

Document of
The World Bank

Report No: ICR00003860

IMPLEMENTATION COMPLETION AND RESULTS REPORT
(IBRD-48570/IDA-42910)

ON A

LOAN

IN THE AMOUNT OF SDR 63 MILLION
(US\$94.5 MILLION EQUIVALENT)

TO THE

REPUBLIC OF INDIA

FOR AN

ANDHRA PRADESH – TELANGANA COMMUNITY-BASED TANK
MANAGEMENT PROJECT

January 31, 2017

Global Water Practice
India Country Management Unit
South Asia Region

CURRENCY EQUIVALENTS

(Exchange Rate Effective January 15, 2017)

Currency Unit = Indian Rupee (Rs.)

Rs. 67.98 = US\$ 1

US\$ 1.00 = SDR 1

FISCAL YEAR
April 1 – March 31

ABBREVIATIONS AND ACRONYMS

APCBTM	Andhra Pradesh Community-Based Tank Management
APFMIS	Andhra Pradesh Farmers Management of Irrigation Systems Act
ALSS	Agricultural Livelihood Support Services
CCA	Culturable Command Area
CAD	Command Area Development
CAS	Country Assistance Strategy
CRRI	Central Rice Research Institute
DPU	District Project Unit
DLIC	District Level Implementation Committee
ERR	Economic Rate of Return
ENPV	Economic Net Present Value
EMF	Environmental Management Framework
EWS	Effective Water Spread
FIG	Farmers Interest Group
FRR	Financial Rate of Return
FNPV	Financial Net Present Value
GoAP	Government of Andhra Pradesh
GoTS	Government of Telangana State
GSDP	Gross State Domestic Product
IBRD	International Bank for Reconstruction and Development
IDA	International Development Association
IPM	Integrated Pest Management
INM	Integrated Nutrient Management
ICR	Implementation Completion Report
INR	Indian Rupees
ISR	Implementation Status and Results Report
ICAR	Indian Council of Agricultural Research
LSWI	Land Surface Wetness Index
MID	Minor Irrigation Department
M&E	Monitoring and Evaluation
MTR	Mid-Term Review
MIS	Management Information System
MU	Moderately Unsatisfactory
O&M	Operation & Maintenance
PSC	Project Steering Committee
PIM	Participatory Irrigation Management
PAD	Project Appraisal Document

PDO	Project Development Objective
PMU	Project Management Unit
PMKSY	Pradhan Mantri Krishi Sinchayee Yojana
RAP	Resettlement Action Plan
SHG	Self-Help Group
TIMP	Tank Improvement and Management Plan
TDP	Tribal Development Plan
U	Unsatisfactory
WP	With Project
WOP	Without Project
WRD	Water Resources Department
WUA	Water User Association
WALMI	Water & Land Management Institute

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INDIA
Andhra Pradesh Community Tanks Management Project

CONTENTS

Data Sheet

- A. Basic Information
- B. Key Dates
- C. Ratings Summary
- D. Sector and Theme Codes
- E. Bank Staff
- F. Results Framework Analysis
- G. Ratings of Project Performance in ISRs
- H. Restructuring
- I. Disbursement Graph

1. Project Context, Development Objectives, and Design.....	1
2. Key Factors Affecting Implementation and Outcomes	5
3. Assessment of Outcomes	10
4. Assessment of Risk to Development Outcome.....	24
5. Assessment of Bank and Borrower Performance	24
6. Lessons Learned	26
7. Comments on Issues Raised by Borrower/Implementing Agencies/Partners	28
Annex 1. Project Costs and Financing.....	29
Annex 2. Outputs by Component	30
Annex 3. Economic and Financial Analysis.....	43
Annex 4. Bank Lending and Implementation Support/Supervision Processes	54
Annex 5. Beneficiary Survey Results	56
Annex 6. Stakeholder Workshop Report and Results.....	57
Annex 7. Summary of Borrower's ICR and/or Comments on Draft ICR	58
Annex 8. Comments of Co-financiers and Other Partners/Stakeholders.....	60
Annex 9. List of Supporting Documents	61
MAP	62

A. Basic Information			
Country:	India	Project Name:	IN Andhra Pradesh and Telangana State Community- Based Tank Management
Project ID:	P100789	L/C/TF Number(s):	IBRD-48570,IDA- 42910
ICR Date:	01/31/2017	ICR Type:	Core ICR
Lending Instrument:	SIL	Borrower:	GOVERNMENT OF INDIA
Original Total Commitment:	USD 189.00M	Disbursed Amount:	USD 158.18M
Revised Amount:	USD 174.02M		
Environmental Category: B			
Implementing Agencies: Government of Andhra Pradesh Government of Telangana			
Cofinanciers and Other External Partners:			

B. Key Dates				
Process	Date	Process	Original Date	Revised / Actual Date(s)
Concept Review:	07/11/2006	Effectiveness:	07/27/2007	07/27/2007
Appraisal:	02/13/2007	Restructuring(s):		12/22/2014
Approval:	04/19/2007	Mid-term Review:		09/13/2010
		Closing:	12/31/2012	07/31/2016

C. Ratings Summary	
C.1 Performance Rating by ICR	
Outcomes:	Satisfactory
Risk to Development Outcome:	Moderate
Bank Performance:	Satisfactory
Borrower Performance:	Moderately Satisfactory

C.2 Detailed Ratings of Bank and Borrower Performance (by ICR)			
Bank	Ratings	Borrower	Ratings
Quality at Entry:	Satisfactory	Government:	Satisfactory
Quality of Supervision:	Satisfactory	Implementing Agency/Agencies:	Moderately Satisfactory

Overall Bank Performance:	Satisfactory	Overall Borrower Performance:	Moderately Satisfactory
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C.3 Quality at Entry and Implementation Performance Indicators

Implementation Performance	Indicators	QAG Assessments (if any)	Rating
Potential Problem Project at any time (Yes/No):	No	Quality at Entry (QEA):	None
Problem Project at any time (Yes/No):	Yes	Quality of Supervision (QSA):	None
DO rating before Closing/Inactive status:	Satisfactory		

D. Sector and Theme Codes

	Original	Actual
Major Sector/Sector		
Agriculture, Fishing and Forestry		
Other Agriculture, Fishing and Forestry	12	12
Irrigation and Drainage	59	59
Public Administration		
Sub-National Government	26	26
Industry, Trade and Services		
Agricultural markets, commercialization and agri-business	3	3
Major Theme/Theme/Sub Theme		
Environment and Natural Resource Management		
Renewable Natural Resources Asset Management	20	20
Biodiversity	10	10
Landscape Management	10	10
Water Resource Management	14	14
Water Institutions, Policies and Reform	14	14
Finance		
Finance for Development	7	7
Agriculture Finance	7	7
Urban and Rural Development		
Rural Development	60	60
Land Administration and Management	10	10
Rural Infrastructure and service delivery	29	29

Rural Markets	21	21
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E. Bank Staff		
Positions	At ICR	At Approval
Vice President:	Laura Tuck	Praful C. Patel
Country Director:	Junaid Kamal Ahmad	Isabel M. Guerrero
Practice Manager/Manager:	Meike van Ginneken	Gajanand Pathmanathan
Project Team Leader:	Ranjan Samantaray	Deepak Ahluwalia
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	Yanoma Yukitsugu	

F. Results Framework Analysis

Project Development Objectives (from Project Appraisal Document)

The proposed project development objective is for selected tank based producers to improve agricultural productivity and water users associations to manage tank systems effectively.

Revised Project Development Objectives (as approved by original approving authority)

(a) PDO Indicator(s)

Indicator	Baseline Value	Original Target Values (from approval documents)	Formally Revised Target Values	Actual Value Achieved at Completion or Target Years
Indicator 1 :	% increase in productivity (paddy, maize, groundnut, fish, milk).			
Value quantitative or Qualitative)	0%	Paddy 25% Maize 30% G'nut 25% Fish 300 % Milk 150 % Tomato 25%		Paddy 36% Maize 72% G'nut 112.5 % Fish 324 % Milk 128% Tomato 40%
Date achieved	02/08/2008	07/31/2015		07/31/2016
Comments (incl. % achievement)	Achieved. Productivity increase in paddy, maize and groundnut exceeded targets; fish productivity showed significant increase over baseline value.			
Indicator 2 :	% WUA in rehabilitated tank systems whose O&M expenditure is as per agreed annual O&M plans			

Value quantitative or Qualitative)	0.00	80%		97%
Date achieved	02/08/2008	07/31/2015		07/31/2016
Comments (incl. % achievement)	Achieved. WUA effectively responded to capacity-building activities in developing O&M plans.			
Indicator 3 :	% of water users in rehabilitated tank systems satisfied with WUA operation and maintenance			
Value quantitative or Qualitative)	0%	75%		80.9%
Date achieved	02/08/2008	07/31/2015		07/31/2016
Comments (incl. % achievement)	Achieved.			
Indicator 4 :	% increase in cropping intensity			
Value quantitative or Qualitative)	103%	118%		137%
Date achieved	02/08/2008	07/31/2015		07/31/2016
Comments (incl. % achievement)	Achieved. This was attributed to increase in irrigation intensity (by 37%), and 80% middle and tail-end farmers reporting improved water availability.			
Indicator 5 :	Direct project beneficiaries			
Value quantitative or Qualitative)	0.00	605,188		605,052
Date achieved	02/08/2008	07/31/2015		07/31/2016
Comments (incl. % achievement)	Achieved. The project fell short of just 136 people in meeting its target.			
Indicator 6 :	Female beneficiaries			
Value quantitative or Qualitative)	0.00	17%		17%
Date achieved	02/08/2008	07/31/2015		07/31/2016
Comments (incl. % achievement)	Achieved. Implementation of Gender Action Plans and creation of Gender CIGs contributed to women getting significant share of project benefits.			
Indicator 7 :	Area provided with irrigation and drainage services (ha)			
Value quantitative or Qualitative)	100,000	216,164		253330
Date achieved	02/08/2008	07/31/2015		03/31/2016
Comments (incl. %	Achieved.			

achievement)				
Indicator 8 :	Area provided with irrigation and drainage services - Improved (Ha)			
Value quantitative or Qualitative)	0	216,164		253,330
Date achieved	02/08/2008	07/31/2015		07/31/2016
Comments (incl. % achievement)	Achieved			
Indicator 9 :	Operational water user associations created and/or strengthened (number)			
Value quantitative or Qualitative)	0	2,157.00		2,157.00
Date achieved	02/08/2008	07/31/2015		07/31/2016
Comments (incl. % achievement)	Achieved. WUAs have shown significant operational performance as reflected in their increased capacity for resource mobilization. As many as 61% WUAs are collecting water charges, and 89% WUAs are receiving share of lease income from fisheries cooperative			

(b) Intermediate Outcome Indicator(s)

Indicator	Baseline Value	Original Target Values (from approval documents)	Formally Revised Target Values	Actual Value Achieved at Completion or Target Years
Indicator 1 :	% WUAs holding regular General Body Meetings			
Value (quantitative or Qualitative)	0%	80%		95%
Date achieved	02/08/2008	07/31/2015		07/31/2016
Comments (incl. % achievement)	Achieved.			
Indicator 2 :	% tank command area irrigated			
Value (quantitative or Qualitative)	54%	60%		66%
Date achieved	02/08/2008	07/31/2015		07/31/2016
Comments (incl. % achievement)	Partially Achieved. The project was primarily designed to provide protective irrigation during Kharif season only. However, the tanks recorded 28% increase in irrigated area during Kharif, and as much as 38% during Rabi.			
Indicator 3 :	% WUAs maintaining appropriate cash books			
Value (quantitative or Qualitative)	0%	80%		91%
Date achieved	02/08/2008	07/31/2015		07/31/2016

Comments (incl. % achievement)	Achieved. WUAs performance reflects capacity building trainings by the project.			
Indicator 4 :	% WUAs having co-opted members			
Value (quantitative or Qualitative)	0%	90%		100%
Date achieved	02/08/2008	07/31/2015		07/31/2016
Comments (incl. % achievement)	Achieved. The co-option of fishermen and groundwater users expanded and enriched the membership base of			
Indicator 5 :	% of total current year assessed water charge collected			
Value (quantitative or Qualitative)	0%	80%		84%
Date achieved	02/08/2008	07/31/2015		07/31/2016
Comments (incl. % achievement)	Achieved. The collection of water charges is an important indicator of the financial sustainability of the WUAs.			
Indicator 6 :	% of WUAs with fisheries receiving their share of lease income (from award of tank fishing rights)			
Value (quantitative or Qualitative)	0%	90%		90%
Date achieved	02/08/2008	07/31/2015		07/31/2016
Comments (incl. % achievement)	Achieved. Lease income augmented the financial resources of the WUAs and is therefore a contribution to the financial viability of the WUAs.			
Indicator 7 :	% of middle and tail end farmers reporting improved water availability			
Value (quantitative or Qualitative)	n.a.	75%		80%
Date achieved	02/08/2008	07/31/2015		07/31/2016
Comments (incl. % achievement)	Achieved. The increase was on account of improvements in feeder channels, tank bund, sluices, canal lining, and surplus weir.			
Indicator 8 :	% increase in value of crop output per unit of water in command area of rehabilitated tanks			
Value (quantitative or Qualitative)	0%	25%		35%
Date achieved	02/08/2008	07/31/2015		07/31/2016
Comments (incl. % achievement)	Achieved.			
Indicator 9 :	Increase in value of crop output per unit of groundwater for Groundwater User Groups			

Value (quantitative or Qualitative)	0%	10%		39%
Date achieved	02/08/2008	07/31/2015		07/31/2016
Comments (incl. % achievement)	Achieved. The capacity building for better crop planning and water utilization through water budgeting helped farmers adopt conjunctive surface and groundwater use.			
Indicator 10 :	% farmers in tank command adopting improved production techniques			
Value (quantitative or Qualitative)	0%	20%		57.4%
Date achieved	02/08/2008	07/31/2015		07/31/2016
Comments (incl. % achievement)	Achieved.			
Indicator 11 :	% paddy area under SRI paddy cultivation in rehabilitated tanks			
Value (quantitative or Qualitative)	0%	10%		0.76%
Date achieved	02/08/2008	07/31/2015		07/31/2016
Comments (incl. % achievement)	The project could not achieve SRI target.			
Indicator 12 :	% of tank fishing communities in project tanks adopting improved production harvesting techniques			
Value (quantitative or Qualitative)	0%	80%		100%
Date achieved	02/08/2008	07/31/2015		07/31/2016
Comments (incl. % achievement)	Achieved. Fishing communities benefitted from adoption of improved techniques.			
Indicator 13 :	Increase in number of improved breed cattle in project tank areas (in '000)			
Value (quantitative or Qualitative)	0	350		198
Date achieved	02/08/2008	07/31/2015		07/31/2016
Comments (incl. % achievement)	This sub-component was dropped at MTR.			
Indicator 14 :	% increase in command area under non-paddy crops			
Value (quantitative or Qualitative)	0%	100%		30.26%
Date achieved	02/08/2008	07/31/2015		07/31/2016
Comments (incl. %)	Partially achieved.			

achievement)				
Indicator 15 :	% increase in share of final sale value obtained by farmer marketing groups in targeted community.			
Value (quantitative or Qualitative)	0%	10%		80%
Date achieved	02/08/2008	07/31/2015		07/31/2016
Comments (incl. % achievement)	Achieved.			
Indicator 16 :	Number of functioning farmer marketing groups established			
Value (quantitative or Qualitative)	0	1500		1122
Date achieved	02/08/2008	07/31/2015		07/31/2016
Comments (incl. % achievement)	Partially achieved.			
Indicator 17 :	Number of formal/contractual marketing agreements reached by Farmer Interest Groups (FIGs)			
Value (quantitative or Qualitative)	0	100		97
Date achieved	02/08/2008	07/31/2015		07/31/2016
Comments (incl. % achievement)	Achieved.			
Indicator 18 :	% beneficiaries satisfied with the volume and relevance of market information (in tank areas with market information networks)			
Value (quantitative or Qualitative)	0%	75%		50%
Date achieved	02/08/2008	07/31/2015		07/31/2016
Comments (incl. % achievement)	This was a one-time survey done as part of the final impact assessment taking fisheries and high value vegetables samples into account.			

G. Ratings of Project Performance in ISRs

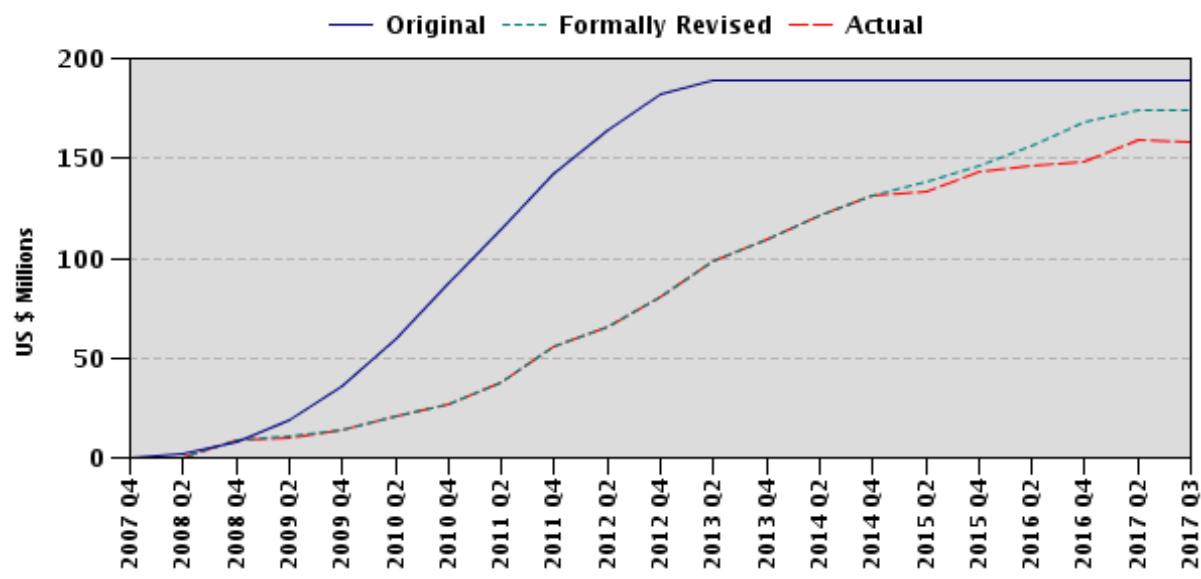
No.	Date ISR Archived	DO	IP	Actual Disbursements (USD millions)
1	11/04/2007	Satisfactory	Satisfactory	0.00
2	05/26/2008	Satisfactory	Satisfactory	8.73
3	11/28/2008	Satisfactory	Moderately Satisfactory	10.44
4	05/26/2009	Satisfactory	Moderately Satisfactory	13.45
5	07/10/2009	Satisfactory	Moderately Satisfactory	13.45

6	01/23/2010	Satisfactory	Moderately Satisfactory	21.26
7	09/23/2010	Satisfactory	Moderately Satisfactory	35.75
8	12/08/2010	Satisfactory	Moderately Satisfactory	37.69
9	06/09/2011	Satisfactory	Moderately Satisfactory	48.64
10	12/13/2011	Satisfactory	Moderately Satisfactory	57.06
11	06/07/2012	Satisfactory	Moderately Satisfactory	75.37
12	08/27/2012	Satisfactory	Moderately Satisfactory	80.26
13	11/27/2012	Satisfactory	Moderately Satisfactory	87.85
14	03/30/2013	Satisfactory	Satisfactory	104.09
15	08/31/2013	Moderately Satisfactory	Moderately Satisfactory	109.60
16	03/24/2014	Moderately Unsatisfactory	Moderately Satisfactory	127.11
17	10/08/2014	Moderately Satisfactory	Satisfactory	133.52
18	05/21/2015	Moderately Satisfactory	Satisfactory	137.35
19	12/07/2015	Satisfactory	Satisfactory	146.44
20	06/10/2016	Satisfactory	Satisfactory	147.34
21	07/28/2016	Satisfactory	Satisfactory	149.28

H. Restructuring (if any)

Restructuring Date(s)	Board Approved PDO Change	ISR Ratings at Restructuring		Amount Disbursed at Restructuring in USD millions	Reason for Restructuring & Key Changes Made
		DO	IP		
10/30/2012		S	MS	87.85	Extension of Closing Date from December 31, 2012 to September 30, 2014
02/28/2014		MS	MS	127.11	Partial Cancellation of savings resulting from the depreciation of INR
05/29/2014	N	MU	MS	129.10	Cancellation of US\$7.5 M under IBRD, and extension of closing date from Sep 30, 2014 to July 31, 2016
12/22/2014	N	MS	S	133.52	Bifurcation of the State of Andhra Pradesh into the State of Andhra Pradesh and State Telangana

I. Disbursement Profile



xi

1. Project Context, Development Objectives and Design

1.1 Context at Appraisal

1. Andhra Pradesh (AP) is the fourth largest state by size and fifth largest by population in India, and has the largest number of tanks in the country. A virtual lifeline for the large agrarian population, 74,000 tanks hold the capacity to irrigate about 1.5 million hectares of land. However, at the time the project began, there had been a steady reduction in the area under tank irrigation from 1 million ha in 1990 (24 per cent of irrigated area at that time) to 0.5 million ha in 2004 (12 per cent of irrigated area). The decline was due to lack of maintenance and an increase in the use of groundwater for irrigation.

