and squatters. Three community platforms will also be affected by the project. The compensation for all the affected categories is determined based on the RPF.

54. **Gender Action.** The project is expected to increase the number of women engineers hired to 7% from the current baseline of 4.5% in IWD during the project period. This will be achieved by (i) outreach activities targeting female students enrolled in STEM (Science, Technology,

Engineering and Mathematics) courses across local Universities, (ii) gender sensitive infrastructure in IWD premises such as separate toilets for women, adequate lighting, separate seating spaces, etc. and (iii) strengthened anti-sexual harassment cells in line with the requirements of the Sexual Harassment of Women at Workplace (Prevention, Prohibition and Redressal) Act, 2013.

55. **Occupational Health and Safety, Labor and Employment Conditions.** The issues on occupational health and safety, labor and working conditions have been discussed in the ESIA and measures to address the issues are developed in the ESMP. IWD will ensure that the provisions on these measures are included in the bid documents.

56. **Stakeholder Consultation and Information Disclosure.** The key stakeholders include farmers (including small and/or marginal farmers, women farmers); farmer organizations; fisherfolk; local self-governments; IWD staff at state, district and block levels; staff of other relevant line departments; and nongovernment organizations. Stakeholder consultations were organized as part of the process of development of the ESMF and ESIA. The draft ESMF was disclosed on the WB's website on Oct. 12, 2018 and updated on Dec. 1, 2018<sup>8</sup>; the RAP and ESIA (including ESMP) have been disclosed on the WB's website since Oct. 12, 2018 and Dec. 4, 2018 respectively. The draft ESMF, ESIA and ESMP documents including the Executive Summary in Bengali (the local language) were disclosed on the website of the Project Implementation Agency, the West Bengal Irrigation and Waterways Department (IWD) on November 30, 2018, and the RAP, including the Executive Summary in Bengali, was disclosed on November 29, 2018.<sup>9</sup> Stakeholder consultations on the draft documents were organized by IWD on Nov. 16, 2018. Final versions of all documents have been disclosed on the IWD website on October 22, 2019 and WB's website on November 1, 2019.

57. **Project-level Grievance Redress Mechanism.** The project will establish and implement a three-tier grievance redress mechanism (GRM) at the project site (up to DPMU), state (SPMU), and judicial levels. The project will also have a web-based GRM platform. The IWD website will include a link where affected persons can register their complaints online. Communities and individuals who believe that they are adversely affected by the project may submit complaints to existing project-level GRM or the WB's GRS.

58. **Use of WB's Accountability Mechanism** In view of the fact that the WB's Safeguard Policies will apply to this project, and pursuant to AIIB's agreement with the WB, AIIB will rely on the WB's corporate Grievance Redress Service (GRS) and the independent Inspection Panel (IP) to handle complaints relating to environmental and social 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. The WB GRS is designed to ensure that complaints received are promptly reviewed in order to address project-related concerns. Project affected communities and individuals may submit

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<sup>8</sup> <http://projects.worldbank.org/P162679/?lang=en&tab=documents&subTab=projectDocuments>

<sup>9</sup> <https://wbiwd.gov.in/index.php/applications/wbmifmp>

their complaint to the WB's independent IP at any time after concerns have been brought directly to the WB's attention, and its Management has been given an opportunity to respond. For information on how to submit complaints to the WB's corporate GRS, please visit: <http://www.worldbank.org/en/projects-operations/products-and-services/grievance-redress-service> . For information on how to submit complaints to the WB's Independent IP, please visit: <http://www.inspectionpanel.org> .

59. **Monitoring and Supervision Arrangements.** The project's environmental and social safeguard issues will be monitored through the environmental and social professionals engaged at the SPMU and the DPMUs. A third-party monitoring agency will be engaged to monitor the project biannually.

60. **Operational Policy on International Relations.** The international waterways provisions of AIIB's Operational Policy on International Relations (OP on IR) apply because the project involves the use of water from the Damodar river. The Damodar River drains into the Hooghly River, which is a tributary of the Ganga river, before flowing into the Bay of Bengal. Pursuant to Section 2.3 of the OP on IR, AIIB may, instead of carrying out its own assessment, rely on the assessment of a co-financing MDB if the AIIB is satisfied with the assessment capacity and process of such co-financier, as well as with the assessment itself. The WB in its assessment concluded that the Ganga and the Hooghly and their tributaries are international waterways for the purposes of the WB Operational Policy on Projects on International Waterways (OP/BP 7.50) but that notification to the riparians is not required under OP 7.50, because the project involves only minor additions or alterations to an ongoing scheme and is therefore expected to have only minimal effect on the other riparians. This is based on the following: (i) the focus of the proposed project is to modernize and upgrade management systems for improved irrigation and flood management, (ii) the Damodar River flows entirely within India, and (iii) India is the lowest downstream riparian of the Hooghly before it drains into the Bay of Bengal. AIIB has reviewed the supporting WB documentation and is satisfied with the WB's assessment capacity and process, as well as the assessment. AIIB therefore concurs that the project is expected to have minimal or no effect on any of the riparians. As a result, the exception in paragraph 3.3(c)(i) of AIIB's OP on IR to the notification requirement in paragraph 3.3(a) applies.

