Document of

The World Bank

FOR OFFICIAL USE ONLY

Report No: ICR00004618

IMPLEMENTATION COMPLETION AND RESULTS REPORT

(IBRD-8090-IN/IDA-5014-IN)

ON A

CREDIT

IN THE AMOUNT OF SDR 78.2 MILLION

(US$125 MILLION EQUIVALENT)

AND A LOAN

IN THE AMOUNT OF US$125 MILLION

TO THE

REPUBLIC OF INDIA

FOR A

WEST BENGAL ACCELERATED DEVELOPMENT OF MINOR IRRIGATION PROJECT

September 16, 2020

Sustainable Development Department
South Asia Region

CURRENCY EQUIVALENTS

(Exchange Rate Effective June 4, 2020)

Currency Unit =	Indian Rupee (INR)
INR 74.83 =	US$1
US$1.375530 =	SDR 1

FISCAL YEAR

April 1 – March 31

ABBREVIATIONS AND ACRONYMS

ADMI	Accelerated Development of Minor Irrigation
CAS	Country Assistance Strategy
CBA	Cost-Benefit Analysis
CSP	Community Service Provider
DPMU	District Project Management Unit
DPR	Detailed Project Report
DWRID	Department of Water Resources Investigations and Development
EA	Environmental Assessment
EIRR	Economic Internal Rate of Return
EMP	Environmental Management Plan
ENPV	Economic Net Present Value
FIRR	Financial Internal Rate of Return
FM	Financial Management
FNPV	Financial Net Present Value
GIS	Geographic Information System
GoI	Government of India
GoWB	Government of West Bengal
I&D	Irrigation and Drainage
ICR	Implementation Completion and Results Report
IRMA	Institute of Rural Management Anand
ISR	Implementation Status and Results Report
IWMI	International Water Management Institute
M&E	Monitoring and Evaluation
MI	Minor Irrigation
MIS	Management Information System
MOM	Management, Operation, and Maintenance
MTR	Midterm Review
NGO	Non-governmental Organization
NICT	New Information and Communication Technology
O&M	Operation and Maintenance
PAD	Project Appraisal Document
PD	Project Director

PDO	Project Development Objective
PMU	Project Management Unit
SDMP	Scheme Development and Management Plan
SMS	Short Message Service
SO	Support Organization
SPMU	State Project Management Unit
TTL	Task Team Leader
WBADMI	West Bengal Accelerated Development of Minor Irrigation
WoP	Without Project
WP	With Project
WUA	Water User Association

Regional Vice President:	Hartwig Schafer
Country Director:	Junaid Kamal Ahmad
Regional Director:	John A. Roome
Practice Manager:	Michael Haney
Task Team Leader(s):	Anju Gaur, Raj Ganguly
ICR Main Contributor:	Yoro Sidibe

TABLE OF CONTENTS

DATA SHEET

BASIC INFORMATION

Product Information

Project ID	Project Name
P105311	IN West Bengal Accelerated Development of Minor Irrigation
Country	**Financing Instrument**
India	Investment Project Financing
Original EA Category	**Revised EA Category**
Full Assessment (A)	Full Assessment (A)

Organizations

Borrower	Implementing Agency
Republic of India	DWRID, Government of West Bengal, Public Works Department, Government of West Bengal

Project Development Objective (PDO)

Original PDO

The project development objective is to enhance agricultural production of small and marginal farmers in the project area. This will be achieved through development of minor irrigation (MI) schemes, strengthening community-based irrigation management, and support to agricultural development, including provision of agricultural services, encouraging crop diversification and use of new technologies, and creating income generating opportunities.

FINANCING

	Original Amount (US$)	Revised Amount (US$)	Actual Disbursed (US$)
World Bank Financing			
IBRD-80900	125,000,000	20,193,004	20,193,004
IDA-50140	125,000,000	125,000,000	110,592,904
Total	**250,000,000**	**145,193,004**	**130,785,908**
Non-World Bank Financing			
Borrower/Recipient	50,000,000	30,000,000	22,330,000
Total	**50,000,000**	**30,000,000**	**22,330,000**
Total Project Cost	**300,000,000**	**175,193,004**	**153,115,909**

KEY DATES

Approval	Effectiveness	MTR Review	Original Closing	Actual Closing
04-Oct-2011	19-Mar-2012	18-Aug-2014	31-Dec-2017	20-Dec-2019

RESTRUCTURING AND/OR ADDITIONAL FINANCING

Date(s)	Amount Disbursed (US$M)	Key Revisions
18-Feb-2016	38.09	Change in Components and Cost Cancellation of Financing Change in Financing Plan
30-Jun-2017	72.95	Change in Results Framework
10-Nov-2017	72.95	Change in Implementing Agency Change in Results Framework Change in Loan Closing Date(s) Change in Implementation Schedule

KEY RATINGS

Outcome	Bank Performance	M&E Quality
Moderately Satisfactory	Moderately Satisfactory	Substantial

RATINGS OF PROJECT PERFORMANCE IN ISRs

No.	Date ISR Archived	DO Rating	IP Rating	Actual Disbursements (US$M)
01	17-May-2012	Satisfactory	Satisfactory	.57
02	03-Dec-2012	Satisfactory	Satisfactory	1.48
03	08-Jun-2013	Satisfactory	Moderately Satisfactory	6.60
04	06-Nov-2013	Moderately Satisfactory	Moderately Unsatisfactory	6.60
05	19-Apr-2014	Moderately Unsatisfactory	Unsatisfactory	15.15
06	11-Nov-2014	Moderately Unsatisfactory	Moderately Unsatisfactory	15.15
07	09-Jun-2015	Moderately Unsatisfactory	Moderately Unsatisfactory	15.15
08	15-Dec-2015	Moderately Unsatisfactory	Moderately Unsatisfactory	38.09
09	06-Jun-2016	Moderately Unsatisfactory	Moderately Satisfactory	38.09
10	28-Nov-2016	Moderately Unsatisfactory	Moderately Satisfactory	52.96
11	19-Jun-2017	Moderately Unsatisfactory	Moderately Satisfactory	72.95
12	01-Nov-2017	Moderately Satisfactory	Moderately Satisfactory	72.95
13	23-Apr-2018	Moderately Satisfactory	Moderately Satisfactory	83.32
14	12-Dec-2018	Moderately Satisfactory	Satisfactory	103.86
15	05-Jun-2019	Moderately Satisfactory	Satisfactory	110.64
16	09-Dec-2019	Moderately Satisfactory	Satisfactory	117.64

SECTORS AND THEMES

Sectors

Major Sector/Sector	(%)
Agriculture, Fishing and Forestry	**100**
Agricultural Extension, Research, and Other Support Activities	8
Fisheries	3
Crops	4
Irrigation and Drainage	82
Livestock	3

Themes

Major Theme/ Theme (Level 2)/ Theme (Level 3)	(%)
Private Sector Development	**100**
Jobs	100
Finance	**2**
Finance for Development	2
Agriculture Finance	2
Urban and Rural Development	**51**
Rural Development	51
Rural Markets	2
Rural Infrastructure and service delivery	47
Land Administration and Management	2
Environment and Natural Resource Management	**47**
Renewable Natural Resources Asset Management	4
Biodiversity	2
Landscape Management	2
Water Resource Management	43
Water Institutions, Policies and Reform	43

ADM STAFF		
Role	**At Approval**	**At ICR**
Regional Vice President:	Isabel M. Guerrero	Hartwig Schafer
Country Director:	N. Roberto Zagha	Junaid Kamal Ahmad
Director:	John Henry Stein	John A. Roome
Practice Manager:	Simeon Kacou Ehui	Michael Haney
Task Team Leader(s):	Joop Stoutjesdijk	Anju Gaur, Raj Ganguly
ICR Contributing Author:		Yoro Sidibe

I. PROJECT CONTEXT AND DEVELOPMENT OBJECTIVES

A. CONTEXT AT APPRAISAL

Context

1. **In 2011, West Bengal was the fourth most populous state in India with a population of over 91 million people,[1] most of whom lived in rural areas.[2]** About 55 percent of the population derived their income directly from agriculture.[3] Poverty prevailed among small and marginal farmers and tribal groups.[4] Tribal groups who are significant in the western region of the State faced recurrent droughts and had much lower incomes than other groups.[5]

2. **Though West Bengal is richly endowed with surface water and groundwater, its agricultural performance was spatially varied.** The relative abundance of water resources[6] masked the wide disparity in their availability across the diverse agroclimatic zones.[7] In large rainfed mono-cropped tracts mainly located in the western districts,[8] agricultural production was constrained by low water storage and ineffective water management, contributing to pockets of poverty.[9] While the possibility of large storage infrastructure was limited, the potential for developing small-scale storage systems was substantial. By limiting the variability of irrigation water availability, improved water storage could limit the effect of climate vagaries, particularly dry spells, provided solutions are tailored to the agroclimatic diversity.

3. **Since the 1990s, West Bengal's response to irrigation development has primarily focused on infrastructure.** Since the 1990s, the interventions of the Government of West Bengal (GoWB) have emphasized structural measures with less attention paid to nonstructural measures.[10] As a result, irrigation schemes suffered from poor maintenance and the low capacity of irrigation water users.[11] However, irrigation had the potential to play a vital role in reducing poverty[12] through an increase in crop

[1] Population Census of India, 2011.
[2] Nearly 70 percent of the population lived in villages.
[3] The figure reaches 70 percent when agriculture related sectors are considered.
[4] Tribal populations represent about 6 percent of the population of West Bengal.
[5] The annual income of Scheduled Tribes in West Bengal was about 50 percent lower than that of other groups. Tribal populations are considered among marginalized groups. Adhikary, M., and R. Mazumder. 2010. "Income Inequality and Poverty among Scheduled Castes and Scheduled Tribes in Selected States." *The Indian Journal of Economics* XC (358): 997–1010.
[6] The state has three major rivers systems, the Ganga, the Brahmaputra, and the Subarnarekha, that account for annual usable surface water of 58.8 billion cubic meters. Annual renewable groundwater resources in the state is estimated at 27.4 billion cubic meters. However, water availability varies greatly across both space and time.
[7] West Bengal cuts across six agroclimatic zones with specific characteristics. See Saha, A., and C. Sarkar. 2005. "An Assessment of Climatic Risk Involved in Growing Rainfed Rabi Crops in Different Agroclimatic Zones of West Bengal." *J Agromet* 7: 36–43.
[8] Refer to Das, A., A. Khan, P. Daspattanayak, S. Chatterjee, and M. I. Hassan. 2016. "Regional Model for Agricultural Imbalances in West Bengal, India." *Modeling Earth Systems and Environment* 2 (2): 58. The paper shows maps with low agricultural intensity in southern districts due to groundwater salinity.
[9] The World Bank's 2017 publication 'West Bengal - Poverty, Growth and Inequality' reports that population below the poverty line in 2012 in the western districts of Purulia, Bankura, and Jhargram ranged from 26 to 38 percent.
[10] Structural measures refer to physical infrastructure development while nonstructural measures refer to capacity strengthening, institutions, management, and technical assistance.
[11] Deloitte. 2017. *Study of Existing Minor Irrigation Schemes in West Bengal*. 122 p.
[12] Jin, S., W. Yu, H. G. Jansen, and R. Muraoka. 2012. *The Impact of Irrigation on Agricultural Productivity: Evidence from India* (No. 1007-2016-79777).

yields, improvement in cropping intensity, and diversification in favor of higher-value crops. Most irrigation schemes relied on traditionally designed tube wells operated with inefficient diesel pumps leading to high operational costs. Adequate infrastructure with community-based irrigation management was indispensable to support rural growth and improve food security for small and marginal farmers.

4. **The rationale for World Bank intervention was threefold.** First, the World Bank was well placed to bring international experience to the project.[13] Areas of partnership would include innovations in planning and design of irrigation infrastructure and enhancing the performance of irrigation investments. World Bank intervention would ensure sustainability through operation and maintenance (O&M) arrangements and stakeholder ownership. The Project design incorporated lessons from similar World Bank-financed projects in Assam and Karnataka.[14] Second, a World Bank intervention would ensure better targeting of poor rural areas through community mobilization and focus on relatively medium- and small-size works that benefit small and marginal farmers. Third, the project objective was fully aligned with the World Bank's Country Strategy. The World Bank Group's Country Assistance Strategy (CAS) for the Republic of India, 2009–2012 (Report No. 46509-IN; November 14, 2008) focused, among others, on development of infrastructure, including water resources, and support for poorer states.[15] The project was also consistent with the World Bank's water resources strategy[16] that recognizes (a) water resources management and development are central to sustainable growth and poverty reduction, (b) there is a need to develop and maintain appropriate stocks of well-performing hydraulic infrastructure, and (c) assistance must be tailored to a country's context and be consistent with the country strategy.

Theory of Change (Results Chain)

5. **Problem statement:** Community ownership and management of irrigation schemes are insufficient; O&M of schemes is poor; irrigated area is insufficient; farmers' knowledge of new agricultural technologies is lacking. **Underlying assumptions:** A1. Communities are willing to participate in water user associations (WUAs) and follow established guidelines and protocols including pay fees on time and in full; A2. WUAs successfully maintain new schemes, A3. Damage from natural disasters (droughts, floods) and pests is minimized; A4. Farmers use knowledge gained through the project to enhance production.

6. **Project Development Objective (PDO).** The PDO was "to enhance agricultural production of small and marginal farmers[17] in the project area[18]." This objective was to be achieved through the development of minor irrigation (MI) schemes, strengthening of community-based irrigation management, and support to agricultural development, including provision of agricultural services and use of new technologies, encouraging crop diversification, and creating income generating opportunities.

[13] During implementation, the World Bank also mobilized national expertise.
[14] Examples include Assam Agricultural Competitiveness Project (P084792) and Karnataka Community-Based Tank Management Project (P102328).
[15] In 2011, West Bengal gross domestic product per capita was estimated at US$690 much lower than the national average of US$1,462 according to data from the World Bank and the Planning Commission, Government of India (GoI).
[16] The Water Resources Sector Strategy: An Overview – Managing and Developing Water Resources to Reduce Poverty. 2004.
[17] Average landholding size for marginal and small farm holders is 0.65 ha to support an average farm family size of five.
[18] As stipulated in the Schedule 1 of the Loan Agreement 8090-IN. The PDO in the Loan Agreement is identical to the PDO in the Project Appraisal Document (PAD).

Figure 1. Theory of Change

Activities	Outputs	Lower Outcomes	Middle Outcomes	Higher-level Outcomes (aspirations)
Technical assistance for strengthening community-based irrigation management	Support organizations (SOs) recruited WUAs formed and trained Scheme development and management plans (SDMPs) developed and agreed Management, operation, and maintenance (MOM) plans developed, budgeted, with service fees	WUAs operational for planning, managing, and sustaining schemes (A1)	Agricultural production enhanced (A3)	Rural incomes increased; food security improved
Investments for development of irrigation schemes	New minor surface water irrigation schemes constructed New minor groundwater irrigation schemes constructed	Area under irrigation increased (A2)		
Technical assistance for provision of agricultural development services	Farmers trained in crop diversification Farmers trained in new agricultural technologies (for example, horticulture, fisheries)	Farmers have increased knowledge of water management and agricultural technologies and products (A4)		

Key Expected Outcomes and Outcome Indicators

7. The four original PDO indicators were the following:

- Increase in yield of main agricultural crops
- Operational water user associations created
- Number of female and male water users (defined as member of the WUA) provided with water delivery services: (i) number of female water users; (ii) number of male water users; (iii) the percentage of female WUA executive committee members
- Resources generated by user groups to manage, operate, and maintain the developed schemes.

Components

8. **Component A. Strengthening Community-based Institutions** (estimated US$8.10 million, actual US$5.18 million). This component supported the development of WUAs and other farmer organizations to assume the responsibilities for MOM of minor irrigation schemes and improved irrigated agricultural practices. This was to be achieved by assisting with their formation and strengthening through various training and support activities. The Department of Water Resources Investigations and Development (DWRID) recruited SOs to assist with the formation of WUAs and with training and support during and after scheme construction. The SOs provided assistance with the preparation, implementation, and monitoring of brief Scheme Development and Management Plans (SDMPs) to spell out the proposed developments and responsibilities at each scheme.

