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PROJECT PERFORMANCE ASSESSMENT REPORT

WHAT WORKS

INDIA

Andhra Pradesh and Telangana State Community-Based Tank Management Project

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DECEMBER 11, 2019

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PROJECT PERFORMANCE ASSESSMENT REPORT

INDIA

ANDHRA PRADESH AND TELANGANA STATE COMMUNITY-BASED TANK MANAGEMENT PROJECT

(IBRD-48570, IDA-42910)

December 11, 2019

Financial, Private Sector, and Sustainable Development

Independent Evaluation Group

Currency Equivalents (annual averages)

Currency Unit = Indian Rupee (Re)

2007	$1.00	Re 41.2
2009	$1.00	Re 46.4
2011	$1.00	Re 44.5
2013	$1.00	Re 59.5
2015	$1.00	Re 63.6

Abbreviations

APTCBTMP	Andhra Pradesh and Telangana State Community-Based Tank Management Project
IBRD	International Bank for Reconstruction and Development
IDA	International Development Association
IEG	Independent Evaluation Group
M&E	monitoring and evaluations
MLE	Monitoring, Learning, and Evaluation
O&M	Operations and Maintenance
PMU	Project Management Unit
WRD	Water Resources Department
WUA	Water Users' Association

All dollar amounts are U.S. dollars unless otherwise indicated.

Fiscal Year

Government: July 1 – June 30

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Task Manager	Mr. Ramachandra Jammi

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Principal Ratings

Indicator	ICR	ICR Review	PPAR
Outcome	Satisfactory	Satisfactory	Satisfactory
Risk to development outcome	Modest	Modest	Substantial
Bank performance	Satisfactory	Moderately satisfactory	Moderately satisfactory
Borrower performance	Moderately satisfactory	Moderately satisfactory	Moderately satisfactory

Note: The Implementation Completion and Results Report (ICR) is a self-evaluation by the responsible Global Practice. The ICR Review is an in–termediate Independent Evaluation Group product that seeks to independently validate the findings of the ICR. PPAR = Project Performance Assessment Report.

Key Staff Responsible

Project	Task Manager or Leader	Division Chief or Sector Director	Country Director
Appraisal	Deepak Ahluwalia	Gajanand Pathmanathan	Isabel M. Guerrero
Completion	Ranjan Samantaray	Meike van Ginneken	Junaid Kamal Ahmad

IEG Mission: Improving World Bank Group development results through excellence in independent evaluation.

About This Report

The Independent Evaluation Group (IEG) assesses the programs and activities of the World Bank for two purposes: first, to ensure the integrity of the World Bank's self-evaluation process and to verify that the World Bank's work is producing the expected results, and second, to help develop improved directions, policies, and procedures through the dissemination of lessons drawn from experience. As part of this work, IEG annually assesses 20–25 percent of the World Bank's lending operations through fieldwork. In selecting operations for assessment, preference is given to those that are innovative, large, or complex; those that are relevant to upcoming studies or country evaluations; those for which Executive Directors or World Bank management have requested assessments; and those that are likely to generate important lessons.

To prepare a Project Performance Assessment Report (PPAR), IEG staff examine project files and other documents, visit the borrowing country to discuss the operation with the government, and other in-country stakeholders, interview World Bank staff and other donor agency staff both at headquarters and in local offices as appropriate, and apply other evaluative methods as needed.

Each PPAR is subject to technical peer review, internal IEG panel review, and management approval. Once cleared internally, the PPAR is commented on by the responsible World Bank Country Management Unit. The PPAR is also sent to the borrower for review. IEG incorporates both World Bank and borrower comments as appropriate, and the borrowers' comments are attached to the document that is sent to the World Bank's Board of Executive Directors. After an assessment report has been sent to the Board, it is disclosed to the public.

About the IEG Rating System for Public Sector Evaluations

IEG's use of multiple evaluation methods offers both rigor and a necessary level of flexibility to adapt to lending instrument, project design, or sectoral approach. IEG evaluators all apply the same basic method to arrive at their project ratings. Following is the definition and rating scale used for each evaluation criterion (additional information is available on the IEG website: http://ieg.worldbankgroup.org).

Outcome: The extent to which the operation's major relevant objectives were achieved, or are expected to be achieved, efficiently. The rating has three dimensions: relevance, efficacy, and efficiency. *Relevance* includes relevance of objectives and relevance of design. Relevance of objectives is the extent to which the project's objectives are consistent with the country's current development priorities and with current World Bank country and sectoral assistance strategies and corporate goals (expressed in Poverty Reduction Strategy Papers, country assistance strategies, sector strategy papers, and operational policies). Relevance of design is the extent to which the project's design is consistent with the stated objectives. *Efficacy* is the extent to which the project's objectives were achieved, or are expected to be achieved, taking into account their relative importance. *Efficiency* is the extent to which the project achieved, or is expected to achieve, a return higher than the opportunity cost of capital and benefits at least cost compared with alternatives. The efficiency dimension is not applied to development policy operations, which provide general budget support. *Possible ratings for outcome:* highly satisfactory, satisfactory, moderately satisfactory, moderately unsatisfactory, unsatisfactory, highly unsatisfactory.

Risk to development outcome: The risk, at the time of evaluation, that development outcomes (or expected outcomes) will not be maintained (or realized). *Possible ratings for risk to development outcome:* high, significant, moderate, negligible to low, and not evaluable.

Bank performance: The extent to which services provided by the World Bank ensured quality at entry of the operation and supported effective implementation through appropriate supervision (including ensuring adequate transition arrangements for regular operation of supported activities after loan or credit closing, toward the achievement of development outcomes). The rating has two dimensions: quality at entry and quality of supervision. *Possible ratings for Bank performance:* highly satisfactory, satisfactory, moderately satisfactory, moderately unsatisfactory, unsatisfactory, and highly unsatisfactory.

Borrower performance: The extent to which the borrower (including the government and implementing agency or agencies) ensured quality of preparation and implementation, and complied with covenants and agreements, toward the achievement of development outcomes. The rating has two dimensions: government performance and implementing agency(ies) performance. *Possible ratings for borrower performance:* highly satisfactory, satisfactory, moderately satisfactory, moderately unsatisfactory, unsatisfactory, and highly unsatisfactory.

Preface

This is a Project Performance Assessment Report (PPAR) prepared by the Independent Evaluation Group (IEG) of the World Bank Group for the Andhra Pradesh and Telangana State Community-Based Tank Management Project in India (P100789).

The project was approved on April 19, 2007, for $217.8 million, supported by a World Bank loan and International Development Association credit, each of $94.5 million. The project cost at completion was $175.8 million, nearly 20 percent lower than envisaged, of which $71.6 million was financed by the International Bank for Reconstruction and Development and $86.6 million by the International Development Association. The project closed on July 31, 2016, three years and eight months later than originally scheduled.

This project was selected for an assessment because its design goes significantly beyond typical irrigation projects that focus mainly on traditional infrastructure rehabilitation. It addresses institutional strengthening for water user associations; support services for agriculture, livestock, and fisheries; and participatory groundwater management, all geared toward improving agricultural productivity and rural livelihoods. Lessons from this project provided input to IEG's evaluation on sustainable irrigation service delivery. The primary target audiences for this project assessment are the Water and Agriculture Global Practices of the World Bank.

This assessment is based on a review of relevant documentation, interviews with World Bank staff at headquarters and in country offices, and the findings of an IEG mission to Telangana February 18–22, 2019, and to Andhra Pradesh from February 25 to March 1, 2019. Project performance was discussed in interviews with officials of the state government, Project Management Units, and staff of the World Bank's country office.

IEG visited six villages in Telangana and five villages in Andhra Pradesh with the Project Management Unit and district-level officials and conducted discussions in each location with village officials, farmers, and fishers. Discussions were followed by a general assembly of villagers with large representation of women and tail-end (far downstream) farmers. Appendix G lists the persons met during the mission. The mission expresses deep appreciation to Project Management Unit officials in both states for their meticulous preparation and support for the field visits and to the project directors and district officials, for liberally sparing time for insightful discussions on the project experience.

As per IEG procedure, a copy of the draft PPAR was sent to government officials and implementing agencies for their review and comments, but no comments were received.

Summary

This Project Performance Assessment Report assesses the development effectiveness of India's Andhra Pradesh and Telangana State Community-Based Tank Management Project, which was approved in 2007 and closed in 2016. The development objectives of the project were to (i) improve agricultural productivity with the assistance of selected tank-based producers; and (ii) improve the management of tank systems with the assistance of selected water user associations.

States and Sector Context

At project appraisal in 2007, Andhra Pradesh state (which was bifurcated into Andhra Pradesh and Telangana in 2014) faced slowing growth in its agriculture sector. Consecutive droughts and inadequate investments in irrigation were key factors explaining poor agricultural performance.

Among irrigation infrastructure, tanks (artificial water reservoirs fed by rainfall, streams or rivers) have historically played an important role in both states. However, 1990 to 2005 saw a collective, steady decline in tank-based irrigation—from 1.0 million hectares (24 percent of the irrigated area) to 0.5 million hectares (12 percent of the irrigated area)—due to lack of maintenance and an increase in the use of groundwater for irrigation (which further affected water levels in the tanks). The rehabilitation and modernization of tanks became the priority to improve levels of water storage and, thereby, the adequacy and reliability of irrigation water supply.