## **E. Risks and Mitigation Measures**

61. The project has an overall risk rating of "High" before mitigation. This risk rating reflects a combination of the standard risks associated with implementing a complex water sector project in West Bengal. Weak institutional capacity and lack of experience in developing and managing large scale MDB-financed investments could have an impact on project activities. The risks identified will be mitigated through project activities, including targeted support for institutional strengthening, skills building and capacity development. A WB-financed project is being implemented by WRIDD. Lessons from this experience will be applied to the SPMU, which will recruit technical and operational experts to enhance project-related functions of IWD.

**Table 2:** Summary of Risks and Mitigating Measures

Risk Description	Assessment Ratings (H/M/L)	Mitigation Measures
<p><b>1. Sector Strategies and Policies</b> Lack of the State Water Policy in West Bengal may undermine the sustainability of the irrigation sector</p> <p>Lack of long-term strategic guidance on irrigation sector performance may undermine the achievement of the longer-term objectives</p>	High	<p>Dialogue with SoWB on the broader sector narrative will continue during project implementation</p> <p>Global experience will be leveraged to improve irrigation performance and strengthen the financial viability and sustainability</p>
<p><b>2. Technical Design</b> Capacity to manage the innovative performance-based ISP's contracts may be insufficient</p>	High	An international project management consultant will be recruited to support the contract management
<p><b>3. Institutional Capacity for Implementation</b> IWD has no recent experience in the implementation of MDB-financed projects</p> <p>IWD has limited experience in working with ISPs and use of modern monitoring systems</p>	High	<p>Capacities of the SPMU will be strengthened, and the SPMU will be adequately staffed with competitively recruited specialists, supported by specialized consultant services.</p> <p>Through outsourcing the O&amp;M services to the performance-based ISPs, the long-term O&amp;M of the project will be ensured.</p>
<p><b>4. Fiduciary</b> Insufficient experience at IWD in the implementation of MDB-financed projects.</p>	High	The SPMU's capacity will be enhanced through: (i) strengthened procurement staffing and capacity during project implementation, (ii) procurement training for all staff of SPMU and line departments; (iii) development of a procurement manual as part of PIM; and (iv) using the WB's STEP in Procurement to monitor processes and governance, etc.
<p><b>5. Stakeholder</b> Farmers' perceptions may lead to high levels of anxiety about the use of the private sector for delivering irrigation services.</p>	High	A communication campaign to inform stakeholders about the details of the project will be launched, including the performance nature of the services, and the management of the ISPs.

<b>6. Environmental and Social</b> Insufficient oversight and monitoring for triggered safeguards issues	High	The SPMU will recruit highly qualified safeguard specialists and strengthening of safeguards capacities of SPMU staff will be conducted systematically during preparation and implementation.
<b>7. Dam Safety</b> Potential safety issues of the five upstream dams and the Durgapur Barrage	Medium	Dated covenants are included in the loan agreement to ensure the government fulfills the dam safety requirements to the satisfaction of the WB.
<b>Overall</b>	High	

### Annex 1: Results Monitoring Framework

<b>Project Objective:</b> To improve irrigation service delivery, strengthen flood risk management & improve climate change resilience.					
<b>Project Objective Indicators:</b>					
<b>To improve irrigation service delivery</b>	Unit	Baseline	End Target	Freq	Responsibility
1. Area provided with new/improved irrigation or drainage services	Hectare (Ha)	0	376,448	Annual	SPMU
2. Compliance with agreed water delivery schedule of the ISP's contract	Percentage	0	90	Annual	SPMU
3. Compliance with irrigation water supply from main canal to distributary canal	Percentage	0	90	Annual	SPMU
<b>To strengthen flood risk management</b>					
4. Rate of reduced flood depth at the monitoring points compared with equivalent flood depth for the period 1999-2017	Percentage	0	30	Annual	SPMU
<b>To improve climate change resilience</b>					
5. Arrest in the rate of decline of groundwater levels in semi-critical blocks in each defined groundwater management area <sup>1</sup>	Percentage	0	50% in area south of Damodar River; 50% in area between Damodar and Hooghly rivers	Annual	SPMU
6. No deterioration of groundwater level trends in	Percentage	0	100% in area south of Damodar	Annual	SPMU

<sup>1</sup> Groundwater monitoring and data collection/analysis will be carried out by Central Ground Water Board.

safe blocks in each defined groundwater management area <sup>2</sup>			River; 100% in area between Damodar and Hooghly rivers		
<b>Intermediate Results Indicators:</b>					
<b>Component A: Irrigation Management</b>					
1. Three modules of management information system functional	N/A	None	Fully functional	Annual	SPMU
2. Grievances registered related to delivery of project benefits that are resolved	Percentage	0	80	Annual	SPMU
3. Asset management plan prepared	Yes/No	No	Yes	Annual	SPMU
4. Groundwater study completed to the satisfaction of the WB/AIIB	N/A	Not yet started	Completed	Annual	SPMU
5. Percentage of women engineers recruited by IWD	Percentage	4.5	7	Annual	SPMU
<b>Component B: Modernization of Irrigation Infrastructure</b>					
6. Length of main canals modernized	Kilometers	0	166.9	Annual	SPMU
<b>Component C: Flood Management</b>					
7. Length of river embankment rehabilitated	Kilometers	0	111	Annual	SPMU
<b>Component C: Project Management</b>					
8. Number of project monitoring reports submitted on time annually	Number	0	4	Annual	SPMU

<sup>2</sup> Groundwater monitoring and data collection/analysis will be carried out by Central Ground Water Board.