9. **Component B. Irrigation System Development** (estimated US$235.00 million, actual US$110.77 million). To improve availability of water for agriculture and fisheries, about 2,400 new surface flow minor irrigation systems (command area varying from 5 to 50 ha) and about 2,260 new minor groundwater irrigation schemes (command area varying from 20 to 36 ha) were to be developed. Development of individual irrigation scheme followed the preparation of a brief SDMP framed by DWRID with the help of SOs and in consultation with the users. The total area to be developed under the project was about 139,000 ha, benefiting an estimated 166,000 farm families.

10. **Component C. Agriculture Support Services** (estimated US$22.10 million, actual US$14.75 million). This component supported the provision of agricultural support services in the project area to enhance productivity and diversification in agriculture involving improvements in production and water management technologies for agriculture, horticulture, and fisheries and more efficient and effective farm advisory services.

11. **Component D. Project Management** (estimated US$34.80 million, actual US$22.43 million) This component supported the strengthening of DWRID to ensure effective project management through State and District Project Management Units (SPMU and DPMU); provision of information management and social, environmental, and fiduciary management systems; monitoring and evaluation (M&E) and impact assessment activities.

B. SIGNIFICANT CHANGES DURING IMPLEMENTATION (IF APPLICABLE)

Revised PDOs and Outcome Targets

12. The PDO was not revised. The outcome targets were reduced due to a partial cancellation of US$95 million.

Revised PDO Indicators

13. The outcome indicators at project completion were the following:

- Relative change in value of outputs measured as ratio between post to pre-project values
- Operational water user associations created and/or strengthened
- Water users provided with new/improved irrigation and drainage services
- Water user associations that are generating at least 80% of resources required to manage, operate and maintain the developed schemes

Table 1. Summary of Revisions Made to the PDO Indicators over the Project Period

Original PDO Indicators as Given in the PAD	End Target	Revised PDO Indicators - June 2017	End Target	Revised PDO Indicators - November 2017	End Target
Increase in yield of main agricultural crops (MT/ha) • Rice • Oilseeds • Vegetable	 4.2 0.9 15.3	Relative change in value of outputs measured as ratio between post to pre-project values (percentage)	120	Same indicators as previous restructuring	140
Operational water user associations created (IDA core indicator; measured in number)	4,200	Operational water user associations created and/or strengthened (number)	1,400		2,000
Number of female and male water users (defined as member of the WUA) provided with water delivery services	166,000	Water users provided with new /improved irrigation and drainage services (number)	63,000		100,000
Resources generated by user groups to manage, operate, and maintain the developed schemes (as percentage of required resources)	90	Water user associations that are generating at least 80% of resources required to manage, operate and maintain the developed schemes (percentage)	80		70

Revised Components

14. The description and content of components and subcomponents were not revised. However, the estimated costs associated with the components were revised following the cancellation of funds.

Other Changes

15. The project underwent three restructurings:

- **First project restructuring (February 2016).** This restructuring cancelled loan proceeds of US$95 million from Loan No. IN-8090 following a request of the Department of Economic Affairs. The objective of the partial loan cancellation was to adjust the project funding to the capacity of the project management team and the state institutions. The financing plan was changed to reflect a total financing package of US$155 million from the World Bank and US$50 million from the borrower.
- **Second project restructuring (June 2017).** This restructuring introduced changes to the Results Framework to align it with the reduced project scope after cancellation. Changes to the Results Framework (table 1) were not included in the 2016 restructuring as the request from the GoI did not include such a proposal.
- **Third project restructuring (November 2017).** This restructuring sought a two-year extension of the project closing date from December 31, 2017, to December 20, 2019, along with associated changes to the Results Framework (table 1), disbursement estimates, implementation schedule, and change in implementing agency. The main rationale of the restructuring was to provide sufficient time to ensure the completion of ongoing schemes and ensure the sustainability of the community-level institutions at project completion taking into account the increased focus on poorest districts. Considering its experience in building construction, the restructuring introduced the Public Works Department of West Bengal as one of the implementing agencies for carrying out construction of the administrative building for the project.

Rationale for Changes and Their Implication on the Original Theory of Change

16. The project became effective in March 2012 and experienced some delays in setting up and strengthening District Project Management Units (DPMUs) with a dedicated engineering and contracted multidisciplinary team. This resulted in implementation lags in delivering irrigation schemes to the farmers.

17. However, the midterm review (MTR) mission (August 2014) undertook an independent assessment and recommended revising target of a few indicators in view of the time remaining for project implementation. Changes in the indicators and their targets were justified by the need to simplify the Result Framework considering the capacity of the state and the reduced financing. The closing date was extended to allow completion of ongoing activities.

18. The restructurings did not affect the theory of change.

II. OUTCOME

A. RELEVANCE OF PDOs

Assessment of Relevance of PDOs and Rating
Rating: High

19. The PDO remained relevant through completion. It remained fully consistent with the current World Bank's Country Partnership Framework (FY18–FY22)[19] for India at closing. The PDO was well aligned with focus areas 'Resource Efficient Growth' and 'Enhancing Competitiveness and Enabling Job Creation'. Under the focus area 'Resource Efficiency Growth', the project contributed to "Promote more resource-efficient, inclusive and diversified growth in rural sector" by enhancing agricultural productivity and supporting diversification of income sources through various income-generating activities including horticulture and aquaculture. The project also ensured inclusiveness by targeting women, poor, and tribal communities. It promoted the efficient use of water resources through multiple channels: (a) different productive activities undertaken in conjunction with the same water resources resulting in more value per volume (example: irrigation and aquaculture carried out in the same ponds); (b) promotion of water-efficient technologies and management systems including drip, sprinkler, and system of rice intensification; (c) formation and trainings of WUAs in advanced water management approaches including water resources assessment and irrigation water budgeting; (d) promotion of less water-intensive and high-value horticultural crops in the project areas.

20. Under the focus area 'Enhancing Competitiveness and Enabling Job Creation', the project contributed to "Increase access to market-relevant skill development" by emphasizing market-driven agricultural diversification and generated good practices and innovations that are now being institutionalized by the state. Good practices and innovations included SMS-based advisory systems to enable access to day-to-day market information, especially crop prices and WUA-to-WUA services. The project is also aligned with the National Agricultural Policy (2000) that promotes increase in agricultural production.

B. ACHIEVEMENT OF PDOs (EFFICACY)

Assessment of Achievement of Each Objective/Outcome

21. The PDO is to enhance agricultural production of small and marginal farmers in the project area. The PDO was achieved through development of minor irrigation (MI) schemes, strengthening community-based irrigation management, and support to agricultural development, including provision of agricultural services, encouraging crop diversification and use of new technologies, and creating income generating opportunities. Overall, the project achieved both the qualitative and quantitative dimensions of the PDO. Due to the project's reduced scope after the first two restructurings, a split assessment was conducted to obtain the final outcome rating. The project attained or exceeded most of its revised PDO indicator targets and most intermediate indicator targets by the project closing date. Further, clear causal links exist

[19] Report No.126667-IN

between project outputs, intermediate outcomes, and PDO-level indicators and outcomes as described in annex 1.

22. Overall, the project reached 124,700 beneficiaries, out of whom 111,203 (89 percent) are small and marginal farmers and sharecroppers, exceeding the target of 100,000 set in the November 2017 restructuring. The number of beneficiaries is derived primarily from irrigation and drainage (I&D) services and support to agriculture, horticulture, and fisheries services. Other beneficiaries enjoyed benefits generated from orchard-related activities. The achievement of project outcomes can be imputed to the adoption of various innovative approaches including (a) tailored solutions that were responsive to agroclimatic constraints and farmer demands in community contexts, (b) extensive use of GIS and remote sensing during planning and scheme siting for better targeting and monitoring, and (c) adoption of an adequate mix of structural and nonstructural solutions to maximize project benefits. Four outcome indicators, introduced in the third restructuring, are reviewed regarding achievement of the PDO. The original indicators are also briefly discussed in table 4.

Table 2. Project Beneficiaries: Changes and Achievements

Parameter	Original - September 2011	Restructuring - November 2017	Achievement
Number of WUAs	4,200	2,000	2,277
Command area (ha)	139,000	75,000	67,594
Beneficiaries	166,000	100,000	111,203[20]

Strengthening Community-based Irrigation Management

Outcome Indicator 1: Operational water user associations created and/or strengthened

- Operational water user associations created and/or strengthened (number). Achieved 2,277 (114 percent of revised target value and 54 percent of original target value)

23. WUAs are organizations created to bring together farmers for managing a shared irrigation system by collectively performing O&M.[21] The project supported the creation and/or strengthening of 2,277 operational WUAs throughout the project area to carry out O&M of irrigation infrastructure. This result represents 114 percent of the revised target value of 2,000 and 54 percent of the original target value. In the restructuring of 2017, the WUAs were merged to serve different strategic purposes. Fewer but larger WUAs in terms of membership, compared to the original target value (4,200 WUAs), were deemed more appropriate to foster economies of scale and to reduce the transaction costs that additional WUAs may induce. The number of WUAs created is adequate to guarantee the functionality of irrigation schemes. In fact, more than 50 percent of the WUAs have been operational for more than three years and have performed well in managing delivery of irrigation water to their members. Some WUAs have advanced to agribusiness-based activities, and mature WUAs are training new WUAs or providing them with agricultural inputs. Further, more than 73 percent of the WUAs (against a revised target value of 70

[20] Out of the 2,277 WUAs formed, 1,657 were formally handed over and fully operating by project completion. The remaining WUAs are being handed over and the process is expected to be finalized by December 2020. Beneficiaries include the number of farmers benefiting from the completed minor irrigation schemes. The total number of beneficiaries who are benefiting from training and technical support under agriculture support services is 124,700.

[21] As irrigation water and infrastructure are public goods, collective action of WUAs enables economies of scale and economies of scope. Lopez-Gunn, E. 2003. "The Role of Collective Action in Water Governance: A Comparative Study of Ground water User Associations in La Mancha aquifers in Spain." *Water International* 28 (3): 367–378.

percent) are currently generating at least 80 percent of resources required to manage, operate, and maintain the developed schemes.[22]

24. These results were achieved through proactive community mobilization and engagement with intensive participatory methods starting from identification stages. Involving local populations during the first stages of community-level interventions boosted ownership and commitment to project sustainability, leading to improved propensity to contribute financially to O&M.[23] Community participation was catalyzed by SOs that were both internationally and locally recruited nongovernmental organizations (NGOs) familiar with communities and their cultural context. The SOs played a crucial role in fueling communities' engagement in irrigation solution design from inception to completion. The formation of WUAs combined with other support activities, including the provision of technical assistance at grassroots level, created tangible added value.

25. To strengthen implementation of subprojects, the project identified small and marginal farmers who had successfully implemented irrigation services in their own villages as community service providers (CSPs). Some 288 CSPs were appointed in 18 districts.[24] The outcome of this process is illustrated through an assessment by the International Water Management Institute (IWMI) demonstrating that the project generated an incremental median income of US$319 per ha compared to a counterfactual government scheme where capacity building of WUAs and scheme development were different.[25] The project also introduced an innovative WUA performance management system which involves ratings based on different sets of criteria (governance, representativity, adoption of appropriate water and agricultural management practices, creativity). The performance system created an additional incentive that is fostering continuous improvement. The project developed guidelines for the development of community-based institutions that are now adopted throughout the Water Department. Demonstration activities, farm schools, networking, and interactions among WUAs promoted under the project enabled farmers to evolve in an upward spiral of learning and innovation, ultimately resulting in benefits in agriculture and fishery-based activities (table 3). Agricultural support services contributed to set up more than 20,000 small-scale demonstrations to promote crop diversification and adoption of new technologies. Considering the sense of ownership of project assets among communities and strong commitment to pursue productive endeavors, the activities of the WUAs are likely to be sustainable.[26] The WUAs created are inclusive organizations on three counts, as planned: (a) women membership exceeded target, (b) tribal farmers were brought in, which also exceeded target, and (c) the majority of members (about 90 percent) are small and marginal farmers.

Table 3. Number of WUAs Performing Activities Beyond O&M of Schemes

Agency	Activities	Number of WUAs
Executing agency	Training, workshop, and exposure visits	1225

[22] This indicator was added to the Results Framework during restructuring and had no original target value.
[23] Socioeconomic impact of WUA including the contribution to O&M is evinced by an in-depth socioeconomic study carried out by the Institute of Rural Management Anand (IRMA).
[24] CSPs had the advantage of being highly trusted by communities as they belong there and have set examples through their successful adoption of novel irrigation practices.
[25] Refer to the IWMI report 'WBADMI Project Rapid Impact Assessment Report'. See also annex 3.
[26] The project was awarded the 2018–2019 UNESCO-supported Water Digest Award for 'Best Community Project of The Year in Water Sector - Government'.

Agency	Activities	Number of WUAs
Entrepreneur	Raising fingerling, seedlings, vermicomposting, and so on, for other WUAs	161
Resource organization	Newly formed WUAs are visiting lighthouse WUAs to understand the WUA ecosystem	233
Social institution	Response to others in distress/disaster, Celebration of important international days e.g. Environment Day, Women's Day, Independence Day Campaign on social causes	1021

Investments for Development of Irrigation Schemes

Outcome Indicator 2: Relative change in value of outputs measured as ratio between post to pre-project values (introduced in 2017 restructuring).

- Relative change in value of outputs measured as ratio between post to pre-project values (percentage). Achieved 282 percent (201 percent of revised target value of 140 percent).

26. The increase in the value of agricultural production in project areas as reflected by the ratio between post-project and pre-project values attained 282 percent against the target of 140 percent. Increase in agricultural production value was achieved through multiple pathways including: (a) an increase in the area provided with new I&D services (67,594 ha against a revised target value of 75,000 ha); (b) an increase in water harnessed with new and improved irrigation services; and (c) an increase in cropping intensity in the project area, reaching 192 percent against a target value of 170 percent. All major crops experienced a substantial increase in production, achieving their target values, except for rice. However, the production of rice is more than compensated by the additional value created by other less water-intensive crops including oilseed, pulses, and other vegetables. Additionally, as more schemes are delivered, the target value for rice production is expected to be achieved during the next kharif season, by November 2020, which is favorable for rice farming.

27. The project enhanced access to irrigation water by supporting the development of different types of water retention infrastructure in diverse terrains of the state, ranging from coastal lands to hilly areas (annex 7). The water harvesting structures installed by the project included ponds, check dams, and excavated creeks. The nature and design of the infrastructure were tailored to the agroecological conditions and topography of the terrain to limit costs and boost benefits. For example, the project exploited natural creeks in the southern coastal lands of the state and spring rejuvenation in the northern hills. Concurrently implemented with structural measures, the project's nonstructural measures provided comprehensive support to the value chains which proved critical. Mobile SMS-based crop advisory services facilitated through Reuters Market Light provided an innovative decision support system to farmers from pre-sowing to marketing stages. The provision of agricultural services in the form of improved seeds, access to mechanization, and access to markets boosted production beyond initial expectations.[27]

[27] Mobile SMS-based crop advisory services facilitated through Reuters Market Light provided an innovative decision support system to farmers from pre-sowing to marketing stages. Different technologies (drip irrigation, greenhouses, sprinklers) were demonstrated on more than 6,000 ha.

Outcome Indicator 3: Water users provided with new/improved irrigation and drainage services

- Water users provided with new/improved irrigation and drainage services (number). Achieved 111,203 (107 percent of the revised target value and 67 percent of the original target value).

28. The number of water users provided with new/improved I&D services stood at 111,203 by project closing (representing 107 percent of the revised target value and 67 percent of the original target value). This result was achieved through the development of 2,291 irrigation schemes and the formation of 2,277 adequately trained WUAs to manage them. Additionally, the project supported social inclusion by ensuring representation of marginalized groups among beneficiaries. For example, the number of female water users at closing stood at 17,099 against a target value of 12,000 (representing 142 percent of the target value) and tribal farmers represented 12 percent of water users almost achieving its target value of 13 percent. This outcome was achieved through the development of 67,594 ha of irrigated land with 2,328 schemes. The provision of improved irrigation services because of well-trained WUAs enhanced the reliability of irrigation water. With more reliable irrigation water, an increasing number of farmers were satisfied with project infrastructure and diversified high-value crops which stimulated additional income generation.