Community-based organizations, mainly water user associations (WUAs), played a crucial role in the basic maintenance of irrigation facilities and the efficient use and equitable sharing of water. However, the challenges of ensuring the financial viability and technical capacity of WUAs or similar organizations required ongoing support from the government.

Performance and Ratings

Relevance of project objectives is rated **high**. At appraisal, the government of Andhra Pradesh placed emphasis on decentralized irrigation development with beneficiary participation. The World Bank Group's India Country Assistance and Partnership Strategies covering FY05–17 aimed at increasing the efficiency of irrigation systems together with a community empowerment approach, to improve agricultural productivity and rural livelihoods. At completion, the project objectives continued to be relevant to the governments of Andhra Pradesh and Telangana for boosting agricultural productivity and management of tank irrigation systems.

Relevance of project design is rated **substantial**. To achieve the stated objectives, the project appropriately combined the modernization of irrigation structures with institutional strengthening of WUAs for tank management and agricultural livelihood improvement. The project design could have benefited from a stronger sustainable agricultural production and marketing component and from a value chain analysis to complement efforts for crop diversification. Greater attention could have been given to mechanisms and incentives for ensuring better coordination across multiple government departments, including agriculture, horticulture, fisheries, and animal husbandry.

Objective 1, to improve agricultural productivity with the assistance of selected tank-based producers, is rated **substantial** on efficacy. At completion, agricultural and water productivity exceeded project targets significantly, whereas crop diversification toward high-value and water-efficient activities was somewhat lower than expected. Sale values for rice paddy, groundnuts, and maize improved to some extent. All tank-based fishing communities adopted improved fish production and harvesting techniques, leading to a steep increase in fish productivity.

The impact assessment study carried out at the end of the project largely attributes these results to the project meeting its targets for tank rehabilitation: 975 tanks in Andhra Pradesh and 1,182 tanks in Telangana irrigated 122,116 and 131,214 hectares, respectively, and covered 605,502 beneficiaries. The planned diverse capacity building activities for 42,000 farmers also contributed to the positive results.

Independent Evaluation Group (IEG) findings. IEG triangulated observations from site visits, feedback from project and government officials, beneficiaries, various data sources, and research studies. The IEG mission visited a purposefully selected sample of five project sites and tanks in Andhra Pradesh and six in Telangana to assess the extent to which results from the project are being sustained. The rehabilitated tank structures (bunds or embankments, check dams, guide walls, irrigation channels, sluices and shutters) were mostly in good operating condition. Despite both states receiving less than normal rainfall in the last two years, most of the tanks reported availability of water in February, at the end of the *rabi* (winter crop) growing season and three to four months before the onset of the monsoon. Groundwater has been recharged in most sites, with most tanks reporting higher water levels, and previously dry wells yielding water. In some cases, tail-end (far downstream) farmers reported receiving larger quantities of water than before the project. Feedback from beneficiaries and officials supports an overall positive trend toward crop diversification and significantly increased productivity in several instances. Fishers at 8 of the 11 tanks visited by the IEG mission reported longer fishing seasons—from greater availability of water—and increased yields.

The IEG mission was unable to get any systematic update about the commodity interest groups. Informal feedback from officials and beneficiaries suggests that several of them may not be functioning at the level that they had reached at project completion.

Some farmer and fisher beneficiaries in the drought-prone Mehboobnagar district in Telangana reported that due to increases in production and income from agricultural activities attributable to the project, there is now less need for them to seek seasonal employment in urban areas.

Objective 2, improve the management of tank systems with the assistance of selected WUAs, is rated **substantial** on efficacy. During the project, WUAs were provided with training in administrative and accounting functions and given responsibility for maintenance and allocation of water. To that effect, the WUAs were assisted by members of support organizations (nongovernmental organizations engaged based on demonstrated relevant expertise). By project completion, 1,791 tanks were handed to WUAs for operation and maintenance. Most WUAs reported holding general body meetings (about all members) regularly and maintaining appropriate cash books. WUAs co-opted members from the public and included fishers and groundwater users.

The project introduced a self-rating tool for WUAs covering four work areas: participation and dialogue; performance; self-management; and innovations and technology adoption. At project completion, the distribution of WUA performance based on this tool was as follows: 28 percent excellent; 56 percent good; 14 percent average; 2 percent poor. But this exercise does not appear to have been continued after project completion.

Since project completion, WUAs in their original form have been discontinued in Telangana state, and plans are under way to replace them with institutions that will be composed of accountable bodies consisting of nominated rather than elected members. In Andhra Pradesh, however, WUAs are expected to be strengthened in their current form including through the successor Andhra Pradesh Integrated Irrigation and Agricultural Transformation Project (P160463).

IEG findings. The IEG mission visited the WUA office building in the Kallepalli and Chinnapatha tank areas in Andhra Pradesh. At these sites, the WUA had a dedicated building with an office and facility for meetings. WUA members at both sites maintained records of meetings conducted regularly, and accounts for WUA fees and expenses. Both WUAs displayed self-rating cards introduced under the project.

The increased availability of water from the project was not leveraged by any significant measures for improving water use efficiency, apart from the construction/ rehabilitation

of field channels. The farmers appear to continue with the traditional practice of flood irrigation, which is especially wasteful in drought-prone areas.

Efficiency is rated **substantial** with an estimated economic rate of return of 27.5 percent at project completion, higher than the 23.6 percent estimated at appraisal. Three factors contributed to the increased benefits: First, an additional 63,740 hectares was brought into full irrigation status. Second, improved water availability; and third, the adoption of improved technologies, such as hybrid seeds and better crop varieties and integrated nutrient management. Administrative and implementation efficiency was negatively impacted by political disturbances between 2012 and 2014.

Overall project development outcome is rated **satisfactory** based on **high** relevance of objectives, and **substantial** ratings for relevance of project design, efficacy, and efficiency.

Risk to development outcome is rated **substantial**. The main risks relate to the maintenance of rehabilitated infrastructure, which is subject to the continued improvement of the financial and technical capacity of WUAs and broader support from minor irrigation departments; continued support from multiple government agencies dealing with irrigation, agriculture, and market linkages; and the farmers' ability to adopt water-efficient and sustainable agricultural practices and market diversified produce effectively.

Bank performance, based on quality at entry and supervision, is rated **moderately satisfactory**. At appraisal, the World Bank identified several risks relating to adoption of new practices by farmers, overexploitation of groundwater, variability in rainfall, delays in implementation and coordination among government agencies, and water charge collection. The risk of inadequate water charge collection and slow transfer of Operations and Maintenance funds to WUAs materialized during project implementation, and multisectoral coordination among the implementing agencies was not adequately addressed. On balance, the World Bank's quality at entry is rated **moderately satisfactory**. Throughout project implementation, the World Bank maintained a productive relationship with the client despite political disruption that ultimately resulted in the separation of Telangana state from Andhra Pradesh. The quality of supervision is rated **satisfactory**.

Borrower performance is rated **moderately satisfactory** based on government and implementing agency performance. At project preparation, government of Andhra Pradesh demonstrated leadership through decentralizing water resources development at the community or farm level. The project activities got off to a slow start and were gradually picking up pace when events leading to the state's bifurcation posed fresh

challenges. After state bifurcation, both states provided autonomy to their PMUs to effectively manage project activities. Overall, implementing agency performance is rated **moderately satisfactory**.

Lessons

The potential economic benefits from improved irrigation infrastructure cannot be adequately realized by beneficiaries without the coordinated and ongoing support of multiple government agencies and research extension services in agriculture. The improved availability of water from the project could have been leveraged to a greater extent by providing coordinated and ongoing support for improved water management and sustainable agricultural practices, crop diversification to reduce risks and expand income sources, and developing better market linkages. This could have been attempted through this project or parallel projects as had been done in other states in the country.

Continued support to WUAs in terms of resources and social intermediation, such as through nongovernmental organizations, is key to enhancing their capacity for improved water management in drought-prone areas. Support provided under this project enabled WUAs to improve their performance on administrative functions but less so on financial and technical aspects. A lack of stable and predictable technical and financial support after project completion has limited the efficacy of WUAs. Although WUAs can be expected to take care of minor repairs and maintenance and clearing of vegetation, they need access to services and technical support for repairs of any significance and for mainstreaming sustainable agriculture and water management practices.

Benefits from increased water availability can be further increased if cropping decisions by smallholder farmers in drought-prone areas are informed by water budgeting and collective governance principles for sustainable use. This project undertook significant initiatives to raise awareness and provide technical support to beneficiaries for making informed cropping decisions and applying water budgeting principles. However, to mainstream these practices and overcome social and political barriers for their adoption, appropriate policies and incentives need to be instituted, as suggested by experience from similar projects in other states in India. Such efforts can be usefully supported by introducing increasingly affordable measurement techniques using sensors and information and communication technology tools, making it increasingly feasible and affordable to reliably measure water conveyance and use.

José Carbajo Martínez

Director, Financial, Private Sector,
and Sustainable Development

1. Background and Context

1.1 At project appraisal in 2007, the state of Andhra Pradesh (which was bifurcated into the states of Andhra Pradesh and Telangana in 2014) faced slowing growth in its agriculture sector. Between 1999 and 2006, agriculture grew at 2.5 percent per year, with almost all growth coming from the livestock and fisheries subsectors; however, the crop subsector, which accounted for about 60 percent of state domestic product from agriculture, stagnated. Consecutive droughts and inadequate investments in irrigation were key factors for poor agricultural performance.