2. To respond to the issue, the Government of AP (GoAP) increased the state capital budget for irrigation from an average of 36 per cent between 2001/2002 to 84 per cent in 2006/2007. The government also launched an irrigation development program called *Jalayagnam*, which aimed to double the irrigated area over a five to ten year period. The program was estimated to cost Rs.700 million. However, it focused mainly on medium and major irrigation schemes (greater than 2,000 hectares) rather than small-scale tank-based systems. In addition to action aimed at boosting tank irrigation in the state, the GoAP instituted participatory management of irrigation systems, making it the first state in India to adopt this approach. The Andhra Pradesh Farmers Management of Irrigation Systems (APFMIS) Act of 1997, which laid out the responsibilities of water user associations (WUAs), provided the legal framework. The Act introduced the election of WUAs in tanks with a command area of more than 40 hectares, expanded the membership structure of WUAs to include non-farmer groups and empowered WUAs on tank maintenance and the collection of water charges.

3. At the time of deciding to finance the Andhra Pradesh Community-Based Tank Management (APCBTM) project, the World Bank had several years of experience in India's irrigation sector. After decades of financing large irrigation construction projects, the Bank switched course in the early 2000s to focus on rehabilitation of existing irrigation systems and policy reforms¹. When the APCBTM project was initiated, there had already been three World Bank funded irrigation improvement projects in AP, the last of which had been approved in 1997. These projects, stemming from the old model, faced long delays in completion of irrigation works, low involvement of users in irrigation management, and poor cost recovery. The World Bank had also financed a tank rehabilitation project in neighboring Karnataka (approved in 2002), with a strong emphasis on strengthening community-based institutions. It proved to be the precursor to the APCBTM. Further, supporting the tank management project in AP was aligned with the World Bank's Country Partnership Strategy for India, which aimed to increase the efficiency of irrigation systems by enhancing agricultural productivity and improving rural livelihoods through a participatory approach.

¹*An Impact Evaluation of India's Second and Third Andhra Pradesh Irrigation Projects: A Case of Poverty Reduction with Low Economic Returns*, World Bank 2008.

1.2 Original Project Development Objectives (PDO) and Key Indicators

4. The Project Development Objective (PDO), as defined in the Legal Agreement, was “to assist the project implementing entity in (a) improving agricultural productivity with the assistance of selected tank-based producers; and (b) improving the management of tank systems with the assistance of selected WUAs”.² It remained unchanged throughout the project. The PDO was well conceived, as it highlighted agricultural productivity as a clear and measurable outcome of the rehabilitation of tank irrigation systems. In addition, by focusing on engaging local communities through WUAs as the primary stakeholders for managing minor irrigation tanks in project areas, the PDO applied the right prescription with specified outcomes for managing water resources in a decentralized manner.

Listed below are the project outcome indicators elaborated in the results framework:

a) Increases in productivity/intensity:

- per cent increase in crop productivity
- per cent increase in cropping intensity
- per cent increase in fish productivity
- per cent increase in milk productivity

b) Improved tank management:

- per cent of WUAs in rehabilitated tank systems whose O&M expenditure is as per agreed annual O&M plans
- per cent of water users in rehabilitated tanks systems satisfied with WUA operation and maintenance

5. The indicators remained unchanged throughout the project.

1.3 Revised PDO (as approved by original approving authority) and Key Indicators, and reasons/justification

6. The PDO was not revised, as the project was deemed to be on track to meeting its goals of increasing agricultural productivity and enhancing the ability of WUAs to manage tank systems effectively.

1.4 Main Beneficiaries

7. The PAD identified WUAs, fisheries cooperative societies (FCSs), and farmer interest groups (FIGs) as the primary beneficiaries of the project. Groundwater users (Component 2), agricultural producers (Component 3) and project management units at the state and district levels (Component 4) were the additional beneficiaries. The results framework set a target of

² The PDO in the PAD is fairly similar: “for selected tank based producers to improve agricultural productivity and water user associations to manage tank systems effectively.”

605,188 direct project beneficiaries in 0.25 million hectares of the project area. The project virtually managed to meet this target, falling short by just 136 people. Of the number of project beneficiaries, 17 per cent were women against a target of 14 per cent.

8. As part of project design, the interventions were tailored to respond to the needs of different groups, thereby benefiting stakeholders in different ways. For instance, an impact evaluation found that 90 per cent of trainings organized by the project benefitted the WUA managing committee, sub-committees, para-workers and commodity interest group (CIG) members. The CIGs benefitted from trainings on CIG formation, agribusiness, livelihood interventions for gender CIGs, exposure visits for tribal CIGs and O&M of assets procured.

9. The Project Management Units (PMU) of both states benefitted in direct and indirect ways from the project. The project allowed PMU staff to hone their skills, including in areas such as monitoring and evaluation, irrigation planning and scheduling, budget control and financial management. In addition, the state governments of Andhra Pradesh and Telangana benefitted from the improved irrigation efficiency and increased agricultural productivity brought about by the project, which were both important for the states' goals for their agricultural sectors. The experience from the project has the potential to improve the design and implementation of future community-led irrigation projects in both the states.

1.5 Original Components

The project had four components as summarized below:

10. **Component A: Institutional Strengthening** (US\$16.4 million): The objective of this component was to focus on strengthening community-based institutions to enable them to assume greater responsibility for tank system improvement and management. Technical assistance for preparation, implementation and monitoring of Tank Improvement and Management Plans (TIMPs) was financed under this component. It further supported WUA training and capacity building in planning and implementation of tank system rehabilitation works; preparation and implementation of O&M plans; assessment and collection of water charges; maintenance of records and accounts; improved water-sharing and utilization; and participatory monitoring, learning and evaluation. It also assisted in mobilization and training of various production and marketing groups.

11. **Component B: Minor Irrigation Systems Improvements** (US\$150.6 million): Composed of two sub-components, the overall objective of this component was to improve the operational performance and enhance the efficiency of water use from 3,000 tanks with an estimated culturable command area (CCA) of about 250,000 hectares, spread across 21 districts. The sub-component on Tanks System Improvement supported physical rehabilitation works for the safety of the tank structure and distribution systems. The second sub-component, on pilot groundwater management (PGM), aimed at enabling groundwater users in tank systems subject to groundwater stress to improve the management of their groundwater resources in order to enhance agricultural productivity and livelihoods. This sub-component was implemented in the project tanks falling in critical and over-exploited groundwater zones in the state, meeting specific criteria for effective groundwater management.

12. **Component C: Agricultural Livelihoods Support Services** (US\$25.2 million): This component was designed to enhance tank-based livelihoods by increasing production, productivity and profitability of agriculture, horticulture, fisheries and livestock through improvements in production technologies, management practices, better input-output market linkages, and augmentation of community-level productive capacities as well as infrastructure. The outputs expected from this component included higher productivity in agriculture, livestock and fisheries; better alignment of farm-based productive activities with water availability; and diversification into more market-oriented agriculture and livestock production. This component consisted of five sub-components: C1: Agriculture and Horticulture (US\$8.8 million); C2: Livestock (US\$2.4 million); C.3: Fisheries (US\$1.6 million); and C.4: Foreshore Area Treatment (US\$4.2 million); and C5: Agri-Business and Marketing (US\$8.1 million).

13. **Component D: Project Management** (US\$12.5 million): The objective of this component was to ensure smooth implementation of project activities, monitoring of project implementation progress and outputs/outcomes achieved, and documenting lessons learned. Activities included in this component were: (i) setting up and supporting project management units at the state and district levels; (ii) setting up and leading the project monitoring, evaluation and learning activities; (iii) contracting an external M&E agency as consultant for the duration of the project; (iv) supporting emerging needs and innovations during implementation; (v) liaising with other agencies and government departments; and (vi) documenting project experience and disseminating it to the wider development community.

1.6 Revised Components

14. Despite two extensions, there were no revisions to the project's components. However, to facilitate increased focus on implementation efforts, the team undertook a number of measures. The first was greater attention to improving the distribution system in tank command areas to ensure efficient water delivery across head, middle, and tail-end farmers in the aayacut. Secondly, there was increased attention to farm productivity enhancing activities by diverting new investments from the foreshore plantations and livestock sub-components.

1.7 Other significant changes

15. The Mid-Term Review (MTR) during September 2010 did not foresee the need for any change in project scope and components. However, based on the lessons learned from first three years of implementation, it was agreed to discontinue any new investments in the foreshore plantations and livestock sub-components. Given the nature of the project and the tasks involved, discontinuation of these sub-components did not affect the achievement of the stated project objectives.

16. The project timeline was extended four times, in July 2012 for a period of 16 months, in February 2014 for 3 months, in May 2014 for 7 months, and in December 2014 for 19 months, on account of political disturbances leading to the state bifurcation that had caused delays in execution of works. As a result, the project closing date was extended from the original date of December 31, 2012 to June 30, 2016. The extended timeline did not elicit any change in project components or their respective targets. In 2013, the project realized US\$25 million in savings

due to a combination of exchange rate fluctuations (US\$15 million saved) and savings from within the project components and sub-components (US\$10 million). Concerning the latter, most of the savings were in the minor irrigation systems improvement component, accounting for about 43% of the total component savings. In response to the exchange rate gains, GoAP requested a partial cancellation of US\$15 million from the original loan of US\$189 million, which led to an envelope of US\$176 million from the World Bank upon approval. The remaining US\$10 million in component savings was used to extend the project by 18 months to achieve project outcomes.

2. Key Factors Affecting Implementation and Outcomes

2.1 Project Preparation, Design and Quality at Entry

17. **Background Analysis:** The background analysis leading to project preparation drew on a sound study of the irrigation situation in the state. The GoAP was concerned about the decline in tank irrigated areas, from about 1 million hectares in 1990 to about 0.5 million hectares in 2004, and the consequent reduction in agriculture productivity. Tank irrigated areas constituted 24 per cent of the 10.6 million hectares of irrigated area and its decline posed a serious threat to the predominantly rain-fed agriculture economy of the state. The project team further realized that WUAs elected following the enactment of APFMIS were largely ineffective in the absence of rehabilitated tank infrastructure.

18. Given this sound analysis, the Project Implementation Plan (PIP) covered all aspects of the project, making a valid case for linking increased agriculture production to tank system improvement and management. The Government of India (GoI)'s emphasis on irrigation development and expansion through the 'Bharat Nirman' program, launched in 2005, acted as a precursor for the GoAP to seek additional funding from external agencies. The initial plan was to combine the tanks project with the Andhra Pradesh Water Sector Improvement Project (APWSIP). However, this option was rejected because there was a strategic difference between the dam-based and tank-based irrigation projects. In addition, tank system improvement across 23 districts of the state required distinct implementation arrangements whereas APWSIP was restricted to five districts focused on institutional and regulatory reforms in the major irrigation sector only. The GoAP's interest in a separate tank project was aligned with its goal of integrating agriculture and fisheries in improving tank command area in the state.

19. **Project Design:** The project design incorporated lessons on stakeholder participation and implementation effectiveness from the Andhra Pradesh Economic Restructuring Project (Cr. 4360-IN/Ln. 3103-IN) and the Bank-supported Karnataka Community-Based Tank Management Project (Cr. 3635-IN). The project design was transformative in nature as it integrated modernization of irrigation structures with institutional strengthening and livelihood improvement. It was a first of its kind project that measured irrigation water efficiency at the farm level, improved water productivity by improving production of tank fisheries, and piloted participatory groundwater development in selected tanks. As increasing irrigated agriculture productivity was the focus of the project, the sub-component on 'agri-business and marketing' was incorporated at the design stage to increase profitability through market linkages.

20. **Quality at Entry:** The State Government demonstrated a strong commitment to the project throughout the identification and design stages. It established a Project Management Unit (PMU) with the Command Area Development (CAD) in the Irrigation and Command Area Development (I&CAD) Department of GoAP to ensure timely preparation and ownership of the project by the five line departments of the state. The PMU was fully staffed but multi-sectoral coordination among the implementing agencies was not adequately addressed at entry, even though it was correctly identified as a substantial source of risk. In hindsight, a significant shortcoming was the failure to recognize climatic aberration such as severe droughts as potential threats to the achievement of expected outcomes. However, some of the project tanks managed to mitigate the adverse impact of consecutive droughts in 2014-15 and 2015-16 on agricultural performance.

21. **Identification of Risks:** The PAD outlined a number of risks to the achievement of the PDO (three in total) and to the successful implementation of the project components (six in all). While most of the risks were well managed e.g. the over-exploitation of groundwater or proved negligible (e.g. elite capture of WUAs), the risk of water charge collection was different. The assessment correctly identified the risk of inadequate water charge collection and slow transfer of O&M funds to WUAs, issues that did materialize during project implementation. However, the mitigation measures – such as awareness raising and expanding the WUAs' source of revenue – did not address the fact that the plough-back process from the Revenue Department to the WUAs was an inherently bureaucratic process, as it required funds to be approved at different administrative levels. Moreover, awareness raising was not enough to overcome weak capacity to pay among the farmers.

22. Aside from the water charge collection, the PAD did not address the risk due to drought and climate variability. The project design factored in climate variability to a limited extent based on analysis of past rainfall data, which suggested that in a ten-year cycle, there are three years with above normal rainfall, three years with normal rainfall, and four years with below normal rainfall. However, the rainfall analysis during the project period indicated that the number of 'below normal rainfall' years (drought years) and 'normal rainfall years' were higher in several project districts. Further, it was observed that the higher rainfall in some years was shifting to later months than the traditional south-west monsoon months. These patterns are suggestive of possible impacts of climate change, reflecting a trend towards lower and more concentrated precipitation in future.

2.2 Implementation

23. **Delays in kick-starting implementation:** In the early stages of project implementation, there were some delays in getting all the project components started on time. One challenge was staffing of the PMU and Batch 1 district project units (DPUs), which was exacerbated by high staff turnover. It was also difficult to recruit support organizations (SOs) to help the WUAs with their responsibilities. Almost a year after project effectiveness, none of the contractors had begun civil works, although the WUAs had made modest progress in this area. Persistent delays in the release of funds to implementing departments also led to delays in starting the agricultural livelihoods component.

24. The problem was temporarily resolved when the Finance Department issued instructions in June 2009 exempting the project from expenditure ceilings but the failure of the district units to implement the instructions undermined the action and led to an average delay of 2 to 3 months in payments. Moreover, an overall fiscal crisis in Andhra Pradesh resulted in low project disbursement halfway through the project (19% by 2010), which picked up subsequently.

25. **Mid-Term Review:** Conducted in September 2010, the MTR rated implementation progress as moderately satisfactory. By this time, the handover of the first batch of rehabilitated tanks had begun, thereby shifting the project's emphasis to O&M performance assessment of WUAs. At the same time, the scope of the project was downscaled from 3,000 to 2,157 tanks. Fund flow improved by early 2011, as the provision of Advanced Contingency bills allowed DPUs to withdraw advance cash payments of up to Rs 2 million.

26. Despite these positive developments, delays in completing the civil works persisted on account of political turmoil leading to the state bifurcation. Delays in executing planned activities forced the project to seek two extensions of the closing date. However, it is notable that with a cumulative extension of 39 months, the project completed all planned activities before the revised closure date.

27. **Challenges related to bifurcation:** Bifurcation of Andhra Pradesh and Telangana states raised new challenges for project implementation due to uncertainty over the legal framework, the election of WUA members and the sharing of implementation arrangements between the two states. The political aftermath notwithstanding, the transition to two implementing units under the Command Area Development (CAD) of the respective Irrigation Departments of Andhra Pradesh and Telangana was smooth. The unspent budget was reallocated to the two states, with Andhra Pradesh implementing works in 12 districts and the new state of Telangana in 11 districts. Both PMUs functioned efficiently to complete ongoing contracts and report progress on other activities within the extended timeline.

2.3 Monitoring and Evaluation (M&E) Design, Implementation and Utilization

Overall, Monitoring and Evaluation was conducted properly and it was methodically implemented.

28. **M&E design.** The design of the outcome indicators was comprehensive and clearly defined. All the indicators were measurable as well as realistically achievable. An M&E system was designed through five elements: (1) baseline survey; (2) monthly monitoring of implementation and outputs; (3) two impact assessments of the project (Mid-term and end Project); (4) social and environment management auditing; and (5) systematic monitoring of project impacts through repeated monitoring of the same set of tanks, WUAs and households throughout the project implementation.

29. **M&E Implementation.** Despite delays in contracting, project implementation was satisfactory. The implementation team regularly and systematically communicated with the project stakeholders. A baseline survey was conducted in the first year, and was followed by regular monitoring of project outputs and targets. In addition, the project field staff and PMU

created an excellent database. However, due to state bifurcation, M&E staff was reshuffled, which adversely affected M&E implementation as data collection and monitoring activities were delayed. Despite major disruptions in project implementation, including delays in securing the services of the Third Part Monitoring Agency, the project advanced the monitoring of the targets, outputs, and outcomes, and delivered the final impact assessment in a timely manner.