29. The project brought about significant positive changes to siting, designing, implementing, and monitoring minor irrigation infrastructure. The changes were supported by several outputs including (a) updated guidelines for the construction of various types of schemes (tube wells, water detention structures, check dams) and (b) innovative digital technologies and online tools for designing schemes adapted to topographic conditions (annex 7). The innovative model emerging from the project led to (a) low proportion of failed schemes, (b) targeting investments to most vulnerable farmers, (c) improved sustainability of structures, (d) reliable service levels, and (e) better manageability and reduced cost of operations. On the use of energy, the schemes delivered by the project for the first time in the state replaced the costly option of diesel and the most unreliable option of electricity with solar power. Yet another noteworthy aspect of the irrigation system development is the involvement of prospective user farmers up front in the participatory planning process and preparation of SDMP. The immediate impact of this has been ownership of the schemes by the farmers. Consequently, the schemes delivered under the project were farmer friendly and supportive of their livelihood.

Support to Agricultural Development

Outcome Indicator 4: Water user associations that are generating at least 80% of resources required to manage, operate and maintain the developed schemes

- The end target for WUAs that were generating at least 80% of resources required to manage, operate and maintain the developed schemes. Achieved 73 percent (104 percent of the target values).

30. WUAs that are generating at least 80 percent of resources required to manage, operate, and maintain the developed schemes reached 73 percent against a target value of 70 percent indicating a high level of involvement of project beneficiaries in sustaining their activities and the project assets. This result was achieved because of the mobilization of communities who participated in particular aspects of project design and the elaboration of SDMP. The mobilization of communities was supported by the project through the recruitment of SOs (NGOs) that are highly familiar with communities and command trust.

31. The project was able to deliver affordable irrigation services through adoption of a series of design and technical improvements. Adoption of energy generating devices including solar systems instead of classic diesel option substantially reduced operational costs. Overall, scheme performance turned out to be the right incentive for the farmers to pay for irrigation services. The WUA institutional mechanism, irrigation scheduling, and crop planning helped equitable distribution of water resources. The project also provided guidelines and trained WUA members on the norms and standards of computation of water charges. Above all, the schemes delivered by the project are in areas where there existed unmet demand for irrigation water. The changes brought about through the provision of the service included favorable changes in the cropping patterns, increase in cropping intensity, and better price realization which together enhanced the payment capacity of the users.

32. Agricultural support activities that helped introduce farmers to new technologies and new adapted crops also played a crucial role in building confidence and ownership. More than 80 percent of WUA members expressed their satisfaction with schemes developed under the project according to a satisfaction survey. From an economic perspective, the outcome also stems from improved income that beneficiaries are able to derive from irrigated schemes as explained under the efficiency section.

Table 4. Achievement Compared to Targets for Original and Revised PDO Indicators

Original PDO Indicators	End Target	Actual values	% Achieved	Revised PDO Indicators	End Target	Actual values	% Achieved
Increase in yield of main agricultural crops (MT/ha)				Relative change in value of outputs measured as ratio between post to pre-project values (percentage)	140	282	201
				Increase in production (metric tons/year)			
• Rice	4.2	4.3	102	• Rice	95,000	85,696	90
• Oilseeds	0.9	1.4[a]	156	• Oilseeds	8,800	14,406	164
• Vegetable	15.3	14.6[a]	95	• Pulses	2,500	2,970	119
Operational WUAs created	4,200	2,277	54	Operational WUAs created and/or strengthened (number)	2,000	2,277	114
Number of female and male water users (defined as member of the WUA) provided with water delivery services	166,000	106,963	64	Water users provided with new/improved irrigation and drainage services (number)	100,000	111,203	107

Original PDO Indicators	End Target	Actual values	% Achieved	Revised PDO Indicators	End Target	Actual values	% Achieved
Resources generated by user groups to manage, operate, and maintain the developed schemes (as percentage of required resources)	90	62[a]	69	Water user associations that are generating at least 80% of resources required to manage, operate and maintain the developed schemes (percentage)	70	73	104

Note: a. The project formally tracked these indicators until June 2017. The figures represent the actual values in June 2017.

Project Management

33. The project established a State Project Management Unit (SPMU) and a DPMU in each district. By project completion, the project had strengthened the capacity of DWRID to ensure effective project management through an SPMU and DPMUs. The project also supported SO staff to be better prepared to achieve their mission of mobilizing communities. Table 5 shows actual values for indicators of project management and capacity.

Table 5. Status of Staff in SPMU and DPMU

Project Management	Actual	Target
Number of DPMUs established	18	18
Number of workshops organized	107	72
Number of project staff trained in project activities	725	500

Justification of Overall Efficacy Rating

34. As the project was reduced in scope in the June 2017 restructuring, a split evaluation is used. At the time of the second restructuring, the original project had disbursed US$72.95 million or 55.8 percent of the final total disbursement and the revised project had disbursed US$57.84 million or 44.22 percent of the total. The performance of the project evaluated against the original targets is ‘modest’ and against the revised targets is ‘substantial’. (see table 6)

C. EFFICIENCY

Assessment of Efficiency and Rating

Rating: Substantial

35. At appraisal, an ex-ante economic and financial analysis was conducted to assess the economic and financial performance of the project. The analysis encompassed all the key components of the project. The ex post analysis followed a similar approach at completion (see annex 4).

36. The project achieved benefits through various channels including (a) increase in irrigated areas, (b) increase in yield of crops, (c) increase in cropping intensity, (d) diversification of crops, and (e) increase in fish production. The project generated an incremental value estimated at US$1,077 per ha. The economic analysis shows that the overall project was economically justified with an economic internal rate of return (EIRR) of 22.8 percent (against an appraisal projection of 25.1 percent and a restructuring projection of 12 percent) and an economic net present value (ENPV) of US$52.7 million (against an appraisal projection of US$117.4 million and a restructuring estimate of US$13.8 million) with a 10 percent discount rate. The financial results at completion show a financial internal rate of return (FIRR) of 20.5 percent and a financial net present value (FNPV) of US$46.8 million with a discount rate of 10 percent. The sensitivity analysis confirms the robustness of these results. Results at completion are comparable with projections at appraisal and much higher than projections at restructuring. The appraisal analysis had showed that a two-year delay in project benefits will reduce the economic rate of return to 23.2 percent, close to what is observed at completion - 22.8 percent. This economic and financial performance is the result of improved design of irrigation structures, efficient procurement, and the active involvement of beneficiaries. Details of the analysis are provided in annex 4 on efficiency analysis.

37. **Implementation efficiency.** The project experienced various capacity challenges (section III) which resulted in slow implementation, particularly in processing procurement and financial reporting. This ultimately led to a reduction in the project scope. The project was also extended by over 23 months to allow the completion of planned activities.[28] At closing, the project disbursed most of the allocated funds.[29] Further, sensitivity analysis proved that the extension of the closing date did not have a significant impact on the economic performance of the project as the extension enabled the project to consolidate the capacity of several community-based institutions. At appraisal, the cost per beneficiary was estimated at INR 98,801 (INR 118,077 per ha). At completion, current estimates show a cost per beneficiary of INR 68,491 (INR 108,109 per ha). The result indicates greater value for money.

38. By mainstreaming a consistent approach to irrigation planning and development after the MTR, and by adopting an adequate suite of technologies, the project improved administrative efficiency and reduced management costs. Remote sensing technology proved to be a low-cost and effective alternative considering the vast geographical spread of the project activities. Finally, the project procured competent consultants and scaled up capacity building resulting in more efficient processes as teams acquired increasing experience. The improvement in processes is well illustrated by the fact that the time between work order and handing-over of schemes was reduced from an average of 494 days for Batch 1 to an average of 105 days for Batch V.

D. JUSTIFICATION OF OVERALL OUTCOME RATING

Rating: Moderately Satisfactory

[28] The costs of project management represented about 14 percent of total project costs. Although this value is on the high side, it is important to note that the component on project management included more activities than other projects. It included capacity building for the whole Water Department that includes more than 600 staff.

[29] Undisbursed amount of about US$9.8 million was because of technical difficulties to file financial records due to COVID-19. This is explained in annex 3.

Table 6. Split Evaluation

	Against Original PDO Targets	Against Revised PDO Targets
Relevance of objective	High	
Efficiency	Substantial	
Efficacy	Modest	Substantial
Outcome ratings	Moderately Unsatisfactory	Satisfactory
Numerical value of the outcome ratings	3	5
Disbursement	US$72.95 million	US$57.84 million
Weight (% disbursed before/after change)	55.78 percent (US$72.95/US$130.79)	44.22 percent
Weighted value of the outcome rating	1.67	2.21
Final outcome rating	Moderately Satisfactory (1.67 + 2.21 = 3.88 rounding to 4.0)[30]	

E. OTHER OUTCOMES AND IMPACTS (IF ANY)

Gender

39. The project created gender awareness through targeted trainings, by encouraging female plot holders to take up WUA committee positions and by promoting the inclusion of women in the running of WUAs. On average, in the project schemes, females represented 16 percent of project beneficiaries, 15 percent of WUA members, and 25 percent of managing committee members. Compared to the control schemes developed under state government irrigation programs, the previous figures on gender composition fall respectively to 2 percent for beneficiaries, 2 percent for WUA membership, and 0 percent for managing committee membership.[31] Planned and effective interventions with focus on gender helped bring female farmers to the forefront. The economic independence of women also resulted in improving their overall decision-making power.[32]

40. These results were achieved through gender-based actions intently involving women in irrigation and fisheries development activities. Forty WUAs are all women members estimated at 2,080. Nearly 18,500 women participated in various agricultural support services activities including 9,070 in agriculture demonstrations, 5,937 in horticulture demonstrations, and 3,440 in fisheries demonstrations.

Institutional Strengthening

41. Component A was dedicated to strengthening community-based institutions. The project helped form more than 2,270 WUAs. Owing to community mobilization and engagement, WUA members were trained to plan, supervise, manage, operate, and maintain irrigation schemes. The agricultural support activities combined with capacity building for nonagricultural activities increased the scope for economic diversification. The activities undertaken by WUAs have further strengthened members' commitment to

[30] Actual reduction in ambition of the project took place when the project had disbursed only US$38.09 million.
[31] The reader may refer to the socioeconomic study conducted by IRMA.
[32] Rapid Impact Assessment Report, 2019.

pursue productive endeavors. Further, several WUAs and fisheries associations have been able to develop innovative business models including WUA-to-WUA services and lucrative recreational angling.

42. Capacity building of irrigation institutions progressed considerably during implementation. The intensity of training activities increased to match the growing need for specialized skills in horticulture, agriculture, fisheries, and monitoring. Trainings were delivered to divisional DWRID staff, including divisional accountants, on the business processes and financial reporting requirements. The project also supported training for DPMU and SO staff on topics including environmental due diligence and use of GIS-based planning. Long-term institutional outcomes encompass the following:

- Creation of well-trained community-based institutions likely to sustain activities
- Introduction of advanced WUA management and governance systems combined with performance improvement mechanism
- A substantial number of institutional staff have appropriated modern I&D planning and development approaches that can now be mainstreamed into state government programs
- State-level experience in implementing complex community-level I&D project likely to facilitate new projects
- State-level experience in advanced M&E techniques using a combination of management information system MIS/GIS and remote sensing tools such as Google Earth Engine to assess land use change on near real time basis.

Mobilizing Private Sector Financing

43. The project did not involve mobilizing World Bank guarantees. However, it promoted private sector partnerships with farming communities through different approaches explained in paragraph 44.

Support to Market Creation

44. To provide agriculture support services, the project tapped into the vast potential of private sector-driven modern technologies to facilitate access by farmers. Specific benefits for farmers included links to distribution networks, capacity building, and introduction to new practices. In remote areas, the input distribution network was largely absent or weak; the project presented this 'market creation' opportunity with few lead private companies active in West Bengal. As the newly irrigated areas and the smallholders mobilized in WUAs offered opportunities to create new market opportunities, national and international agro-marketing companies expressed interest in working with the project. While the project facilitated links of these companies with WUAs, the companies supplied demonstration kits and arranged training programs and field visits at their own cost. This approach helped demonstrate improved practices and triggered accelerated adoption of new technologies including the use of hybrid rice seeds at 102 locations in eight districts and use of small greenhouses for the cultivation of exotic vegetables. International private companies contributed to building capacity of small farmers, technology transfer, and post-project sustainability through continuous supply of seeds and planting material and access to market. The partnership with private companies also facilitated market links with companies that purchased the high-value vegetables from the farmgate at remunerative prices.

Poverty Reduction and Shared Prosperity

45. **Although there was no direct assessment of the impact of the project on poverty because of the lack of recent data, analysis of survey data indicates significant improvement of agricultural income in project areas compared to comparable control areas.** The project investment likely contributed to significant reduction in poverty. For project beneficiaries, the average monthly per capita agricultural incomes were INR 503 and INR 1,879, respectively, before and after the project, representing an increase of 273 percent in incomes. For the control farmers, selected in the same villages and who did not directly benefit from Accelerated Development of Minor Irrigation (ADMI) schemes but potentially benefited from spillovers from the project, the average monthly per capita incomes were INR 928 and INR 1,684, respectively, before and after the project, representing an increase of 81 percent -- much lower than increase in incomes for ADMI beneficiaries. This result suggests a larger increase in income among project beneficiaries. Further, the project successfully targeted poor and marginal communities mainly in the western districts of Bankura, Birbhum, Bardhaman, Purulia, Paschim Medinipur, and Jhargram which accounted for 26 percent of the schemes at the time of appraisal. At the time of restructuring, there was a radical shift in focus toward these districts with almost 60 percent of all schemes planned to be located in these six districts. These districts represent some of the poorest districts of the state. Considering the strong associations between improvement of agricultural income and poverty reduction, the project likely contributed to poverty reduction in vulnerable communities of West Bengal.[33]

Other Unintended Outcomes and Impacts

45. **The project facilitated the generation of socioeconomic and sociocultural impacts that span beyond outcomes captured by the project's Result Framework.** With improved access to water and diversification of activities, anecdotal evidence suggests that the overall resilience of socioecological

[33] De Janvry, A., and E. Sadoulet. 2010. "Agricultural Growth and Poverty Reduction: Additional Evidence." *The World Bank Research Observer* 25 (1): 1–20.

systems increased. The wide range of vegetables, pulses, and fisheries contributed to increased access to diet diversity not only to direct beneficiaries but also to other villagers in the western districts.[34] Additionally, innovative models have emerged among fishery communities including fee-based recreational angling targeting urban dwellers. The project contributed to improve the self-confidence of communities who are now more inclined to engage in innovative undertakings. Emerging impacts include improved nutrition and education for children because families can afford school fees. Almost 82 percent of the members reported that, after the introduction of Accelerated Development of Minor Irrigation Project (ADMIP), their income improved which discouraged migration among their family members.[35] Additionally, case studies in selected villages indicate increased expenditures on their children's education as reflected by improved school supplies and greater roles for private tutors.

III. KEY FACTORS THAT AFFECTED IMPLEMENTATION AND OUTCOME

A. KEY FACTORS DURING PREPARATION

46. **The overall project concept integrated structural measures (irrigation system development) and innovative non-structural solutions (institutional strengthening and agricultural support services).** Structural measures would focus on the development of new minor surface water and groundwater irrigation schemes to promote irrigation services for small and marginal farmers. Non-structural measures would form, train, and operationalize community-based organizations for water management and provide farmers support for increasing production of agriculture, horticulture, and fisheries. The agriculture support would help improve productivity through large-scale adoption of improved crop husbandry and water management practices. This was the first project in West Bengal bringing together three line departments—Department of Agriculture, Food Processing Industries, and Horticulture and Fisheries—to work closely with DWRID. Moreover, the engineering department was now expected to work with the communities.

47. **The project design incorporated relevant lessons from previous projects.** Successful factors identified under other pertinent projects were reflected in the ADMIP design. Lessons included WUA empowerment, meaningful community participation, strong agricultural support services, concurrent and independent evaluation, and implementation arrangements built on multilevel Project Management Units (PMUs).[36] Based on international experience, the project integrated other broader lessons from operations elsewhere including the design and establishment of a project-specific MIS.