## Annex 2: Detailed Project Description

### A. Damodar Valley Command Area

1. The Damodar Valley Command Area (DVCA) is an irrigation scheme that is located downstream of Durgapur on the Damodar River in the districts of East Bardhaman, West Bardhaman, Howrah, Bankura and Hoogly. The scheme covers 393,964 hectares (ha) and provides an important source of livelihood for 2.68 million people. The canals are fed via headworks at Durgapur Barrage. Flow in the Damodar River to Durgapur is regulated by five upstream dams located in the neighboring State of Jharkhand. Irrigation water is supplied from these dams during three seasons: *Kharif* (July 25 to Oct. 31), *Rabi* (Dec. 25 to Feb. 5) and *Boro* (Jan. 25 to April 30).

2. DVCA is managed by the IWD of the SoWB. The operation, maintenance and management of water distribution are managed by engineers from block levels to subdivisional and district levels. IWD supplies water up to the level of field outlets (*chaks*). After the field outlet, distribution of water, management and maintenance of the irrigation infrastructure is conducted by the beneficiaries that are organized in Chak committees. Distribution infrastructure is generally absent within chaks and water flows from plot to plot. DVCA is supplied with water from five dams located in Jharkhand. Four of the five dams (Konar, Maithon, Panchet, and Tilaiya) are managed by the Damodar Valley Corporation (DVC), while the fifth dam, Tenughat, is managed by the SoJ. The Durgapur Barrage is operated and managed by IWD.

### B. Challenges in Project Area

3. The project will address the following challenges identified during project preparation:
- (i) **Degraded and outmoded irrigation infrastructure.** The project will modernize canal system to improve the efficiency and the conveyance capacity to ensure that the canal system can deliver the required water and the hydraulic infrastructure supports improved quality of service delivery. This will include, in selected chaks, installing subsurface pressurized pipe micro-irrigation systems.
  - (ii) **Inadequate irrigation management.** The project will introduce modern asset management that will allow for systematic monitoring and rational assessment of maintenance needs and allocation of resources based on these needs.
  - (iii) **Declining groundwater levels.** The project will reduce the declining groundwater levels by modernizing irrigation infrastructure and improving irrigation management. The project will invest in a groundwater study to establish a more accurate water balance (including subsurface in- and outflow), identify opportunities for groundwater recharge, and define levels for sustainable groundwater withdrawal.

- (iv) **Insufficient flood risk management.** The project will invest in structural measures<sup>1</sup> to reduce the flooding, including selected desilting and construction and rehabilitation of embankments. The project will also support the rehabilitation for the Durgapur Barrage.
- (v) **Limited capacity to adapt to climate change.** The project will improve efficient use of surface water and improve the long-term sustainability of groundwater use, thereby improving farmers' capacity to respond to water variability and making the project area become more resilient to floods and droughts.

## C. Project Components

4. The project consists of four components: (i) improved management of irrigation to improve service delivery, performance monitoring and irrigation efficiency evaluation and strengthen institutions; (ii) strategic investments in the modernization of irrigation infrastructure; (iii) strengthened flood risk management that will result in flood reduction in the downstream parts of the project area; and (iv) project management. Improving climate change resilience is integrated within each of the first three components. The project management component supports strengthening both IWD's and the SPMU's capacity for project management.

5. **Component A: Irrigation Management.** This component will improve the management of the DVCA irrigation scheme. The component includes the following subcomponents: (i) establishment of MIS & performance monitoring and automated gate operation at the Main Canal level using SCADA-PLC, (ii) improving the quality of service delivery, (iii) aquifer management, (iv) capacity strengthening of the IWD, and (v) improvement works in sectors closely associated with irrigation.

- (i) **Subcomponent A.1: Establishment of MIS and Performance Monitoring.** The project will establish a robust MIS including installing associated data capture, transmission and management infrastructure as well as SCADA system and a central control room to accommodate these facilities, to improve monitoring of hydraulic data in the project area. The MIS and web-based GIS based software and associated servers, and High-Resolution Satellite Imagery will be procured under this sub-component. IWD, with support from a Project Management Consultant (PMC), will design the MIS system which will not only support the monitoring needs specific to this project, but also all the departmental (IWD) schemes and projects. The MIS will have the following functions:
  - a. **Administrative Functions**, including procurement, design approvals, project implementation and physical progress, finance and expenditure benchmarking, and human resources;
  - b. **Irrigation Operations and Decision Support System**, including a water balance module for conjunctive water management; a disaster management module including

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<sup>1</sup> The nonstructural measures are covered under a separate project being funded by the World Bank, i.e., National Hydrology Project (See Component C for details).

infrastructure operational thresholds, flood warning and alerts; and an asset management module, including asset maintenance records, status, and date of next service. These modules will be tied together with a high-level dashboard for decision makers/water managers. The project will pilot use of satellite services for irrigation scheduling;

- c. **Performance Monitoring and Irrigation Efficiency Evaluation**, including service delivery performance module measured as a factor of quantity and timeliness of delivery with subsequent benchmarking at outlets, personnel performance, beneficiary registration and engagement, service delivery verification and citizen's feedback, grievance redressal, diagnostics tracking and high-level performance review dashboard.