30. **M&E Utilization.** Despite various delays and disruptions because of state bifurcation, the external M&E experts provided timely and reliable data. They regularly reported the project progress to the PMU and were receptive to feedback provided by the PMU. Moreover, the project achievements and any reflections from the project implementation were communicated to the relevant project teams. In addition, the external experts prepared two impact assessment reports with the project team, which highlighted the project's major achievements and the lessons learned from implementation. The reporting was based on both qualitative and quantitative analysis with statistics, and they were used extensively by the project team and World Bank staff, including the ICR preparation team.

2.4 Safeguard and Fiduciary Compliance

31. Six environmental and social safeguards were triggered in the project. On the environmental side, this included the Environmental Assessment (OP 4.01), Pest Management (OP 4.09), and Safety of Dams (OP 4.37) safeguards. In addition, three social safeguards on Involuntary Resettlement (OP 4.12), Indigenous Peoples (OP 4.10) and Cultural Property were triggered. Project activities did not require any land acquisition or resettlement and rehabilitation (R&R).³

32. **Environmental Management:** An Integrated Social and Environmental Assessment was undertaken as part of project implementation based on field level assessments in a sample of 50 tanks. Some of the baseline environmental issues identified by the assessment included land degradation, siltation in tanks, groundwater exploitation and deteriorating water quality. The pest management safeguard was triggered because of the possibility of increased use of pesticides due to improved irrigation practices. Inspection by the Dam Safety Panel (DSP) was undertaken for all 68 tanks with a bund height at or above 10 meters (this included 13 tanks with a bund height at or above 15 meters). There was full compliance with all environmental safeguard measures, including dam safety interventions. Moreover, a Social and Environmental Management Framework (SEMF) was developed in order to manage and mitigate the social and environmental risks identified in the initial assessment.

33. In addition, a tribal development strategy and a tribal development plan at the tank level was developed to ensure that tribal groups in tank areas would equally benefit from the project interventions as other groups. By project closure, 77 tanks with 10 to 50 per cent tribal

³Partial encroachments were found in 643 tanks and seasonal cultivation in 243 tanks with 29 seasonal cultivators having temporary dwelling units in 2 tanks but in each of these tanks the seasonal cultivators with temporary dwellings willingly agreed to vacate/stop the encroachment/cultivation to help tank rehabilitation.

ayacutdars⁴ were identified; tribal development plans were implemented in 63 tanks; and 988 tribal ayacutdars benefitted from the project interventions. PMU supported training on sustainable water management practices, the formation of tribal CIGs and exposure visits to progressive farms, which benefitted 42,151 tribal farmers.

34. **Social Safeguards:** Involuntary resettlement was triggered because of the risk that the water spread area and feeder channels might be encroached. Provisions were made for affected people to gain R&R entitlements and other project benefits in the event that resettlement was required. Cultural property was triggered because of the chance of finding some objects of cultural or archaeological value during civil works. There were minor cultural protection measures, such as ensuring that a temple near a bund in Rai Rao Cheruvu in Medak district that was being widened was not compromised.

35. **Financial Management:** When the project was initiated, it was clear that PMU and DPUs had quite satisfactory financial management capacity but WUAs had significantly less. The project sought to enhance the capacity of WUAs in financial management by inviting them to implement up to Rs 500,000 worth of minor civil works such as de-weeding, de-silting and other earth works such as filling of berm cracks and rain gulleys on the tank bunds. It financed these works through existing state government budgetary systems, as well as the standard fiduciary procedures of the Works Department, to manage the flow of funds.

36. One of the requirements for signing contracts with the WUAs was that they needed to have access to other sources of funds, and not be dependent on sub-project financing. The WUA contracts specified that the District Project Director, Executive Engineer or a similar official would hold monthly meetings at DPU level, where the representatives of the committees, and the assistant engineers in charge of the site would submit the latest project information. Such information included progress reports duly authenticated by the President of the WUA and highlighting the difficulties, if any, in the execution of the work. Overall, it reflected an adequate financial management system, timely fund disbursement backed by regular monitoring and submission of expenditure statements.

37. The internal audit mechanism was considered weak at project appraisal, as there was no internal audit unit in place. The Bank and the Borrower agreed that the internal audit function would be contracted to an independent chartered accountant firm. As for the external audit, this was entrusted to the Comptroller and Auditor-General (CAG) of India through the State Accountant General of Andhra Pradesh. The CAG's audit was done on an annual basis. A World Bank mission observed in June 2013 that the internal audit review process was working satisfactorily.

38. In 2013, the project estimated US\$15 million in savings due to exchange rate gains (INR to US\$ and US\$ to SDR). As a result, US\$15 million of the original loan of US\$189 million was cancelled due to rupee devaluation, resulting in a total financing envelope of US\$174 million from the World Bank. An additional US\$10 million was saved through savings from within the

⁴ ayacutdar refers to the beneficiary landowner in the tank command area.

project components and sub-components and was used to extend the project by 18 months to achieve project outcomes.

39. **Procurement:** Procurement covered all contracts for goods, consultancy services and works. The procurement assessment report by the procurement specialist of the World Bank did not suggest any serious lapses in procurement of goods, works and services.

40. The bifurcation process did not affect the status of civil works nor of procurement compliance. Both states assigned the required procurement staff, and both states followed the project's procurement manual. When the project was extended in 2014, six ongoing consultancy contracts were extended on a single source procurement basis. However, in March 2013, the project was found not in compliance with the legal covenant to appoint an external M&E agency. The lapse was rectified in December 2014 when an external consultant was contracted as the new M&E agency. Other than these few instances, there were no notable procurement problems during the course of the project.

2.5 Post-completion Operation/Next Phase

41. The APCBTMP was designed to build WUA capacity so that they would be able to take over water tariff collection and tank system O&M. A number of tools and mechanisms were developed to help the WUAs to discharge their O&M responsibilities. A Tank Improvement Management Plan (TIMP) and the OK Card were developed to outline and monitor the civil works undertaken by the WUAs, as well as capacity building activities and record maintenance. Good administrative practices are now in place to enable the WUAs to manage tank operations in an organized and predictable way⁵. A well established Water Users Organization system, formed under the APFMIS 1997, lends support to the effective functioning of WUAs as post-project institutional structure, ensuring sustainability of project interventions and outcomes.

42. The GoAP is taking forward the experience and learning from the project in designing a follow-up project, AP Integrated Irrigation and Agriculture Transformation Project (APIIATP), aimed at enhancing agricultural productivity by creating resilience in tank-based smallholder production systems through climate-resilient technology innovation and transfer. It is proposed as a first-of-its-kind project, where conservation efficiency of minor irrigation tanks within a defined catchment will be conjunctively treated to maximize climate co-benefits. The project will also benefit an equal or greater number of stakeholders who depend on tank-based livelihoods, particularly through fisheries. The Government of Telangana State (GoTS) sees the learning from the project in pursuing 'resilience' in the micro basin/catchment level projects under the Pradhan Mantri Krishi Sinchayee Yojana (PMKSY).

3. Assessment of Outcomes

3.1 Relevance of Objectives, Design and Implementation

Relevance of Objectives: High

⁵ Source: Borrower's Completion Report

43. The project's objectives were as relevant at ICR as they were at initiation in 2007. The PDO was relevant in the context of GoI's National Water Policy 2012 (NWP) and the World Bank's Country Partnership Strategy (CPS, 2013-17). The project addressed NWP's core objective of strengthening irrigated water resource management and supported CPS Engagement Area-2 on transformation through increased agricultural productivity. In addition, the project acknowledged the 'National Framework for State Projects for World Bank Assistance for Renovation of Water Bodies, 2006' which aligned with GoAP emphasis on beneficiary participation for decentralised irrigation development in the state.

44. Within Andhra Pradesh, the project's emphasis on tank system improvement had full political support. At the time of appraisal, GoAP had launched a massive irrigation development program with an estimated cost of over Rs.700 billion over the next 5-10 years, and had taken steps to strengthen participatory irrigation management in the state following enactment of the APFMIS in 1997. The project addressed a key constraint on the development of the state agricultural sector, namely the dependence of farmers on tank systems in areas with limited possibilities of providing conventional surface irrigation and areas where groundwater irrigation had led to a serious decline in the water table. Moreover, the emphasis on tank systems was highly relevant given that tanks play an important role in the state agricultural sector and that their contribution to the irrigation sector had declined due to poor tank maintenance.

45. The PDO was appropriately formulated to align with the national and state contexts. The project scope was to revive the irrigation potential created by tank system rehabilitation, with the aim of improving agriculture productivity with participatory management by WUAs in managing improved storage structures, water distribution, and tax collection. The project followed inclusive criteria in (i) rehabilitating tank systems with acceptable construction quality standards; (ii) sustaining the restored systems through empowered community participation; (iii) improving the production and productivity of selected agricultural commodities; and, (iv) converting diversified production surplus into market-oriented agriculture.

Relevance of Design and Implementation: Substantial

46. The project was designed to engage several types of community-based institutions, namely FCS and FIGs alongside WUAs, in building an ALSS component for harnessing gains from irrigation improvement schemes. The project design rightly focused on the need to rehabilitate and modernize irrigation infrastructure, which at appraisal was functioning at sub-optimal level, resulting in low overall productivity. All the components of the tank system improvement contributed to achieving the PDO, as each TIMP was appropriately developed for each selected tank with associated physical works to improve the distribution network of sluice gates, feeder channels and drainage systems.

47. The results framework measured indicators with respect to the project components and sub-components. The project was designed to demonstrate that the cause-effect relationship between inadequate tank maintenance and declining irrigated tank command area is best addressed when tank restoration and rehabilitation is backed by operative maintenance by WUAs that effectively harnesses productivity gains through improved irrigation efficiency. Quantifying

the improved productivity achieved along with the high satisfaction levels of water users with the WUAs management of tank systems in the PDO indicator effectively captures water productivity and the benefits of participatory water management. The indicators contributed adequately to the measurement of the projects overall outcomes, as well as the various components.

48. PGM was an innovative sub-component that aimed at enabling farmers to improve the management of their groundwater resources by promoting integrated use of surface and groundwater in the tanks' influence zones. PGM interventions enabled borewell owners to share their groundwater resources with neighboring farmers, thereby reducing the demand for additional borewells and sustaining the existing borewell yields.

49. The project implementation plan was relevant to delivering the project development objectives. The combination of effective engineering options, irrigation modernization approaches, water management considerations and agricultural and livelihood support services were clear and effective. In agriculture, the involvement of various agencies reflected the need to use scarce irrigation water efficiently through crop intensification and diversification, water saving practices and optimization of incomes per drop of water through livestock, fishery and agri-marketing sub-components.

3.2 Achievement of PDO

50. Built on two key elements: (a) Improving agricultural productivity with the assistance of selected tank-based producers; and (b) Improving the management of tank systems with the assistance of selected WUAs, the PDO was well conceived as it highlighted agricultural productivity as a clear and measurable outcome of the rehabilitation of tank irrigation systems through a set of indicators.

i) Improving agricultural productivity with the assistance of selected tank-based producers:
Substantial

51. On the first PDO indicator, the project enhanced agricultural productivity by strengthening irrigation coverage and efficiency. The project envisaged the rehabilitation of 2,157 minor irrigation tanks with a target ayaicut area of 254,957 ha. At project completion, all the selected tanks (i.e. 1182 tanks in Telangana with a design ayaicut of 131,214 ha and 975 tanks in Andhra Pradesh with a design ayaicut of 122,116 ha) were rehabilitated. Improvement of tank systems resulted in a 28 per cent increase in the tank command area (Table 1), bringing an additional 70,932 ha under irrigation from a baseline of 136,798 ha. These results are due to improved water storage in the reservoir, strengthening of the reservoir embankment, renovation of sluice/head regulator, and improved water distribution through field channels.

52. As for irrigation efficiency, effectiveness of on-farm water management recorded a significant 39 per cent increase in water productivity. The crop output per unit of water from surface water irrigation in the command area of the rehabilitated tanks was INR 39,606 per hectare meter (ha-m) at the end of the project, increasing from the mid-term value of INR 28,708 per ha-m in 2011-12. Water productivity improvement was a clear reflection of improved irrigation efficiency achieved by reducing application and conveyance losses combined with

productivity gains. Despite an average 20 per cent decrease in south west monsoon rainfall during 2014-15 (Figure 1) in Andhra Pradesh project districts, the modernization and rehabilitation of tank system infrastructure has shown an ability to buffer against weather anomalies, while irrigation in the tank commands for the Kharif season has increased by 4.5 per cent. This was possible as water conveyance efficiency through lining of canals had reduced seepage losses and helped in irrigating 105 per cent of the designed ayacut area (taking into account both Kharif and Rabi crops) with a 37 per cent increase in irrigation intensity from the baseline. Consequently, 80 per cent of middle- and tail-end farmers in the tank command reported improved water availability.

Table 1. Change in irrigated area and water productivity (2007-2016)

	Pre-Project (2007)	Post-Project (Kharif 2015 & Rabi 2016)	Project Results (Outcome)	Comments
Irrigated area - Kharif (in '000 ha)	136.8	207.7	+ 70.9	Increase in irrigated area: 28 %
Irrigated area - Rabi (in '000 ha)	76.3	105.2	+ 28.9	Increase in irrigated area: 38 %
Gap area in rainfed Kharif (in '000 ha)	116.5	45.6	- 70.9	Gap area brought under irrigation in Kharif
Cropping intensity	1.03	1.38	+ 0.35	Increased by 34%
Surface water productivity for Paddy (in kg/m ³) using tank water	0.211	0.294	+ 0.08	Increased water productivity due to efficient water delivery & improved farm practices for Kharif paddy: 39%
Groundwater productivity (in PGM tanks) for Kharif Paddy (kg/m ³)	NA	0.41	-	The groundwater productivity is relatively higher than surface water productivity due to minimal losses from water conveyance (i.e. higher water use efficiency).
Groundwater productivity (in PGM tanks) for Rabi paddy (kg/m ³)	-	0.495	-	

53. **Rehabilitation:** The project successfully introduced several structural interventions, including rehabilitation and modernization of tank structures, earthen dams, water distribution systems and on-farm development (OFD) works. These structural interventions have greatly helped in enhancing the integrity and durability of tank bunds/earthen dams; accurate measurements of discharge; ensuring the design flows reach tail ends of the canal and distribution systems; and promoting workmanship and construction quality of works. A total of 3,762 sluices and 2,280 cut throat flume (CTF)/calibrated scales were provided in 2,157 tanks.

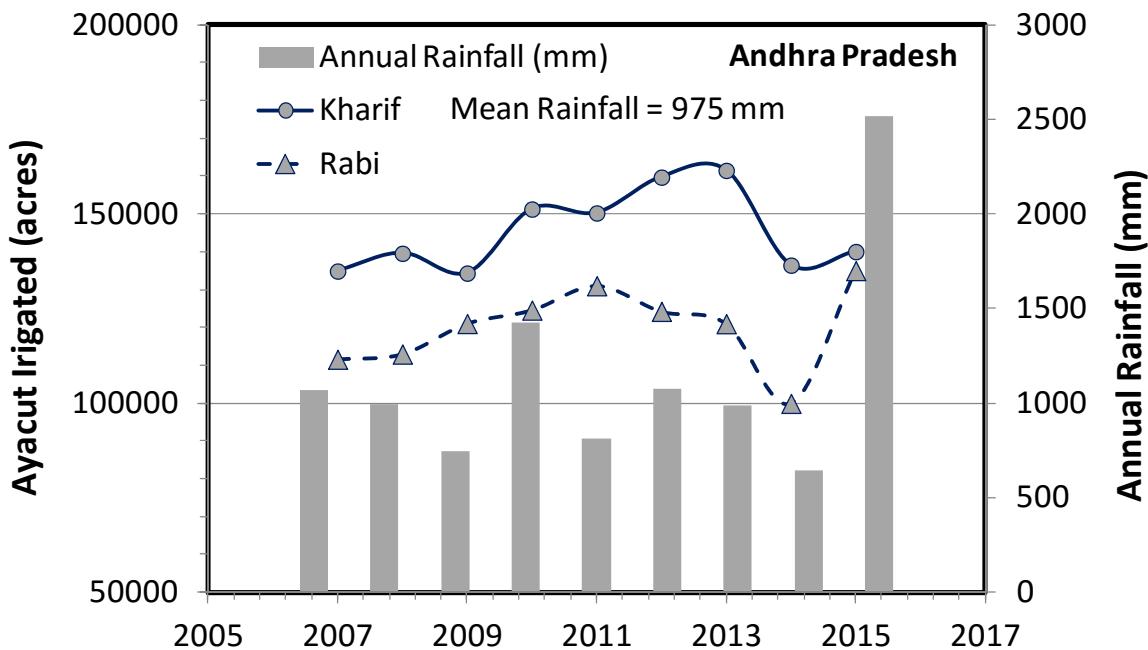


Fig. 1. Changes in irrigated areas for Kharif and Rabi seasons in the project tanks of Andhra Pradesh during 2007-2015.

54. The project focused on strengthening the quality management system by enhancing the in-house capability of project engineers on quality control and quality assurance aspects, which increased farmers' satisfaction as captured in the external M&E surveys. The condition of tank bunds and surplus weirs were reported to be 'satisfactory' in 96 per cent (10% at baseline) and 83 per cent (32% of control tanks) of the project tanks in respective states. Similarly, the condition of feeder channels and canal linings were reported to be 'satisfactory' in 92 per cent and 88 per cent of the project tanks respectively.

55. **Quality Management System:** A functional QMS was put in place to ensure that rehabilitation works conformed to good construction quality standards and technical specifications. Quality control testing of soils, materials, concrete, mortar, and associated inputs were accorded high importance to ensure that correct construction materials conforming to the relevant Indian Standards were used. In this context, a 3-tier system of conducting quality control tests on inputs and outputs was introduced. The department's quality control engineers and construction engineers conducted laboratory tests while a third party quality consultants conducted independent tests. In addition, to ensure that every activity was executed with full enforcement of relevant specifications, an O.K. Card system was introduced with the due involvement of WUAs in construction supervision. This intervention helped in promoting construction quality at every stage of work execution.

56. **Groundwater Recharge:** PGM was included as a sub-component in the project, recognizing that groundwater is an important element in tank irrigation systems, and its management is critical for sustainable benefits from tank improvement program. The Ground Water Departments (GWDs) of both states were key stakeholders, responsible for implementing

the PGM sub-component in 314 tanks (172 and 142 tanks in Telangana and AP respectively) with a tank command area of 25,000 ha.