48. **Introduction of new concepts and approaches.** The project design proposed new approaches on multiple fronts. At the community level, the design introduced farm advisory services, efficient technologies including drip and sprinkler systems, and crop diversification. WUAs would be constituted and trained. Further, a performance management mechanism would be implemented to pave the way for water management excellence. Water storage solutions would be diversified and adapted to various

[34] A case study in Purulia shows an improvement of fish production from 350 kg/ha to 2,805 kg/ha due at least in part to trainings in aquaculture (removal of weeds, supplementary feeding, health care, and harvesting). Bose, M. 2017. *Accelerating Advancement of Irrigation to Agricultural Technology Adoption of Small Farmers in West Bengal, India*. 71p.
[35] IRMA report.
[36] Key projects considered included Assam Agricultural Competitiveness Project (Credit No. 4013-IN), Karnataka Community-Based Tank Management Project (Credit No. 3635-IN), and Maharashtra Water Sector Improvement Project (Loan No. 4796-IN).

agroecological realities throughout the state. Similarly, support services would be demand driven and tailored to the community context with emphasis on gender aspects. Further, the project would promote in-built sustainability through the development and implementation of SDMPs. At the department and agencies, the project would progressively build capacity for integrated project management.

49. **Implementation capacity of implementation agencies.** While the project design incorporated several advanced concepts for community-level irrigation management, in hindsight, the capacity assessment appears to be overly optimistic. The identification of capacity gaps and mitigation measures for such a complex project is crucial during preparation. As the proposed community-based approach to irrigation development was innovative and a first of its kind in the water management landscape of the state, DWRID lacked the specific expertise needed to operationalize the proposed concepts. Further, the World Bank reengaged with the state and DWRID after almost two decades, so concerned institutions had only limited familiarity with procedures and policies.[37] Finally, the large geographical spread over several districts made coordination and monitoring a challenge.[38] This capacity gap resulted in a sluggish project start and contributed to the decision to restructure the project to reduce its ambition.

50. **Delays in environmental assessment (EA).** EA experienced delays especially due to modifications introduced into the project initial designs to meet the requirements of the World Bank's Operational Policy on International Waterways as a large number of schemes were located on international rivers. The project design consciously (a) avoided groundwater schemes in the coastal saline belt areas adjoining neighboring countries and (b) exploited only unconfined aquifers for minor irrigation schemes. The project also had to substantially limit schemes in Atrai and Sankosh Rivers where the possible incremental abstraction for the project could be around 15 percent. Different steps needed for rigorous assessment to ascertain that the project complied with OP 7.50 took much more time than expected.[39]

51. **Results Framework and monitoring.** The PDO was stated clearly and was realistic. The different project components contributed directly to the achievement of the PDO through infrastructure, institutions, and capacity building as shown in the theory of change (figure 1). Overall, the Results Framework was sound. A multidisciplinary team maintained constant dialogue with the state counterparts during the four years of project preparation and provided support to the main project agencies on technical, environmental, social, fiduciary, and economic aspects until appraisal. The SPMU would have overall responsibility for planning and coordinating M&E activities while coordinating with DPMU and SOs. Beneficiaries would also play an active role and that process would be facilitated by SOs.

52. **Identification of risks and adequacy of mitigation measures.** Critical risks were identified, and corresponding mitigation measures were integrated into the project design. After accounting for mitigation measures, overall residual risk was rated Moderate.[40] Only the risk that MOM of schemes would suffer because of inadequate irrigation service fees collections was rated Substantial; other risks were rated Moderate. This risk would be mitigated through awareness and training sessions and

[37] The previous minor irrigation project financed by the World Bank was completed in 1994 (Credit 1619-IN).
[38] The project covered up to 18 out of the 19 districts of the state.
[39] Assessment required the following information for each river crossing over to Bangladesh: (a) sub-basin flow (annual average flow and lean flow) and current use estimates; (b) expected additional storage for the project (volume, proportion to average, and lean flow); and (c) map of confined and unconfined aquifers in the state.
[40] In hindsight, because of risks related to Water Department capacity, a risk rating 'Substantial' would have been more appropriate.

interventions that enhance irrigated agricultural production and hence strengthen incentive to pay irrigation service fees. However, low capacity of implementing agencies should have been identified as a substantial risk with more substantive mitigation measures put in place.

B. KEY FACTORS DURING IMPLEMENTATION

53. **Challenges in human resources and organizational capacity.** The project experienced slow implementation in its first 43 months.[41] The project suffered from delays in setting up and strengthening DPMUs with dedicated engineering and contracted multidisciplinary team. The recruitment of multidisciplinary teams was delayed due to difficulties in selecting a firm for recruitment of staff.[42] Additionally, because of lack of transport provisions, and scattered schemes during Batch 1, NGOs were unable to travel to all the schemes and devote time in preparation of SDMPs which affected the quality and the timeliness of their outputs. Remedial measures included shift from scattered to clustered approach, and frequent training of trainers and community workers. However, the problem of lack of a dedicated team in the field and retention of staff persisted until 2014, over two years after Board approval, and resulted in significant implementation lags.

54. **Slow disbursement during initial period.** Though the SPMU moved quickly with the identification of the first batch of schemes, the delay in approval procedures for bids and recruitment of management consultancies for the SPMU and DPMU resulted in delays in scheme implementation. Additionally, shortage of contractors due to additional programs initiated by the state in focus districts and unfamiliarity with Bank procurement bidding process delayed the implementation of scheme construction. Slow implementation translated into slow disbursement that persisted through the MTR.[43]

55. **MTR and incremental implementation improvements.** Considering the slow pace of implementation, an early MTR was undertaken in August 2014 to restructure the project and get it back on track. MTR assessment confirmed that the PDO continued to be relevant and achievable. However, the project was restructured with a cancellation of funds and a downscaling to focus on activities that would optimize achievement of the PDO. The cancellation of funds took place in the context of a larger portfolio clean-up effort that was led by the CMU and the Ministry of Finance, in consultation with the states. This complex process, which entailed iterative negotiations between the national and sub-national governments, required time to decide post-cancellation modalities. In the case of this project, the Government of West Bengal was reluctant to surrender funds until it received confirmation from the Ministry of Finance of GOI's willingness to support a future project in the irrigation sector[44]. The subsequent turnaround of the project is the result of series of incremental changes whose effects started to enhance implementation progress in 2016 as explained in the following paragraphs.

56. **Shift of focus areas and customization of activities.** To improve the project development impact, a major decision pertained to the shift of focus area to five drought-prone western districts, emphasis on storage structures including check dams, and increased scope of agricultural support services especially horticulture and fisheries (section II). The project increasingly prioritized investment in surface water

[41] Implementation progress was rated Moderately Unsatisfactory or Unsatisfactory from November 2013 to December 2015.
[42] As only few firms qualified for recruitment of staff in the state, the procurement method was adjusted from Quality and Cost-Based Selection to Quality-Based Selection. This change was implemented after a first round of bids leading to delays.
[43] At MTR, the disbursement was at 6 percent.
[44] West Bengal Major Irrigation and Flood Management Project (P162679).

storage instead of lift irrigation interventions that have been customized with increased focus on five underdeveloped districts in western part of state with predominantly rainfed agriculture.[45] This shift improved the focus on marginal and vulnerable beneficiary communities for better development impacts. The project also advanced the customization of irrigation solutions adapted to different agroclimatic, soil, and hydrogeological conditions to ensure technical sustainability of the irrigation infrastructure services.[46]

57. **Shift from scattered implementation to cluster-based approach.** To facilitate logistical arrangements and better provide effective multidisciplinary support, the project opted for a more efficient selection process based on clusters of selected blocks and villages in each district. Modern survey and design techniques were used to make schemes more cost-effective and with improved success rate.[47] The updated approach focused on all aspects including location, design, construction technique, and monitoring during and post construction. These changes made schemes more socio-environmentally viable and reduced the cost by more than 30 percent.[48]

58. **Shift from DPR to SDMP.** The project made a shift from preparing traditional Detailed Project Reports (DPR), which often ignored site-specific suitability of schemes, to preparing more comprehensive and site-specific SDMP with socially, environmentally, and technically viable solutions documented through meaningful consultation and active involvement of beneficiaries. The SPMU was strengthened with a consultancy firm to support the specifications for scheme development and monitoring through high-quality SDMPs. Modern survey and design techniques were used to make schemes more cost-effective and with improved success rate.[49]

59. **Introduction of modern technology.** The use of modern GIS and remote sensing technology played a critical role in project implementation. The project introduced various types of new information and communication technologies (NICT) at different levels. Remote sensing combined with tools such as Google Earth Engine allowed the project to locate appropriate areas for scheme implementation considering water availability, topography, and sociodemographic characteristics of populations. The real time tracking of cropping pattern and moisture content in command areas guided agricultural support services. The project introduced annual performance grading of schemes based on this technology. It also allowed advanced customization of scheme design to fit the diverse agroclimatic conditions of the state. The online geographically targeted MIS proved to be a powerful tool for project monitoring. Finally, SMS-based advisory services allowed the project to reach the most remote farming communities.[50]

60. **Consolidation of achievements.** During the last two years of implementation, decisive action helped solve bottlenecks from earlier phases. The well-oiled planning mechanism developed in the early years helped expedite the selection of subsequent batches of irrigation schemes. Additional SOs were

[45] The five focused districts in West Bengal are Purulia, Bankura, Bardhaman, Birbhum, and West Medinipur.
[46] Groundwater schemes were concentrated in central districts with high aquifer yield, surface irrigation in western districts, and creek-based water detention structures in southern districts.
[47] From Batch IV to Batch VI, the per area cost of solar tube well-equipped schemes declined from INR 2.94 million per ha to INR 1.69 million per ha.
[48] Using remote sensing technologies also helped reduce the time from approval to hand-over of schemes. For Batch I to Batch V, the time from approval to handing over was reduced from an average of 589 days to an average of 206 days and the time from work order to handing over was reduced from 494 days to 105 days.
[49] From Batch IV to Batch VI, the per area cost of solar tube well-equipped schemes declined from INR 2.94 million per ha to INR 1.69 million per ha.
[50] Please refer to annex 7 for details on technologies used to address different challenges that the project faced.

engaged to address needs for community mobilization and participation in scheme development and O&M. This approach, fueled by a change of project leadership , further strengthened the planning process with a watershed-based approach and with improved targeting of upland and tribal farmers who were more vulnerable to drought. The adoption of a streamlined staffing plan allowed the SPMU to rehire competent experts whose contracts were terminated. The two-year extension of the project closing date was dedicated to the finalization of irrigation schemes, the consolidation of WUAs through the implementation of a performance management system, and mainstreaming of key innovations, which were maintained through closing and beyond.

IV. BANK PERFORMANCE, COMPLIANCE ISSUES, AND RISK TO DEVELOPMENT OUTCOME

A. QUALITY OF MONITORING AND EVALUATION (M&E)

M&E Design

61. **The Results Framework included four PDO-level indicators to measure achievement of the PDO and intermediate outcome indicators to track implementation progress.** The results indicators were aligned with the PDO with appropriate targets. However, target values were adjusted following a cancellation of project funds and minor changes were made to the intermediate indicators' definition and description. The project design included a sound monitoring, learning, and evaluation framework to facilitate (a) results-based management; (b) learning and process enhancement (through process monitoring by participatory methods, involving group self-ratings, reviews, score cards, satisfaction surveys, and so on); and (c) impact evaluation (involving use of appropriate baseline and controls).

62. M&E staffing arrangements were adequate with an M&E specialist and a data/documentation analysis expert recruited at SPMU for planning, coordinating, and consolidating reporting from M&E activities at the district level. These experts would have the overall responsibility for developing systems and procedures for analysis and presentation of the collected data to ensure appropriate use of the indicators for monitoring, evaluation, and learning. Additionally, the arrangements included contracting the services of an external M&E agency for specific M&E and impact studies and partnering with WUAs. However, the challenges of implementing such a complex arrangement were not fully appreciated.

M&E Implementation

63. M&E implementation faced start-up challenges due to staffing issues and inexperience of the project team (section III). However, following the MTR, different systems were progressively put in place to improve management and planning (section III). Robust GIS and remote sensing tools were adopted with visible impact on project implementation. The use of these advanced tools enhanced the selection process of project investment within the department. Project monitoring was strengthened with a web-based MIS, GPS-based photographs, and real-time updates using mobile-based applications. WUAs became effective partners in project monitoring. Owing to good bookkeeping practices, WUAs supported the M&E team especially with the determination of crop types and cropped areas.

M&E Utilization

64. At completion, the project M&E system was well synchronized with the MIS and GIS to support PMUs through implementation and completion. This integrated system was instrumental for contract management, disbursements, financial management (FM), tracking of implementation status, and the implementation of safeguard instruments. This robust M&E system enabled the World Bank to conduct a meaningful MTR in August 2014, readjusting the project focus. Specifically, the GIS component focused interventions on poorer areas of the state where water constraints were serious impediments to the development of irrigated agriculture. Finally, M&E data and evaluation studies provided vital information to assess project outcomes and impact on beneficiaries during the preparation of the Implementation Completion and Results Report (ICR).

Justification of Overall Rating of Quality of M&E

Rating: Substantial

65. Overall, the M&E system was adequately designed and implemented albeit with an initially slow pace due to capacity challenges. However, the project overcame those issues and built a system that became a reference in the state and beyond. The system was highly useful during the evaluation as it allowed the capture of a vast amount of data thanks to the remote sensing technology combined with ground-truthing data. Another value addition of the M&E system was that it integrated planning, design, and implementation with operation and service delivery. Geotagging all investments added a layer of transparency. Therefore, the overall rating of the quality of M&E is Substantial.

B. ENVIRONMENTAL, SOCIAL, AND FIDUCIARY COMPLIANCE

66. Relevant safeguard policies were identified at appraisal and no additional safeguard policy was triggered during implementation. The project triggered the following safeguard policies: Environmental Assessment (OP 4.01); Pest Management (OP 4.09); Indigenous Peoples (OP 4.10); Physical Cultural Resources (OP 4.11); Safety of Dams (OP 4.37); and Projects on International Waterways (OP 7.50).

67. **Environmental Assessment (OP 4.01).** The project was assessed as an Environmental Category A project. A full-size EA report and an Environmental Management Plan (EMP) were prepared for the project. The EA report was disclosed on November 24, 2010 in the InfoShop and nationally on December 9, 2010. The major mitigation measures included the avoidance of areas where groundwater abstraction is critical, the avoidance of contaminated areas, and assessment of water resources adaptability for irrigation. Environmental provisions were included in construction contracts and strictly monitored by the full-time Safeguards Unit. Mitigation measured were adequately implemented and progress reports regularly submitted for World Bank review. OP 4.01 was rigorously complied with.

68. **Pest Management (OP 4.09).** Although the project was not expected to procure or promote the use of pesticide, the creation of additional irrigation capacity could result in higher incremental use of pesticides. A pest management plan was therefore developed and integrated into the EMP to ensure

compliance with this policy.[51] The measures proposed in the pest management plan were implemented in a satisfactory manner. OP 4.09 was complied with.

69. **Indigenous Peoples (OP 4.10).** In September 2010, the project prepared and disclosed a Tribal Development Plan with the following objectives: (a) ensuring inclusion through selective targeting, and (b) establishing a new or strengthening the existing tribal institutions to undertake irrigated agriculture. Throughout implementation, tribal populations received special consideration. As part of this strategy, the project prepared a block-wise list of tribal dominated villages for all the districts of the state. Additionally, the project set aside up to 13 percent of the total financial envelope for tribals and 11 percent of the project beneficiaries were tribal farmers. The project complied with OP 4.10.

70. **Physical Cultural Resources (OP 4.11).** The project was not expected to affect any archaeological or protected sites. However, OP 4.11 was triggered as a precaution because the possibility of an impact on physical cultural resources could not be ruled out. The Environmental Impact Assessment outlined the procedures to be adopted if culturally significant sites were discovered during project implementation. Appropriate clauses detailing 'chance find' procedures were included in all construction contracts. No prominent physical cultural resources were discovered during implementation.

71. **Safety of Dams (OP 4.37).** Although the project was not expected to build any dam higher than 15 m, about 117 surface schemes in three districts were anticipated to include the construction of a bund. All structures were designed following design standards and guidelines already adopted in the state, certified by an executive engineer of DWRID to ensure its compliance with the safety guidelines and verified by a qualified design engineer at the SPMU with experience of implementing safety norms during design and construction of dams. The project complied with OP 4.37.

72. **Projects on International Waterways (OP 7.50).** ADMIP was expected to support water development activities in sub-basins that could be classified as international waterways shared with Bangladesh, Bhutan, and India.[52] By adapting the project design, the project ensured incremental water abstraction from any of the eight rivers would be negligible. It also anticipated water abstraction in the Ganga River basin. By letters dated September 23, 2010, the World Bank notified the states of Bangladesh, Bhutan, and Myanmar on behalf of India in accordance with OP 7.50. OP 7.50 was complied with.