1.2 Among irrigation infrastructure, tanks (artificial water reservoirs fed by rainfall, streams, or rivers) have historically played an important role in the state. Farmers who do not have access to canal irrigation rely on surface irrigation from tanks for cultivation in addition to rainfall during the monsoon season and groundwater if they own a borewell. The state had the largest number of tanks (approximately 74,000) and the largest area irrigated by tanks in India. However, from 1999 to 2005, the state saw a steady decline in tank-based irrigation, from 1.0 million hectares (24 percent of the irrigated area) to 0.5 million hectares (12 percent of the irrigated area)—due to a lack of maintenance and an increase in the use of groundwater for irrigation. Most tanks were performing well below capacity with the percentage of actual area irrigated to potential created varying between 35 and 55 percent depending on rainfall.

1.3 Tank rehabilitation and modernization, to improve levels of storage and, therefore, adequacy and reliability of water supply for a greater period of the year, was therefore a priority. Improvements to tanks can also potentially reduce overuse of groundwater and improve climate adaptation and water management and contribute to making agricultural activities more sustainable.

1.4 Evidence from a similar World Bank project (the Tamil Nadu Irrigated Agriculture Modernization and Water-Bodies Restoration and Management Project [P090768]; 2007–15) that was recently assessed by the Independent Evaluation Group (IEG), shows that when accompanied by well-rounded technical, financial and institutional support, tank rehabilitation can improve economic benefits from crop diversification, improved water use efficiency, and agricultural productivity (World Bank 2019a). This involves coordinated support from multiple government departments (agriculture, agricultural marketing, fisheries, animal husbandry, and water resource management) and connections with the private sector for market linkages and selected inputs.

1.5 The role of community-based organizations, mainly water user associations (WUAs), was crucial for basic maintenance of irrigation facilities and for the efficient use

and equitable sharing of available water. However, ensuring the financial viability and technical capacity of WUAs or similar organizations is a challenge that requires ongoing support from the government.

1.6 At project appraisal, the World Bank had already been engaged in financing large irrigation construction projects in the state for a few decades. Given the World Bank's familiarity and experience with the state's irrigation sector, as well as relevant support to other states in the country, the government of Andhra Pradesh approached the World Bank for support in its new emphasis and major effort to upgrade tank-based irrigation infrastructure.

World Bank Support for the Irrigation Sector

1.7 The Andhra Pradesh and Telangana Community-Based Tank Management Project (APTCBTMP; which is being assessed in this report) is succeeded by the Andhra Pradesh Integrated Irrigation and Agricultural Transformation Project (P160463) in the new state of Andhra Pradesh. The new project builds on APTCBTMP and was approved in 2018 for a planned duration of seven years. The development objective of the Andhra Pradesh Integrated Irrigation and Agriculture Transformation Project is to enhance agricultural productivity, profitability, and the climate resilience of smallholder farmers in selected districts. The project's activities cover the rehabilitation and modernization of additional water tanks and small-scale community-based irrigation systems and capacity building for WUAs. At the time of the IEG mission, no follow-up project was planned for Telangana state.

Table 1.1. World Bank Irrigation Sector Project in Andhra Pradesh and Telangana States

Project Title and Identification Number	Duration *(fiscal year)*	World Bank Commitment *($, millions)*
Andhra Pradesh and Telangana State Community-Based Tank Management Project (P100786)	2007–17	174.0
Water Sector Improvement Project (P100954)	2010–19	450.6
Andhra Pradesh Integrated Irrigation and Agricultural Transformation Project (P160463)	2018–25	172.2

1.8 The Water Sector Improvement Project (P100954; 2010–19), which addressed canal irrigation, was implemented largely in parallel with the APTCBTMP. Its objectives were to improve irrigation service delivery on a sustainable basis to increase productivity of irrigated agriculture in the Nagarjunasagar irrigation canal system and to strengthen Andhra Pradesh's institutional capacity for multisectoral planning, development, and management of its water resources. The project also provided training and capacity building for members of WUAs. The development outcome of this project was rated moderately satisfactory (World Bank 2019b). At the time of project

preparation for APTCBTMP, the option of combining the Water Sector Improvement Project's objectives into one project was considered but not pursued because of potential complexity of project design and institutional arrangements. The projects were implemented by different World Bank teams through separate government departmental and Project Management Units (PMUs).

2. Relevance of the Objectives and Design

Objectives

2.1 The project objectives were to (i) improve agricultural productivity with the assistance of selected tank-based producers; and (ii) improve the management of tank systems with the assistance of selected WUAs (World Bank 2007).

2.2 The project covered the undivided state of Andhra Pradesh until it was bifurcated into two states—Andhra Pradesh and Telangana—at the end of 2014. The project subsequently covered both the states until closure.

Relevance of the Objectives

2.3 At appraisal, project objectives were highly relevant to the government of Andhra Pradesh's priorities and its emphasis on decentralized irrigation development in the state. By 2006–07, the state had allocated 84 percent of its irrigation budget for capital improvements, up from an average of 36 percent between 2001–02 and 2003–04. Also, in 2005, the government of India initiated the Bharat Nirman program, which sought to increase irrigated area in the country by 10 million hectares. As part of this program, the government of India included the restoration and renovation of tanks as a priority task for which a pilot scheme was launched in several states, including Andhra Pradesh. The APTCBTMP's objectives were also in line with the World Bank Group's India Country Assistance Strategy for FY05–08, which aimed to increase the efficiency of irrigation systems together with a community empowerment approach, to improve productivity of irrigation water and rural livelihoods.

2.4 At project completion, the project objectives continued to be highly relevant to the priorities of the governments of the new states of Andhra Pradesh and Telangana and the government of India. This is underlined by major statewide schemes covering tank-based irrigation—Neeru Chettu in Andhra Pradesh and Mission Kakatiya in Telangana—which commenced around the time this project was reaching completion. These schemes are discussed in some detail in the Risk to Development Outcome section in chapter 6. The objectives are in line with the government of India's 2012 National Water Policy to strengthen irrigated water resource management and increase

agricultural productivity. The World Bank Group's Country Partnership Strategy for India (2013–17) highlighted the urgency of boosting India's agricultural productivity in the face of ongoing global food security concerns, pronounced food price volatility, and concerns about climate change.

2.5 The relevance of project objectives is rated **high**.

Project Design

2.6 The project included three components:

- **Institutional strengthening** (appraisal cost: $16.4 million; actual cost: $12.85 million). This component financed capacity building, training, and extension activities aimed at enabling community-based institutions—WUAs, fisheries cooperative societies, and farmer interest groups—to assume greater responsibility for tank system management and for improvement of tank-based agricultural livelihoods.

- **Irrigation systems improvements** (appraisal cost: $150.6 million; actual cost: $144.46 million). This component financed infrastructure and related activities aimed at enhancing the efficiency of water use in tank areas selected under the project. It included two subcomponents:

    - *Tank systems improvements*: (i) improving the physical and operational performance of selected tank systems (which includes feeder channels above the tank reservoir, the tank itself, and the irrigation channels in the command area) through a range of interventions identified and executed in partnership with tank WUAs; (ii) securing the safety of the tank structure; and (iii) improving on-farm water management and water use efficiency. This subcomponent would support the physical rehabilitation and modernization of tank systems with cultivated command area of between 40 and 2,000 hectares. About 3,000 tanks on about 250,000 hectares, spread across 21 districts of the state, would be rehabilitated under the project.

    - *Participatory groundwater management*: The aim of this subcomponent was to enable groundwater users in those tank systems that were subject to groundwater stress to improve the management of their groundwater resources, and thereby enhance their agricultural productivity and livelihoods.

- **Agricultural livelihoods support services** (appraisal cost: $25.2 million; actual cost: $23.44 million). This component financed support services to enhance tank-

based livelihoods by increasing production, productivity, and profitability of agriculture, horticulture, fisheries, livestock, and other significant productive activities. It included five subcomponents:

- *Agriculture and horticulture*: increasing production and productivity of field, horticultural, and fodder crops in tank command areas.
- *Livestock*: increasing the production and productivity of milk, meat, and related animal products.
- *Fisheries*: improving production and productivity of tank fisheries.
- *Foreshore plantation*: effective use of tank foreshore areas in selected locations.
- *Agri-business and marketing:* increasing profitability and promoting product diversification and greater market orientation of production.

2.7 **Project cost and financing**. The project cost estimated at appraisal was $217.80 million, to be financed by an International Bank for Reconstruction and Development (IBRD) loan and an International Development Association (IDA) credit of $94.5 million each; the borrower contributed $28.80 million; and WUAs contributed $7 million. The IBRD and IDA shares were reduced to $87 million each through restructuring in 2012. Actual project cost at completion was $202.80 million, about 7 percent lower than the appraisal estimate of $217.80 million. This consisted of actual IBRD and IDA contributions of $71.59 from IBRD, $86.60 million from IDA, and a borrower contribution of $17.58 million. The contribution from WUAs was not reported. An amount of $15 million was canceled from the original loan amount due to currency devaluation and an additional $10 million was saved through savings within the project components and due to discontinuation of the livestock and foreshore plantation subcomponents after the midterm review.