57. Periodic measurement of groundwater levels and crop planning through pre-Rabi crop water budgeting workshops resulted in irrigation of 34 per cent of the tank command area of PGM tanks by groundwater during Kharif, and 22 per cent of the tank command area during Rabi. In contrast, the area irrigated in PGM tank command areas by surface water during Kharif and Rabi was 26 per cent and 15 per cent respectively. Overall, the area irrigated in Rabi season increased by 38 per cent, utilizing water in the reservoir after meeting Kharif crop requirements under normal rainfall conditions, primarily due to improvement in water use efficiency, promotion of less water intensive crops and crop diversification during Kharif. Groundwater productivity, i.e. crop output per unit of water recorded an increase of 39 per cent (from INR 59,920 per hectare-meter (ha-m) in MTR to INR 83,256 per ha-m at project closure).

58. The groundwater levels measured in a few selected tanks even before the project started indicated that tank rehabilitation had resulted in improved groundwater conditions in the tank ayacut. Figure 2 presents the case of a modernized tank in the Chittoor district of Andhra Pradesh. The groundwater levels in the ayacut of this tank have shown an increase post-2007 relative to the levels observed during 2002-07, despite lower rainfall during the project period. Figure 3 shows the improvement of groundwater levels in the ayacut in the case of another tank wherein the depth to groundwater table reduced by approximately 7.5 m and 8.6 m for pre- and post-monsoon seasons respectively from "without project (WOP)" to "with project (WP)" situation.

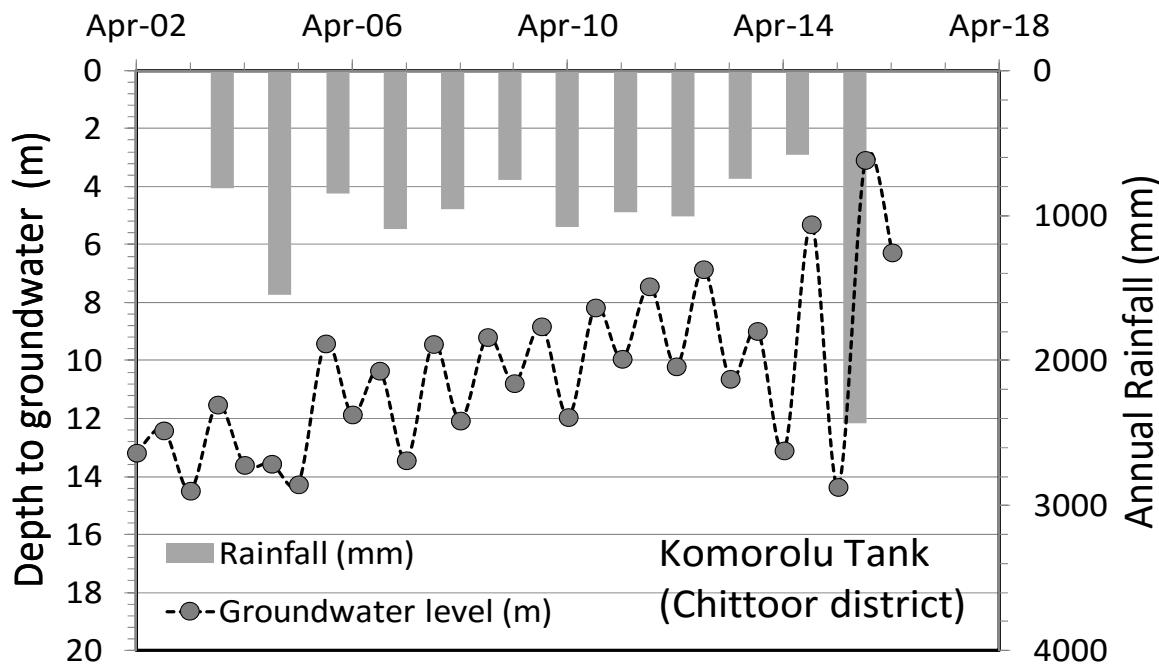


Fig. 2. Change in the groundwater levels in Komorolu tank during 2002-15

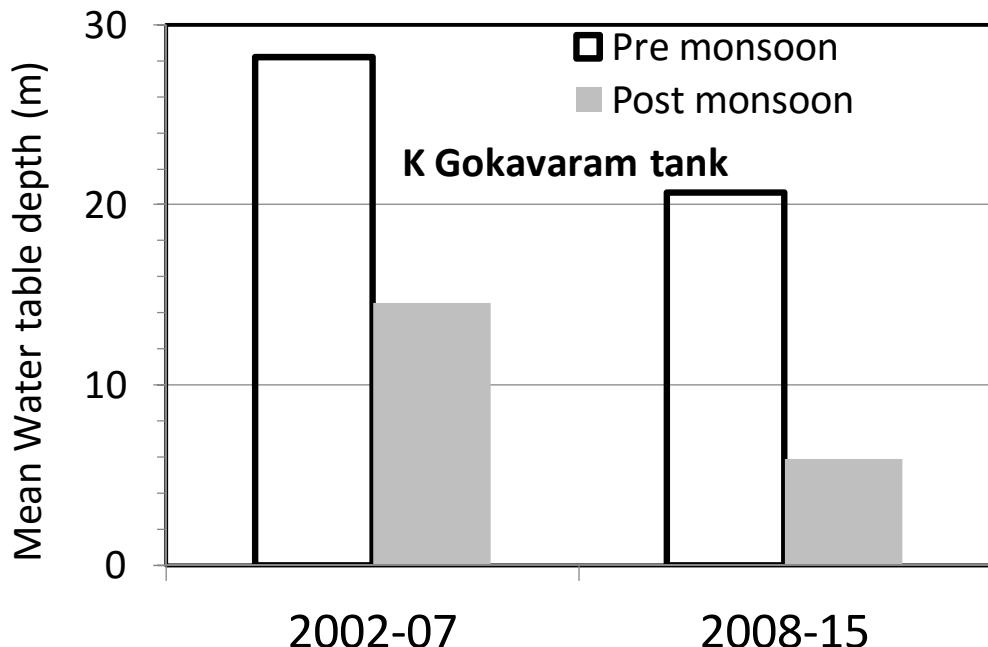


Fig. 3. Rise in pre- and post-monsoon groundwater levels at K Gokavaram tank in WP situation with reference to WOP situation.

59. **Increased Water Productivity:** The project resulted in increased crop productivity, 36.2 per cent in paddy, 72.26 per cent in maize, 112.5 per cent in groundnut, and 40 per cent in vegetables. These figures were much higher than the targeted 20 to 30 per cent. Extensive trainings, demonstrations, exposure visits, supply of implements to stakeholders, adoption of high yielding varieties, and improved techniques of integrated nutrient and pest management have contributed to the higher crop productivity than the PDO target. The water productivity of Kharif paddy in the rehabilitated tank systems due to improved water use efficiency and reduced conveyance losses from OFD works - increased by 39 per cent (from the baseline value of 0.211 kg/m³ to 0.294 kg/m³ at WP).

60. **Crop Choices:** There is encouraging evidence that PGM interventions have enabled farmers to shift to less water-intensive crops. For example, in the districts known to have been affected by severe consecutive droughts (Anantapur, Kurnool and Prakasam), the area under paddy in Rabi decreased significantly, by an average 85 per cent over a period of seven years (2009-10 to 2015-16). Over the same period, the area under high value crops that are not as water intensive (such as sunflower, tomato, green gram, ground nut, finger millet, sesame, maize and mulberry) increased by an average 42 per cent.

61. **Efficient Irrigation:** Groundwater users have adopted efficient irrigation techniques, including drip irrigation and alternate furrow irrigation. For example, 11 PGM tanks in Nalgonda district reported that 30 per cent of groundwater users adopted efficient irrigation techniques during 2014-15. Because of increased awareness on the available groundwater resources, PGM interventions have enabled borewell owners to share their groundwater resources with neighboring farmers, thereby reducing the demand for drilling additional borewells and sustaining the existing borewell yields.

62. **Livestock and Fisheries:** At the end of the project, milk productivity increased to 5.6 liters per day per cattle, which exceeded the target of 4.9 liters per day per cattle. At project design, there was a target of a 100 per cent increase in milk productivity but the final impact assessment reported a 128 per cent increase. On-farm training and demonstrations on improved nutrition through fodder production combined with need-based technical backup services contributed to achieving the project outcome indicator. Training and capacity development activities on improved feeding and harvesting techniques and fishery management practices demonstrated to the fishermen and fish farmers resulted in an increase in fish productivity of 324 per cent against a target of 300 per cent. Fish productivity increased to 5.3 quintal from a baseline value of 1.25 quintal per hectare of effective water spread (EWS) area. These results clearly indicate the add-on impact of integrating livestock and fisheries in decentralised tank rehabilitation projects.

*ii) Improving the management of tank systems with the assistance of selected WUAs:
Substantial*

63. The involvement of water user associations in the rehabilitation, operations and management (O&M) of tank systems was an innovative aspect of the project. The project allocated 5 per cent (about \$10 million) of the total project budget to contracting WUAs to undertake minor civil works with a value of up to Rs 500,000. The remaining works, for values generally greater than Rs 500,000, were entrusted to private contractors through a tendering process. As Table 2 shows, WUAs managed to execute 86 per cent of the budget allocated for civil works.

64. WUAs had to mobilize 5% cash contribution in order to develop their corpus fund but by project closure, they managed to mobilize only 2.5 per cent. Various World Bank missions emphasized that WUAs' 5% cash contribution was one way for WUAs to learn how to collect money in a timely manner. Moreover, the responsibility of WUAs for civil works helped build a sense of ownership over the tanks thus improving the prospects for O&M.

Table 2. Status of WUA Civil works approval vs. expenditure

	State	No. of tanks	Admin. Approval for WUA works (Rs. lakhs TBC)	Expenditure (Rs. lakhs TBC)	per cent Expenditure
1	Telangana	1182	7220.95	5965.72	82.62
2	Andhra Pradesh	975	5186.89	4705.63	90.72
		2157	12407.84	10671.35	86

Note: Expenditure is likely to increase as final bills are under process of payment

65. Upon completion of rehabilitation works, the first sets of tanks were handed over to the WUAs starting in August 2010. As of project closure, 1791 tanks were handed over to WUAs for operation and maintenance. Table 3 summarizes the main achievements of the project on the institutional component of the project.

Table 3. Indicators and Results for the Institutional Component

Project Outcome Indicators	Baseline (2008) %	End Project Target %	End-project value (end July 2016) %
PDO Indicators			
% of WUA in rehabilitated tank systems whose O&M expenditure is as per agreed annual O&M plans	0	80	97
% of water users in rehabilitated tank systems satisfied with WUA operation and maintenance	0	75	80.9
Intermediate indicators			
% of WUAs holding regular General Body meetings	0	80	95
% of WUAs maintaining appropriate cash books and water regulation registers	0	80	91
% of WUAs having co-opted members from GPs	0	90	100
% of annual assessed water charges collected	0	80	84
% of WUAs with fisheries receiving their share of lease income (from award of tank fishing rights)	0	90	90

66. A number of tools and mechanisms developed to help the WUAs to discharge their O&M responsibilities. A Tank Improvement Management Plan (TIMP) was developed to outline and monitor the civil works undertaken by the WUAs, as well as capacity building activities and record maintenance. Another crucial tool was the OK card, a novel document in irrigation projects in India. The OK card served as an inspection document for tank bunds, sluices, mechanical fixtures and other physical components of the rehabilitated tank systems. It was also a tool for self reporting on institutional and financial aspects and provided guidelines on emergencies. WUAs were responsible for filling out the OK cards and submitting theses to the project director. A training module on the maintenance of OK cards was developed and the results showed that WUAs were collecting OK cards data in all the tank command areas. There was also strong agreement (88 per cent) by WUA members that the OK cards made it easier for them to understand the status of the institutional and technical aspects the tank. The OK cards undoubtedly supported the WUAs' effective operations and maintenance of the tank systems.

67. The solid results on meetings and membership suggest that good administrative practices are now in place to enable the WUAs to manage tank operations in an organized and predictable way. In an ex-post evaluation of the impact of the project using a sample of 220 WUAs, there was significant progress on the conduct of General Body Meetings (an increase from 9 per cent to 93 per cent) and on the maintenance of appropriate cash books (an increase from 19 per cent to 87 per cent). Management Committee meetings were undertaken in 95 percent of selected project tanks.⁶ In addition, the co-option of fishermen and groundwater users expanded WUA

⁶ Source: Borrower's Completion Report

membership. Similarly, two Panchayat members from the Gram Panchayat (the local government) joined the management committee of the WUAs, thereby allowing the WUAs to establish stronger linkages to local government and to lobby for their interests, which is crucial for their long-term performance. However, women's overall representation in WUAs, at 14 per cent, was sub optimal. Moreover, women occupied only 16 per cent of seats on WUA Management Committees. The low representation is mainly due to land tenure laws, which stipulate that only landholders and tenants within established tank command areas can become WUA members.

3.3 Efficiency

Rating: Substantial

68. The Economic Internal Rate of Return (EIRR) in the ICR analysis is 27.5 percent with a NPV of Rs. 2.02 billion (US \$29.36 million) at a discount rate of 12 per cent. The EIRR is moderately higher than that resulting from the economic analysis at appraisal (23.6 percent). The Financial Internal Rate of Return is 21.0 percent with the NPV of Rs. 2.0 billion (US\$29.34 million). This is moderately higher than at the time of appraisal (18.2 percent).

69. Three factors contribute to the strong economic rate of return of the project. First, the project brought a higher percentage of registered command areas into full irrigation than originally planned for. An additional 63,740 hectares of the areas were brought to fully irrigated status. Second, additional water availability in both Kharif and Rabi seasons brought more crop diversification than planned for at appraisal by shifting to the non-paddy, higher value-added commodities such as maize and groundnuts. Finally, by adopting improved technologies such as hybrid seeds and better crop varieties, and techniques such as Integrated Pest Management (IPM) and Integrated Nutrient Management (INM), the crop productivities for the key crops were much higher than projected at appraisal. These factors offset the reduction in economic returns due to the delays in project implementation after state bifurcation.

70. Due to discontinuation of the livestock and foreshore plantation sub-components at MTR, the final total project cost was Rs.9.3 billion (US\$136.30 million) inclusive of contingencies, which was lower than the appraisal estimate of Rs. 10.4 billion (US\$152.53 million). Despite the lower project costs, the major benefits of the project were created. Therefore, the cost effectiveness was at least equal to the amounts planned.

71. Several sensitivity analyses were conducted to test the robustness of the project's incremental benefits against some unpredicted contingencies. An unexpected increase of 25 per cent in future recurring costs could maintain the ERR at 27.3 per cent. Similarly, an expected reduction of 25 per cent in incremental benefits of area expansion, diversification and technology adoption lowered the ERR levels to 18.7 per cent, 25.6 per cent and 24.3 per cent respectively.

3.4 Justification of Overall Outcome Rating

Rating: Satisfactory

72. The overall project outcome is rated Satisfactory based on the rating of 'High' for relevance of objectives, and the 'Substantial' ratings for the relevance of design and implementation, achievement of PDO and project efficiency.

3.5 Overarching Themes, Other Outcomes and Impacts

(a) Poverty Impacts, Gender Aspects, and Social Development

73. **Poverty Impacts:** While poverty reduction was not an explicit objective of the project, an assessment of various socio-economic parameters was conducted on sample households throughout the course of the project which provides an indication on the project impact on some proxies of poverty.

74. On asset possession, the results show an increase in farmer ownership of agricultural implements such as tractors, weeders, threshers and harvesters. Farmers at the head of the canal had the highest increase (12.39%) from the beginning of the project compared to tail-end farmers (5.18%), but this was expected given that head farmers tend to have more resources than middle or tail end farmers. Another indicator was household income, which is a proxy for the economic status of farmers and their capacity to undertake agricultural investments. The results indicate that net income increased at a rate of 0.36 per cent for tail, 0.41 per cent for middle and 0.48 per cent for head reach farmers. The increase in income accelerated towards the end of the project compared to the beginning.

75. The project certainly generated awareness about on-farm and off-farm income generating activities like petty business, poultry, fish-rearing and custom hiring centers. The increase in crop intensity also helped in increasing farmers' incomes. Lastly, because the project led to increased water availability for Kharif and Rabi crops, there was an increase in production and employment. The per cent change over baseline to the end project was 15.4 per cent compared to 12.4 per cent in control areas. The relatively small difference between project and control households in agricultural employment is because farmers had engaged in diversified employment generating activities, and not all of them are attributable to the project.

76. Taken together, the increase in agricultural assets, household income and employment suggest that there was an enabling environment for poverty reduction in project areas. While the benefits were not equally distributed among head reach, middle and tail end farmers, it is clear that the project activities did help all farmer groups to improve their baseline financial situation. Future interventions could focus on ensuring that tail-end farmers catch up with head reach farmers by allocating water more equitably.

77. **Gender Aspects:** The project did not specifically design a sub-component on gender empowerment but its activities, particularly capacity building, directly benefitted 84,675 female aayatdars (14%) in the project tanks. There was virtually equal participation (48%) of women in participatory groundwater groups. Gender Action Plans were developed and implemented in 379 WUAs in 18 districts of both states, and were used as the basis for implementing customized interventions for women's groups. A gender CIG training module was added in the sixth year of the project to respond to the capacity building needs of this group. Gender CIGs were created and these groups procured flour mills, generators and other implements for use in generating additional income through custom hiring. Through exposure visits, gender CIG members reported an 87 per cent improvement in their knowledge of different livelihood options, internal

savings, mutual trust, marketing and leadership. Women's CIGs also generated significant savings (Rs. 45 million) during the project.

78. Despite these positive gains, women's overall representation in WUAs, at 14 per cent, was sub-optimal. Moreover, women occupied only 16 per cent of seats on WUA Management Committees. The low representation is mainly due to land tenure laws, which stipulate that only landholders and tenants within established tank command areas can become WUA members. Despite the legal obstacle, the success of gender CIGs and the PGM activity suggests that women will continue to play a central role in important aspects of tank management, particularly livelihoods and agribusiness.

79. **Social Development:** SEMF included three social issues to be managed under the project: tribal development plans, gender action plans and resettlement action plans. While there was virtually no resettlement under this project, the tribal and gender components proved to be significant. Project tanks with 10 to 50 per cent of WUA members belonging to tribal communities were designated as tribal tanks. By project closure, there were 77 such tribal tanks, the majority in Telangana state. Tribal action plans were prepared and commodity interest groups formed in tribal tanks. Activities focused on providing agribusiness assets (oil engines, sprayers and ice boxes), promoting member savings, book keeping and income generation. Tribal ayacutdars were also trained in sustainable water management practices. As a result of these interventions, tribal CIGs achieved about INR 1.3 million in savings and boosted their earnings from agricultural activities.

80. In addition to supporting tribal and gender groups, the project provided INR 2.00 lakhs and the WUAs contributed INR 0.50 lakhs to the construction of permanent buildings and godowns (storage houses for agricultural produce). About 65 per cent of the targeted 55 godowns were completed in Telangana and 49 WUA office buildings out of 110 buildings (45 per cent) were constructed in Andhra Pradesh. The office buildings increased the participation of WUA members in meetings and provided a conducive environment for discussing and resolving tank-related issues. There is need for more construction to ensure that WUAs have an operational space in which to manage their affairs. In addition, social audit boards (SABs) were displayed at prominent parts of the tank area to inform community members on the status of rehabilitation works and the expenditure incurred.