73. **Procurement.** The SPMU was responsible for the overall procurement system while the DPMUs were in charge of procurement coordination and review at district levels using a procurement manual developed following World Bank guidelines. Several trainings were successfully delivered to familiarize staff with World Bank procurement procedures. The project team experienced initial challenges including the selection of adequate staff recruitment firm. Those challenges were overcome through ad hoc capacity strengthening and guidance on appropriate procurement methods. From 2013, the SPMU maintained a permanent procurement specialist regularly submitting Procurement Plans to the World

[51] Good agricultural practices were promoted with the bio-village program in 48 villages of eight districts.
[52] The World Bank received from Bangladesh a response to the riparian notification requesting for water sharing agreements before the project can be implemented. To avoid further delays in the preparation process, the World Bank team decided to include only tributaries that would not adversely affect either the quality or quantity of any of the water flows or otherwise result in appreciable harm to Bangladesh or any of the riparian.

Bank to reflect implementation. Procurement efficiency improved as the project team gained experience. Procurement policies were satisfactorily complied with.

74. **Financial management.** From the start, the FM arrangements were mainstreamed into the state's own accounting, internal controls, and financial reporting systems. Initially, persistent delays in submission of interim unaudited financial reports affected the project's ability to draw down on the loan/credit on a timely basis. With simplifications and consistent implementation support, the project's performance progressively improved. Additionally, disbursement effectiveness was further improved by adjusting financial arrangements through introduction of US$10 million advance withdrawal. The submission of annual audit reports was delayed except in the last two years and resulted in the application of World Bank remedies by way of discontinuation of disbursements. Undertaking financial planning remained a challenge through completion, leading to an undisbursed amount of about US$9.8 million. The audit reports were qualified during the first years of implementation but by project completion, the PMUs were adequately staffed to carry out FM and audit reports and interim unaudited financial reports were timely submitted. The project largely complied with World Bank FM policies albeit with difficulties.

C. BANK PERFORMANCE

Quality at Entry

75. **The World Bank team mobilized a relevant mix of expertise to incorporate appropriate concepts in the project design (section III).** Project concept was well aligned with the CAS and lessons from previous operations were adequately integrated. In hindsight, the project could have adopted a more realistic assessment of the capacity to implement such an innovative approach to I&D development and a more realistic assessment of the absorptive capacity of the implementing agencies[53]. Identifying skill gaps and balancing different methods of skill acquisition would have helped SPMU and DPMU staff familiarize themselves with the project's concepts and facilitated implementation. The project faced readiness issues resulting in implementation delays. Considering the level of ambition of the original project, intensive capacity development could have started during preparation. The lack of a clear plan and ownership of the SDMP approach also contributed to the start-up delays seen later during implementation.

76. During preparation, the State of West Bengal experienced political shifts leading to delays or cancellation in a number of projects throughout the state.[54] ADMIP preparation was affected by the ensuing lags in decision-making and the bureaucratic changes.[55] To some extent, the project preparation was also delayed by the request of Bangladesh to establish water sharing agreements before project implementation (see safeguard section and factors during preparation). The project was led by three successive task team leaders (TTLs) from initiation to completion. However, the changes in TTL did not significantly affect project quality as there was a continuity in task team.[56] The project preparation costed US$730,000[57].

[53] The overall appraisal value of the project was US$ 300 million, however the project disbursed only US$ 153 million at closing
[54] During project preparation, the All India Trinamool Congress won the state elections after the Communist Party of India-led Left Front government.
[55] The project concept review took place on June 26, 2007, and was approved on October 04, 2011, representing 51 months.
[56] Successive TTLs were already members of the project team at the time they took charge.
[57] The project was also supported by Trust Funds (TF094837, TF093224 and TF017943) for a total amount of US$ 0.47 million.

Quality of Supervision

77. **Focus on development impact.** In 2014, the World Bank team conducted the MTR to identify corrective actions to ensure the achievement of PDO. To enable continued focus on development impact, the project underwent major shifts including (a) increased emphasis on poorer areas in western districts, (b) shift from scattered implementation to cluster-based approach, and (c) adoption of scheme development management plan. Further, the World Bank team opted for significant flexibility and innovations to adopt cost-effective solutions and adapt to local realities (section II). Processing with formal restructuring including the cancellation of funds and alignment of Results Framework required lengthy negotiations between different levels of government.[58]

78. **Supervision of fiduciary and safeguard aspects.** The World Bank provided ongoing implementation support on fiduciary and safeguard issues during project implementation. Capacity challenges were progressively addressed through ad hoc trainings (sections II) and considerable hand-holding with the procurement of a recruitment firm. At project completion, fiduciary and safeguard capacity had improved and reporting had become more regular.

79. **Candor and quality of performance reporting.** Following a steep learning curve early on, the quality of performance reporting improved with the introduction of new technology and deployment of field staff (section III). Project ratings in the Implementation Status and Results Reports (ISRs) were candid and the Aide Memoires reflected project challenges and issued recommendations to address them. Following the MTR, the World Bank team was instrumental in encouraging the adoption of major changes to get the implementation back on track. The Bank recommended that the SPMU recruit competent staff that were once part of the consultant team (section III). The World Bank also played an instrumental role in creating an enabling environment that led to positive unintended outcomes. For example, the Bank team, through its recommendations, oriented the project to establish partnership between farmers and private companies that created substantial network and social capital for farmer and fishery groups.[59]

80. **Adequacy of supervision inputs and processes.** The World Bank helped overcome the start-up challenges by developing an adequate project implementation plan and conducted a combination of regular implementation support missions and just-in-time technical visits to the project areas. The World Bank team offered regular, demand responsive, and thematic technical assistance besides regular missions. Some major inputs that influenced project outcome include (a) standardization of the design of specific types of schemes, (b) preparation of protocols for quality assurance and quality control, and (c) use of modern survey and design techniques for more cost-effective and successful schemes. The capacity-building efforts provided included field-level interactive sessions, thematic workshops, and knowledge exchange events. To accelerate knowledge acquisition, the SPMU was advised to organize exposure visits to other similar World Bank-financed projects.[60] The World Bank mobilized multidisciplinary teams with expertise in procurement, FM, community participation, and project evaluation to review relevant implementation documents.

[58] There were about 18 months between MTR and fund cancellation and another 16 months to formally introduce changes in the Results Framework. In a Federal system such as India, negotiations between central government and state government took inevitable but necessary time to arrive at a consensus.
[59] Farmers are able to share experiences through formal and more informal forums.
[60] Karnataka Community-Based Tank Management Project (P071033).

Justification of Overall Rating of Bank Performance

81. Considering that the World Bank undertook several proactive actions, provided useful recommendations while keeping a focus on impact, it was instrumental in making a major turnaround of moving the project from initial slow implementation to a successful project. However, the Bank could have made a better assessment to align the project ambition with the state implementation capacity. As a result, the overall World Bank performance is rated Moderately Satisfactory.

D. RISK TO DEVELOPMENT OUTCOME

82. **Three major categories of risks to development outcome have been identified.** They are risk to sustainability of activities, risk to sustainability of institutions, and risk to sustainability of infrastructure. The overall risk to development outcome is rated Moderate.

83. **Risk to sustainability of activities.** The beneficiaries largely took ownership of the various activities promoted by the project. In addition, the communities were able to adopt favorable business models, allowing them to reap the full benefits of the water storage options (section II). Finally, the diversification of activities and crops offered the opportunity for greater adaptation in the face of changes in market conditions. With these considerations that substantiate financial sustainability of project activities, risks associated with activities continuity remained Low at the project completion.

84. **Risk to sustainability of institutions.** The project focused on strengthening community-based institutions and promoting convergence with other agencies and government departments. Several WUAs were established (section II). The project continues to enjoy high support of government and grassroot stakeholders. However, WUAs are new institutions in the state irrigation landscape and will need continued support. Government adopted guidelines and protocols to continue the provision of adequate hand-holding for WUAs. At completion, staff remained deployed at the district level to ensure extension services to irrigation schemes. The risk to sustainability of institutions is rated Moderate.[61]

85. **Risk to sustainability of infrastructure.** The sustainability of infrastructure depends partly on proper and regular O&M. The project made adequate provision for O&M using a flexible approach that considers the need of communities (section III). Project works were realized following international norms. Most of the O&M of small-scale storage facilities including ponds is under the control of communities and there is emerging evidence that farmers can also maintain larger infrastructure such as check dams to some extent[62]. The risk to sustainability of infrastructure remains Moderate.[63]

V. LESSONS AND RECOMMENDATIONS

86. **An integrated design of structural measures (irrigation infrastructure), and nonstructural measures (management institution development and agricultural support) is essential for a successful**

[61] Note that although the World Bank financing in the project was closed by December 20, 2010, from the Government side, the project is still continuing with state funding and the approach promoted by the World Bank is still in use. Therefore, the institutional sustainability is thought to be a moderate challenge.
[62] Reports indicate at least eight WUAs removing sediments from check dams to prevent potential siltation issues.
[63] The project O&M activities were not significantly affected by the COVID-19 situation.

irrigated agriculture operation. While the project invested in infrastructure to improve water availability, agricultural support services and institution building were cornerstones of the project outcomes. These 'soft components' were absent in state-supported I&D programs and constituted major value added for ADMIP. Finding the right incentive mechanisms for WUAs through both agricultural service support and performance monitoring was a key nonstructural innovation (section II). Such mechanisms that require multidisciplinary teams are showing results on the ground and can contribute to sustainability.

87. **Transforming rainfed farms into irrigated ones is a gradual process that should be factored in project design.** It takes around two years to fully convert rainfed farms to irrigated farms.[64] The process requires continuous support throughout the value chain. Knowledge acquisition is crucial to this process. For ADMIP, the challenge of post-scheme development support is low because the project is still being pursued by the GoWB. Future operations should find mechanisms to ensure farmers are accompanied for at least two years following scheme completion. This can be done through the borrower's firm commitment to deploy adequate technical assistance after World Bank loan, credit, or grant closes.

88. **Developing and implementing a sound human resources development strategy is a cornerstone of project implementation.** Adequate capacity assessment is a crucial step in project preparation. However, human resources development strategy should also include risks to appropriate staffing level and skills, staff retention, and bureaucratic hurdles. Adopting the right type of incentives to ensure staff motivation can substantially reduce detrimental and frequent turnover. In hindsight, a full-fledged strategy developed with key stakeholders and accounting for the constraints and risks could have limited the impact of human resources challenges that the project faced (section III).

89. **Complex projects with many subprojects scattered over large areas require active learning and adaptive change management with innovations.** The first phases of project implementation allowed stakeholders to accumulate knowledge which proved crucial during successive phases. The experience enabled adjustments which contributed to the turnaround of the project. Owing to flexible approaches, the project capitalized on innovations such as MIS integrated into the GIS, the introduction of a cluster-based approach, and the adoption of an integrated landscape management model. Also, the project adopted a flexible approach by involving communities to express concerns and derive suitable solutions (section II). This approach boosted beneficiary satisfaction and improved poverty targeting (section III).[65]

90. **Adoption of SDMP can be a superior alternative to traditional DPR.** In contrast with traditional DPR, SDMP goes several steps beyond by developing an O&M plan delineating the roles and responsibilities with funding arrangements. This inbuilt system was instrumental to the sustainability of irrigation schemes and contributed to the low proportion of dysfunctional schemes following handing over. The project approach to SDMP development was streamlined by adopting a standard format and using digital online tools that enabled site-specific design of schemes and led to sustainability.

[64] IRMA report.
[65] Further details are provided in annex 7.

ANNEX 1. RESULTS FRAMEWORK AND KEY OUTPUTS

A. RESULTS INDICATORS

A.1 PDO Indicators

Objective/Outcome: The project development objective is to enhance agricultural production of small and marginal farmers in the project area.

Indicator Name	Unit of Measure	Baseline	Original Target	Formally Revised Target	Actual Achieved at Completion
Relative change in value of outputs measured as ratio between post to pre-project values	Percentage	0.00 31-Mar-2012	0.00 31-Dec-2017	140.00 10-Nov-2017	282.00 20-Dec-2019
Increase in production of major outputs: Rice	Metric tons/year	94756.00 31-Mar-2012	0.00 31-Dec-2017	95000.00 10-Nov-2017	85696.00 20-Dec-2019
Increase in production of major outputs: Oilseed	Metric tons/year	149.00 31-Mar-2012	0.00 31-Dec-2017	8800.00 10-Nov-2017	14406.00 20-Dec-2019
Increase in production of	Metric	0.00	0.00	2500.00	2970.00

major outputs: pulses	tons/year	31-Mar-2012	31-Dec-2017	10-Nov-2017	20-Dec-2019

Comments (achievements against targets):
Achieved 201% of revised target value thanks to increase in cropping areas and in cropping intensity beyond expectations. Original target does not apply because this indicator was introduced during restructuring.

Indicator Name	Unit of Measure	Baseline	Original Target	Formally Revised Target	Actual Achieved at Completion
Operational water user associations created and/or strengthened (number)	Number	0.00 31-Mar-2012	4200.00 31-Dec-2017	2000.00 10-Nov-2017	2277.00 20-Dec-2019

Comments (achievements against targets):
Achieved 54% of original target value and 114% of revised target value. For efficiency reasons, the project decided to promote larger Water User Associations (WUAs). Although the number of WUAs created is slightly below formal target value, they are sufficient to operate and maintain adequately irrigation schemes developed under the project funding.

Indicator Name	Unit of Measure	Baseline	Original Target	Formally Revised Target	Actual Achieved at Completion
Water users provided with new/improved irrigation and drainage services (number)	Number	0.00 31-Mar-2012	166000.00 31-Dec-2017	100000.00 10-Nov-2017	111203.00 20-Dec-2019
Water users provided with irrigation and drainage services - female (number)	Number	0.00 31-Mar-2012	30000.00 31-Dec-2017	12000.00 10-Nov-2017	17099.00 20-Dec-2019

Water users provided with new/improved irrigation and drainage services: Small and Marginal Farmers	Percentage	0.00 31-Mar-2012	0.00	80.00	83.00 20-Dec-2019
Water users provided with new/improved irrigation and drainage services: Tribal farmers	Percentage	0.00 31-Mar-2012	0.00	13.00	12.00 20-Dec-2019

Comments (achievements against targets):
Achieved 67% of original target value and 111% of revised target value due to effective outreach and mobilization of farming communities.

Indicator Name	Unit of Measure	Baseline	Original Target	Formally Revised Target	Actual Achieved at Completion
Water user association that are generating at least 80% of resources required to manage, operate and maintain the developed schemes	Percentage	0.00 31-Mar-2012	0.00 31-Dec-2017	70.00 10-Nov-2019	73.00 20-Dec-2019

Comments (achievements against targets):
Achieved 104% of revised target value thanks to water pricing systems adopted by WUAs and high collection rate. After 3 years of functioning, more than 82 percent of WUAs experience regular payment of water charges by all WUA members according to IRMA report. Original target does not apply because this indicator was introduced during restructuring.

A.2 Intermediate Results Indicators

Component: Component B. Irrigation System Development

Indicator Name	Unit of Measure	Baseline	Original Target	Formally Revised Target	Actual Achieved at Completion
Area provided with new/improved irrigation or drainage services	Hectare(Ha)	0.00 31-Mar-2012	139000.00 31-Dec-2017	75000.00 10-Nov-2017	67594.00 20-Dec-2019
Area provided with improved irrigation or drainage services	Hectare(Ha)	0.00 31-Mar-2012	139000.00 31-Dec-2017	75000.00 10-Nov-2017	67594.00 20-Dec-2019
Increase in water harnessed with new/improved irrigation services	Cubic Meter(m3)	0.00 31-Mar-2012	0.00	250000000.00	202800000.00 20-Dec-2019
Area diversified to less water intensive cash crops	Percentage	5.00 31-Mar-2012	0.00	20.00	30.00 20-Dec-2019

Comments (achievements against targets):
Achieved 49% of the original target and 90% of the revised target value. The value of this indicator is expected to increase over the coming year as schemes delivered towards the project closing date becomes fully exploited.