2.8 **Dates**. The project closed on July 31, 2016, three years and seven months after the originally scheduled date of December 31, 2012. There were four project extensions that were needed to accommodate delays in the execution of works that resulted from political disturbances in the state during implementation. The project had four level 2 restructurings (meaning the original objectives were not revised) as follows:

- October 30, 2012 (amount disbursed by this date: $87.85 million): closing date extended from December 31, 2012, to September 30, 2014, due to slow pace of implementation.

- February 28, 2014 (amount disbursed by this date: $127.11 million): to approve the partial cancellation of savings resulting from the depreciation of the Indian rupee.
- May 29, 2014 (amount disbursed by this date: $129.10 million): to approve the cancellation of $7.50 million under IBRD and extend the closing date from Sep 30, 2014, to July 31, 2016, to compensate for implementation delays due to political events leading to the state's bifurcation.
- December 22, 2014 (amount disbursed by this date: $133.52 million): to accommodate the bifurcation of Andhra Pradesh into the new Andhra Pradesh and Telangana states.

2.9 A Midterm Review was carried out on September 13, 2010, leading to the cancellation of the livestock and foreshore plantation subcomponents due to lack of interest on the part of the corresponding government departments. One reason for this appears to be the relatively low quantum of funds allocated by the project to these activities relative to departmental budgets.

Relevance of Project Design

2.10 The project objectives are stated clearly but do not directly address the expected impacts from the project in terms of increased incomes and improved livelihoods of the target beneficiaries, though these issues are discussed at length in the project appraisal document. Thus, the first objective of improving agricultural productivity with the assistance of selected tank-based producers is stated in terms of an outcome. Similarly, the second objective of improving the management of tank systems with the assistance of selected WUAs is an intermediate outcome.

2.11 The range of inputs, outcomes, and impacts contained in the results framework can be logically linked to the stated objectives. The main inputs were tank rehabilitation and capacity development for WUAs. These were accompanied by activities for enhancing tank-based livelihoods and supporting agri-business and marketing. Collectively, these inputs would improve the management of tank systems, enhance water availability and efficiency of water use, and therefore improve agricultural production and productivity. Because it addressed tank rehabilitation and support activities that would help farmers realize the expected benefits from increased availability of water, the project design was quite comprehensive and robust. The project appraisal document additionally states that the resulting outcomes would be increased profitability of agriculture, horticulture, fisheries, and livestock activities.

2.12 Given that the project design necessitated the involvement of multiple government departments, including agriculture, horticulture, fisheries, and animal husbandry, greater attention should have been paid to arrangements in the field for coordination and for incentivizing cooperation among them.

2.13 The project design could have benefited from a stronger marketing component and value chain analysis to complement efforts for crop diversification.

2.14 Overall, the relevance of project design is rated **substantial**.

Monitoring and Evaluation

2.15 **Design**. The Project Management Unit (PMU), through its dedicated Monitoring, Learning, and Evaluation (MLE) unit—comprising one monitoring and evaluation (M&E) expert and one data analysis and documentation expert—had overall responsibility for planning and coordinating M&E activities. The PMU coordinated the M&E activities of three sets of entities: (i) the implementing departments or agencies at the state and district levels; (ii) an external M&E agency engaged as consultants for the duration of the project; and (iii) beneficiaries, primarily WUAs and various project-supported farmer interest groups. The process of participatory MLE by beneficiaries was facilitated by local support organizations, an external agency, or the PMU or district-level units. The structure adopted by the project to organize the M&E effort, the entities involved, and their responsibilities, from the village or tank level upward to the district and state levels, is described in box 2.1.

2.16 The results framework included six outcome indicators, four to assess the first objective and two to assess the second. There were also 16 intermediate outcome or output indicators to assess activities under the different project components. These indicators were relevant and directly linked to the project objectives and were realistic and measurable, such as increase in productivity (kilograms per tonne per hectare, cropping intensity; percentage), and WUAs in rehabilitated tank systems whose Operations and Maintenance (O&M) expenditure is as per agreed annual O&M plans (percentage). The M&E design also provided for a baseline survey, and two impact assessments of the project (midterm and end of project) were completed. Most indicators included targets at output and outcome levels, and several critical indicators also included baselines (for example, cropping intensity, irrigated areas, and productivity of crops).

2.17 The baseline study was conducted in the first year of the project. The project outputs were regularly monitored, and the PMU created a database for project activities. However, the state's bifurcation in 2014 disrupted M&E activities and contributed to

delays in maintaining continuity in an external M&E agency, as described in the Procurement section.

Box 2.1. Institutional Arrangements for Monitoring, Learning, and Evaluation or Management Information Systems

The Project Management Unit's Monitoring, Learning, and Evaluation (MLE) unit activities included a baseline study; regular performance tracking of inputs and outputs by concerned implementing agencies; concurrent performance monitoring (on a sample basis) by external monitoring and evaluation agency; systematic ("panel data" type) analysis of project impacts through repeated monitoring of the same sample set of households through project lifetime; midterm and final impact evaluations; and continuous participatory MLE by beneficiary groups at various levels. The modalities at the village or tank, district, and state levels were as follows:

- **Village or tank level.** Responsibility for monitoring and evaluation was with the water user associations (WUAs) and the project facilitators. The project had over 250 support organizations involved in facilitating the project across 2,155 tank locations.
- **District level.** The manager of the management information system coordinated with the District Project Unit staff on capacity building for MLE for support organizations, district project units and WUAs.
- **State level**. The 21 project districts were divided among into four groups, and each group was assigned, for the purpose of mentoring and monitoring, to a multidisciplinary team comprising Project Management Unit experts and senior staff. Each team had an appointed group leader.
- **WUA performance assessment**. This was consolidated group-wise, and the team responsible for it was held accountable for the results of the zone. Each team had four or five members from the PMU, and the number of tanks assigned to each group ranged from 465 to 651.

2.18 **Use**. The MLE system generated data on the results framework and for annual action plans. Management information systems reports included progress of project implementation, release of funds, stakeholder details, and results of participatory assessments, all of which were regularly posted on the project website. These data highlighted the project's achievements and reflected lessons learned from implementation. These reports benefited from both qualitative and quantitative analysis of project activities. Feedback from PMU officials suggests that impact assessment reports were used in planning implementation by the project team and World Bank staff as well as the Implementation Completion and Results Report preparation team.

2.19 The project's M&E is rated **substantial**.

3. Implementation

3.1 At the beginning of the project, the overall responsibility for project implementation and coordination was with the Command Area Development wing in the Irrigation and Command Area Development Department of Andhra Pradesh. The project was managed through a PMU. The PMU, headed by the state project director with the rank of Special Commissioner, Command Area Development, included a multidisciplinary team comprising 13 specialists covering the Departments of Agriculture, Horticulture, Animal Husbandry, Fisheries, Forestry, Rural Development, Groundwater, and various support organizations and private service providers, as well as an M&E expert, a management information system manager, and a geographic management information system manager.

3.2 Corresponding District Project Units (DPUs) were established at the district level for each district headed by District Project Directors with smaller multi-disciplinary dedicated teams. Eventually, the animal husbandry and forestry (foreshore plantation) aspects of the project were dropped, and the related departments ceased to have a role. After state bifurcation, a second PMU was created in the state of Telangana under the same institutional structure as the original one.

3.3 **Environmental and social safeguards compliance**. The project was classified in category B under the World Bank's safeguard policies. It triggered the following Operational Policy / Bank Procedure (OP/BP): Environmental Assessment (OP/BP 4.01), Pest Management (OP 4.09), Physical Cultural Resources (OP/BP 4.11), Indigenous Peoples (OP/BP 4.10), Involuntary Resettlement (OP/BP 4.12); and Safety of Dams (OP/BP 4.37). Likely adverse environmental impacts from tank rehabilitation were identified as improper disposal of silt, loss of tree cover or biodiversity, increase in the use of pesticides and chemical fertilizers after tank rehabilitation, and potential impacts on cultural property. The project complied with each of the triggered safeguard policies, as detailed in appendix B.

3.4 **Fiduciary compliance**. The PMU and the district project units had satisfactory financial management capacity. The WUAs benefited from project activities and generally demonstrated their ability to successfully run a financial management system, which included timely fund disbursement, and regular monitoring and submission of expenditure statements. The internal audit mechanism was assessed to be weak, and therefore, the internal audit function was contracted to an independent chartered accountant firm, which carried an internal audit annually. The audit reports were not qualified.

3.5 **Procurement**. The World Bank's specialist report on procurement assessment did not find any serious lapses in procurement of goods, works, and services. In March 2013, the project was found to be not in compliance with the legal covenant to appoint an external M&E agency. The first contract awarded to an external M&E agency expired in February 28, 2013, in keeping with the original closing date. Contracting a new M&E agency was delayed due to queries raised by the Andhra Pradesh Finance Department, which took time to resolve, especially in the runup to the state's bifurcation. The lapse was rectified in December 2014 when an external consultant was contracted as the new M&E agency.

4. Achievement of the Objectives

4.1 This section discusses the outputs and outcomes against each of the two project objectives at project completion, and the extent to which they are likely to have been sustained in the two years since project completion.