- (ii) **Subcomponent A.2: Improving Service Delivery.** The project will improve the quality of service delivery through: (i) introduction of performance-based operation of selected distributary and minor canals, (ii) support for individual irrigation service providers, (iii) introduction of rational asset management, and (iv) strengthening of accountability and transparency.

The project will introduce performance-based irrigation operation through recruitment of ISPs. IWD, with support from a transaction advisor, will outsource the O&M of selected distributary and minor canals (serving on average 10,000 hectares) to ISPs. ISPs will sign two contracts with IWD: (i) a multiyear framework contract that lays down the broad principles, and (ii) annual water supply and bulk water delivery contracts that are based on the amount of water available in the upstream reservoirs in that year. They will also sign on a voluntary basis separate service delivery contracts for promoting micro-irrigation.

ISPs will be paid by IWD on per hectare<sup>2</sup> basis. The amount of the payment per hectare by IWD will be determined through competitive bidding. The compliance with a water delivery schedule that will be agreed as part of the annual contract will be used as a KPI of the ISP and project objective indicator. The M&E consultant (under Component D) will be responsible for monitoring the performance of the ISPs. The project will hire a consultant to provide extensive training of ISPs after contract signing and organize a short refresher course and experience-sharing workshop at the end of each year, and promote the development of a market for ISPs, including for women.

The project will also promote individual service providers to offer irrigation related services to farmers and farmers group. The project will support these service providers and encourage them to scale up their services through capacity strengthening and assistance in preparation of business plans and credit requests to banks. The project will leverage the ISPs in promoting these services.

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<sup>2</sup> The SoWB has adopted the policy that irrigation investment and O&M costs should be covered by the public budget, and that recovery of costs for surface water delivery from farmers is not a short-term priority.

The project will introduce modern asset management, through hiring consultant for establishment of a geo-tagged asset database, development of maintenance standards, budget planning, and reporting.

The project will strengthen accountability and transparency in irrigation service delivery by:

- a. Introducing a benchmarking system of irrigation performance, including identification of KPIs, regular measurement and reporting of performance.
- b. Introducing client feedback, including regular user surveys and disclosure of the results, establishment of user and third-party complaint mechanisms, promotion of citizen participation and disclosure of performance, e.g., through cellphone apps.
- c. Preparing an annual Citizen Report Card<sup>3</sup> to report on IWD's KPIs.
- d. Staff management: job descriptions, annual performance evaluation, job requirements, in-house training, career management, etc.
- e. Introducing service level standards for irrigation services.
- f. Launching (under Component D) of a communication campaign to inform stakeholders about the details of the project, including the importance of efficient water use, and the benefits of pressurized micro-irrigation for groundwater.

- (iii) **Subcomponent A.3: Aquifer Management.** The project will establish a groundwater monitoring system, including tubewells and monitoring equipment, that will be managed by SWID under the State Water Resources Investigation and Development Department (WRIDD). The Project will install adequate number of new testing wells and procure remote automatic monitoring equipment to transfer the field data to the MIS (Sub-Component A.1). Through the MIS, the project will collect baseline data on groundwater use, levels and quality. WRIDD will operate a service that will disclose geo-tagged groundwater level information through a mobile phone app that will be developed by PMC under subcomponent D, and that will issue regular groundwater alerts.

The project will also invest in the groundwater database by conducting a study into the groundwater situation in the project area. The study will be carried out by a consultant to establish a more accurate water balance (including subsurface inflow and outflow), identify opportunities for groundwater recharge, and define levels for sustainable groundwater withdrawal. An Expert Groundwater Consultant with international exposure would be engaged to assist WRIDD to prepare and implement an Action Plan to identify opportunities for groundwater recharge and define level of sustainable groundwater withdrawal.

- (iv) **Subcomponent A.4: Capacity Strengthening.** The project will strengthen capacities of IWD staff, ISPs, to improve the quality of service delivery. A consultant will be hired to

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<sup>3</sup> A "citizen report card" is an annual communication to customers on how the agency has progressed in the current year on a number of results indicators, including items such as: time to resolve a complaint; performance of the ISPs, area irrigated, water use per ha; etc. Report Card results are typically published in the local media and posted on the IWD's website.

conduct the capacity strengthening needs assessment during the first year of the project and the assessment results will be revisited and updated periodically based on feedback from beneficiaries. IWD staff will be trained in effective contract design, management and monitoring.

The project will hire consultant to help IWD prepare separate financial reports of the accounts of different irrigation schemes in West Bengal to lay the foundations for reforms in the future.

The project will support the SoWB's program to transform the River Research Institute (RRI) into a center of excellence affiliated with the Jadavpur University. Investments in upgrading RRI's infrastructure have been identified, including upgrading the RRI's laboratory (civil works and equipment) and procurement of hydraulic modelling software.

- (v) **Subcomponent A.5: Improvement Works in Sectors Closely Associated with Irrigation.** The project will invest in improvement works in sectors closely associated with irrigation, including Agriculture, Agri-Marketing, Food Processing and Horticulture Department, and Fisheries. Proposed investments include support for diversified cropping (including fruits and vegetables), demonstrations to promote water conservation and promotion of pressurized micro-irrigation (see sub-Component B.2), capacity strengthening of farmers and farmer producers' organizations, construction of pack houses, support for value chains, and promotion of pisciculture. The project will hire consultants to confirm these investments.