Indicator Name	Unit of Measure	Baseline	Original Target	Formally Revised Target	Actual Achieved at Completion

Change in cropping intensity in areas provided with new/improved irrigation services	Percentage	122.00 31-Mar-2012	0.00 31-Dec-2017	170.00 10-Nov-2017	192.00 20-Dec-2019

Comments (achievements against targets):
Achieved 113% of the revised target value. This achievement is mainly the result of intensive awareness campaign to promote a large variety of fruit and vegetable crops.

B. KEY OUTPUTS BY COMPONENT

Objective/Outcome 1: Enhance agricultural production for small and marginal farmers	
Outcome Indicators	1. Relative change in value of outputs measured as ratio between post to pre-project values 2. Operational water user associations created and/or strengthened 3. Water users provided with new/improved irrigation and drainage services 4. Water user associations that are generating at least 80% of resources required to manage, operate and maintain the developed schemes
Intermediate Results Indicators	1. Area provided with new/improved irrigation or drainage services 2. Area diversified to less water intensive cash crops 3. Change in cropping intensity in areas provided with new/improved irrigation services
Key Outputs by Component (linked to the achievement of the Objective/Outcome 1)	1. Number of WUAs formed (Component A): 2,277 formed and 1,657 formally registered (original target: 4,200; revised target: 2,000) 2. Members of the WUAs (Component A): 111,203 members provided with new irrigation services (original target: 166,000, revised target: 100,000) 3. Women members of WUAs (Component A): 22,336 formed and 17,099 formally registered (original target: 30,000, revised target: 12,000) 4. Beneficiaries of development of orchards (Component A): 4,000 5. Irrigated land developed (Component B): 67,594 ha (revised target: 75,000 ha) 6. Guidelines for the construction of tube well 7. Guidelines for the construction of water detention structures (Component B) 8. Guidelines for implementation of small-size schemes by WUAs (Component B) 9. Online tools including remote sensing-based MIS and GIS (Component B) 10. Demonstration area for agriculture (Component C): 7,068 ha (original target: 5,040 ha) 11. Demonstration area for horticulture (Component C): 2,841 ha (original target: 252 ha) 12. Demonstration area for fisheries (Component C): 1,151 ha (original target: 600 ha) 13. 98 plastic greenhouse with drip irrigation to 50 WUAs and 110 users (Component B) 14. Direct seeded rice in 40 ha (Component B); 15. Hybrid rice promotion and system of rice intensification 270 ha (Component B) 16. Bio-village program in 48 villages of 8 districts covering 372 ha (Component B)

ANNEX 2. BANK LENDING AND IMPLEMENTATION SUPPORT/SUPERVISION

A. TASK TEAM MEMBERS

Name	Role
Preparation	
Joop Stoutjesdijk	Task Team Leader
Musa S.C. Asad	Co-Task Team Leader and Sr. Financial Analyst
Paul Singh Sidhu	Sr. Agricultural Specialist
R.R. Mohan	Sr. Social Development Specialist SASDI
S. Satish	Sr. Social Development Specialist
Tapas Paul	Sr. Environmental Specialist
Debabrata Chakraborti	Sr. Procurement Specialist
Manvinder Mamak	Sr. Financial Management Specialist
Juan Carlos Alvarez	Sr. Counsel LEGES
Jacqueline Julian	Program Analyst
Jai Mansukhani	Program Assistant
Lilac Thomas	Program Assistant
Prabir Joardar	Consultant - Engineer
S. Selvarajan	Consultant - Economist
Kunduz Masylkanova	Economist
Supervision/ICR	
Anju Gaur, Raj Ganguly	Task Team Leader(s)
Satyanarayan Panda	Procurement Specialist(s)
Manvinder Mamak	Financial Management Specialist
Tapas Paul	Environmental Specialist
Jai Mansukhani	Procurement Team
Parthapriya Ghosh	Social Specialist
Pamela Patrick	Procurement Team
Yoro Sidibe	ICR Main Author
Stuti Sharma	Team Member

Biri Singh	Consultant – Agricultural Specialist
C.S. Renjit	Consultant – Community Development Specialist
Hitesh Kumar Thakur	Consultant – M&E and MIS
K.A.S. Mani	FAO-CO Groundwater Specialist
Kirtida Gandhi	Consultant Design Engineer
Mahesh Somchand Patel	Consultant - Construction Specailst
Pooja Khosla	Consultant-Economist
Prabhat Chandra Chandra	Consultant-Senior Geophysist
Shouvik Mitra	Consultant – Social Development Specialist
Vinay Tuli	Consultant – Agriculture Specialist

B. STAFF TIME AND COST

Stage of Project Cycle	Staff Time and Cost	
	No. of staff weeks	US$ (including travel and consultant costs)
Preparation		
FY07	11.425	61,794.07
FY08	12.502	58,849.31
FY09	16.503	90,027.17
FY10	26.076	275,533.55
FY11	28.087	212,052.49
FY12	7.532	31,632.37
Total	**102.13**	**729,888.96**
Supervision/ICR		
FY12	10.693	66,141.29
FY13	26.854	101,366.35
FY14	29.050	80,999.38
FY15	33.919	121,795.71
FY16	25.798	133,473.47

FY17	28.106	248,318.12
FY18	41.383	153,662.06
FY19	40.090	143,238.41
FY20	41.208	192,077.45
Total	**277.10**	**1,241,072.24**

ANNEX 3. PROJECT COST BY COMPONENT

Components	Amount at Approval (US$, millions)	Amount at Cancellation (US$, millions)	Actual at Project Closing (US$, millions)	Percentage of Cancellation	Percentage of Approval
Component A. Strengthening Community-based Institutions	8.10	5.00	5.18	103.20	63.91
Component B. Irrigation System Development	235.00	149.00	110.77	74.10	47.13
Component C. Agricultural Support Services	22.10	15.00	14.75	98.00	66.74
Component D. Project Management	34.80	36.00	22.43	62.11	64.47
Total	**300.00**	**205.00**	**153.12**	**74.40**	**51.04**

Source: Latest financial information.

Note: The final US$ equivalent of the IDA financing was US$110,592,904 instead of the US$125,000,000 because of the fluctuations in the SDR exchange rates. The project disbursed US$110.6 million of IDA and US$20.2 million of IBRD. Undisbursed balance of US$9.8 million was cancelled from IBRD loan as of June 26, 2020. Due to the exceptional circumstances created by COVID-19 situation in the country, processing of expenditures to document the spending of part of the US$9.8 million to the IBRD loan proved too challenging. Therefore, the expenses were rather credited to state funds.

ANNEX 4. EFFICIENCY ANALYSIS

Introduction

1. The objective of the economic and financial analysis is to assess the ex post economic and financial performance of the West Bengal Accelerated Development of Minor Irrigation (WBADMI) project at completion in December 2019. At appraisal, the project total costs were estimated at US$300 million equivalent including contributions from IDA, IBRD, and the borrower. The project underwent a restructuring to adjust its scope and was completed with an estimated cost of US$152.6 million. The PDO was to enhance agricultural production of small and marginal farmers in the project area. The PDO was to be achieved through development of minor irrigation (MI) schemes, strengthening community-based irrigation management, and support to agricultural development, including provision of agricultural services, encouraging crop diversification and use of new technologies, and creating income generating opportunities. The PDO was not revised during project implementation.

2. Specifically, the following components contributed to PDO achievement.

3. **Component A. Strengthening Community-based Institutions.** This component facilitates the development of WUAs and other farmer organizations to assume the responsibilities for MOM of minor irrigation schemes and improved irrigated agricultural practices. This will be achieved by assisting with their formation and strengthening through various training and support activities.

4. **Component B. Irrigation System Development.** This component facilitates the construction of about 1,340 new minor surface water irrigation schemes (command area varying from 1.5 to 150 ha) and about 990 new minor groundwater irrigation schemes (command area varying from 0.5 to 64 ha). The total area to be developed under the project is about 37,130 ha, benefiting an estimated 106,700 farm families.[66]

5. **Component C. Agriculture Support Services.** This component facilitates the provision of agricultural support services in the project area to enhance productivity and diversification in agriculture. This will involve improvements in production and water management technologies for agriculture, horticulture, and fisheries and more efficient and effective farm advisory services.

6. **Component D. Project Management.** This component facilitates the strengthening of DWRID to ensure effective project management through the SPMU and DPMUs; provision of information management and social, environmental, and fiduciary safeguard management systems; and M&E and impact assessment activities.

7. At appraisal, the analysis estimated that the economic and financial returns to farm households and the economy will be derived from investments in I&D infrastructure, capacity building, and support services. It was expected that benefits to farming households would result from (a) expansion of irrigated areas, (b) intensification of irrigation, (c) diversification to high-value crops, (d) fisheries development, (e)

[66] Only schemes that were formally handed over were considered in the analysis.

efficient water management, and (f) drought mitigation. The project was anticipated to generate net incremental economic and financial benefits with an EIRR of 25.1 percent and an FIRR of 21.6 percent.

8. Although the project objective set at appraisal remained unchanged through implementation, the project's total funding, scope, and closing date were adjusted. The first restructuring cancelled US$95 million from Loan No. IN-8090. The second restructuring introduced changes to the Results Framework to align it with the reduced project scope after cancellation. The third and final restructuring extended the project closing date from December 31, 2017, to December 20, 2019. The ex post economic and financial analysis closely follows the appraisal methodology while accounting for the closing date extension of nearly 24 months, the actual project benefits, and the cancellation of funds. It also makes conservative assumptions regarding future changes in irrigation, fisheries, and other benefits over the project horizon estimated at 15 years. Economic and financial benefits are estimated as incremental variation between the 'with project' (WP) scenario and the 'without project' (WoP) scenario. A 10 percent discount rate is used in the analysis. However, sensitivity analyses are conducted to assess the robustness of the results in relation to key variables that may be subject to uncertainty.

9. The analysis builds on several studies conducted from the appraisal to the completion of the project. The studies include regular M&E information, socioeconomic surveys, and institutional assessment. As part of the World Bank's effort to ground-truth the project's administrative data, a representative household survey was conducted for a sample of 240 handed-over schemes. Comprehensive information was collected on WUAs, their membership and governance, socioeconomic characteristics of farms, irrigation technology, and output and input prices in the project areas. Roughly two beneficiaries (treatment group) and one nonbeneficiary (control group) were randomly selected and surveyed in each village. A total of roughly 450 ADMI and 230 non-ADMI farmers were surveyed. The questions included details of cropping patterns, production, farming practices, and incomes of individual farmers both before and after the scheme was constructed. The analysis presented in this section builds on the data collected in the ground-truthing surveys.[67] The net incremental benefits are estimated for farmers benefiting from WBADMI project intervention, also referred to as the 'treatment' farmers. To account for the WoP scenario, the net incremental income is estimated for farmers who did not benefit from any irrigation intervention, also referred to as the 'control' farmers.

10. To summarize, the cost-benefit analysis (CBA) assesses the stream of benefits and costs over the project horizon in the WP and WoP scenarios. For the WP scenario, the net incremental benefits were calculated from agriculture and fishery activities accruing to the farmers as a result of the project using information from before and after scheme hand-over. Similarly, in the WoP scenario, the net incremental benefits were calculated from agricultural and fishery activities that would have accrued to farmers in the absence of project intervention by examining trends for the control farmers. A comparison of the WP and WoP scenarios gives the project benefits. The project costs consider the investment costs and the recurring costs due mainly to recurring O&M. The CBA for inputs and outputs uses 2011 constant prices to enable comparability over time.

[67] Data suggest that non-ADMI farmers were slightly better-off than ADMI farmers before the start of the project. This suggests that ADMI farmers might have been positively selected.

Irrigation System Development

11. At appraisal, the project planned to provide irrigation services to about 139,000 ha in 19 districts in West Bengal.[68] During implementation, the project was restructured to adjust scope to capacity. US$95 million was cancelled and as a result the target of areas provided with irrigation services was reduced to 75,000 ha. At completion, the project provided irrigation services to about 67,600 ha, representing 90 percent of the revised target.

Project Benefits

12. The project generated significant benefits increasing irrigation farmers' net margins. The irrigation development allowed for increased and reliable supply of irrigation water and strengthening of community-based institutions, WUAs, coupled with agricultural support services that contributed to enhanced management of I&D infrastructure. The overall project contributed to enhanced revenues through different channels, including (a) increase in cropped area, (b) increase in cropping intensity, (c) increase in crop yield for almost all major crops, (d) changes in cropping pattern favoring high-value crops, and (e) increase in fish production.

(a) **Variation in cropping areas.** The various surveys as well as remote sensing data show a remarkable increase in cropped areas in both project and non-project intervention areas. However, the project intervention areas experience a larger increase due to increased water availability in the dry seasons. The majority of irrigation schemes became operational in 2018 and 2019 when the project was coming to a close. Therefore, the surveys provide only a conservative picture of the full potential. Table 4.1 shows the change in gross cropping areas before and after the project for the 19 districts. These estimates are calculated using cropping patterns observed in the individual farmer surveys. A 27 percent increase is found in cropped area for treatment farmers and 17 percent for control farmers. Further, the analysis indicated an increase in cropped area both on the extensive (new area brought under cultivation) and intensive (intensity of cultivation) margins.

Table 4.1. Gross Area Cropped

District	Gross Cropped Area, Before (ha)	Gross Cropped Area, After (ha)	Change in Cropped Area (ha)
Bankura	1,383	1,913	531
Bardhaman	4,027	4,552	524
Birbhum	1,392	1,861	469
Dakshin Dinajpur	4,568	4,440	−128
Darjeeling	1,458	1,674	216
Hooghly	802	1,605	804
Howrah	664	683	19
Jalpaiguri	7,720	8,689	968

[68] At the time of appraisal there were 18 districts in West Bengal. Over the project period, 2 new districts have been carved out from these 18 districts. There were 19 districts at the time of restructuring and for the current analysis, those 19 districts are considered (instead of 18 at appraisal or 20 at completion).

District	Gross Cropped Area, Before (ha)	Gross Cropped Area, After (ha)	Change in Cropped Area (ha)
Jhargram	2,615	3,900	1,285
Cooch Behar	5,672	6,444	772
Malda	1,957	2,521	564
Murshidabad	1,536	1,812	276
Nadia	1,233	1,456	223
North 24 Parganas	946	1,187	241
Paschim Medinipur	1,915	4,065	2,151
Purba Medinipur	2,078	3,976	1,897
Purulia	1,990	2,547	557
South 24 Parganas	4,674	6,093	1,419
Uttar Dinajpur	2,800	3,188	388

(b) **Changes in cropping intensity.** The surveys show an increase in cropping intensity in different WUAs and for different crops. Table 4.2 presents the district-wise cropping intensities before and after the schemes were constructed. Overall, the treatment farmers experienced a 35.5 percentage point increase in cropping intensity while the control farmers saw a 21.5 percent increase in cropping intensity. Note that control farmers were positively selected and may have been in a better position to invest in tube wells once the government restrictions on them were eased in 2011. This can explain the significant increase in cropping intensities even without irrigation development or extension services. It is also possible that the control framers may have benefited from other government schemes in the region or from the ADMI scheme if there were spillovers (there is evidence of water being provided to non-WUA members too). If so, this will lead to an underestimation of project benefits.

Table 4.2. Change in Cropping Intensity

District	Cropping Intensity, Before (%)	Cropping Intensity, After (%)	Change (Percentage Points)
Bankura	104	144	40
Bardhaman	131	148	17
Birbhum	113	151	38
Dakshin Dinajpur	168	164	−5
Darjeeling	135	155	20
Hooghly	116	232	116
Howrah	170	175	5
Jalpaiguri	148	167	19
Jhargram	118	175	58
Cooch Behar	149	169	20
Malda	108	139	31
Murshidabad	159	188	29
Nadia	145	172	26
North 24 Parganas	157	197	40
Paschim Medinipur	103	218	115
Purba Medinipur	100	191	91

District	Cropping Intensity, Before (%)	Cropping Intensity, After (%)	Change (Percentage Points)
Purulia	103	132	29
South 24 Parganas	129	168	39
Uttar Dinajpur	170	193	24

(c) **Changes in crop yield.** The household surveys also indicate an increase in yields of major crops in the project intervention areas due to improved access to water, increased capacity in water management, and enhanced access to market opportunities. Non-project areas also experienced modest increases in yield for some crops. For this analysis, it is assumed conservatively that no further yield improvements would occur during the project horizon.[69] Table 4.3 shows change in paddy yields that are observed across different districts using household-level survey data. Yields for other crops such as potato increased from 2,096 kg/bigha to 3,895 kg/bigha, brinjal from 1,066 kg/bigha to 1,361 kg/bigha, and sesame from 116 kg/bigha to 150 kg/bigha.[70]

Table 4.3. District-wise Improvements in Paddy Yield (kg/bigha)

District	Paddy Yield, % Change	Potato Yield, Before (kg/bigha)	Paddy Yield, After (kg/bigha)
Bankura	50	436	652
Bardhaman	50	435	653
Birbhum	69	404	681
Dakshin Dinajpur	38	476	656
Darjeeling	37	447	611
Hooghly	34	447	599
Howrah	35	438	593
Jalpaiguri	25	474	593
Jhargram	29	444	575
Cooch Behar	46	408	594
Malda	23	471	581
Murshidabad	142	273	661
Nadia	38	468	644
North 24 Parganas	42	487	694
Paschim Medinipur	-6	475	446
Purba Medinipur	14	500	568
Purulia	55	379	588
South 24 Parganas	43	414	592
Uttar Dinajpur	73	329	571

[69] One could think of it as a situation where both project and non-project areas experience similar changes in yield over time. As a result, there will be no further incremental improvements in yield due to the project. Since project areas are likely to reap the benefits from improved agricultural practices and irrigation facilities gradually over time, this assumption will underestimate the benefits that will accrue over the project cycle.