4.2 **IEG field visits**. The IEG mission visited five project activity locations in Andhra Pradesh and six locations in Telangana (table 4.1; appendix C). The purpose of these site visits was to assess the extent to which the outcomes from the infrastructure, institutional, and capacity building activities have been sustained and built on since project completion; and to get firsthand feedback from beneficiaries and field officials in this regard. The locations were purposively selected to cover the main subregions and varying rainfall levels.

Table 4.1. Irrigation Tanks Visited

State	Tank Name	District	Mandal	Village	Ayacut (Irrigated Area) *(no. acres)*
Telangana	Pedda Cheruvu	Medak	Kowdipally	Kowdipally	232
	Rairao Cherevu	Medak	Narsapur	Narsapur	515
	Pentoni Cherevu	Mahboobnagar	Bijnepalli	Palem	280
	Kesarasamudram	Mahboobnagar	Nagarkurnool	Nagarkurnool	1,594
	Pedda Cherevu	Warangal	Ghanpur	Ghanpur	628
	Chalimela Vagu	Warangal	Bhupalpalle	Bhupalpalle	730
Andhra Pradesh	Kallepalli	West Godavari	Lingalapalem	Asannagudem	264
	Chinnapatha	East Godavari	Prathipadu	K. Kothapalle	184
	Appalaraju	Visakhapatnam	Nakkapalli	Vempadu	152
	Haresamudram	Ananthapuramu	Madakasira	Haresamudram	907
	Kriyasakthi Vadayar	Ananthapuramu	C K Palli	Mustikovela	417

4.3 At each site, the mission visited the rehabilitated irrigation tank and related structures and standing crops in the *ayacut* (area served by an irrigation source) and conducted walking tours with farmers, fishers, and officials from the PMU and line departments. The mission visited WUA offices where feasible and noted the quality of facilities and records maintained by the managing members. At each village, these walking tours were followed by a one- to two-hour meeting with a broader assembly of 60–100 village residents, including village leaders and members of the WUA, and tail-end (downstream) farmers in the irrigation system. At least one-third of those present were women. These assemblies served to gather the views of a cross section of farmers and other beneficiaries about how the project activities had impacted their work and livelihoods and to corroborate feedback given by the PMU and line department officials.

Objective 1: Improve Agricultural Productivity

4.4 Efficacy of the project's first objective, "improve agricultural productivity with the assistance of selected tank-based producers," is rated **substantial** on efficacy.

Outputs at Project Completion

4.5 Overall, the project was successful in achieving the planned outputs for tank rehabilitation, increasing irrigated area, and capacity building. At completion, the project met or exceeded its targets for tank rehabilitation; irrigation coverage of tank ayacut area; capacity building, training, and demonstration activities for farmers and fishermen; and creating commodity interest groups for marketing produce. The number of direct beneficiaries from the project reached 605,052—nearly equal to the target of 605,188. No attributable results were reported for the livestock and foreshore plantation

components, which were dropped during project implementation. Findings were as follows:

- **Tank rehabilitation**. The project rehabilitated 2,157 minor irrigation tanks as per the revised target, with a total area of 254,957 hectares. This comprised 975 tanks in Andhra Pradesh and 1,182 tanks in Telangana with a design ayacut of 122,116 hectares and 131,214 hectares, respectively. The improvements covered strengthening of reservoir embankments, renovating sluice or head regulators, and improving water distribution through field channels. The quality of construction was broadly confirmed through about 5,000 quality control tests conducted by third party external consultants.

- **Irrigated area**. At the end of the project, 82 percent of the command area covered by the rehabilitated tanks was irrigated compared with a target of 75 percent and a baseline of 54 percent, amounting to an additional area of 63,739 hectares being covered by irrigation.

- **Participatory groundwater management**. This was implemented at 314 tanks (142 tanks in Andhra Pradesh and 172 in Telangana) as planned in 13 districts with a total tank command area of 25,000 hectares, to enable groundwater users to reduce groundwater stress and improve the sustainability of management of groundwater resources.

- **Capacity building for crop productivity and diversification**. The project supported training for 42,000 farmers and 7,343 crop technology demonstrations on adopting improved cultivation and water management practices. Crop and input choices met or exceeded targets.

- **Agri-business and marketing**. Against a target of 1,500 commodity interest groups, 1,406 were started, with 22,154 members at project completion. The purpose of creating commodity interest groups was to increase profitability, promote crop diversification, and expand market opportunities.

Outcome at Project Completion

4.6 The project outputs resulted in generally positive outcomes for agricultural and water productivity, though results were lower than expected for crop diversification. The project covered physical rehabilitation and modernization of tank systems with cultivated command area between 40 and 2,000 hectares. About 3,000 tanks with an estimated ayacut of about 250,000 hectares (approximately 6 percent of all irrigated area) spread across 21 of 46 districts in undivided Andhra Pradesh.

4.7 Based on the results of the impact assessment at project completion, agricultural and water productivity significantly exceeded targets in project areas, whereas crop diversification away from rice paddy was lower than targeted. Sale values for rice paddy, groundnuts (peanuts), and maize improved to some extent. All tank-based fishing communities adopted improved fish production and harvesting techniques, and fish productivity increased steeply. These positive results can be attributed to the project meeting its targets for tank rehabilitation, diverse capacity building activities for farmers, and creation of commodity interest groups. Findings were as follows:

- **Agricultural and water productivity**. Rice paddy, maize, groundnuts, and vegetables saw productivity increases of 36, 72, 113, and 40 percent, respectively, against corresponding targets of 25, 30, 25, and 30 percent. Water productivity, calculated as crop output per unit of water from groundwater irrigation, increased by 38.9 percent to Re 83,256 per hectare-meter, exceeding the target of 10 percent.

- **Crop diversification**. Rice paddy still covered 75 percent of the cultivated area (against a target of lowering it to 66 percent by substituting with higher-value crops), though results were better than expected in some drought-prone areas.

- **Marketing produce**. The creation of commodity interest groups helped increase the final sale value of rice paddy, groundnut, and maize by 9, 8, and 17 percent, with only maize exceeding the common target of 10 percent.

- **Fisheries**. All the tank-based fishing communities adopted improved fish production and harvesting techniques against a target of 80 percent, and fish productivity increased steeply by 324 percent overall in 1,146 tanks. The project also generated employment for 99,956 fishers who were landless and/or belonged to weaker sections of society.

- **Water use efficiency**. The increased availability of water from the project was not leveraged by any significant measures for improving water use efficiency, apart from the construction/ rehabilitation of field channels. The farmers appear to be continuing with the traditional practice of flood irrigation, which is especially wasteful in drought-prone areas.

IEG Findings

4.8 Findings for all the visited tanks are presented in appendix C.

4.9 **Infrastructure**. IEG triangulated observations from site visits, feedback from project and government officials, beneficiaries, various data sources, and research studies. In all 11 tanks visited by the IEG mission, the rehabilitated tank infrastructure

(bunds or embankments), check dams, guide walls, irrigation channels, sluices, and shutters) were mostly in good operating condition, as confirmed by department officials, WUA members, and other local beneficiaries. Selected pictorial illustrations of the physical facilities and meetings are presented in appendix D. In some cases, some additional enhancements have been made by using state and local resources, such as bund widening and desilting.

4.10 For instance, at Pedda Cheruvu (Kowdipally) tank in Telangana, the bund was widened, the weir reconstructed, two sluices were replaced, and a 3-kilometer canal was relined. Since then, the tank has been desilted and a stairway leading into the lake has been built for the convenience of washermen. At Kallepalli tank in Andhra Pradesh, the bund was expanded from 0.5 to 1.7 meters and is now useful for basic transport, including agricultural inputs and produce, and three sluices were replaced.

4.11 **Fisheries**. The IEG mission saw evidence of strong fisheries activity at 8 of the 11 tanks visited. Fishers generally reported longer fishing seasons due to greater availability of water and increased yields. The fisheries cooperative societies at these sites also received complementary support from the state governments in the form of free fish seed or fingerlings and two-wheelers and "tempos" (small vans) for transporting their produce to the market.[1]

4.12 **Water adequacy**. Despite both the states receiving less than normal rainfall in the last two years, most of the tanks reported availability of water in February, at the end of the *rabi* (winter) growing season and three to four months before the onset of the monsoon.[2] Beneficiaries reported that the tank rehabilitation works have contributed greatly to increase in water availability. Groundwater has been recharged in most sites, with most tanks reporting higher water levels, and previously dry wells yielding water. In some cases, tail-end farmers reported receiving larger quantities of water than before the project.

4.13 **Crop diversification, intensification, and agricultural productivity**. The IEG mission was not able to obtain systematic updated information on agricultural productivity specific to the project areas since project completion. This is because after project completion there were no resources or incentive for continuing M&E that was focused on the project sites. Also, the separation of Telangana state from Andhra

[1] When they have developed to the point where they can feed themselves, the fish are called fry. When, in addition, they have developed scales and working fins, the transition to a juvenile fish is complete and it is called a fingerling. Fingerlings are typically about the size of fingers.

[2] The *kharif* cropping season is from July–October during the south-west monsoon and the *rabi* cropping season is from October–March (winter).