6. **Component B: Modernization of Irrigation Infrastructure.** This component will invest in the modernization of irrigation infrastructure at main, branch, distributary and minor levels. The component includes the following subcomponents: (i) Main and Branch Canal Modernization, and (ii) Distributary and Minor Canal Modernization.

- (i) **Subcomponent B.1: Main and Branch Canal Modernization.** The project will invest in the modernization and rehabilitation of the Right and Left Bank main canals and branch canals. There are 10 branch canals in the DVCA with an average service area of 39,000 hectares. Specially designed flap gates will be installed to ensure uniformity in distribution and help better manage water levels. Selected sections of canals will be lined to reduce the risk of bank erosion.
- (ii) **Subcomponent B.2: Distributary and Minor Canal Modernization.** There are 39 distributary canals in the command area, with an average service area of 10,000 ha. The 220 minor and sub-minor canals in the project area each serve on average an area of 2,000 ha. The project will upgrade these canals through investments in rehabilitation of cross-regulators, installation of modern closable and lockable outlet structures, and lining selected sections of canals to reduce bank erosion.

7. **Component C: Flood Management.** This component will invest in structural measures to reduce flooding in the downstream parts of the project area. Nonstructural measures are

covered under the World Bank-funded National Hydrology Project, including monitoring, preparation of an emergency preparedness plan, establishment of an early flood warning system, hydrological studies and capacity strengthening. Structural measures will include investments to ensure that flood flow discharge is more evenly shared between the Mundeswari River and Amta Channels. Specific investments have been identified, including increasing the conveyance capacity of the Mundeswari River, construction and rehabilitation of embankments, selected desilting, controlling and reducing discharge into the Amta Channel under high flow conditions, implementing small improvements and modifications to the Amta Channel left bank, construction of groynes and improving several sluice gates to facilitate more rapid evacuation of flood water. The component will also include construction of fall-board shutters at three locations across the Mundeswari River and Amta channels to replace earthen embankments constructed across the rivers annually. A lump sum provision is reserved in the project budget for the implementation of the recommendations of Dam Safety Review Panel (DSRP).

8. **Component D: Project Management.** This component will strengthen IWD's and SPMU's capacity for project management including inter alia procurement and financial management, monitoring and evaluation (M&E) through the provision of office equipment, consultant services, capacity building training, and financing the incremental operating costs of SPMU, DPMUs and DPIUs. Staffing of the SPMU will be strengthened to include several technical, financial management, M&E and safeguards experts. A consultant will be recruited that will be responsible for M&E, data collection and reporting. A PMC will be recruited to assist the SPMU in managing and coordinating project activities and setting up the MIS. The PMC will also conduct construction supervision of civil works. A communication strategy consultant will be hired to help IWD to launch a communication campaign to inform stakeholders about the details of the project, including the importance of efficient water use, and the benefits of pressurized micro-irrigation for groundwater. The project will also reach out to central and state governments and share the results of the project in improving the quality of irrigation service delivery and in reducing flood risks, through regular workshops organized in West Bengal and New Delhi, and exchange visits. The PMC will also help IWD to develop and manage a mobile-based website as part of IWD's existing web domain, which will allow farmers to access data and file complaints with IWD.

## Annex 3: Economic Analysis

### A. Introduction

1. Irrigation has been central for the development of agricultural sector and improvement of food security in India. Over the past years, the country has invested substantially in the development of large dams, storage structures and canal networks to support its irrigation practices and fulfill other water needs. This has improved the food and water security; yet in many areas with limited surface water resources, the increasing irrigation demand and growing population has led to a higher and unsustainable extraction of groundwater. Further, the country is also facing the threat of climate change, which will exacerbate the current challenges as the climate change is expected to intensify water-related disasters (especially flooding and drought) and adversely affect the quality of surface water.

### B. Methodology

2. A cost-benefit analysis was carried out to assess the economic viability of the project, based on its Economic Internal Rate of Return (EIRR) and Economic Net Present Value (ENPV), comparing “with--project” and “without-project” scenarios. The analysis was undertaken in four main steps: (i) identifying project benefits and costs; (ii) quantifying and valuing the benefits and costs (in their market or financial prices); (iii) adjusting the costs and benefits to reflect their economic values; and (iv) comparing economic benefits with economic costs to calculate the EIRR and ENPV.

3. **Key Assumptions.** The following assumptions were adopted when performing the cost-benefit analysis:

- (i) Standard conversion factor was assumed to be 0.88
- (ii) Project duration was assumed to be 30 years
- (iii) Project construction period was assumed to be five years and, thus, the benefits will be accrued in the sixth year
- (iv) Discount rate was assumed to be 12 percent
- (v) Annual operation and maintenance (O&M) costs after the construction period was assumed to be two percent of the total capital investment and being one percent during the construction period<sup>1</sup>
- (vi) Population growth was assumed to be 1.02 percent per year<sup>2</sup>
- (vii) Increase of electricity tariff was assumed to be 0.5 percent per year

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<sup>1</sup> The assumption of the O&M cost is based on the assessment of the Irrigation and Waterways Department of the Government of West Bengal.

<sup>2</sup> Source: Statistical Abstract of West Bengal (2015), issued by the Department of Planning, Statistics and Program Monitoring of Government of West Bengal.