[70] For pulses, oilseeds, and some vegetables, there is variation across districts with some experiencing improvements and others experiencing decline. This is probably a result of sampling variation (differences in rainfall in the baseline periods, characteristics of the farmer) but a deeper examination is required to understand why this might be the case.

(d) **Changes in cropping patterns.** The surveys show a shift of cropped areas away from paddy and in favor of more profitable crops. High-value crops including vegetables (for example, brinjal, potato, cauliflower); oilseeds; and pulses now represent a significantly larger portion of cropped area. Cropping pattern assumptions (as observed in survey data) are summarized in table 4.4. This clearly demonstrates a diversification in cropping patterns in the project areas after the project interventions.

Table 4.4. Cropping Patterns Assumptions by Regions

District	Before Project (% Area)				After Project (% Area)			
	Paddy	Vegetables	Oilseeds	Pulses	Paddy	Vegetables	Oilseeds	Pulses
Bankura	96	1	3	0	67	22	5	3
Bardhaman	69	21	9	0	59	24	11	0
Birbhum	90	5	5	0	60	14	22	1
Dakshin Dinajpur	78	8	6	0	79	8	5	0
Darjeeling	80	12	0	0	58	27	2	0
Hooghly	80	10	9	0	42	35	20	0
Howrah	45	26	23	6	41	29	20	6
Jalpaiguri	68	14	3	0	59	22	2	0
Jhargram	84	3	10	3	57	7	31	1
Cooch Behar	66	9	2	0	70	12	2	0
Malda	58	0	0	0	60	10	2	0
Murshidabad	71	2	17	0	33	32	8	14
Nadia	43	10	26	10	31	19	15	3
North 24 Parganas	70	12	2	0	52	24	8	0
Paschim Medinipur	100	0	0	0	77	0	23	0
Purba Medinipur	100	0	0	0	100	0	0	0
Purulia	97	2	1	0	58	21	17	3
South 24 Parganas	69	20	0	0	93	5	0	2
Uttar Dinajpur	75	6	11	0	59	10	7	0

13. All benefits arising from (a) to (d) are clubbed together as agricultural benefits. They are reflected in the net income of farmers before and after the project. It is assumed that only 20 percent of the benefits are realized in the first year after project hand-over and 50 percent in the next year, and the full potential is only realized in the third year after WUAs have taken charge of the scheme.

14. **Increase in fish production.** The surveys found that increased support for fisheries under the project was associated with increased production and greater income through various channels including increase in fish variety, increase in area under fisheries, modern practices, and improved access to markets. Major fish species cultivated by project beneficiaries are Rohu (99 percent), Catla (96 percent), Mrigal (63 percent), Silver (39 percent), and Tilapia (18 percent), while previously Rohu and Catla were the dominant (100 percent), followed by few other fishes such as Mrigal (20 percent) and Silver (15 percent). This trend suggests that diversity of fish under cultivation has increased. Further, farmers involved in fisheries increased from 4.3 percent to 14.3 percent. Demonstration centers and mass demonstrations were conducted on almost 1,870 ha of pond over the project period with an adoption rate of almost 45 percent. Anecdotal evidence suggests that farmer interest group members are using savings from fishery activities to further expand area under fisheries. For the economic and financial

analysis , it is assumed conservatively that the area under fisheries does not increase after the project period. There has been a significant increase in fish yield as well providing substantial benefits to rural communities in project areas, especially to women. Mean income per hectare of pond was substantially higher after scheme intervention at around INR 176,935 per ha compared to INR 57,300 per ha before the WBADMI project. The net incremental benefit is estimated from adopting advanced practices (WP scenario) compared to fishing using traditional practices (WoP scenario) as a result of the project interventions.

Project Costs

15. This analysis considers different costs associated with the project. First, it accounts for all the investment costs, including capacity building and coordination costs. These costs were estimated at US$152.60 million. Second, project costs also conservatively assume that O&M costs will represent up to 1 percent of investment costs annually over the lifetime of the project. Lastly, using primary data from field surveys, membership and irrigation fees collected from the WUA members are also included. These amount to roughly US$51,500 for each WUA on average. Note that some of these costs might be used for O&M and irrigation costs have been accounted for in costs of cultivation. However, to be conservative these costs are included separately.

Results of the CBA

16. **Financial returns to the farm households.** The investments in irrigation system development and the accompanying measures generated incremental gross margin to farm households estimated at US$1,077 per ha annually compared to non-rehabilitated areas over a horizon of 15 years. The FIRR is estimated at 20.5 percent and the FNPV estimated at US$46.8 million at a discount rate of 10 percent. Benefit-to-cost ratio is estimated at 4.12. The results are summarized in table 4.5.

Table 4.5. Results of the CBA - Financial Results

Economic and Financial Indicators	ICR Values
Incremental gross margin (US$/ha)	1077
FNPV - financial net incremental benefits (US$, millions) (discount rate 12 percent)	30.6
FNPV - financial net incremental benefits per ha (US$/ha) (discount rate 12 percent)	823
FNPV - financial net incremental benefits (US$, millions) (discount rate 10 percent)	46.8
FNPV - financial net incremental benefits per ha (US$/ha) (discount rate 10 percent)	1,260
FNPV - financial net incremental benefits (US$, millions) (discount rate 8 percent)	69.7
FNPV - financial net incremental benefits per ha (US$/ha) (discount rate 8 percent)	1,877
FIRR (percent)	20.5
Discounted benefit-to-cost ratio (discount rate of 10 percent)	4.12

17. The economic analysis shows that the project generates an EIRR of 22.8 percent and an ENPV of US$52.7 million at a discount rate of 10 percent. The benefit-to-cost ratio is estimated at 4.26, as shown in table 4.6.

Table 4.6. Results of the CBA - Economic Results

Economic and Financial Indicators	ICR Values
ENPV - financial net incremental benefits (US$) (discount rate 12 percent)	35.8

Economic and Financial Indicators	ICR Values
ENPV - financial net incremental benefits per ha (US$/ha) (discount rate 12 percent)	965
ENPV - financial net incremental benefits (US$, millions) (discount rate 10 percent)	52.7
ENPV - financial net incremental benefits per ha (US$/ha) (discount rate 10 percent)	1,419
ENPV - financial net incremental benefits (US$, millions) (discount rate 8 percent)	76.3
ENPV - financial net incremental benefits per ha (US$/ha) (discount rate 8 percent)	2,056
EIRR (percent)	22.8
Discounted benefit-to-cost ratio (discount rate of 10 percent)	4.26

Sensitivity Analysis of the Project Results

18. To assess the robustness of the results, a sensitivity analysis was performed on key variables, including cropping intensity in the project areas. The analysis tests the impact of a 10 to 50 percent decrease in the cropping intensity (or overall benefits) on the EIRR starting from 2019. The results are shown in table 4.7.

Table 4.7. Results of Sensitivity Analysis - Economic Results

Assumptions for Sensitivity Analysis	EIRR Values
EIRR for 10 percent decrease in benefits (percent)	21.3
EIRR for 20 percent decrease in benefits (percent)	19.7
EIRR for 30 percent decrease in benefits (percent)	17.9
EIRR for 40 percent decrease in benefits (percent)	15.9
EIRR for 50 percent decrease in benefits (percent)	13.6

19. The economic results are robust to changes in the cropping intensity (or overall benefits). The project remains economically justified even for a cropping intensity reduced by 50 percent. The results are presented in table 4.8.

Summary of Financial and Economic Results

Table 4.8. Summary of Financial and Economic Results

Economic or Financial Indicator	Values
Financial Results	
FNPV - financial net incremental benefits (US$, millions) (discount rate 10 percent)	46.8
FNPV - financial net incremental benefits per ha (US$/ha) (discount rate 10 percent)	1,260
FIRR (percent)	20.5
Discounted benefit-to-cost ratio (discount rate of 10 percent)	4.12
Economic Results	
ENPV - financial net incremental benefits (US$, millions) (discount rate 10 percent)	52.7
ENPV - financial net incremental benefits per ha (US$/ha) (discount rate 10 percent)	1,419
EIRR (percent)	22.8
Discounted benefit-to-cost ratio (discount rate of 10 percent)	4.26

Comparison of the Appraisal, Restructuring, and ICR Analyses

Table 4.9. Summary of Results and Assumptions Adopted by the Appraisal and ICR Analyses

Key Assumptions	Appraisal	Restructuring	ICR
Total project area (ha)	138,901	38,752	37,130
Number of beneficiaries	166,370	54,170	106,700
Total ENPV (US$, millions)	117.4	13.8	52.7
EIRR (%)	25.1	12	22.8
Total FNPV (US$, millions)	93.5	n.a.	46.8
Per area ENPV (US$/ha)	845	356	1,419
Per area FNPV (US$/ha)	673	n.a.	1,260

Note: Total project area, number of beneficiaries, and economic and financial analysis calculations are for handed-over schemes only. These will be revised upward once ongoing schemes are handed over.

Intangible/Unquantified Benefits

20. The project led to a range of other benefits that have not been quantified for the economic and financial analysis. Quantifying some of these benefits would require medium- to long-term time series data and complex modelling. Therefore, a qualitative description of the benefits is presented here.

- **Education.** In several scheme areas, the increase in farm surplus translated into increased spending on children's education, especially private tuitions in support of higher education. Some case studies by IRMA also found increased expenditure on accessories such as school bags, uniforms, and medical expenses among WUA members. Such investments in human capital would improve employment opportunities and have implication for intergenerational mobility.

- **Health and nutrition.** Since the project inception, several farmers have diversified their crops in favor of fruits and vegetables. Several others have taken up fisheries. This significantly increased farmer incomes, and at the same time improved household consumption of vegetables and fish (IWMI). With almost 86 percent survey respondents indicating increase in food availability, there is suggestive evidence that the project improved nutrition outcomes of the small and marginal farmers and their families. This could in turn contribute to better health and labor productivity. Some studies also found increased food availability for livestock. This could in turn improve returns from owning livestock.

- **Migration.** By increasing water availability in the dry seasons, the project led to increased agricultural potential and consequently demand for labor. Alternative livelihood and income-generating opportunities within the village itself reduced the need for seasonal/permanent migration to urban centers. An independent study by IRMA confirms a downward trend, albeit marginal, in the degree of migration since the inception of the project. Migration is not only costly for the individual (involving both monetary and nonmonetary costs) but it also imposes externalities in urban cities by increase in congestion, overburdening of existing infrastructure, and crime, among other things. The observation that farmers 'choose' to not migrate when given the option suggests that they

are better off after the project. Social welfare is also higher due to reduction in congestion externalities. Quantifying these indirect benefits, however, is not straightforward.

- **Women empowerment.** The ADMI project consciously tried to involve women at all stages—from inception (site selection, design, and construction) to O&M of irrigation scheme. All the executive bodies of the WUAs aim at having a quarter or more of the members as women. The project also provides for awareness creation and targeted training for women in effective committee membership and in technical subjects related to good irrigation and agricultural practices. The early signs are encouraging with several women participating actively in the WUAs. In some scheme areas, women have been involved in activities such as fisheries, cultivation in poly house, vermicomposting, and orchards. This important implications for women empowerment through their greater involvement in decision-making at home. A survey of female WUA members by IRMA revealed significant increases in participation of women in decision-making processes on financial issues. Even though participation in nonfinancial issues remained low, there is suggestive evidence that the project led to qualitative changes in the lives of women members. A large body of literature in economics shown that women empowerment is associated with increased household expenditures on health and education of children (something found in the current project areas as well). Such benefits are hard to quantify.

- **Improved saving habits.** WUA survey respondents demonstrate improved saving habits. For previously credit constraints households, this can provide opportunities to investment in better seeds and inputs for the next season. It could also be used as a cushion against adverse weather or health shocks that have been shown to push agricultural households into poverty.

- **Improved social habits**. Anecdotical evidence from a few tribal communities pointed to a reduction in the drinking habit of men in the community as a result of increased incomes and socialization possibilities offered by WUAs.

- **Flood management.** Creeks developed in the coastal area of West Bengal are likely to contribute to flood management by creating drainage channels for the evacuation of excess water that may result from intensive rainfalls.

- **Ecological benefits.** By increasing water availability, the project helped bring orchards to previously fallow lands. This can help reduce soil erosion. Introduction of system of rice intensification cultivation, drip and sprinkler irrigation, and soil moisture monitors helped improve the efficiency of irrigation water.

Table 4.10. Overview of Main Assumptions Used in the CBA

No.	Description	Value	Unit	Source
Overall Assumption				
1.	Discount rate	10	%	Same as in the PAD
2.	Exchange rate US$/INR in 2019	0.0132	US$/INR	IMF website
3.	Project horizon	2019–2034	Years	Same as in the PAD

No.	Description	Value	Unit	Source
4.	Inflation rates	10, 9.4, 5.8, 4.9, 4.5, 3.6, 3.43, 4.54 (2012–2019)	%	https://www.statista.com/statistics/271322/inflation-rate-in-india/
Cost Assumption				
5.	Investment costs	152.6	US$, millions	From the project financial data
6.	Annual O&M costs	1	%	Assumption based on economic analysis of other similar projects
Benefit Assumption				
7.	Area covered for fisheries under the project	1,867	ha	MIS of the project
8.	Area covered under the project	37,130	ha	MIS of the project
9.	Proportion of benefits accruing after scheme hand-over	20% after year 1, 50% after year 2, and 100% after year 3	%	IWMI studies
10.	Cropping patterns and input and output prices	See summary in previous tables and details in survey report		Survey from IWMI study and ground-truthing data

ANNEX 5. BORROWER, CO-FINANCIER AND OTHER PARTNER/STAKEHOLDER COMMENTS

WBADMIP Comments on ICR

WBADMI Project (2012-2019) with the World Bank support was an innovative project to reach out to the small & marginal farmers particularly tribal and women. The Project is unique in the sense that till now all the irrigation project/programs were executed in the silos/isolation. This is for the first time that an integrated effort was made wherein Irrigation facilities combined with Agriculture, horticulture and fishery activities in the created command area. More importantly, Water Users Associations (WUAs) have been organized and empowered to operate & maintain their Irrigation schemes and better manage available water resource in a sustainable manner. The project provided the full flexibility, human & financial resources and single window delivery system to demonstrate integrated development model around irrigation.

WBADMIP created irrigation potential for 67000 Ha covering 1, 00,000+ farmers (Small & Marginal Farmers-83%, Tribal-12% and Women-17%).

The State Government is very much satisfied with the learning & experiences from WBADMIP. It has clearly demonstrated the importance of community involvement as WUAs for long term sustainability of the project interventions. Introduction & facilitation for the adoption of agriculture, horticulture and fishery activities has helped in improving more effective & efficient functioning of the irrigation schemes. Crop diversification, Introduction of Pulses & Oil seed crops in cultivable waste land, development of private wastelands, facilitating adoption of Good practices & technologies, organic practices and entrepreneurial activities particularly fisheries has helped in improving the socio-economic status collectively.

The project has been very effective in improving the socio-economic status of the community especially tribal and women, improved health-nutrition-education and has reduced conflicts & stressed migration. WUA is now an accepted entity in the villages which participates in water management and conflict resolution. They have operated effectively even during COVID-19, during flood etc.