Pradesh in 2014 affected the location of staff attached to the project and any possibility for continued data collection in terms of project interventions. However, anecdotal information from departmental staff and beneficiaries supports an overall trend toward crop diversification and, in some instances, significantly increased productivity. For example, at the Chalimela Vagu tank area in Telangana, even one crop was difficult to grow before the project, but now two crops are feasible, and there has been an increase in productivity of rice: 20–25 bags per acre during the *kharif* season and 40 bags per acre during the rabi season, representing an overall 20–25 percent increase in yield. The system of rice intensification was partially adopted in this area, resulting in a 40 percent increase in yield. In the Kriyasakthi Vadayar tank area in Andhra Pradesh, drip irrigation has been taken up to some extent for horticulture (bananas, other fruit, and hybrid vegetables), which also takes advantage of government subsidies).

4.14 **Water use efficiency**. Though the project has been able to ensure water for irrigation in the command area, no measures were put in place for improving water use efficiency, apart from the construction or rehabilitation of field channels. The farmers appear to be continuing with the traditional practice of flood irrigation, which is especially wasteful in drought-prone areas. The IEG mission saw evidence of sprinkler and drip systems, and "rain guns"[3] in and around Ananthapuram district, but there is little or no such use in the project sites visited by the mission. Also, the project did not strategically promote such methods. In some of the project sites in Andhra Pradesh, project officials showed the use of piezometers for monitoring groundwater level and reported that local community-level village cadres are providing support to the owners of wells to understand the water availability, discharge rate, and recharge rate at regular intervals. But this practice does not appear to be widespread, nor does it appear to be linked to decision making for water allocation and use.

4.15 **Agricultural marketing**. The IEG mission was not able to get any systematic update of the commodity interest groups. Informal feedback from officials and beneficiaries suggests that several of them may not be functioning at the level that they had reached by project completion.

4.16 **Other benefits**. Tank rehabilitation has improved the availability of drinking water, livestock, and in some places, washermen (traditional laundrymen). In most of the sites, beneficiaries reported improved availability of drinking water in the command area and in nearby villages. This has been made possible by both enhanced recharge of groundwater and lifting water from the tank influence area and by digging new shallow tube-wells in the tank submergence area. Some livestock farmers reported that they do

[3] A rain gun is a high-pressure, high-volume, large-diameter sprinkler irrigation system.

not have to go farther afield for grazing or providing water to their animals. Washermen have access to water for a longer period of the year than before. Some farmer and fisher beneficiaries in the drought-prone Mehboobnagar district in Telangana reported that due to the increase in agricultural activities attributable to the project, there is now less need for them to seek seasonal employment in urban areas. They stated that due to the project, they now have greater scope for work and their incomes have increased.

Objective 2: Improve the Management of Tank Systems

4.17 Eficacy of the project's second objective, "improve the management of tank systems with the assistance of selected WUAs," is rated **substantial** on efficacy.

Outputs at Project Completion

4.18 **WUAs**. During the project, WUAs were provided with training in administrative and accounting functions and with responsibilities for maintenance and allocation of water. Additionally, the WUAs were entrusted with responsibilities relating to rehabilitation activities.

4.19 The project introduced a system using OK cards, which were inspection documents for works being executed by contractors (tank bunds, sluices, mechanical fixtures, and other physical components of the rehabilitated tank systems) that were submitted to the project director. WUAs were involved in filling out details of OK cards in their areas.

4.20 In addition to elected members, all the WUAs co-opted members from the public (farmer beneficiaries) as required, compared with a baseline of 4 percent of WUAs at the beginning of the project and a target of 90 percent. The membership of WUAs also expanded to include fishers and groundwater users. However, there was a low representation of women members in WUAs and management committees, where they occupied 14 percent and 16 percent of seats, respectively.

Outcome at Project Completion

4.21 **WUAs**. At project completion, 1,791 tanks were handed over to WUAs for operation and maintenance. Of these, 97 percent met planned levels of O&M expenditure as agreed in annual O&M plans, compared with a target of 80 percent. Based on a sample of 220 WUAs, the final impact assessment found that 81 percent of water users in rehabilitated tank systems were satisfied with WUA operation and maintenance compared with a target of 75 percent (Andhra Pradesh 2014a).

4.22 Of the WUAs surveyed, 88 percent found that the OK card experience made it easier for them to understand the status of the institutional and technical aspects and to

build a sense of ownership over the tanks. Several WUAs realized increased income from an improved water tax collection rate and lease income from the award of tank fishing rights to a greater extent than targeted.

4.23 A simple tool of Quantified Participatory Assessment was devised by the project for self-monitoring by primary stakeholders (see appendix E). This WUA self-rating tool is a single sheet or poster with 15 criteria in four different areas of the WUA's work (participation and dialogue; performance; self-management; and innovations and technology adoption), each assigned a weight in accordance with its relative importance toward WUA functioning. The maintenance and water allocation functions are reflected in the criteria under the Performance and Self-Management areas of the assessment. The rating process was facilitated by support organizations, and the results showed that 27.7 percent of the WUAs self-rated as excellent, 56.1 percent as good, 13.9 percent as average and only 2.3 percent as poor.

4.24 An FAO study commended the APTCBTMP for its unique MLE design (box 2.1) that conducted M&E during the project (FAO 2013), noting that the project recognized the centrality of WUAs in all interventions and made it possible through "truly participatory systems and processes" (Andhra Pradesh 2010, 4). The study found that participatory MLE by WUAs through self-rating of their own performance increased awareness and clarity of their roles and responsibilities.

4.25 The IEG mission visited the WUA office building in the Kallepalli and Chinnapatha tank areas in Andhra Pradesh. At both these sites, the WUA had a dedicated building with an office and facility for meetings. WUA members in both sites had meticulous records of regularly conducted meetings, and accounts for WUA fees and expenses. Both WUAs displayed self-rating cards introduced under the project. More observations for the two WUAs are presented in appendix C.

4.26 Since project completion, WUAs in their original form have been discontinued in Telangana pending a review to replace them with institutions composed of accountable bodies with nominated rather than elected members. In Andhra Pradesh, however, WUAs will be strengthened in their current form, including through the successor Andhra Pradesh Integrated Irrigation and Agricultural Transformation Project (P160463).

Conclusions on Efficacy

4.27 Against the first objective of improved agricultural productivity, the outcomes for crop productivity and water productivity exceeded their targets, though there were shortcomings in meeting crop diversification goals. These outcomes appear to have been largely sustained based on IEG's observations at selected project sites. Regarding the

second objective of improved tank management, WUAs have improved their administrative and accounting functions and have generally developed the capacity to monitor their own performance for core maintenance and water allocation tasks. But, after project completion, there is an increased need for maintaining or improving overall financial sustainability and technical capacity of WUAs or alternative entities that may replace WUAs in Telangana state, with supplemental resources from the government as needed. Based on the evidence presented in the above discussion for objectives 1 and 2, the project achieved the targets for the outcome indicators, with moderate shortcomings.

5. Efficiency

5.1 At appraisal, the economic rate of return and the financial rate of return for the project were estimated to be 23.6 percent and 18.2 percent, respectively. These values were calculated for a 25-year period using 2007 constant prices and a discount rate of 12 percent.

5.2 These estimates were based on the benefits that could be reasonably attributed to project outputs as follows: (i) expansion in area benefiting from irrigation, which increases production and cropping intensity; (ii) diversification, which involves a shift to higher-value crops; (iii) improved agricultural technology and practices, which increases agricultural productivity; (iv) improved water security for production in irrigated areas, which reduces production losses in low rainfall years; (v) increased output of fish through improvement in fish production techniques; (vi) increased milk production through breed upgradation and improved animal husbandry; and (vii) foreshore plantations, which are expected to produce commercial timber for the WUA. Sensitivity analysis using different scenarios indicated that the project was able to absorb substantial negative impacts and yet generate robust returns.

5.3 The ex post economic analysis generally used the same methodology as at appraisal, except for benefits derived from the livestock and foreshore plantations (timber production) subcomponents, both of which were dropped during project implementation. At project completion, the economic and financial rates of return were 27.5 percent and 21.0 percent respectively, exceeding the estimates at appraisal.

5.4 Three factors contributed to the favorable economic rate of return of the project while offsetting the reduction in economic returns due to the delays in project implementation after state bifurcation. First, the project brought an additional 63,740 hectares of registered command areas into full irrigation status. Second, improved water availability enabled farmers to diversify by shifting to nonpaddy, higher-value-added commodities such as maize and groundnuts. Third, productivity for key crops was higher than projected at appraisal due to the adoption of improved technologies, such as

hybrid seeds and better crop varieties, integrated pest management, and integrated nutrient management.

5.5 **Administrative and institutional efficiency**. The project closing date was extended from the original date of December 31, 2012, to July 31, 2016 (three years and seven months). This extension was needed because of delays in execution of works at the beginning of the project and delays due to political disturbances that began later and eventually led to the state's bifurcation in 2014. Also, the government did not consistently release funds to the implementing departments in a timely manner, which contributed to delays particularly in the agricultural livelihoods component. Further, the overall fiscal crisis in Andhra Pradesh resulted in low project disbursement halfway through, which had reached only 19 percent by 2010, against the planned 50 percent.