4. **Project Benefits.** The main expected benefits of the project, which have been included in the analysis, are: (i) reduced flood damages; (ii) avoided income loss and (iii) energy savings due to reduced groundwater pumping. Other project's benefits, which are not quantified and included in the analysis, include: resources conservation due to reduced groundwater extraction, reduction of greenhouse gas emission due to decreased groundwater pumping, increase of agricultural production due to improved water availability, avoided disrupted access to public infrastructure and services, increase of property values, improved quality of living and business environment. Despite being actual benefits, the quantification and valuation of these benefits were difficult due to limited data availability and, therefore, the analysis was done conservatively and focused on benefits which are readily quantifiable.

5. **Reduced Flood Damages.** Data on flood damages (1999 to 2017) was gathered from flooding reports of the local district/block offices, IWD and Disaster Management Department of SoWB. The costs included value of damaged crops, damaged houses, damaged public goods and expenditure on relief measures (see Table 1). Based on this information, and in combination with data on local hydrological, topographical and other relevant geophysical properties of the project area (including the impact of climate change on the rainfall in Damodar Basin<sup>3</sup>), the future flooding occurrence and magnitude (between 2024 and 2048, with-project and without-project scenarios) were simulated using a computational flood modelling software. The outputs of this simulation were subsequently used to calculate the number of affected population and the expected damage costs (see Table 2).

**Table 1:** Historical flooding damages (adjusted to 2017 price level)

Year	Area affected (sq. km)	Population affected	Total physical damage (INR Crore)
1999	215.00	347,000	844
2000	342	460,320	1,171
2004	132	131,400	257
2005	76	130,952	244
2006	544	595,000	538
2007	604	446,500	699
2008	41	91,899	114
2009	603	1,040,000	1,580
2010	46	97,677	153
2011	555	375,000	440
2013	397	335,150	243
2015	775	1,738,948	5,415
2016	-	-	27
2017	793	1,682,285	2,258

Note:

1. Crore = 10 million.

<sup>3</sup> Due to climate change, rainfall is expected to be increase by 2.3% to 1230% in terms of both frequency and intensity (Source: Chatterjee, M., Roy, D., Das, S. and Mazumdar, A., 2014. Assessment of water resources under climate change: Damodar River Basin, India. ARPN J Eng Appl Sci, 9(11), pp.2183-2191). In the economic analysis, a conservative assumption was made: the rainfall in the project area will intensify by 30% after the project implementation; while its frequency was assumed to remain unchanged.

**Table 2:** Expected flood impacts for with- and without-project scenarios

Year	Without Project			With Project		
	Area affected (sq. km)	Population affected	Total physical damage (INR Crore)	Area affected (sq. km)	Population affected	Total physical damage (INR Crore)
2024	319	488,671	927	165	252,523	440
2025	503	770,245	1,423	260	398,029	694
2026	621	950,657	1,743	321	491,258	857
2027	208	318,407	646	107	164,539	287
2028	354	541,467	1,042	169	259,393	452
2029	560	857,397	1,599	268	410,742	716
2030	719	1,100,415	2,030	344	527,161	919
2031	232	355,280	739	111	170,199	297
2032	389	595,250	1,165	175	267,955	467
2033	612	936,505	1,769	275	421,573	735
2034	778	1,191,799	2,224	350	536,494	936
2035	248	380,451	819	112	171,262	299
2036	417	638,445	1,280	176	270,210	471
2037	656	1,004,917	1,930	278	425,312	742
2038	835	1,278,471	2,420	353	541,088	944
2039	266	406,734	913	112	172,142	300
2040	445	681,437	1,406	178	271,861	474
2041	701	1,072,935	2,104	280	428,049	746
2042	891	1,364,705	2,629	356	544,452	949
2043	283	433,102	1,021	113	172,787	301
2044	490	750,083	1,592	178	273,069	476
2045	772	1,182,530	2,366	281	430,502	751
2046	983	1,505,638	2,951	358	548,131	956
2047	312	476,971	1,180	113	173,642	303
2048	493	755,269	1,689	180	274,957	480

6. **Avoided Income Loss.** Floods have regularly prevented the local population and business from working and generating income for days, or even weeks, every year. The proposed project will reduce both the flood duration and coverage, which will decrease the disruption for the population to work and, therefore, lead to a higher productivity and income. Similar to the quantification of flood reduction benefits, using historical flood data, hydrological data and other geophysical data, the future flooding was computationally simulated for with-project and without project scenarios. From the simulation, the number of benefiting population (living in flood-prone areas) and the reduction of flooding duration was derived, which showed that, the flooding will be shortened by four to ten days every year; which are assumed to be fully convertible to productive days. Using this, in combination with data on income generation<sup>4</sup> and workforce participation rate<sup>5</sup>, the avoided income loss was calculated and shown in Table 4.

7. **Energy Savings.** The increase of surface water availability due to the project is expected to significantly reduce the need for groundwater pumping and, thus, reduce the expenditures on electricity (as its main energy source). Based on water balance analysis, it is expected that groundwater pumping will drop by, at least, 744 million cubic meter per year (between the without-

<sup>4</sup> Per Capital Income is used to estimate the daily income of the population.