(b) Institutional Change/Strengthening

81. Following the APFMIS 1997, 12,000 WUAs were established in Andhra Pradesh. The APCBTMP was the first project in which WUAs were made responsible for minor civil works in tank irrigation systems and for subsequent O&M functions. To help the WUAs undertake their functions, a set of 23 training modules were developed on topics ranging from community mobilization, financial management, crop planning to formation of commodity interest groups. About one million WUA members participated in trainings, exposure visits and demonstrations..

82. The training module on Demand Raising and Collection of Charges evoked an encouraging response, highlighting a need to reinforce farmers' knowledge and practices about tax collection to bridge the demand-collection gap. However, a training evaluation noted some knowledge gaps on the supervision of civil works, activities related to CIGs (formation, production, marketing and business plan preparation) and water use management through

cutthroat flumes. As for the adoption of the processes and new technologies introduced during project implementation, the results suggest that performance needs to be improved on grievance redressal, water management through cut throat flumes, works management, supervision of civil works, procurement of O&M assets, maintenance of the OK card and water use management.

83. With the end of the project, some of the existing support mechanisms for WUAs – the NSOs, paraworkers and external training agencies in particular - will be significantly scaled back or stopped altogether. CAD will take up the capacity building activities of the WUAs going forward, but may not be able to provide the same level of support to which the WUAs are accustomed. For instance, the department engineers were not able to fully provide technical support to the WUAs as they are busy with their regular departmental activities. DPUs will henceforth have to play a bigger role in the capacity building of WUAs and to address remaining capacity gaps.

(c) Other Unintended Outcomes and Impacts (positive or negative)

84. *Drought Resilience:* By design, the project did not consider implementation of climate change adaptation and mitigation measures, but has effectively promoted several good practices that have helped build climate resilience. Through participatory groundwater management in 314 tanks, the project promoted conjunctive water use in 46% of tank command areas, which contributed to improved management of groundwater resources (Figure 4). Further, WUAs and PGM groups were engaged in crop water budgeting, and made informed choices regarding crop selection and irrigation intensity, resulting in resource conservation and risk reduction to extreme weather events. Tank rehabilitation interventions in conjunction with demonstration of improved crop husbandry practices have provided supplemental irrigation during critical stages of crop growth.

85. *Food Security:* Crop production system intensification and diversification generated high yields and had a positive effect on food security. Furthermore, the project generated initially unintended but significant positive nutritional impacts on consumers through increased production of vegetables, milk and fish products.

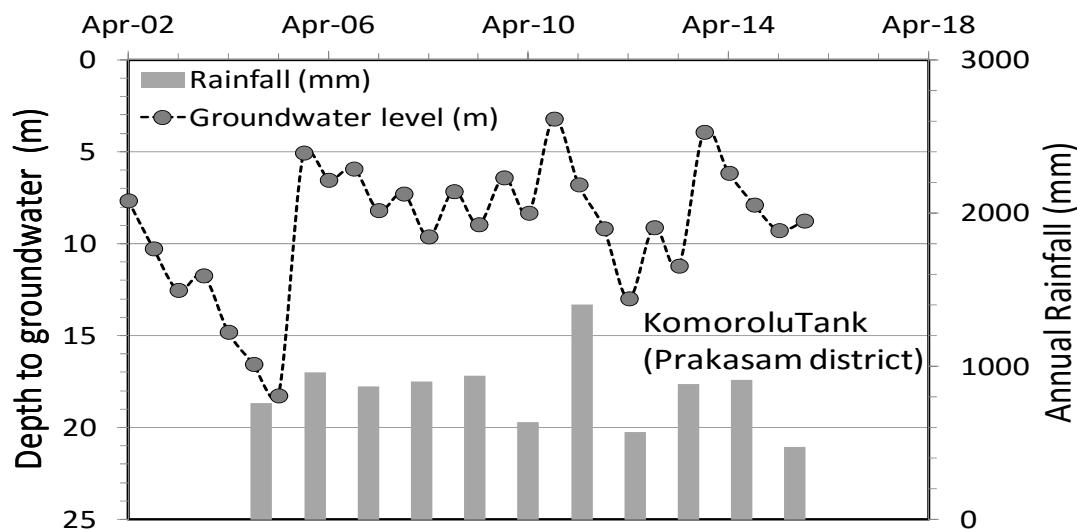


Fig. 4. Improved groundwater levels in Komorolu tank in Prakasam district during 2007-12 with-the-project buffering the drought impacts during 2012-13.

3.6 Summary of Findings of Beneficiary Survey and/or Stakeholder Workshops

86. The project at appraisal held extensive discussions with local communities and other stakeholders about the project and its likely impacts. The findings of these consultations were publicly disclosed, and shared with concerned institutions at all levels. During project implementation, stakeholders' consultations were directed to capture the outcomes and impacts of project components through beneficiary surveys.

87. **Tank System Improvements:** The project invested in improving 2,157 tank systems that benefitted a total of 609,331 ayacutdars through improved irrigation services. On an average, each tank covered 118 ha and benefitted 282 families directly. The post-project survey indicated that the completed tank improvement projects benefitted 293 families directly on an average, and an additional 301 families indirectly. Of these, an average of 266 families benefited directly from the construction of diversion weirs, while 266 benefited directly from reservoir construction. In addition, 103 families benefited indirectly from diversion weirs and 225 from reservoir construction, respectively. Substantial gains have accrued to families in the command area from labor employment in the construction activities.

88. **Institutional Strengthening:** A survey conducted to assess the satisfaction amongst water users with the level of water delivery service following tank system improvement revealed that 86% of respondents were satisfied with the level of services provided. This was attributable to strong leadership, cooperation among members, regular meetings, and WUA self-assessment during the course of project implementation. The fact that the WUAs accumulated Rs. 257.8 million at project closure, which is nearly 2.5 per cent of the total project cost, by way of membership fees, fisheries leases, the plough back fund and other contributions is a significant reflection on institutional strengthening by the project. Interviews indicated that for the WUAs to discharge their duties effectively, support of para-workers would need to be institutionalized alongside regular plough back of water tax collected to the WUAs.

4. Assessment of Risk to Development Outcome

Rating: **Moderate**

89. The risk to the sustainability of development outcomes is rated moderate. This rating takes into account three aspects: the sustainability of assets created by the project, the sustainability of institutions established or supported by the project, and financial sustainability. Only by ensuring sustainability of assets plus institutional and financial sustainability, can project benefits be sustained during the post-completion operation phase.

90. The sustainability of assets created by the project is secured through the appropriate construction method used, the ownership of farmers and water users association of the assets, and the operation and maintenance arrangements that have been put in place by the project. The assets financed by the project are simple in construction and easy to maintain. Users are familiar with the type of assets that have been built. No complex spare parts have to be transported from outside the project area.

91. The project set up durable institutions. The sustainability of institutions established and supported by the project is secured through the extensive capacity building that was carried out. The project significantly enhanced the capacity of MID. The institutional sustainability of the Water User Associations is assessed to be high. Water users have seen the benefit of functional WUAs, and it is likely that the water users and WUA members would continue to secure the functioning of WUAs. Andhra Pradesh and Telangana recognized and pioneered the role of WUAs in the country. It should be noted that bifurcation generated uncertainty over the legal framework of the WUAs, which has not yet been fully addressed. The training programs and monographs developed during the course of the project has helped capacitate both MID and WUA to internalizing knowledge. The project has helped to develop a symbiotic relationship between MID and WUA, with engineering saturation and social accountability emerging as a leitmotif for respective domain responsibility for comprehensive management of local resources for agriculture development.

92. WUAs have been innovative in combining various in-kind and financial resources to carry out operation and maintenance. The vast majority of WUAs maintains appropriate cash books, collect annual assessed water charges and tank fishing rights. These revenue streams are combined with continued State support, as is customary in India. The two State Governments intend to continue investing time and effort including allocation for minor repairs and maintenance support to WUAs.

5. Assessment of Bank and Borrower Performance

(a) Bank Performance in Ensuring Quality at Entry

Rating: **Satisfactory**

93. The World Bank team incorporated extensive national sector knowledge into the project design, and provided timely and quality support during project identification, preparation, and appraisal. The team at design reflected the lessons learned from previous projects in the design of the new project. For example, the successful experience of a World Bank-financed tank rehabilitation project in neighboring Karnataka (approved in 2002) was a reference point for the Andhra Pradesh project as the former emphasized the role of community-based institutions. Moreover, the World Bank employed a broad range of expertise at the design stage, which contributed to high quality appraisal documentation. Risks were properly identified and addressed in the project design, except for minor shortcomings regarding the risk of inadequate water charge collection and climate variability risks. The Bank team ensured that the project components were strongly aligned with the project objective. For instance, “Institutional Strengthening” directly helped WUAs to manage the tanks efficiently; “Minor Irrigation Systems Improvements” rehabilitated the tanks and thereby improved water use efficiency while “Agricultural Livelihoods Support Services” boosted agricultural productivity by focusing on various agricultural activities. The results framework was aligned to the PDO and the indicators were well defined.

(b) Quality of Supervision

Rating: **Satisfactory**

94. Throughout the project, the Bank maintained a productive relationship with the client, the state government of Andhra Pradesh, and after bifurcation, the state government of Telangana as well. The Bank team demonstrated significant candor when it downgraded the project's ratings to MU (in 2011) following delay in implementation and slow disbursement due to political turmoil leading to the state bifurcation. At the same time, the Bank proved to be a steady force during the bifurcation process and through its support to CADA, was able to turnaround the project's rating to MS (in 2012) following the resumption of project activities. The World Bank extended full support at the project re-structuring stage for the two PMUs to perform effectively. The deployment of experienced and technically capable World Bank specialists created substantial value for the client, and contributed to high quality of engineering work being undertaken, as well as fiduciary, procurement and safeguards policies being put into place.

(c) Justification of Rating for Overall Bank Performance

Rating: **Satisfactory**

95. Overall Bank performance is rated Satisfactory based on the Satisfactory ratings for ensuring quality at entry and supervision.

5.1 Borrower Performance

(a) Government Performance

Rating: **Satisfactory**

96. From the preparation stage of the project, the State Government of AP was a leader in decentralized water resources development at community/farm level. This vision was translated in the creation and strengthening of WUA, to not only take up O&M but to manage water distribution equitably as well. After bifurcation, the State Governments of AP and TS continued with this vision to transform MID and change the mindset of irrigation engineers towards a participatory irrigation approach. The Governments strongly supported project implementation towards this vision which helped to focus various stakeholders on obtaining project results.

97. Keeping the sustainability of the project in view, the project accorded a high priority to institutional strengthening. High level government officials at State and District level took a lead role in coordinating various agencies to cooperate in effectively implementing the project. At the state level, a Project Steering Committee (PSC) headed by the Chief Secretary was effective in coordinating the annual plans of the irrigation, agriculture, animal husbandry, fisheries and rural development departments. At the project level, a District Level Implementation Committee (DLIC) chaired by the District Collector was the main forum for field-level coordination of project activities. The constitution of the PMU was efficient and after state bifurcation, the institutional structure was replicated for the new state. Both State Governments provided sufficient autonomy to the PMUs on project implementation.

(b) Implementing Agency or Agencies Performance

Rating: **Moderately Satisfactory**

98. A PMU was created for the project at the start of the Project. Because of state bifurcation, the PMU was split in two with one PMU serving each of the two states during project

implementation. Overall, the PMUs carried out their duties in a timely and quality manner. Early in the project, it proved difficult to recruit appropriate staff and staff turnover continued during project implementation. Bifurcation created some delays in project implementation but the political uncertainty ultimately had limited bearing on the project progress. The project's MIS system continued to generate good data on the Results Framework and for Annual Action Plans. Integrated with Geographic-MIS, the system contributed to transparency, as various MIS reports including progress of project implementation, fund release, stakeholder details, and results of participatory assessments were regularly posted on the project website. The recruitment of a new external M&E agency after the initial agency's contract ended in February 2013 was lengthy which caused the Borrower to be out of compliance on the legal covenant to appoint as external M&E agency for next 20 months. The new agency completed the end project Social and Environmental Management Audit and ex-post project impact evaluation before project closure. The performance of the borrower with respect to dam safety was satisfactory. There were no serious lapses in compliance recorded in mission reports.

(c) Justification of Rating for Overall Borrower Performance

Rating: Moderately Satisfactory

99. The Borrower's overall performance is rated Moderately Satisfactory. This rating combines the Satisfactory rating for the Government, and the Moderately Satisfactory rating for the Implementing Agency performance. The Borrower delivered all results and proved adept at navigating the various obstacles it encountered during implementation. Some of these challenges were within its control, such as hiring an external M&E agency and deploying some of the sector specialists, and others were beyond its control, such as the bifurcation process. The Moderately Satisfactory rating takes into account project delays.

6. Lessons Learned

100. Tools and techniques for ensuring quality surveillance and efficacy always determine the sustainability of a project. APCBTMP developed innovative tools and approaches that contributed to project performance and led to unintended positive consequences emerging as an end result. Some of the lessons learned areas under:

101. ***Quality Control Efficacy:*** The project introduced specific tools such as O.K Card that not only allowed quality control by engineers but also by WUAs, use of non-nuclear density compaction meter at the district level helped assess and ensure quality of civil works, and introduction of water discharge/measuring devices ensured water reaching the tail-end. Together these tools/techniques transformed quality control at the community level, inculcating ownership of the community in mainstreaming participatory irrigation management.

102. ***Assessing Water Productivity and Efficiency:*** Even though the main goal was to create and promote overall water efficiency in the tank system, doing so required an assessment of water productivity and water use efficiency in farm plots and water conveyance infrastructure. Water productivity at various locations of the tank system have to be assessed in order to choose the best choice of water saving methods and technologies in addition to the right infrastructure options (canal or pipe options) for tank modernization. Accurate measurement of water flows in

the distribution system can be better measured by bringing automation (sensors and ICT tools) at the farm level.

103. **Tank Impact on Groundwater:** The rehabilitation of tank systems and modernization of OFD works have shown a significant impact on crop productivity and crop diversification. However, critical information is lacking regarding the amount of water saved by the groundwater system related to the tank ayacut, which are critical for assessing the surface and groundwater productivity of various crops in the ayacut. This would require groundwater monitoring and budgeting into the mainstream of TIMP.

104. **Use of Remote Sensing:** M&E in the project relied heavily on field surveys in a selected sample, as per the design of the project. Although advanced and robust remote sensing tools are available for retrieving and tracking the crop and water variables with a good spatial resolution in the tank ayacut, and good temporal frequency during the entire project period, the project did not use such approaches to fill the information gap from field surveys or to compliment the output indicators. Not only is such complimentary data extremely useful in monitoring the performance of the modernized tanks systems, it is valuable beyond the project period as well, and is therefore highly recommended.

105. **Better Agribusiness Design:** Diversification was a crucial part of the project where cultivating non-paddy crops were encouraged. While the project realized overall net economic benefits from diversification, there were cases where the market opportunities remained limited despite farmers' allocating more areas under non-paddy crops. The project could have been more effective if a careful marketing analysis that identified market opportunities, developed product strategies, pricing, distribution channels, and promotional methods had been conducted during the course of implementation. Diversification itself does not always lead to an increase of net economic benefits, unless it is complemented with well-designed marketing strategies and value chain analysis.

106. **Institution Building for Participatory Irrigation:** Normal perception in India on WUA or similar institutions is that these organizations will undertake 100% O&M. This seems ambitious in light of the overall failure of WUA in the country. However, the project engaged WUAs in extensive training and capacity building to provide strategic support and partnership with MID to create substantial impact in improving the efficiency of the project. This led to a robust mechanism of social auditing and accountability at the community level.

107. **Focused WUA Responsibilities:** WUAs performed well on some issues, but to expect them to address a wide array of responsibilities is unrealistic. WUAs not only had to manage themselves in an organizational sense, but also had to carry out some minor civil works as well as O&M of rehabilitated tanks. The results show that WUA performance was much stronger on administrative matters than on the financial and technical aspects. Moving forward, it will be important to simplify the responsibilities of the WUAs so that they focus primarily on water distribution and agricultural activities. There should also be a more stable and predictable flow of funds to WUAs, with assured governmental assistance in extreme weather events.

7. Comments on Issues Raised by Borrower/Implementing Agencies/Partners

(a) Borrower/implementing agencies

108. Annex 7 provides combined comments on the implementation and progress of components by the project (PMUs of Andhra Pradesh & Telangana). In general, the government(s) is satisfied with the results of the project. The importance of tank system rehabilitation and improvement in meeting the project development objective has been highlighted.

109. The Principal Secretaries of both AP and Telangana Governments appreciate the support provided by the Bank's supervision team, and the GoAP seeks continued engagement with the World Bank through a follow up project.

(b) Co-financiers

Not Applicable

(c) Other partners and stakeholders

Not Applicable

Annex 1. Project Costs and Financing

(a) Project Cost by Component (in USD Million equivalent)

Components	Appraisal Estimate (USD millions)	Revised Estimate at Restructuring (USD millions)	Actual (USD millions)	Percentage of Appraisal
A. Institutional Strengthening	16.42	15.29	12.85	78.24
B. Minor Irrigation Systems Improvement	150.59	140.22	144.46	95.93
C. Agricultural Livelihoods Support Services	25.17	23.44	10.70	42.50
D. Project Management	12.54	11.68	7.76	61.88
Total Baseline Cost	204.71	190.61	175.77	
Physical Contingencies	3.59	3.34	-	-
Price Contingencies	9.50	8.85	-	-
Total Project Costs	217.80	202.80	175.77	80.70
Front-end fee PPF	-	-	-	-
Front-end fee IBRD (financed from the Loan)	0.24	0.24	0.24	-
Total Financing Required	217.80	202.80	175.77	

(b) Financing

Source of Funds	Appraisal Estimate (USD millions)	Revised Estimate at Restructuring (USD millions)	Actual (USD millions)	Percentage of Appraisal
Borrower	28.80	28.80	17.58	61.04
International Bank for Reconstruction and Development (IBRD)	94.50	87.00	71.59	75.76
International Development Association (IDA)	94.50	87.00	86.60	91.64
Total	217.80	202.80	175.77	80.70

Annex 2. Outputs by Component

Component A. Institutional Strengthening

This component was designed to enable community-based institutions – WUAs, FCS, and CIGs (formerly defined as Farmer Interest Groups) – to have autonomous administrative, financial and operational responsibilities for tank management and improvement of agricultural livelihood through various mechanisms of strong regulatory framework, capacity building assistance, establishment of a dialogue platform, and benefit sharing mechanisms. The following seven outcome indicators were identified in the PAD for measuring the achievement. Two of them are PDO outcome indicators, and the others are intermediate outcome indicators.