5.6 Overall, efficiency is rated **substantial**.

6. Ratings

Outcome

6.1 The relevance of project objectives is **high** because of the importance of tank irrigation to the states of Andhra Pradesh and Telangana, the clear case for rehabilitation of these structures, and the accompanying institutional needs. The relevance of project design is **substantial**, as it provides for physical rehabilitation and capacity building geared to improved outcomes of crop productivity and management of tank systems. Against the first objective, the outcomes for crop productivity and water productivity exceeded their targets, though there were shortcomings in meeting crop diversification goals. Regarding the second objective, WUAs have improved their administrative and accounting functions and are able to monitor their own performance better for their core maintenance and water allocation tasks; but to improve their effectiveness, their overall financial sustainability and technical capacity needs to be either improved or supplemented by additional resources from the government. Efficiency is rated **substantial** given the favorable rates of economic and financial return despite administrative and other delays, some of which are outside the control of both the World Bank and borrower.

6.2 Based on the ratings for relevance, efficacy, and efficiency, the project development outcome is rated **satisfactory**.

Risk to Development Outcome

6.3 The risks to sustainability of the project's development outcomes relate to the maintenance of rehabilitated infrastructure, effective functioning of WUAs, continued support from multiple government agencies dealing with irrigation, agriculture, and market linksages, and the ability of farmers to market diversified produce effectively. In addition, there are uncertainties from uneven rainfall.

- **Maintenance of rehabilitated infrastructure**. The project used sound construction methods and quality control mechanisms for rehabilitating irrigation assets, and the responsibility for managing them was transferred to farmers and WUAs at project completion, after putting arrangements in place for O&M. The rehabilitated assets are likely to be in good condition, given that the physical works were carried out with good quality control between four and nine years ago, and assuming that the sample of tanks visited by the IEG mission is representative of all rehabilitated tanks. However, the ongoing condition of the tanks is subject to the financial and technical capacity of WUAs and broader support from minor irrigation departments.

- **Financial sustainability of WUAs**. Although the WUAs are generally capable of carrying out simple maintenance activities and clearing vegetation, they have limited technical and financial capacity for larger maintenance needs. Although collection of water charges has improved, the amount that is collected (usually Re 100 or $1.40 per acre) is a small fraction of O&M requirements. For major maintenance needs, the WUAs are dependent on the resources allocated by the state governments for O&M, which are subject to competing priorities.

- **Technical and administrative capacity of WUAs**. During project implementation, WUAs had the backing of support organizations (nongovernmental organizations with demonstrated relevant expertise) to improve their capacity for carrying out their responsibilities. The WUAs also gained exposure to maintenance and rehabilitation activities through their participation in less complex project-related works and their role in certifying portions of the OK card for quality control of the major works by contractors. However, these sources of support and exposure have not continued after project completion, and unless ongoing arrangements for capacity building are made, WUAs (or their successors in Telangana) may relapse to preproject levels unless suitable provisions are made in a timely manner. The institution of WUAs is sought to be strengthened in its present form in the new state of Andhra Pradesh, whereas Telangana is replacing it with a new mechanism.

- **Ongoing support for improving agricultural and water use practices**. For farmer beneficiaries to derive potential economic benefits from tank rehabilitation, considerable handholding is needed on an ongoing basis from various government departments. These departments cover agriculture and horticulture, fisheries and animal husbandry, and the extension arms of agricultural universities or research institutes and will need to provide their inputs in an coordinated manner for efficiency and synergy. This has not happened to any significant extent during the project, and it is not clear whether there is any systematic thinking in this regard in either Andhra Pradesh or Telangana to undertake this effort.

- **Marketing facilities and linksages**. Although commodity interest groups were formed during the project, the status and functioning of these entities have not been tracked after project completion. Providing common facilities for storage and drying can create strong incentives to members of commodity interest groups and other farmers to work cooperatively and put themselves in a stronger position to develop market linkages with public and private entities. However, there does not appear to be statewide systematic efforts in this regard.

- **Variable rainfall and climate resilience**. Although the project did not have any explicit objective or component for climate resilience, by promoting conjunctive water use, improving the management of groundwater resources, and investing in storage tanks, farmers in Andhra Pradesh and Telangana have become relatively more resilient to successive drought episodes. The ongoing successor, the Andhra Pradesh Integrated Irrigation and Agricultural Transformation Project, addresses climate resilience more directly. The statewide schemes of Neeru Chettu and Mission Kakatiya are also likely to contribute to increased water storage more widely in the tanks in both Andhra Pradesh and Telangana, though positive results may take some years to materialize.

6.4 Andhra Pradesh and Telangana both have flagship programs playing a significant role in the expansion and sustainability of the development outcomes from APTCBTMP. The schemes have internalized processes from the project related to participatory approaches for identifying and prioritizing infrastructure investments, quality control methods, and M&E for outputs and outcomes. In particular, the project team in Telangana shared a letter from the chief minister to the finance minister of the government of India in the context of seeking funds for Mission Kakatiya, the state government's flagship project for irrigation. According to the letter, "the State mechanism has had enough expertise in handling externally aided projects including ongoing projects like Water Sector Improvement Project, Community-based Tank

Management Project funded by the World Bank."[4] It further states that "the vast experience and lessons learnt under [APTCBTMP] … will help in the design, implementation and management of the tank restoration project with greater convergence of line departments."

6.5 Andhra Pradesh started the Neeru Chettu (literally, "tree of water")[5] scheme in 2014. This scheme covers repairing and renovating existing water harvesting structures and the construction of new structures such as check dams, percolation tanks, minor irrigation tanks, subsurface dams and farm ponds for increasing the groundwater recharge; and conducting repairs, renovation and desiltation of tanks.

6.6 Similarly, the state government of Telangana launched Mission Kakatiya in 2015,[6] a program for restoring all the minor irrigation tanks and lakes in the state. The program aims to rejuvenate 46,531 tanks and lakes, storing 265 billion cubic meters water across the state in five years. The tanks and lakes are dug to remove silt for increasing water storage capacity. Initial results show that the gap ayacut under Mission Kakatiya tanks was brought down effectively from 42 percent in 2013 to 23 percent in 2016. A marked improvement in groundwater table is also reported. Telangana's Irrigation department has created the Telangana Water Resources Information System, which is a web-based portal using geo-spatial technologies to enhance the M&E for planning and decision making.[7]

6.7 The lessons learned from the implementation of APTCBTMP have been valuable for designing a second World Bank–financed phase of the project, Andhra Pradesh Integrated Irrigation and Agriculture Transformation Project with greater focus on climate-resilient sustainable agriculture and water management. The focus of the project is for system improvement at a cascade level and use of remote sensing for efficient resource monitoring.

6.8 Based on the preceding discussion, the risk to development outcomes is rated **substantial**.

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[4] Letter from Telangana Chief Minister Shri K. Chandrasekhar Rao to Finance Minister Shri Arun Jaitley. 2014.

[5] https://irrigationap.cgg.gov.in/wrd/neeruchettu.

[6] https://missionkakatiya.cgg.gov.in.

[7] https://www.isro.gov.in/earth-observation/twris.

Bank Performance

Quality at Entry

6.9 The project design incorporated lessons on stakeholder participation and implementation effectiveness from the World Bank–supported Andhra Pradesh Economic Restructuring Project and Karnataka Community-Based Tank Management Project.

6.10 At appraisal, the World Bank identified several risks relating to crop diversification, adoption of new practices by farmers, overexploitation of groundwater, variability in rainfall, delays in implementation, and water charge collection. The project provided for mitigating measures for most of these risks. However, it could have made a more nuanced analysis of changing rainfall patterns in time and across districts. Also, the risk of inadequate water charge collection and slow transfer of O&M funds to WUAs materialized during project implementation, despite attempted mitigation measures.

6.11 Multisectoral coordination among the implementing agencies was not adequately addressed at entry, even though it was correctly identified as a substantial source of risk.

6.12 On balance, the World Bank's quality at entry is rated **moderately satisfactory**.

Quality of Supervision

6.13 The project was implemented in a challenging environment, particularly in 2011, when there was an increase in political instability in Andhra Pradesh, ultimately resulting in the state's bifurcation in 2014. However, the World Bank maintained a productive relationship with the state government of Andhra Pradesh and, after bifurcation, the state government of Telangana as well. In 2011, the World Bank team demonstrated candor through downgrading the project ratings to moderately unsatisfactory due to implementation delays that stemmed from political instability before bifurcation of the state. The World Bank team steadily guided the project during the challenging time of state bifurcation and successfully resumed project activities in 2012. The World Bank was also supportive and facilitated restructuring the project to reflect the creation of two PMUs in each state and ensure effective implementation of activities. The project benefited from experienced World Bank specialists who contributed to the high quality of engineering work being undertaken and from fiduciary, procurement, and safeguards policies being put into place.

6.14 The quality of supervision is rated **satisfactory**.

6.15 Based on moderately satisfactory quality at entry and satisfactory quality of supervision, overall Bank performance is rated **moderately satisfactory**.

Borrower Performance

Government Performance

6.16 The government of India appropriately recognized the restoration and renovation of tanks to be a priority task to spur agricultural growth, for which it launched pilot schemes in many states, including Andhra Pradesh, and sought multilateral funding for the effort.

6.17 At the preparation stage, the government of Andhra Pradesh demonstrated leadership through decentralizing water resources development at the community or farm level. This approach helped in strengthening WUAs and expanded their mandate beyond operation and maintenance to ensuring equitable water distribution among its members. After state bifurcation, another PMU was created in the state of Telangana. The two PMUs benefited from autonomy to effectively manage project activities. High level government officials continued to coordinate various agencies to cooperate in implementing the project. At the state level, a project steering committee headed by the chief secretary coordinated the annual plans of the irrigation, agriculture, animal husbandry, fisheries, and rural development departments.