Use of various technologies particularly GIS has revolutionized departmental planning, approval, design & estimation, monitoring and impact assessment of the project. It has helped in more effective decision making, effective, efficient & quality delivery of the desired outputs, judicious use of available resource & cost estimates, saving in costs & wasteful expenses, establishing two way communications between the State and District teams. More importantly it helped in taking corrective actions based on the experiences.

WBADMIP experiences & learning were intensively used in State flagship Project “Jaltirtha” Project on Minor irrigation schemes in Western Districts since 2015. Another scheme, namely, “Matir-Sristi” deals with Mix-fruit plantation on wastelands which has been designed based on the experiences. GIS expertise developed under the project has been used by Panchayat & rural development Department, Ananddhara

Project (State Rural Livelihood Mission), Kolkata Municipal Corporation etc. World Bank has also shared these experiences at various platforms.

WBADMIP also explored and executed the possibilities of collaboration through convergence with various departmental schemes/programs. Now the Project facilitated models are emerging where the Departmental schemes/programs are coming forward to help the Project promoted WUAs. Project also initiated the convergence/collaborative efforts with Private sector for high value crop production and floriculture in Poly houses. Recently initiated Mobile based agri-advisory services “Krishi-Katha” for agriculture and fishery activities to WUA members has been a very effective tool to reach the community during Covid-19.

The project has collaborated with prestigious national and international institutions for Impact evaluation and recommendation for further improvement. Those institutes include Harvard Kennedy School, International Water Management Institute (IWMI) and Institute of Rural management Anand (IRMA), Australian Centre for International Agricultural Research ACIAR), Indian Institute of Technology Kharagpur etc. and reached at the stage of collaborative working agreement with International Center for Agricultural Research in Dry Areas (ICARDA) and World Agro Forestry Center etc.

Department has proposed formation of design-cum-GIS Cell and WUA cell in the Department supported by Project’s experience. This is to ensure WBADMIP’s Standard operating procedures as Department’s common practice. The only challenge is to meet the cost of NGOs as support organizations for promoting WUA system. The proposal is being submitted to the finance Department for their approval.

WBADMIP has demonstrated and has come out with various District/Agro-Climatic region / different topography specific models and now the Department has realized the importance of these models and is willing to adopt these experiences in their departmental regular practices. The challenge with the department is to institutionalize the whole process and continued World Bank support will help the department to institutionalize and replicate the Project learning/experiences.

Accordingly the Department has submitted proposal for the World Bank support as WBADMIP-Phase II as replication phase for six years. It is with the objective to increase the income of the 250000 farmers by creating 125000 Ha additional command area through agribusiness support to Water Users Associations/Federations (Farmers Producer Organizations-FPOs). It will be mainly to upgrade existing Schemes/WUAs, Strengthening Departmental Schemes and new schemes created by the Project.

ANNEX 6. SUPPORTING DOCUMENTS (IF ANY)

1. World Bank. 2011. *West Bengal Accelerated Development of Minor Irrigation Project*. Project Appraisal Document. Report No: 60529-IN, 122p.
2. World Bank. 2011. *West Bengal Accelerated Development of Minor Irrigation Project*. Loan Agreement. Loan Number 8090-IN, 14p.
3. World Bank. 2011. *West Bengal Accelerated Development of Minor Irrigation Project*. Financing Agreement. Credit Number 5014-IN, 13p.
4. World Bank. 2016. West Bengal Accelerated Development of Minor Irrigation Project. Restructuring Paper. Report No: RES18898.
5. World Bank. 2017. *West Bengal Accelerated Development of Minor Irrigation Project*. Restructuring Paper. Report No: RES28658.
6. World Bank. 2017. *West Bengal Accelerated Development of Minor Irrigation Project*. Restructuring Paper. Report No: RES29816.
7. Project supervision documents, Aide Memoires, and ISRs.

ANNEX 7. PROJECT INNOVATIONS AND GOOD PRACTICES

Project Management through NICT

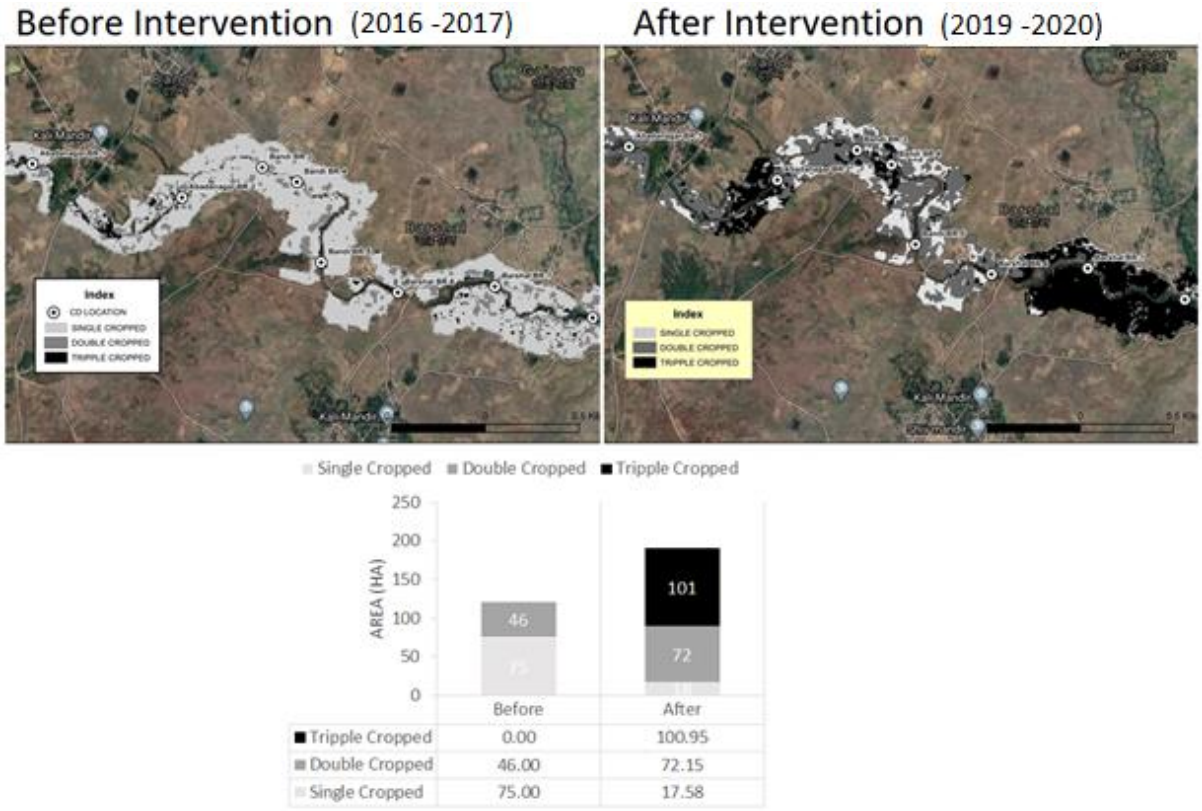
1. During the initial implementation phase, the project faced challenges associated with the agroclimatic diversity of the State of West Bengal. The crucial challenge of the project was then to reconcile the objectives of targeting poverty with the imperatives of accounting for the availability of water resources in the context of geographic diversity. To overcome these difficulties, the project adopted the use of a robust system based on NICTs supported by WebGIS technology. The system harmoniously combined remote sensing datasets with GIS-enabled tools such as the Google Earth Engine. This system was used to conduct sound project management with the following specific outcomes.

2. **NICT provided opportunity to modernize and expedite the planning process during the second phase of implementation.** The ability to locate appropriate project areas is a crucial part of the irrigation planning process. Extensive use of remote sensing and GIS was instrumental in achieving the project objective. These tools played a major role in rapid identification and assessment of suitable areas for the development of various types of irrigation schemes. The villages were selected based on GIS data which enabled field officials to reach to those areas and start fieldwork. This reduced selection time considerably. The WebGIS system enabled stakeholders to access appropriate information on agriculture practices and advanced technologies ultimately contributing to increased production.

3. **By allowing customization, the system supported the design of I&D structures in the context of agroclimatic variety.** The construction of minor irrigation structures was one of the main investments under the project. By design, structures are dispersed over large tracts of rural areas that are often difficult to access. Due to the lack of adequate hydrogeological information, several government projects have failed to account for the diversity of communities' situations and resulted in flawed designs. Traditionally, weir type structures on streams were constructed with inaccurate assumptions due to unreliable hydrogeological data, resulting in hydraulic failure of the structure with the loss of public money. With the implementation of the GIS-based approach under the WBADMI project, the information needed to design schemes was easily available to workers in the field even in remote areas which enabled the construction of adapted structures. The online automated system generated vital parameters including the catchment area, peak flood discharge, and suitable width and height of check dams. With these data, the design was fine-tuned, leading to safer and more economically viable structures.

4. **The GIS-MIS based IT system was instrumental in project monitoring.** Although each subproject is located in remote rural areas, they could be individually tracked with the live monitoring system in the online platform supported with project's photos. The automated system facilitated the decision-making for midcourse correction by allowing to assess the adequacy between resource availability, irrigation technology, and community needs. The system informed evidence-based approach to shift the focus of the project to western districts and was a powerful instrument to persuade stakeholders. It also facilitated regular project monitoring by updating the project manager with current status of projects supported by geotagged photos.

Figure 7.1: Illustration of impact of intervention through change in cropping area and cropping intensity



5. **NICT offered a powerful suite of products for the impact assessment of the project.** Through satellite imagery combined with Google Earth Engine, the project was able to monitor the evolution of various indicators including cropped area and agricultural production. By analyzing images before and after implementation of schemes, the project collected precious information on areas cropped in rabbi, kharif, and pre-kharif as well as the volumes of water available to estimate production. Owing to this visualization of the landscape, the project could observe visible transformation from single cropped to double cropped area, tracking the performance of schemes and the demonstration programs.

Adaptation of Solutions to Agroclimatic Zones and Adoption of a Holistic Landscape Management Approach

6. One of the success factors of the project was the flexibility to tailor interventions to the diversity of communities and of agroclimatic zones. West Bengal's agroclimatic zones range from the northern hilly areas to the southern coastal saline areas. These zones correspond to a large variety of geological realities. Smart interventions in the form of minor irrigation and innovative intercropping and plantation supported by the right information and tools have significantly improved the socioeconomic conditions and reduced vulnerability of the farmers in the project area.

7. In the southern coastal area, the project took advantage of the presence of preexisting creeks that were excavated to create more than 205 km of water detention structures, especially in the coastal

region of Sundarbans. This increased water availability, resulting in an extra winter crop on more than 2,000 ha of land. These water detention structures allowed communities to promote novel ideas such as profitable recreational angling targeting city dwellers.

8. In the western lateritic zone, waste land located in upper lands were converted to orchards by planting over 1.26 lakh saplings (for example, mango, cashew, pineapple) through intercropping. In 2019, more than 300,000 saplings were planted on 522 ha of waste land.

9. In the northern zone, the project adapted agronomic solutions to the context of the area. One of the main issues pertains to the presence of elephants causing damage to plantations. This situation could be a great disincentive for farmers to engage in new ventures. The project proposed the cropping of pepper and lemon trees that are repulsive to elephants.

Adoption of a Watershed-based Approach

10. The project progressed from a scheme-level implementation to cluster approach and then finally watershed-based approach. At the community level, it was the first time that communities were involved from the planning stage and the schemes were customized to manage them. The project philosophy was to serve the village and not only a selected group in the village. The watershed scale ensures balancing of surface water and groundwater use while also extending the scope of project to upland development.

11. The major event that shaped project implementation was the MTR 2014. The MTR in addition to recommending fine-tuning of the Results Framework recommended strategic way forward actions which shaped project implementation on a result-oriented trajectory: (a) adopting segmentation approach to target irrigation services to most needy areas, (b) revitalizing already made minor irrigation investments, (c) empowering WUA for institutional sustainability, (d) strengthening SPMU capacity for accelerating implementation, and (e) strengthening need-based skill mixes within the SPMU/DPMU. In addition, the project brought about a series of operational innovations to reduce cost, improve sustainability and create demand for irrigation services.

(a) **Segmentation approach.** Based on the current status of irrigation development already achieved and potential diversities in agro-climatological and hydrogeologic factors existing in the project districts, a segmentation approach was adopted. The project districts were segmented into (i) focused districts characterized by low cropping intensity, mainly rainfed, limited groundwater potential where 70 percent of new irrigation investments will be targeted and (ii) the currently irrigated areas where the need will be efficient water management practices and introduction of high-value agribusiness investments. The focused districts were Purulia, Bankura, Birbhum, Paschim Medinipur, and South 24 Parganas.

(b) **Empowering WUA for institutional sustainability.** To build the organizational capacity of WUA, hand-holding support on social accountability, governance, conflict resolution mechanism, grading system for WUA, and manuals were provided. These measures helped sustain performance of WUA on equity, participation, transparency, and accountability.

(c) **Market-based cultivation of high-value crops with 'safe-to-eat' concept.** To convert gains of productivity and production improvement into incomes for farmers, the project introduced crop scheduling and planning, access to market information, bio-village initiatives, and so on. Rather than focusing on all traditional crops, selected crop value chains were targeted for crop diversification to high-value and nutritive crops. Organic cultivation initiatives using good agricultural practices was introduced through bio-villages. One of the major improvements was enhanced private participation and resources leveraged.

(d) **Strengthening SPMU capacity for accelerating implementation.** The project strengthened the skill mix of the SPMU/CPMU to bring in expertise in the emerging areas of project vision and strategic focus as compared to original staff plans. Since a lot of focus was initially on process improvements, technology innovations, and quality than quantity, the project needed additional staff support to accelerate implementation and chase project targets.

Operational Innovations

12. The project was following an active learning approach in implementation. Implementation issues were documented and innovative solutions were creatively sought. Such an approach of continuous improvement resulted in a homegrown model for picking the right technology type given the contextual characteristics of the area including socioeconomic parameters. The key innovations are summarized below in table 7.1.

Table 7.1: Key innovation areas and good practices

Innovation Area	Usual Practice	Innovation Implemented	Benefits Achieved
Selection of scheme sites	Randomly select locations	Cluster of schemes within a preselected polygon based on micro-watershed	• Equity in meeting irrigation needs • Sustainability of schemes
Selection of scheme type	Arbitrarily without hydrological evaluation	Used digital technologies such as GIS, remote sensing, georesistivity, digital logging for evaluation	• Reduction in proportion of defunct schemes
Scheme proposal preparation	Conventional DPR format	Participatory SDMP preparation	• Comprehensive technical, social, geographic, technical, and livelihood focus.
Energizing schemes	Erratic electricity or costly diesel mode	Solar-based hybrid	• Reliability of service • Reduction in operating costs • Reduction in carbon footprint
Lift irrigation	Old model design	Only mini river lift irrigations , with water storage development first and then lift	• Failure rate reduced
Check dams	One design across the state	GPS integrated total station/3D imaging data for designing	• 50% reduction in cost and stable structures, sustainable schemes

Innovation Area	Usual Practice	Innovation Implemented	Benefits Achieved
Tube well	All types of schemes	Light duty deep tube Well with submersible pumps, after locating aquifer using digital georesistivity survey	• Manageable schemes by WUA

Strengthening Community-based Institutions

13. The project created and strengthened WUAs to perform basic I&D functions. These functions can be grouped into three categories (a) O&M of irrigation scheme; (b) water management practices including water budgeting, schedules of water deliveries, water use efficiency, and water application at the field level; and (c) agricultural support services including crop plans, crop diversification, and market links embedded in key guiding principles including participation and inclusion. The process of formation and nurturing of WUA followed a robust phased approach. During preplanning, intensive awareness campaign motivated farmers, especially tribal communities, to play a central role in appropriating the project concept. The planning phased followed rigorous SDMP that enabled to prepare integrated I&D solutions. During implementation, WUA registration, trainings, and demonstrations contributed to the uptake of advanced practices.

14. **Performance management mechanism**. To incentivize WUAs, the project adopted performance management mechanism based on broad grading parameters pertaining to governance, water management, market links, and innovation. A+, A, and B scores were used to classify WUAs. This instrument allowed the monitoring of WUAs to calibrate the support to be provided. It also acted as an information and comparison tool among WUAs which were able to engage in healthy competition.