PDO Outcome Indicators:

- Per cent of WUAs in rehabilitated tank systems whose O&M expenditure is as per agreed annual O&M plans
- Per cent of water users in rehabilitated tank systems satisfied with WUA operations and maintenance

Intermediate Outcome Indicators:

- Per cent of WUAs holding regular general body meetings
- Per cent of WUAs maintaining appropriate cash books
- Per cent of WUAs having co-opted members
- Per cent of annual assessed water charges collected
- Per cent of WUAs with fisheries receiving their share of lease income (from award of tank fishing rights)

WUA Performance: The self-rating of 1,182 tanks was conducted. The rating was based on three criteria including participation, dialogue, and innovation; performance; and self-management. 72 per cent of the WUAs rated themselves as above A, and 4 per cent of them rated themselves C. The third party evaluation was similar to these ratings. At the end of the project, 80.9 per cent of the water users were satisfied with WUA operations and maintenance, which exceeded the target of 76 per cent. Similarly, the percentage of WUAs in rehabilitated tank systems that have O&M plans and expenditures reached 100, exceeding the target of 80. The project met all the targets of the PDO outcome indicators.

Table 1. PDO Outcome Level Indicators on WUA Tank Management

Project Outcome Indicators	Baseline	Mid-Term	Impact Assessment (Final)	Target
% of WUAs in rehabilitated tank systems whose O&M expenditure is as per agreed annual O&M plans	3	N.A.	97	80

% of water users in rehabilitated tank systems satisfied with WUA operations and maintenance	0	N.A.	81	76
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WUA Structure: In 1997, Andhra Pradesh adopted state-wide participatory irrigation management under the APFMIS Act. Under this act, WUA management committee was elected. In 2007, the Act was amended due to political reasons. Under the new amendment, WUA members were nominated by villagers with a term of six years and a third of the members retire at the end two years. The new amendment also emphasized the sustainability, inclusiveness and empowerment of WUAs by opening the membership not only to the landholding farmers but also to the traditional water users such as fishermen. The state bifurcation disrupted this process. Telangana, the newly created state after bifurcation, had to adopt a similar legislation as APFMIS in Andhra Pradesh. Despite the absence of a formal legal framework for nominating WUA members in Telangana, the bifurcation process did not adversely affect the administrative functions of WUAs. At the baseline survey, only 4 per cent of the WUA had co-opted members. However, all the WUAs (100%) had made membership more inclusive by the end of the project.

WUA Management: Under the APFMIS Act, each WUA is required to keep a record of all financial transactions, and these records need to be transparent and shared among the WUA members so that effective functioning of the WUA can be achieved and maintained. Under this project, WUAs have established good record keeping practices. 91 per cent of the WUAs maintained the appropriate cash books, which exceeded the target by 11 per cent. The bookkeeping practices increased dramatically from the baseline where only 19 per cent of the WUAs kept cash books. Under the Act, each WUA is also required to conduct regular management committee meeting at least once a month. Almost all WUA management committees were in place in Andhra Pradesh, and 95 per cent of the WUAs regularly held regular general body meetings, which exceeded the target of 80 per cent.

In the context of WUA institutional performance improvement, the project met all the targets of intermediate outcome indicators. The KPIs are shown in table below.

Table 2. Intermediate Outcome Indicators on WUA institutional performance

Project Outcome Indicators	Baseline	Mid-Term	Impact Assessment (Final)	Target
% of WUAs conducting general body meetings	9	80	95	80\
% of WUAs maintaining appropriate cash books	19	94	91	80
% of WUAs having co-opted members from general public	4	72	100	90

WUA Financial Performance and Management: According to the APFMIS, 90 per cent of the water use tax is supposed to be plowed back to the WUAs and used for the operation and maintenance of the water tanks; therefore, maintaining a good performance is crucial for the

sustainability of the WUAs and the water tanks. Even though the water tax collection is still a challenge, the project managed to reach the water collection rate of 84 per cent, which exceeded the target of 80 per cent of the total assessed water charge collected. The long process from tax collection to the actual procurement at WUAs leads to the uncertainty of receiving funds on a regular basis, which could be detrimental to the sustainability of the WUAs. Similarly, another important fund to WUAs is the ability to retain 50 per cent of the lease income from FCSs. At the end of the project, 90 per cent of the WUAs received lease income from fishery activities. Even though the length of time from the tax collection to plow back of funds to the WUAs is not part of the intermediate outcome indicator, this could be a very important factor for sustaining financial performance of the WUAs.

Table 3. Intermediate Outcome Indicators on WUA financial performance

Project Outcome Indicators	Baseline	Mid-Term	Impact Assessment (Final)	Target
% of total current year assessed water charge collected	0	50	84	80
% of WUAs with fisheries receiving share of lease income from tank fishery	0	55	90	90

WUA Capacity Building: Capacity building of Irrigation Department and WUAs, and making these entities self-reliant in managing the tank system effectively is the pivotal element of this component. Under the project, 22 training modules were developed. The modules were comprehensive covering operational, financial, administrative, and social aspects of WUA management. More than one million WUA members were trained. The Nodal Support Organizations (NSOs) played crucial roles in building capacity of the WUAs. About 270 NSOs were engaged in the WUA capacity building activities. Topics covered ranged from water release schedule planning and O&M plans and budgeting to book keeping, water tax collection and how to include tail-end water users into the system.

Component B. Minor Irrigation Systems Improvements

This component aimed to enhance the efficiency of water use and productivity enhancement through WUAs. The component consists of two sub-components: Tank Systems Improvement and Participatory Groundwater Management.

Sub-Component B1: Tank Systems Improvements

This sub-component was designed to improve physical and operational performance of selected tank systems, secure the safety of the tank structure, and improve water management and water use efficiency. The following three outcome indicators were identified in the PAD for measuring its achievement.

Intermediate Outcome Indicators:

- Per cent of area fully irrigated (under normal rainfall conditions)
- Per cent of middle- and tail-end farmers reporting improved water availability
- Per cent of increase in value of crop output per unit of water in command area of rehabilitated tanks

This component supported the physical rehabilitation and modernization of tanks in the category of minor irrigation in the command area of between 40 – 2,000 hectares across 21 districts of the states. The project rehabilitated 2,157 minor irrigation tanks with a total area of 254,957 hectares.

Based on consultation with each WUA, the actual physical works required for this project were determined, and each WUA prepared the Tank Improvement and Management Plan (TIMP). The actual physical works covered seven categories including feeder channel improvement, tank bed desiltation, repair or strengthening of tank bunds, repair or replacement of sluices, construction or repair of distribution and drainage systems, and installation of water measuring devices.

The project received varied support for the tank system improvements. In order to keep the works of rehabilitation and modernization of tanks at a higher quality standard, engineering consultants were employed in each district. These consultants were involved in all stages of the rehabilitation work from identifying the deficiencies to completion. Contractual staff was also hired in each District Project Unit (DPU), operating in the technical unit under the supervision of the executive engineers. External consultants for quality control and assurance were also an essential part of this component. Each district procured quality control equipment as a part of quality control and assurance.

Water Productivity: Water productivity was measured to estimate the value of crop output relative to the volume of water depleted. Over the project period, water productivity in the tank areas improved significantly. As per the final impact assessment at the end of the project, water productivity increased to Rs. 39,606 per hectare meter, which was a 38 per cent increase compared with the base figure (Rs. 28,708 per hectare meter). This increase reflects the improvement of water use efficiency.

With regard to the irrigation efficiency, the improvement of tank systems resulted in a 28 per cent increase in the tank command area irrigated. At the end of the project, 82 per cent of the tank command areas was irrigated, which exceeded the target of 75 per cent. The additional area of 63,739 hectares was irrigated as a result of the project.

The final impact assessment indicated that 80 per cent of the farmers having land in the middle and tail end of the tank reported that the water availability increased during the course of the project, which exceeded the target of 75 per cent.

Table 4. Intermediate Outcome Indicators on tank systems improvements.

Project Outcome Indicators	Baseline	Mid-Term	Impact Assessment (Final)	Target
% of increase in value of crop output per unit of water in command area of rehabilitated tanks	Rs. 28,708 /ha m	Rs. 34, 566 /ha m	Rs. 39,606/ha m (38 % increase)	25
% of area fully irrigated under "normal" rainfall conditions	54	68.70	82	75
% of middle- and tail-end farmers reporting improved water availability	0	44.50	80	75

Quality Management System: A total of more than 5,000 quality control tests were conducted by third party external consultants. The tests were performed on soil, building materials, concrete, mortar, and associated inputs to ensure that the correct construction materials and conditions conformed to the national standards.

Post-Project Sustainability: All the tanks rehabilitated in the project now have Tank Improvement Management Plans (TIMPs), and more than 80 per cent of TIMPs were handed over to the WUAs for the future maintenance. The Illustrated Rectification Guideline and Maintenance OK Cards were introduced to WUAs for undertaking the rectification measures when necessary. These guidelines demonstrate the methods for tackling various deficiencies and situations, including subsidence/settlement, leakages, cracking, piping, and breaching. Training and orientations were provided to the selected WUAs.

The improvements in the tank rehabilitation were mainly on feeder channels, tank bund, sluices, canal lining, and surplus weir. At the end of the project, the conditions of feeder channels and tank bund were satisfactory to 92 per cent and 96 per cent of the beneficiaries, respectively. Similarly, a large percentage of the tank users reported 'satisfactory' to the conditions of sluices, canal lining, and surplus weir with the satisfactory levels of 88 per cent, 88 per cent, and 83 per cent respectively.

Sub-Component B2: Participatory Groundwater Management (PGM)

This sub-component aimed to enable groundwater users in the tank command areas to reduce groundwater stress and improve the sustainability of management of groundwater resources. This was to be achieved by (1) creating groundwater user groups, (2) participatory hydrological monitoring by the user groups, (3) adoption of devices including piezometers and automatic water level recorders for groundwater level assessment, (4) use of water distribution pipes, (5) training for water budgeting, water use planning, and on-farm water management, and (6) upgrading the analytical capacity in the state groundwater department.

The following outcome indicator was identified in the PAD for measuring its achievement.

Intermediate Outcome Indicator:

- Per cent of increase in value of crop output per unit of groundwater for ground water user groups

The Participatory Groundwater management (PGM) was implemented in 314 tanks (172 tanks in Telangana and 142 tanks in Andhra Pradesh) in 13 districts. A total of 2,260 groundwater user groups (36,467 members) with a tank command area of 25,000 hectares were formed.

Capacity building activities were a crucial part of this sub-component, and training modules were developed for the Groundwater Department (GWD) and groundwater users (including the farmers). The farmers (total of 9,337 farmers) from 92 per cent of the rehabilitated tanks received training on Participatory Hydrological Monitoring (PHM). Groundwater users from 75 per cent of the tanks participated in the Crop Water Budgeting (CWB) workshops. The capacity building for better crop planning and water utilization through water budgeting, influenced the farmers to shift to less water intensive crops.

The final Impact Assessment reported that the water productivity, which was calculated as crop outputs per unit of water from groundwater irrigation, increased by 38.9 per cent at Rs. 83,256 per ha meter. The final result exceeded the changed target of 10 per cent, which also exceeded the original target of 25 per cent.

Table 5. Intermediate Outcome Indicators on groundwater management

Project Outcome Indicators	Baseline	Mid-Term	Impact Assessment (Final)	Target
% of increase in value of crop output per unit of groundwater for groundwater user groups	Rs 59,920 per ha m	Rs 59,920 per ha m	Rs 83,256 per ha m	10% (after change) 25% (before change)

Component C. Agricultural Livelihoods Support Services

This component aimed to enhance the livelihoods of farmers in the rehabilitated tank areas by increasing production, productivity, and profitability of agriculture, fisheries, livestock, and other activities by adopting improved production technologies, better input and output market linkages, and receiving more effective support services. This component consisted of five sub-components, namely, improvement of livelihoods through (1) agriculture and horticulture, (2) livestock, (3) fisheries, (4) foreshore plantation, and (5) agri-business and marketing.

Sub-Component C1: Agriculture and Horticulture

This sub-component was designed to improve production and productivity as well as the diversification (into non-paddy crops) of agriculture and horticulture commodities by upgrading

technology and production practices, and training and capacity building of farmer groups. Two PAD outcome indicators and three intermediate outcome indicators are relevant to this sub-component.

PDO Outcome Indicators:

- Per cent of increase in crop productivity (4 agricultural and horticulture commodities)
 - Paddy
 - Maize
 - Groundnut
 - Vegetables
- Per cent of increase in cropping intensity

Intermediate Outcome Indicators:

- Per cent of farmers in tank command areas adopting improved production techniques
- Per cent of paddy areas under System of Rice Intensification (SRI) paddy cultivation in rehabilitated tanks
- Per cent of increase in tank command areas under non-paddy crops

Crop Productivity: The project specifically focused on the productivity growth of four key agriculture commodities predominantly grown in the project area: paddy, maize, groundnut, and vegetables. The final impact assessment showed that the project contributed to an increase in yields for all four commodities. Rice paddy productivity increased by 36.3 per cent from 44.3 quintal per hectare to 60.4 quintal per hectare, which exceeded the target of a 25 per cent increase. Similarly, the productivity of maize increased relatively more than paddy with an increase of 72.3 per cent compared with the baseline figure, which also exceeded by far the target of 30 per cent. During the course of the project, the productivity for groundnut and vegetables, such as tomatoes, also increased significantly. The groundnuts productivity increased by 112.5 per cent relative to the baseline figure, which was significantly higher than the project target of 25 per cent. The yield for tomatoes improved by 40 per cent by the end of the project implementation, which was 15 per cent higher than the target.

Crop Intensity: The shift to the short duration and low water requiring crops in conjunction with rehabilitation of tank systems contributed to the increase in cropping intensity. The final impact assessment reported that the cropping intensity at the end of the project increased by 33.4 per cent from 103.3 per cent at the baseline to 137.8 per cent. The conjunctive use of surface and ground water for irrigation helped farmers to grow maize, groundnut, tomatoes, chilies, and other vegetables as a second crop. The project aimed to increase the cropping intensity by 15 per cent, but the project actually resulted in an increase of more than double that figure.

Crop Production Technology: The project enabled farmers to adopt improved cultivation practices including, efficient methods of irrigation, adoption of improved crop seed varieties, adoption of soil test based fertilizer application methods, adoption of Integrated Nutrient

Management (INM) and Integrated Pest Management (IPM) practices. The project also promoted the use of micro irrigation technologies and water saving practices, including sprinkler, drip irrigation, alternate wetting and drying, and ridge and furrow methods of irrigation. At the end of the project, the per centage of farmers who adopted the improved cultivation practices increased by 33.4 per cent, which exceeded the original target of 20 per cent; however, the result was below the revised target of 44 per cent.

Crop Diversity: Despite a decrease in the area cultivated for paddy, the project managed to raise the productivity of rice production. However, system of rice intensification (SRI) did not contribute much to the improvement of productivity. The project could not achieve SRI target. In fact, the area under SRI at the end of the project (0.88%) was smaller than the baseline figure (1.2 %), and the result was much lower than the target of 10 per cent. On the other hand, the change in cropping systems during project implementation brought about crop diversification in the tank command areas. As the project progressed, the area for paddy cultivation gradually decreased both in Kharif and Rabi season. The project area was predominantly covered by paddy with 85.5 per cent of the selected tank areas at the baseline. By the end of the project, the share was reduced to 74.6 per cent, and the cultivation area increased for other crops. This meant that about 25 per cent of the command area was under non-paddy crops, which was below the target of 34 per cent. Therefore, even though crop diversification was taking place in the command tank areas the share was still less than expected.

Table 6. Intermediate Outcome Indicators on agriculture and horticulture.

Project Outcome Indicators	Baseline	Mid-Term	Impact Assessment (Final)	Target
% of increase in crop productivity (4 agricultural and horticulture commodities)				
Paddy	44.37 Quintal/ha	N/A	60.42 Quintal/ha (36.2%)	25%
Maize	32.8 Quintal/ha	38.78 Quintal/ha	56.5 Quintal/ha (72.26%)	30%
Groundnuts	8.8 Quintal/ha	13.08 Quintal/ha	18.7 Quintal/ha (112.5%)	25%
Vegetables	280 Quintal/ha	301.2 Quintal/ha	392 Quintal/ha (40%)	25%
% of increase in cropping intensity	103.30%	110.60%	137.8% (33.4%)	15%
% of farmers in tank command areas adopting improved production techniques	24%	34.30%	57.40%	20% (original) 44% (after revision)
% of paddy areas under System of Rice Intensification (SRI) paddy cultivation in rehabilitated tanks	1.20%	4%	0.76%	10%
% of increase in tank command areas under non-paddy crops	17%	20.50%	30.26%	100% (original) 34% (after revision)

Capacity Development: Crop productivity, cropping intensity, and crop diversification were largely attributed to the variety of capacity development programs introduced in the project. During 2013-2014, 1,934 agriculture and horticulture cultivation demonstrations were conducted. Similarly, about 600 demonstrations took place in the 2014-2015 season. A total of 7,343 crop technology demonstrations were organized during the project implementation period. A total of 223 shade net nurseries and 3,029 vermi-compost units were set up. A total of 42,000 farmers were trained under this project. A total of 4,349 tank level Kisan Melas (Farmer Fairs) and 12,015 farmer exposure visits were organized. The supply of farm implements such as power tillers, rotavators, seed-cum-fertilizer drills, and multi-crop threshers reached 1,346 WUAs.

Sub-Component C2: Livestock

This sub-component was originally designed to increase the production and productivity of milk, meat and related animal products. Even though this sub-component was discontinued at MTR, the project retained one PDO outcome indicator.

PDO Outcome Indicator: Per cent of increase in milk productivity

On-farm training and demonstrations on improved nutrition through fodder development and production combined with need-based technical backup services contributed to meeting the project outcome indicator. The final impact assessment reported that the milk productivity increased up to 5.6 liters per day per cattle, which exceeded the target of 4.9 liters per day per cattle.

Table 7. Intermediate Outcome Indicator on Milk Production

Project Outcome Indicators	Baseline	Mid-Term	Impact Assessment (Final)	Target
% of increase in milk productivity	2.45 liters/day/cattle	3.27 liters/day/cattle	5.6 liters/day/cattle	4.9 liters/day/cattle

Sub-Component C3: Fisheries

Improving production and productivity of fisheries in the tank command areas was the main focus of this sub-component. The activities included (1) upgrading production practices through improved stocking; (2) improving feeding and harvesting techniques through better overall management; (3) organizing demonstration tanks where intensive fish and prawn cultivation were tried; (4) training, capacity development, and exposure visits of Fishery Cooperative Societies (FCSs). One PDO outcome indicator and one intermediate outcome indicator were relevant to this sub-component.

PDO Outcome Indicator: Per cent of increase in fish productivity

Intermediate Outcome Indicator: Per cent of tank fishing communities in project tanks adopting improved production and harvesting techniques.

With regard to the fish productivity, the final impact assessment reported an increase of 324 per cent, which exceeded the target of 300 per cent. At the baseline, fish productivity was 1.25 quintal per hectare of Effective Water Spread (EWS) area, and it increased to 5.3 quintal per hectare at the end of the project implementation in EWS area of 42,859 hectares in 1,146 tanks. The average income per hectare derived at constant prices of per quintal output and cost of production increased from Rs.3,225 at baseline to Rs. 13,674. It is noteworthy that by the end of the project implementation, 100 per cent of the tank fishing communities adopted improved fish production and harvesting techniques, which exceeded the target of 80 per cent adoption rate.