<sup>5</sup> Source: Census Data 2011 issued by Office of the Registrar General of India.

project and with-project scenarios), which would translate to energy saving of nearly 39 million kWh per year. The reduction of groundwater pumping (and energy savings) is expected to continuously increase in the future due to climate change. Climate change will increase irrigation demand (through increased evapotranspiration) and, without the project, would have led to higher groundwater pumping and related energy consumption. However, this additional saving was not factored into the analysis due to limited data availability. Based on this, and data on electricity tariff<sup>6</sup>, the total savings on energy cost were calculated and shown in Table 4.

8. **Project Cost.** The total project cost is estimated at INR 2,932 crores (USD413 million), which will be spent over five years of construction period. By excluding the taxes (GST and CESS<sup>7</sup>, totaling 14 percent) and expected contractor's profit margin (10 percent), the total economic cost of the project is INR 2,228 Crores.

### C. Results of Economic Analysis

9. The analysis has demonstrated the importance and high economic value of the project with EIRR of 20.5% and corresponding ENPV of INR 1,643 Crores. The results are summarized in Table 3 and the cashflows of costs and benefits are shown in Table 4.

**Table 3: Results of Cost Benefit Analysis**

	ENPV in INR Crore <sup>8</sup>
<b>Project costs</b>	1,737
Construction	1,537
Operation and maintenance	200
<b>Project benefits</b>	3,381
Reduced flooding damage	3,155
Avoided income loss	110
Energy savings	117
<b>Economic valuation of the project</b>	
Economic Net Present Value	1,643
Economic Internal Rate of Return	20.5%

10. **Sensitivity Analysis.** Sensitivity analysis was performed by simulating of the following scenarios: (i) construction and O&M cost overrun by 20%, (ii) benefits to be 20% lower than expected, and (iii) a worst-case scenario, which combines the two previous scenarios. The sensitivity analysis shows that the project remains economically viable under all scenarios (see Table 4). It also shows that economic viability of the project is most sensitive to decrease in the project benefits followed by costs overrun.

11. As previously mentioned, the economic analysis was carried out using readily quantifiable benefits and excluding other benefits (paragraph 8). If these other benefits were included, they would further boost the project's economic viability (especially when including the increase of agricultural output). The presence of reliable water delivery may not only lead to a higher crop

<sup>6</sup> Level of tariff charged by the West Bengal State Electricity Distribution Company Ltd.

<sup>7</sup> In India, CESS refers to a tax earmarked for a particular purpose.

<sup>8</sup> Refer to Table 4 for the detailed calculation of ENPV.

yield but also attract farmers to increase its cropping intensity (more cultivating seasons in a year), grow higher-value crops which requires consistent water availability and, even, extend its cultivating area. Further, the protection from flooding will not only lead to a higher labor productivity but also generate business growth in the area which will translate into increased employment. However, as the EIRR is already well above 12% (under all sensitivity analysis scenarios) despite only including selected benefits, the project has managed to demonstrate its solid economic viability through this analysis.

**Table 4: Cashflow and sensitivity analysis**

Year	Costs		Benefits <sup>1</sup>			Net benefits	Sensitivity analysis		
	Construction cost	O & M	Reduced flood damage	Avoided income loss	Energy savings		Increase in costs by 20%	Decrease in benefits by 20%	Increase in costs by 20% and decrease in benefits by 20%
2019	111	1	-	-	-	-112	-135	-112	-135
2020	446	4	-	-	-	-450	-540	-450	-540
2021	668	6	-	-	-	-674	-810	-675	-810
2022	557	5	-	-	-	-562	-675	-562	-675
2023	446	4	-	-	-	-450	-540	-450	-540
2024	-	42	428	10	25	421	413	329	320
2025	-	42	641	15	25	640	632	504	495
2026	-	42	780	19	26	783	775	618	610
2027	-	42	316	8	26	309	300	238	230
2028	-	42	519	14	26	517	508	405	397
2029	-	42	777	22	26	783	775	618	610
2030	-	42	978	29	26	991	983	785	776
2031	-	42	389	12	26	385	377	300	291
2032	-	42	614	20	26	619	611	487	478
2033	-	42	910	31	27	926	918	732	724
2034	-	42	1,134	41	27	1,160	1,151	919	911
2035	-	42	458	17	27	460	451	359	351
2036	-	42	712	28	27	724	716	571	563
2037	-	42	1,046	44	27	1,075	1,066	852	843
2038	-	42	1,299	57	27	1,342	1,333	1,065	1,057
2039	-	42	539	23	27	547	539	429	421
2040	-	42	820	38	27	844	835	667	658
2041	-	42	1,194	60	28	1,240	1,232	984	975
2042	-	42	1,478	79	28	1,542	1,534	1,226	1,217
2043	-	42	634	31	28	651	642	512	504
2044	-	42	982	54	28	1,023	1,014	810	801
2045	-	42	1,422	86	28	1,494	1,486	1,187	1,178
2046	-	42	1,756	113	28	1,855	1,847	1,476	1,468
2047	-	42	772	44	28	802	794	633	625
2048	-	42	1,064	68	29	1,119	1,111	887	879
<b>ENPV<sup>2</sup></b>									
<b>(INR Crore)</b>	1,537	200	3,155	110	117	1,643	1,296	967	619
<b>EIRR</b>						20.50%	17.90%	17.40%	15.00%

Note:

1. Standard conversion factor of 0.88 is adopted for the benefit calculation.
2. Discount rate of 12 percent is adopted for the calculation of ENPV.