Table 8. Intermediate Outcome Indicator on Fishery

Project Outcome Indicators	Baseline	Mid-Term	Impact Assessment (Final)	Target
PDO Outcome Indicator				
% of increase in fish productivity	1.25 quintal per hectare	2.27 quintal per hectare	5.3 quintal per hectare (324% increase)	5 quintal per hectare (300% increase)
Intermediate Outcome Indicator				
% of tank fishing communities in project tanks adopting improved production and harvesting techniques	12%	100%	100%	80%

The productivity increase is attributed to training and capacity development activities on improved feeding and harvesting techniques and fishery management practices provided to the fishermen and fish farmers. The project generated employment for 99,956 fishermen who were landless and belonged to weaker sections of society. A total of 1,126 Fisheries Cooperative Societies were organized for the fishermen. In addition, rehabilitated tanks increased the water availability for longer periods. Repair of feeder channels, strengthening of tank bunds, reducing leakage from sluices, and construction of surplus weir all contributed to an increase of water availability.

Sub-Component C4: Foreshore Plantation

This was a very small sub-component and was discontinued at MTR, and there are no relevant outcome indicators for this sub-component.

Sub-Component C5: Agri-Business and Marketing

This sub-component aimed to increase profitability, promote crop diversification, and expand market opportunities through: (1) promoting agribusiness; (2) promoting greater market awareness; (3) strengthening producer linkages with input and output markets; (4) promoting post-harvest management of perishable products; and (5) expanding the capacities of the farmers through training and participation in the exposure visits. Three intermediate outcome indicators were relevant to this sub-component:

Intermediate Outcome Indicators:

- Per cent of increase in share of final sale value obtained by farmer marketing groups in targeted commodities, namely paddy, maize, and groundnuts
- Number of functioning farmer marketing groups established
- Number of formal/contractual marketing agreements reached by Farmer Interest Groups (FIGs)/Commodity Interest Groups (CIGs)

A total of 1,406 CIGs were formed during the project implementation, and a total of 22,154 members were part of the CIGs at the end of the project. Out of the total CIGs, notably 378 CIGs were women's CIGs, and 77 groups were tribal farmers. Even though a large number of CIGs were formed, the project could not reach the target of forming 1,500 CIGs. In the project, CIGs were provided training on business plan development, production and marketing, packing, storage, drying and post-harvest management, and book keeping. As a result, 903 agribusiness plans by CIGs were approved, and 669 groups implemented their business plans. Some CIGs that were specializing in vegetables had contracts for supplying fresh vegetables directly to large retailers, including Reliance, Heritage, and Spencer. A total of 97 formal contractual marketing agreements were reached by CIGs, although the number of contracts was slightly less than the target of 100 contracts. Many of the CIGs managed to increase their share of final sale value in selected leading commodities. The final sale value of paddy increased by 9 per cent from 63 per cent at the baseline to 72 per cent at the end of the project implementation; however, it was slightly lower than the target of a 10 per cent increase. Similarly, the groundnut CIGs were able to increase the sales value up to 94 per cent, which was an 8 per cent increase from the baseline, it was again slightly less than the 10 per cent target. On the other hand, the maize CIGs were successful in exceeding the target of 10 per cent increase in sales value. The sale value of maize in fact increased from 63 per cent at the baseline to 80 per cent at the end of the project, and a 17 per cent increase was realized.

Table 9. Intermediate Outcome Indicators on agribusiness market linkages.

Project Outcome Indicators	Baseline	Mid-Term	Impact Assessment (Final)	Target
% of increase in share of final sale value obtained by farmer marketing groups in targeted commodities, namely paddy, maize, and groundnuts				
Paddy	63%	N/A	72% (9% increase)	10% increase
Maize	63%	N/A	80% (17% increase)	10% increase
Groundnuts	86%	N/A	94% (8% increase)	10% increase
Number of functioning farmer marketing groups established	0	1,000	1,406	1,500
Number of formal/contractual marketing agreements reached by Farmer Interest Groups (FIGs)/Commodity Interest Groups (CIGs)	0	40	97	100

Due to delays in initiating activities of this sub-component, 4 out of 5 outcome indicator targets were not achieved. Although the project missed the targets in the agribusiness market linkage criteria, CIGs managed to increase their bargaining power and presence in the market. Despite the shorter period for this sub-component, the project managed to accomplish to create a large

number of CIGs, raise CIG members' income, and enhance their market presence by signing various agribusiness contracts, including signing supply contracts to major retail stores.

Component D. Project Management

Project management was a critical component in implementing the project smoothly and effectively by setting up project management units at both the state and district levels. At the state level, a Project Management Unit (PMU) was established to monitor and evaluate the project progression. After bifurcation of the state, another PMU was established in Telangana. The PMUs ensured that the project was implemented at local level by collaborating and coordinating closely with the District Project Units (DPUs) at the district level where they played the crucial role of ensuring that the capacity of WUAs was being strengthened and each rehabilitated tank was being operated and maintained properly. A total of 21 DPUs were working with the PMUs. At the state level, PMUs were responsible for managing project planning and finance, quality assurance, managing external experts, liaising with external organizations, including the World Bank. The PMUs were also responsible for providing technical assistance to the DPUs.

The project installed Management Information System (MIS) in all 21 districts, and information was updated and monitored regularly, and detailed databases were created. The database was utilized for the Results Framework and annual action plans. A Geographic Information System was also integrated to the database so that information became more transparent and was shared through the project website. Progress of project implementation, fund release, stakeholder details, and results of the participatory assessments became available in the website where feedback for the field staff, NSOs, and water users was communicated through to the DPUs and PMUs.

The PMUs were also able to capture several best impact case studies from the project where some innovative practices were recorded. PMUs also produced a short video where key messages and innovative practices were captured visually and additional values were created to further generate outreach for the project.

Annex 3. Economic and Financial Analysis

1. PAD Economic and Financial Analysis

The PAD economic and financial cost benefit analysis estimated that the project investments in institutional strengthening, minor irrigation systems improvements, and agricultural livelihoods support would result in agricultural intensification and diversification. The PAD analysis estimated the following benefits: (1) expansion of production and crop intensity benefiting from the irrigated areas; (2) increased production of higher value crops (non-paddy commodities); (3) improved agricultural technology and practices that increase productivity; (4) improved water security for agricultural production to reduce water availability risk due to seasonal fluctuations; (5) incremental increases in fish production and productivity; (6) incremental increases in revenue from commercial timber plantations; and (7) increased milk production through acquisition of upgraded breeds and improved animal husbandry.

The analysis was estimated for 250,000 ha of tank command areas operated by 3,000 tanks that were planned for rehabilitation. The analysis suggested that at the end of the project, the registered command areas that were fully irrigated would increase to 75 per cent (187,500 ha). The analysis was based on sample data of 230 households in 12 representative tanks.

The project benefits were quantified based on crop production models representing farms. Separate crop budgets were prepared for paddy, maize, groundnuts, green fodder, and vegetables. Fish production was estimated based on the expected increase of fish productivity per hectare to 0.15 tons per hectare in the Water Spread Area (WSA) of 12,000 hectares after investments in the rehabilitation of 1,000 tanks.

The project returns were estimated for a 25 year period calculated with the 2007 constant prices using the discount rate of 12 per cent. Out of 25 years, 5 years were allocated for the project implementation period. The financial prices for traded agricultural inputs and commodities were converted to economic prices at import and export parity prices. The prices of non-traded goods (including agricultural labor costs) and commodities were converted to economic prices using a standard conversion factor of 0.9.

The total project costs were estimated at Rs. 10.4 billion, inclusive of price and physical contingencies. In addition, the recurring costs at 3 per cent of the total project costs were accounted at the sixth project year onwards when the construction of tanks was to be concluded.

The project as a whole was estimated to have a financial rate of return (FRR) of 18.2 per cent, and a financial net present value (FNPV) at Rs. 3.6 billion. The economic rate of return (ERR) and economic net present value were 23.6 per cent and Rs. 5.7 billion respectively.

2. Methodology of ICR Economic Analysis

The ICR economic analysis re-assessed the economic and financial returns to the project based on the following methodology with some modifications to the PAD economic analysis. These modifications are discussed below:

- i. The actual total project costs of Rs. 9.3 billion was used for the calculation of economic and financial analysis, which is equivalent of US\$175.77 million using average exchange rate of Rs. 52.91 per US dollar for the implementation period. In addition, the O&M costs (recurring costs) for maintaining the 2,157 tanks were included. In the PAD assessment, the project implementation period was 5 years; however, the actual implementation period was 9 years. The time frame used for the economic and financial analysis was 25 years, including 9 years of project implementation and 16 years of operation period.
- ii. Price data during the implementation period were available for the representative agricultural commodities. However, in order to measure the project impact of agricultural productivity increase and area expansion effect, the project benefits were calculated using the 2007 prices covering the project period of 25 years. Models of 8 crops and fishery were used for the *ex-post* analysis. The analysis was conducted using a simple farm model applying 2007 farm gate constant prices, and any post-wholesale value creation activities were not considered in the analysis. The ICR analysis incorporated the values of productivity increases that were derived from the Results Framework Analysis of this ICR.
- iii. The sub-components of livestock and foreshore plantations (timber production) were dropped during the course of the project implementation; therefore, the ICR economic and financial analysis did not include the benefits derived from these activities.
- iv. The actual tank command area for the tank rehabilitation was slightly higher than the PAD projection. The benefits from the project were quantified for 254,957 hectares irrigated by 2,157 tanks. The change was reflected in the ICR economic and financial analysis. The final assessment study reported that the total area irrigated by the project increased to 82 per cent, which exceeded the PAD assumption of 75 per cent. The ICR analysis incorporated the actual findings of the assessment.
- v. The without-the-project (WOP) scenario was based on the assumption in which the productivity and area expansions stayed the same as in the baseline figures, and the proportion of commodity allocation in the area stayed the same as in the baseline scenario.

3. Project Benefits

The project interventions produced the following benefits: (1) Irrigated area expansion; (2) Crop intensification and diversification; (3) Improved technology adoption; (4) Fisheries; and (5) Water scarcity mitigation.

a. Impact on Irrigated Areas

The PAD proposed that the tank system improvements would bring 75 per cent of the registered command area into fully irrigated status by improving 45,000 unirrigated hectares. Before the project, about 145,000 hectares were irrigated by the tanks. Based on the impact assessment, the project rehabilitated 2,157 minor irrigation tanks with a target total command

areas of 254,957 hectares. After the rehabilitations, 209,065 hectares of the command areas were irrigated, which was constituted 82 per cent of the total command areas. Additional 63,740 hectares were irrigated by tanks. This meant that an additional 18,700 hectares were in fact irrigated more than originally proposed.

In the WOP situation, 54 per cent of the command areas was irrigated, but the remaining 46 per cent area was dependent solely on rain and did not receive any irrigation water. In the WP situation, the irrigated areas gradually increased and reached 82 per cent of the command areas by the final year of project implementation.

b. Impact on Intensification and Diversification

The PAD proposed the irrigated crop diversification by shifting to the cultivation of non-paddy commodities, and the area under paddy would come down from 85 per cent to 75 per cent. As shown in Table 10 and Table 11 below, the cultivated area of paddy decreased gradually throughout the project implementation. In fact, in 2015-2016 *Khalif* season, the share of paddy was down to about 71 per cent, a reduction of 14 per cent. On the other hand, in the *Rabi* season, a similar shift did not happen when the share was actually up between 2011 and 2014. In the 2015-2016 season, the share came down, but it was still slightly above the base year.

The area share of maize fluctuated during the *Kharif* season where there was no clear pattern of change; however, during the *Rabi* season, the area share of maize increased overall. The area share for groundnuts during *Kharif* season increased toward the end of the project implementation with an increase of about 5 per cent. However, there was no clear pattern for the change in the area share. At the end of the project implementation, no farmers were growing sugarcane and sunflower in both seasons. Instead, the striking change was in the other crops, which include tomatoes, black gram, chilies, and other vegetables. The area share for ‘all the other crops’ category increased toward the end of the project implementation. It was especially pronounced in *Kharif* season where the share increased from 4.1 per cent to 11.9 per cent.

Table 10. Area share by commodity during *Kharif* season.

	2007-08	2009-10	2011-12	2013-14	2015-16
Paddy	85.5%	86.5%	83.5%	76.1%	71.3%
Maize	4.7%	7.2%	6.8%	8.9%	2.7%
Groundnut	2.0%	1.0%	2.4%	8.2%	7.2%
Greengram	0.5%	0.0%	0.0%	0.0%	2.0%
Sunflower	1.5%	2.3%	0.2%	0.0%	0.0%
Sugarcane	1.0%	1.7%	0.2%	1.9%	0.0%
Jowar	0.7%	0.2%	1.3%	0.0%	4.9%
All other Crops	4.1%	1.1%	5.6%	4.9%	11.9%

Table 11. Area share by commodity during *Rabi* season.

	2007-08	2009-10	2011-12	2013-14	2015-16
Paddy	71.2%	14.8%	84.9%	78.2%	71.4%
Maize	2.0%	20.4%	6.5%	7.1%	13.8%
Groundnut	3.5%	13.0%	3.6%	5.2%	2.9%
Greengram	9.0%	15.7%	0.0%	0.0%	2.8%
Sunflower	4.0%	6.3%	0.1%	1.8%	0.0%
Sugarcane	2.5%	1.6%	1.9%	0.0%	0.0%
Jowar	0.6%	4.6%	0.2%	2.1%	0.0%
All other Crops	7.2%	23.6%	2.8%	5.6%	9.1%

The appraisal projections for crop diversification were realized. The areas allocated for paddy which decreased more than projected in the PAD, and the other minor crops such as vegetables increased their share in terms of area allocation. Additional water availability in *Rabi* season allowed farmers to grow more maize, which was also a key commodity for the income increase in a household.

The PAD analysis did not project the cropping intensity increases, but the PAD outcome indicator set the target of a 108% increase. The final impact assessment recorded that the cropping intensity increased by 33.4 % from 103.3% at the baseline to 137.8%, which translated into an additional 45,892 hectares of lands available for crop production.

In the WOP situation, the area share stayed the same as in the baseline where the share for paddy continued to be as high as 85.5 per cent in *Khalif* season and 71.2 per cent in *Rabi* season. The share for the other non-paddy commodities remained the same as in the baseline. The WP situation assumed that the area share for paddy in *Kharif* season decreased and the other commodities such as vegetables and maize in *Rabi* season increased as the project implementation progressed over the project years, reflecting the actual situation as stated in the final impact assessment.

c. Impact on Improved Technology and Production Practices

The PAD proposed that a technique such as SRI in paddy, and other proven technologies could increase the per hectare productivities to 25 per to 30 per cent in four key commodities including paddy, maize, groundnut, and vegetables (tomatoes). Even though the adoption of SRI in paddy was not realized as proposed (it failed to reach the target in the outcome indicator) due to various factors such as labor limitations, the project managed to increase the productivity by adopting other technologies such as hybrid seeds and improved crop varieties and improved techniques including Integrated Nutrient Management (INM) and Integrated Pest Management (IPM). The project resulted in a 36.2 per cent increase in paddy productivity, a 72.26 per cent increase in maize productivity, a 112.5 per cent increase in groundnut productivity, and a 40 per cent increase in vegetable productivity. The final impact assessment found that the PAD projections for the productivity increase for four commodities were conservatively estimated. The actual figures were much higher than what the PAD had proposed.

In the WOP situation, the productivity levels stayed the same as in the baseline and were assumed to stay constant throughout the project years. In the WP situation, the ICR analysis updated the actual yield figures for paddy, maize, groundnuts, and vegetables as reported in the final impact assessment and were assumed to stay at the higher productivity level throughout the project years.

d. Impact on Fishery

The PAD proposed that the project would increase the fish productivity to 0.15 tons per hectares in 12,000 hectares of the Water Spread Area (WSA) with 1,000 tanks. The project brought higher productivity growth than the PAD had projected. The final impact assessment reported that the fish productivity in fact had increased as high as 0.53 tons per hectare, which was far above the projection. The total WSA resulted in 42,859 hectares with 1,140 tanks. As in the PAD analysis, the incremental net benefits were estimated separately and aggregated using the actual areas from the impact assessment in the ICR analysis.

e. Impact on Reduced Water Scarcity

Analysis of rainfall data between 1951 and 2015 in Andhra Pradesh was conducted. As in the PAD analysis, the ICR analysis projected three patterns of rainfall, namely drought, normal and above normal rainfall. In a ten year cycle, the probability of each was 27 per cent, 45 per cent, and 28 per cent respectively. ICR analysis estimated the incremental benefit flow from the reduction of risk for low production and improved water security.

Table 12. Parameters in WOP and WP Scenarios

	Appraisal (PAD)		ICRR	
	WOP	WP	WOP	WP
Agriculture				
Crop Productivity (ton/ha)				
Paddy	3.8	4.8	4.97	6.77
Maize	2.7	3.5	3.61	6.22
Groundnuts	1.5	1.9	0.97	2.06
Vegetables	14.7	18.7		
Vegetables			30.91	43.27
Cropping Intensity (%)	100	118	103	138
Irrigated Areas (ha)	135,000	187,500	145,325	209,065
Fishery				
Fishery Productivity (ton/ha)	0.05	0.2	0.125	0.562
Water Spread Area (ha)		12,432		42,859

4. Project Costs

The actual project cost including the contingencies was Rs.9.3 billion. This was distributed into four components of the project. Around Rs. 680million (7.3% of the total project cost) was allocated to the Institutional Strengthening component. The investment in the Minor Irrigation System Improvement component, including the civil works of tank rehabilitation and participatory groundwater management, was a major part of the project cost, constituting 82.2 per cent of the project cost (Rs. 7.6 billion). Rs. 566 million (6.1% of the project cost) was allocated to the Agricultural Livelihoods Support Services (ALSS) component. The remaining Rs. 411 million (4.4% of the project cost) was distributed to the activities related to Project Management component. Overall, these project budget allocations were much smaller than the budgets projected in the PAD. The biggest change was in the ALSS component where two sub-components were discontinued during the course of the project. In the PAD, Rs. 1.29 billion was allocated to the ALSS component; however, the allocation was reduced to less than half of the original budget (Rs.722 million less than the PAD figure). Furthermore, the actual budget allocations for the Institutional Strengthening, the Minor Irrigation System improvement, and Project Management were Rs. 134 million, Rs. 86 million, and Rs. 201 million less than the projections in the PAD, respectively.

Table 13. Total Project Costs in PAD and ICR

	PAD Estimate (Rs. Million)	Share (%)	Actual Budget (Rs. Million)	Share (%)	% of Actual Allocation Relatrive to PAD Estimate
A. Institutional Strengthening	814	7.8	680	7.3	83.5%
B. Minor Irrigation Systems Improvement	7,729	74.0	7,643	82.2	98.9%
C. Agricultural Livelihoods Support Services	1,288	12.3	566	6.1	43.9%
D. Project Management	612	5.9	411	4.4	67.2%
Total Project Cost	10,444		9,303		89.1%

5. Economic and Financial Results

a. Financial Analysis

Tables 14 and 15 below show the yield (productivity) trends by commodity over the project implementation period. As mentioned above, all the commodities in *Kharif* and *Rabi* season showed an increase in productivity, and these proved that productivity increases met the project target as shown in the outcome indicators.

Table 14. Yield growth over the project period (*Kharif* season) (tons per hectare)

	2007-08	2008-09	2009-10	2010-11	2011-12	2012-13	2013-14	2014-15	2015-16
Paddy	4.9	5.0	5.4	5.1	5.8	6.0	6.5	6.6	6.3
Maize	3.6	3.7	4.3	5.0	4.9	5.0	5.3	6.2	6.2
Groundnut	1.0	1.0	1.4	1.5	1.5	1.5	1.5	2.1	2.1
Greengram	0.8	0.8	0.8	0.8	0.8	1.4	1.5	1.5	1.3
Sunflower	1.7	1.7	1.7	1.8	1.8	1.8	1.9	1.9	1.9
Sugarcane	62.5	63.8	65.2	66.6	68.0	69.4	70.9	71.7	72.5
Jowar	0.9	0.9	0.9	0.9	0.9	1.0	1.0	1.0	1.0
All other Crops	30.9	31.5	33.2	33.9	33.4	34.1	37.5	37.9	43.2

Table 15. Yield growth over the project period (*Rabi* season) (tons per hectare)

	2007-08	2008-09	2009-10	2010-11	2011-12	2012-13	2013-14	2014-15	2015-16
Paddy	4.9	4.9	5.4	5.7	5.8	5.9	6.5	6.6	6.3
Maize	3.6	3.7	4.3	5.7	4.9	5.0	5.3	6.2	6.2
Groundnut	1.0	1.0	1.4	-	1.5	1.5	1.5	2.1	2.1
Greengram	-	-	-	-	-	-	-	-	-
Sunflower	1.5	1.6	1.6	1.6	1.6	1.6	1.7	1.7	1.7
Sugarcane	67.5	68.2	69.0	69.8	70.6	71.4	72.2	73.0	73.8
Jowar	0.9	0.9	0.9	0.9	0.9	0.9	0.9	1.0	1.0
All other Crops	30.9	31.2	33.2	33.6	33.4	33.8	37.5	37.9	43.2

Based on the productivity changes above, the per hectare based net financial benefit (gross margin) for each commodity was calculated. Using the constant prices of 2007, the results are shown below. Overall, the net economic benefits for both *Kharif* and *Rabi* season increased during the course of project implementation. However, some commodities had negative net benefits throughout the project period, including jowar (sorghum) and the other crops, which were mostly vegetables. The reason for the net loss was attributed to a low output price as well as the relatively higher production cost. Despite the productivity growth for these commodities, the prices were too low, and the costs of production were high, which resulted in an overall loss. Sugarcane and groundnut brought the highest financial returns in both seasons, and financial returns for paddy, maize, and sunflower were also quite significant. In particular, the paddy played a crucial role in terms of the financial returns because the land allocation for paddy was by far the largest among these commodities despite a decrease in the share of land under paddy over the years. In the context of the overall financial returns, after multiplying the per hectare financial return by areas by commodities, it became obvious that paddy's net financial return held a crucial part of the financial returns from the project implementation.

Table 16. Gross margin over the project period (*Kharif* season) (Rs per hectare).

	2007-08	2008-09	2009-10	2010-11	2011-12	2012-13	2013-14	2014-15	2015-16
Paddy	5,013	5,935	8,656	7,471	13,188	14,822	19,825	22,206	19,738
Maize	120	250	349	5,086	4,712	5,678	8,256	15,564	15,605
Groundnut	(224)	319	12,900	14,455	14,973	16,736	18,764	38,653	40,544
Greengram	(388)	(282)	(162)	(25)	128	5,030	6,893	7,350	5,467
Sunflower	10,069	11,312	12,671	14,155	15,775	17,542	19,468	21,038	22,723
Sugarcane	17,956	21,268	24,921	28,944	33,368	38,230	43,565	47,691	52,144
Jowar	(5,298)	(5,458)	(5,618)	(5,778)	(5,937)	(6,095)	(6,251)	(6,478)	(6,712)
All other Crops	(2,568)	(2,351)	(2,414)	(3,035)	(4,327)	(5,047)	(4,445)	(5,429)	(3,920)
	24,680	30,993	51,304	61,272	71,880	86,895	106,074	140,595	145,590

Table 17. Gross margin over the project period (Kharif season) (Rs per hectare).

	2007-08	2008-09	2009-10	2010-11	2011-12	2012-13	2013-14	2014-15	2015-16
Paddy	6,015	6,743	10,387	13,804	15,826	17,238	23,790	26,647	23,686
Maize	120	250	349	9,422	4,712	5,335	8,256	15,564	15,605
Groundnut	(224)	59	12,900	(28,941)	14,973	16,260	18,764	38,653	40,544
Greengram	(6,000)	(6,300)	(6,615)	(6,946)	(7,293)	(7,658)	(8,041)	(8,443)	(8,865)
Sunflower	7,865	8,624	9,444	10,329	11,284	12,314	13,424	14,620	15,909
Sugarcane	26,524	29,233	32,163	35,330	38,752	42,447	46,436	50,740	55,381
Jowar	(5,202)	(5,405)	(5,615)	(5,831)	(6,055)	(6,285)	(6,523)	(6,767)	(7,019)
All other Crops	(2,568)	(2,513)	(2,414)	(3,209)	(4,327)	(5,222)	(4,445)	(5,429)	(3,920)
	26,530	30,691	50,600	23,958	67,872	74,428	91,661	125,585	131,322

Results of the ICR financial analysis are shown in Table 18 below. The area and diversification effects produced a return of 12.6 per cent with Net Present Value (NPV) of Rs 0.12 billion (with an opportunity cost at 12%), which was slightly lower than the PAD Financial Rate of Return (FRR) of 13.1 per cent. The lower FRR was attributed to a few factors. First, in the PAD analysis, the returns from the livestock and foreshore plantation sub-components were included, and this was significant for the financial return. In the ICR analysis, these sub-components were not included due to the cancellation. Second, the financial returns from the diversification effects were much smaller than the PAD analysis. Diversification took place in the project; however, the paddy was replaced with the other commodities where financial benefits were much smaller than paddy. Despite these two factors, the financial returns were significant due to a higher than expected area expansion. The area expanded under the project was much higher than the PAD projection, and this factor brought higher financial benefits to the project, and compensated for the negative factors described above.

When the effects of technology were added to the financial analysis of the ICR, the project financial returns were in fact higher than the PAD analysis. The result of the ICR analysis shows that the FRR inclusive of the technology effect is 20.3 per cent with the NPV of Rs 1.83 billion, which was higher than the PAD result of 16.6 per cent. Similarly, when all the factors were considered, the financial return in the ICR analysis was 21.0 per cent with NPV of Rs 2.0 billion, which exceeded the PAD FRR of 18.2 per cent.

Table 18. Summary of project financial analysis.

	Appraisal (PAD)		ICRR	
	FRR (%)	NPV (Rs billion)	FRR (%)	NPV (Rs Billion)
Irrigated Area Expansion & Diversification	13.1	0.6	12.6	0.12
Irrigated Area Expansion, Diversification and Technology Impact	16.6	2.6	20.3	1.8
Irrigated Area Expansion, Diversification, Technology Impact, and Water Security	18.2	3.6	21.0	2.0

b. Economic Analysis

The ICR economic analysis used the PAD opportunity cost of 12 per cent to be comparable with the PAD. The ICR economic analysis was carried out estimating the incremental benefits as stated in the financial analysis. Results of the ICR economic analysis are shown in Table 19 below. The Economic Rate of Return (ERR) was estimated to be 27.5 per cent with the NPV of Rs. 3.11 billion when the entire project components are considered, which was higher than the PAD ERR of 23.6 per cent. The aggregate project economic returns resulted from various components of benefits, including area and diversification effects, technology effects, and water security increase effects. When only the area and diversification effects were considered, the ERR was estimated at 22.1 per cent with the NPV of Rs 2.02 billion, which was also higher than the PAD projection of 17.7 per cent. Similarly, when the technology effects were added to the area and diversification effects, the ERR was 26.9 per cent over a 25 year period, which was 5.4 per cent higher than the PAD analysis.

Table 19. Summary of project economic analysis.

	Appraisal (PAD)		ICRR	
	ERR (%)	NPV (Rs billion)	ERR (%)	NPV (Rs Billion)
Irrigated Area Expansion & Diversification	13.1	0.6	22.1	2.02
Irrigated Area Expansion, Diversification and Technology Impact	16.6	2.6	26.9	2.92
Irrigated Area Expansion, Diversification, Technology Impact, and Water Security	18.2	3.6	27.5	3.1

6. Sensitivity Analysis

The sensitivity analysis was conducted to test the robustness of the project using similar scenarios used in the PAD analysis. Five scenarios were analyzed: escalation of O&M costs, implementation delays, lower accumulated incremental benefits from the expansion, diversification effects, and technology effects.

An unexpected O&M cost increase of 25 per cent could maintain the both financial and economic rate of returns higher than the opportunity cost of 12 per cent. Inflation effects on the O&M costs by 25 per cent brought down the FRR and ERR to 20.6 per cent and 27.3 per cent respectively.

When the incremental benefits from the area expansion were estimated at 75 per cent of the base scenario, FRR and ERR were estimated at 15.7 per cent and 19.5 per cent respectively, which were still much higher than the opportunity cost of 12 per cent. Similarly, when the incremental benefits from the diversification effects were lowered by 25 per cent, both the financial and economic rate of returns were brought down. However, both rates were estimated at 20.0 per cent for FRR and 25.6 per cent for ERR, which showed that the reduction of the incremental benefits from diversification effects have marginal impacts on the financial and economic returns.

Finally, the last sensitivity analysis focused on the delay in project implementation. The FRR and ERR were estimated with the assumption of delaying the project implementation by two years. The results showed that the FRR and ERR were estimated at 20.6 per cent and 25.3 per cent respectively. The effects of the delay in the project implementation on both financial and economic returns were also very marginal.

Table 20. Results of the sensitivity analysis.

Scenarios for the Project	ERR (%)	NPV (Rs billion)	FRR (%)	NPV (Rs billion)
Base Level	27.5	3.6	21.0	2.0
Scenario 1 Escalation in Recurrent Costs Costs at 125% of the base level	27.3	3.00	20.6	1.87
Scenario 2 Risks in Irrigated Area Expansion Benefits at 75% of the base level	18.7	1.82	15.7	0.82
Scenario 3 Risks in Diversification Benefits at 75% of the base level	25.6	2.73	20.0	1.79
Scenario 4 Risks in Technology Effects Benefits at 75% of the base level	24.3	2.25	18.6	1.36
Scenario 5 Delayed Implementation Benefit lagged by two year	25.3	2.42	20.6	1.79

Annex 4. Bank Lending and Implementation Support/Supervision Processes

(a) Task Team members

Names	Title	Unit	Responsibility/ Specialty
Lending			
Deepak Ahluwalia	Lead Agriculture Economist	SASSD	Task Team Leader
Seenithamby Manoharan	Rural Development Specialist	SASSD	Rural Development
Philip Beauregard	Senior Counsel	LEGMS	Legal
Animesh Shrivastava	Senior Economist-FAO	ARD	Agriculture
Reena Gupta	ET Consultant	SASSD	Agriculture
Atul Balachandra Deshpande	Financial Management Specialist	SARFM	Financial Management
Sanjay Pahuja	Environmental Specialist	SASSD	Environment
Paul Singh Sidhu	Senior Agricultural Specialist	SASSD	Agriculture
Priti Jain	Procurement Specialist	SARPS	Procurement
Mohammed Hasan	Senior Social Development Specialist	SASSD	Social
Xiaokai Li	Senior Water Resources Specialist	SASSD	Water Resources
Graham Dixie	Senior Agricultural Specialist	SASSD	Agriculture
S. Krishnan	Consultant	GSU18	Procurement
S. Selvarajan	Consultant	SASDA	Economics
R. K. Malhotra	Consultant	GFA13	Irrigation
N. K. Bandyopadhyay	Consultant		Water Resources
Jacqueline Julian	Senior Program Assistant	GFA06	COSTAB
Deborah Lee Ricks	Program Assistant	GFA06	Administration
Sarita Rana	Program Assistant	SASSD	Administration
Supervision/ICR			
Ranjan Samantaray	Senior Agricultural Specialist	GFA06	Task Team Leader
Deepak Ahluwalia	Lead Agriculture Economist	SASSD	Task Team Leader
Shankar Narayanan	Senior Social Development Specialist	GSU06	Social Development
Tripti Chopra	Financial Management Specialist	GGO24	Financial Development
Balagopal Senapati	Senior Procurement	GGO06	Procurement

Names	Title	Unit	Responsibility/ Specialty
	Specialist		
Jorge Luis Alva-Luperdi	Senior Counsel	LEGES	Legal
Ajay Markaden	Economist	FAO	Economics
R. K. Malhotra	Consultant	GFA12	Irrigation
Maroti A. Upare	Consultant	GFA12	Fisheries
Paul Singh Sidhu	Consultant	GFA12	Agriculture
KalyaniKandula	Consultant	GEN06	Environment
S. Selvarajan	Consultant	SASSD	Economics
Sudhirendar Sharma	Consultant	GFA06	M & E
Siddhartha Kohli	Consultant	GGO24	Financial Management
Anindita Roy	Consultant		Gender
Jacqueline Julian	Operations Analyst	GFA06	Operations
Sarita Rana	Senior Program Assistant	SACIN	Administration
Roshni Sarah John	Program Assistant	SACIN	Administration

(b) Staff Time and Cost

Stage of Project Cycle	Staff Time and Cost (Bank Budget Only)	
	No. of staff weeks	USD Thousands (including travel and consultant costs)
Lending		
FY06	6.60	13.75
FY07	58.64	149.44
Total:	65.24	163.19
Supervision/ICR		
FY08	24.48	95.30
FY09	20.38	98.47
FY10	22.84	97.40
FY11	20.18	99.70
FY12	14.87	65.64
FY13	17.54	83.95
FY14	23.44	75.72
FY15	23.51	82.23
FY16	15.94	74.08
FY17	12.74	60.25
Total:	195.92	832.74

Annex 5. Beneficiary Survey Results

Not Applicable

Annex 6. Stakeholder Workshop Report and Results

Not Applicable

Annex 7. Summary of Borrower's ICR and/or Comments on Draft ICR

Agriculture is the predominant sector in the economy of the state. Historically, the Minor Irrigation Tanks were playing a vital role, providing irrigation to 24% the total area irrigated until 1990. By the year 2004, it has come down to 12% and it is mainly due to deficient maintenance and management of the tanks system. Realizing the fact, the Government decided to take up rehabilitation of certain tanks with the financial assistance from the World Bank, as pilot to see how best it can further be implemented throughout the state. The APCBTMP was designed to the tune of state's needs and the World Bank's procedures, considering all the significant factors to be covered. The Project has come into effect from June 8, 2007. A total of 2,157 tanks with an ayacut of 2.5 lakh ha spread across 21 of the total 23 districts have been taken up for restoration, ensuring that entire state is evenly covered by the project area. Keeping the sustainability of the project in view, the institutional strengthening was given the top priority in project designing, followed by the Minor Irrigation Systems Improvements i.e., civil works and also the Participatory Groundwater Management. The project also covered the other key issues like Agricultural Livelihoods Support Services, which include Agriculture, Horticulture, Livestock, Fisheries, Forestation, Agri-business and Marketing. The well designed project implementation resulted not only in increase of the area irrigated under minor irrigation, crop diversification but also in increase in groundwater availability. The project has come into effect from June 8, 2007 and it has been bifurcated between the two residual states of Telangana and Andhra Pradesh from June 2, 2014. In Andhra Pradesh state, 975 minor irrigation tanks were rehabilitated, covering 12 districts. In Telangana state, 1182 minor irrigation tanks were rehabilitated, covering 9 districts.

The World Bank Task team provided all the required support to the project implementing entity with regular and scrupulous supervision and guidance where and whenever required. The Bank extended its commendable support to the project in the areas of fiduciary and quality control and quality assurance related issues. Certain innovative procedures like introduction of OK cards system have proved to be very successful in completion of the works. All the civil works have been executed following the World Bank procurement guidelines. Proper care has been taken in ensuring the quality of the works. Extensive consultations have been made with the farmers, the primary stakeholders, at every stage of implementation of the project, which has been worked out as Social Audit.

Social and environmental related issues like Gender Development Plans, Tribal Development Plans, security measures to the labour at the work sites, providing hygiene environment at the work sites, implementation of IPM, INM etc., have thoroughly been addressed. The innovative practice of water sharing among the farmers has been inculcated in the project. At the end of the project, the capacity of the Water Users Associations of the tanks under the project has been developed to maintain their tank system on their own, even after withdrawal of the services of Support Organizations, which is one of the prime objectives of the project.

The fishermen community in particular has significantly been benefited with the project interventions of supplying fingerlings, fishing nets, mobile marketing vehicles etc., and imparting training on advanced fishing technologies. The project information system developed and implemented by the project for effective monitoring had good appreciation from the FAO

and the World Bank and the Government desires to adopt the similar system in other projects also. The APCBTMP was selected as a finalist for the “Water for Life” prize by United Nations “Water as part of its World Water Day” programme. The prize is awarded to the best examples of integrated water management.

During the project period, the Government had tough times in implementing the project, encountering so many hurdles out of the agitation for separation of the states of Andhra Pradesh and Telangana. Despite the agitation in the combined state and the teething problems in the newly borne states of Andhra Pradesh and Telangana, the project was implemented successfully. Nevertheless, two of the planned components i.e., Animal Husbandry and Forestry have been dropped from the ambit of the project as most of the activities planned were being implemented by the respective departments. With all the good efforts by the implementing agency and the support from the World Bank, the project could achieve the expected Project Development Objectives.

Implementation of the APTSCBTMP has been instrumental in paving way for implementation of “restoration of minor irrigation tanks” in the name of “Neeru – Chettu” in Andhra Pradesh and “Mission Kakatiya” in Telangana.

Annex 8. Comments of Co-financiers and Other Partners/Stakeholders

Not Applicable

Annex 9. List of Supporting Documents

Project Preparation

Project Information Document, 2006
Environmental and Social Assessment, 2006
Project Appraisal Document, March 2007
Financing Agreement, June 2007
Loan Agreement, June 2007
Project Agreement, June 2007

Supervision

Twenty One Implementation Status and Results Report; Aide Memoires; and Management Letters, 2007 to 2016
Project Paper: Restructuring, October 2012
Project Paper: Restructuring, May 2014
Project Agreement with State of Telangana, January 2014
Amendment to the Loan Agreement and Financing Agreement, December 2014
Amendment to Project Agreement with State of Andhra Pradesh, December 2014

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