## Annex 4: Sovereign Credit Fact Sheet

### A. Recent Economic Development

1. India is a lower-middle-income country, with a population of 1.34 billion<sup>9</sup>. It is the world's seventh largest economy by nominal GDP and third largest economy by purchasing power parity in 2018. Despite the recent slowdown, India's economy has grown at a healthy rate of 7.5% during 2014-2018, helped by an uptick in investment and consumption and lower trade deficit. Following disruptions related to the November 2016 demonetization initiative<sup>10</sup> and the July 2017 goods and services tax (GST) rollout, growth slowed to 7.2 percent in 2017 and 6.8% in 2018. The government has introduced many measures to boost aggregate demand, strengthen banking sector, attract FDI and incentivize private investment. These are likely to aid a recovery in growth.
2. Low food prices on a return to normal monsoon, a supply glut of certain food products, agriculture sector reforms, subdued domestic demand, and currency appreciation contributed to a continued decline in inflation, from 4.5 percent in 2016 to 3.6 percent in 2017 and 3.5 percent in 2018. This provided room for a more accommodative monetary policy with key policy rates being reduced by 110 basis points since February 2019.
3. The current account deficit widened to 1.8 percent of GDP in 2017 and further to 2.1 percent of GDP in 2018. Higher oil prices resulted in strong growth in oil imports, while exports remained subdued as global demand turned sluggish. Despite some fiscal consolidation, aggregate deficit remains high, reflecting tepid growth in revenue and higher recurrent expenditure involving pensions, interest payments and subsidies.

### B. Economic Indicators

#### Selected Macroeconomic Economic Indicators (2015-2020)

Economic Indicators	2015	2016	2017	2018	2019*	2020*
Real GDP Growth	8.0	8.2	7.2	6.8	7.0	7.2
Inflation (change %, average)	4.9	4.5	3.6	3.5	3.9	4.2
Current account balance (% of GDP)	-1.1	-0.6	-1.8	-2.1	-2.5	-2.4
General government overall balance (% of GDP)	-7.0	-6.7	-7.0	-6.6	-6.5	--
Nominal gross public debt (% of GDP)	69.9	69.0	69.8	69.8	69.0	67.8
Public gross financing needs (% of GDP)	--	11.1	11.7	11.1	10.8	10.4
External debt (% of GDP)	23.1	20.7	20.0	20.0	20.0	19.9
Gross external financing need (% of GDP)	10.3	9.5	9.7	10.9	10.8	10.9
Gross reserves (months imports)	8.9	7.6	7.5	6.8	6.5	6.3
Direct investment in India (net, % of GDP,	-1.7	-1.6	-1.2	-1.4	-1.6	--

<sup>9</sup> The income group classification for fiscal year 2019 is based on World Bank criteria, details seen: <https://datahelpdesk.worldbank.org/knowledgebase/articles/906519>; Population data use World Bank 2017 data.

<sup>10</sup> Demonetization initiative: 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.

“-“ signifies inflow)

Broad money (% annual change, EOP)	10.1	10.1	9.5	11.4	11.8	12.3
Exchange rate (Rupee/USD, EOP) **	66.5	67.9	63.7	69.6	71.1	--

Note: \* denotes projected figures.

\*\* FX data from Thomson Reuters, 2019 FX rate as of September 24, 2019

Source: IMF, World Economic Outlook Database, April 2019, IMF, World Economic Outlook Update, July 2019 and IMF Country Report No. 18/254, August 2018.

### C. Economic Outlook and Risks

4. According to IMF's World Economic Outlook Update, July 2019, India's growth is projected to increase to 7.0% in 2019. However, weaker than anticipated growth in the first quarter of 2019 indicates that growth in 2019 may be lower than 2018. The slowdown in 2019 is a result of a decline in consumption growth, weakness in investment and manufacturing due to stress in the financial sector and sluggish export growth as external demand remains weak. Measures taken by the government to boost the economy and a more expansionary stance of monetary policy with some expected impetus from fiscal policy is expected to drive growth up to 7.2% in 2020. Growth in India is expected to stabilize at 7.7 percent over the medium term, based on the continued implementation of structural reforms and easing of infrastructure bottlenecks. With demand remaining sluggish and a modest increase in food inflation from a low base, inflation is projected to be 3.9 percent in 2019, slightly higher than 2018. An improvement in aggregate demand is expected to push inflation to 4.2 percent in 2020. The current account deficit is expected to narrow to be 2.5 percent of GDP in 2019, reflecting subdued exports before moderating to 2.4 percent of GDP as external demand revives.

5. External risks emanate from tighter global financial conditions, a retreat from cross-border integration including spillover risks from a global trade conflict, rising regional geopolitical tensions and higher than expected oil prices. Internally, India faces some risks to targeted fiscal consolidation arising from tax revenue shortfalls due to cut in tax rates and continued issues around GST implementation along with higher than expected recurrent spending. There are also some concerns that the impact of the policies to address problems around the weak bank and corporate balance sheets could take longer than anticipated. Furthermore, policies on key structural reforms involving land and labor could also be delayed.

6. 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. Over the medium term until 2023, the public debt-to-GDP ratio is projected to decline gradually to around 63 percent of GDP from the current level of almost 70 percent. Continued fiscal consolidation is needed to bring down India's elevated public debt. Potential low growth represents the primary risk to the debt outlook. India's external debt, currently at 20.0 percent of GDP, remains sustainable.