6.18 Government performance is rated **satisfactory**.

Implementing Agency Performance

6.19 The implementing agencies faced challenges due to state bifurcation, which contributed to implementation delays. There were also some shortcomings including delays in the recruitment of a new external M&E agency as required by the legal covenant. This delay put the borrower out of compliance for 20 months. The project suffered from implementation delays (as discussed in the Efficiency section), some of which were beyond the control of the implementing agency.

6.20 Implementing agency performance is rated **moderately satisfactory**.

6.21 Based on the ratings for government and implementing agency performance, overall borrower performance is rated **moderately satisfactory**.

7. Lessons

7.1 **The potential economic benefits from improved irrigation infrastructure cannot be adequately realized by beneficiaries without the coordinated and ongoing support of multiple government agencies and research extension services in agriculture**. The improved availability of water from the project could have been leveraged to a greater extent by providing coordinated and ongoing support for improved water management and sustainable agricultural practices, crop diversification to reduce risks and expand income sources, and developing better market linkages. This could have been attempted through this project or parallel projects, as had been done in other states in the country.

7.2 **Continued support to WUAs in terms of resources and social intermediation, such as through nongovernmental organizations, is key to enhancing their capacity for improved water management in drought-prone areas**. Support provided under this project enabled WUAs to improve their performance on administrative functions but less so on financial and technical aspects. A lack of stable and predictable technical and financial support after project completion has limited the efficacy of WUAs. Although WUAs can be expected to take care of minor repairs and maintenance and clearing of vegetation, they need access to services and technical support for repairs of any significance and for mainstreaming sustainable agriculture and water management practices.

7.3 **Benefits from increased water availability can be further increased if cropping decisions by smallholder farmers in drought-prone areas are informed by water budgeting and collective governance principles for sustainable use**. This project undertook significant initiatives to raise awareness and provide technical support to beneficiaries for making informed cropping decisions and applying water budgeting principles. However, to mainstream these practices and overcome social and political barriers for their adoption, appropriate policies and incentives need to be instituted, as suggested by experience from similar projects in other states in India. Such efforts can be usefully supported by introducing increasingly affordable measurement techniques using sensors and information and communication technology tools, making it increasingly feasible and affordable to reliably measure water conveyance and use.

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Appendix A. Basic Data Sheet

Andhra Pradesh and Telangana State Community-Based Tank Management Project (P100789)—(IBRD-48570, IDA-42910)

Table A.1. Key Project Data

Financing	Appraisal Estimate *($, millions)*	Actual or Current Estimate *($, millions)*	Actual as Percent of Appraisal Estimate
Total project costs	218	203	81
Loan amount			
Cofinancing	—	—	—
Cancellation	—	—	—

Table A.2. Cumulative Estimated and Actual Disbursements

Disbursements	FY08	FY09	FY10	FY11	FY12	FY13
Annual	11	31	54	52	35	6
Cumulative	11	42	96	148	183	189
Date of final disbursement: June 2017						

Table A.3. Project Dates

Event	Original	Actual
Concept review	07/2/2007	07/27/2007
Appraisal	-	12/22/2014
Board approval	-	09/13/2010
Signing	-	06/08/2007
Closing date	12/31/2012	07/31/2016

Table A.4. Other Project Data

Borrower or Executing Agency

Follow-on Operations

Operation	Project ID	Amount *($, millions)*	Board Date
Andhra Pradesh Integrated Irrigation and Agricultural Transformation Project (P160463)	P160463	172.2	10/23/2018

Appendix B. Compliance with Environmental and Social Safeguard Policies

Environmental Assessment (Operational Policy / Bank Policy or **OP/BP 4.01**). An Integrated Social and Environmental Assessment was prepared as part of project implementation. Also, a Social and Environmental Management Framework was developed to manage and mitigate the social and environmental risks identified in the initial assessment. The project reported full compliance with all environmental safeguard measures, including dam safety interventions.

Indigenous Peoples (OP/BP 4.10). A tribal development strategy and a tribal development plan at the tank level were developed to ensure that tribal groups in tank areas would equally benefit from the project interventions as other groups. The project supported training on sustainable water management practices, the formation of tribal commodity interest groups and exposure visits to progressive farms. These activities benefited 42,151 tribal farmers.

Safety of Dams (OP/BP 4.37). Sixty-eight tanks with a bund height at or above 10 meters were inspected by the Dam Safety Panel and were reported to be in compliance with safeguard provisions at project completion.

Pest Management (OP 4.09). This safeguard was triggered because of the possibility of increased use of pesticides due to improved irrigation practices. No further information was provided on mitigation or impacts for this safeguard policy, and it did not include a clear statement of compliance.

Involuntary Resettlement (OP/BP 4.12). Involuntary Resettlement was triggered because of the risk that the water spread area and feeder channels might be encroached. Partial encroachments were found in 643 tanks and seasonal cultivation in 243 tanks, with 29 seasonal cultivators having temporary dwelling units in two tanks. At project completion, it was noted that in each of these tanks the seasonal cultivators with temporary dwellings willingly agreed to vacate or stop the encroachment and cultivation to help tank rehabilitation. Provisions were made for affected people to gain relief and rehabilitation entitlements and other project benefits if resettlement was required. The project team reported that project activities did not require any land acquisition or resettlement and rehabilitation.

Physical Cultural Resources (OPBP 4.11). Cultural property was triggered because of the chance of finding some objects of cultural or archaeological value during civil works. According to the project team, 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.

Appendix C. Site Visits and Observations

The Independent Evaluation Group (IEG) mission visited sites in Andhra Pradesh and Telangana to observe outcomes from the Andhra Pradesh and Telangana Community-Based Tank Management Project.

Infrastructure Improvements at Tanks

Telangana

At Pedda Cheruvu (Kowdipally), the bund was widened, the weir reconstructed, two sluices replaced, and a 3-kilometer canal relined. Since then, the tank has been desilted and a stairway leading into the lake built for the convenience of washermen. At Rairao Cheruvu, the bund was extended from 3.5 meters to 18 meters width, and a 2-kilometer channel and 12 offtakes (branches) were upgraded. The bund is now being developed into a recreational area. At Kesarasamudram tank, 800 meters of irrigation channels were upgraded, and although the sluices were repaired, only two of the four are available for use. At Pentoni Cheruvu, breach repair work extended the width of the bund from 3 meters to 6 meters. At Pedda Cheruvu (Ghanpur), the bund of 3- to 4-kilometer radius was strengthened, along with work relating to the guide walls, canal systems, and sluices. At Chalimela Vagu, a 6.3-kilometer canal and a 1.7-kilometer line feeder canal were lined, and check dams over the stream and an aqueduct were reconstructed or repaired.

Table C.1. Selected Details of Tanks and Other Infrastructure in Telangana

Tank Name	Tank Features	Physical Works under the Project
Pedda Cheruvu District: Medak Mandal: Kowdipally Village: Kowdipally	Ayacut: 232 acres Water Spread Area: 0.82 sq m. Mt Total Catchment Area: 14.5 sq km Present Ayacut: 103 Acres	Bund strengthening, sluice construction, skin wall of surplus weir, stone pitching on bund
Rairao Cherevu Tank Medak Mandal: Narsapur Village: Narsapur	Ayacut: 515 acres Water Spread Area.9136 million: Total Catchment Area 22.6884 sq. km Tank Capacity 92.92 million cft Length of Bund: 413 m	Canal lining, bund strengthening, construction of retaining wall
Pentoni Cherevu District: Mehboobnagar Mandal: Palem Village: Bijnepalli	Total Catchment Area: 12.64 sq. km	Breach filling work, bund widening and strengthening, minor repairs of surplus weir, sluice construction, lining of channels

Tank Name	Tank Features	Physical Works under the Project
Kesarasamudram District: Mehboobnagar Mandal: Nagarkurnool Village: Nagarkurnool	Ayacut: 1,594 acres Length of Bund: 1,500 m	Sluice reconstruction, bund strengthening, irrigation channel construction
Pedda Cherevu District: Warangal Mandal: Ghanpur Village: Ghanpur	Ayacut: 628 acres Water Spread Area: 10.64 sq. km	Construction of field channels and side wall, sluice reconstruction
Chalimela Vagu District: Warangal Mandal: Bhupalapally Village: Bhupalapally	Ayacut: 730 acres	Construction of under tunnel and Aquaducts, construction of checkdams (Matt), construction of guidewall
Kallepalli District: West Godavari Mandal: Lingapalem Village: Asannagudem	Ayacut: 262.76 acre Water Spread Area: Total Catchment Area: 11.2 sq. km Tank Capacity: 9.8 m cft Present Ayacut: 263 acres Length of Bund: 1,040 m	Construction of tank; Water User Association office of Asannagudem; Lingapalem, West Godavari district; Jungle clearance, sluice reconstruction, field channel construction, bund strengthening, cause way construction
Chinnapatha District: East Godavari Mandal: Prathipadu Village: K. Kothapalle	Ayacut: 184 acre Water Spread Area: 4.2 Ha Total Catchment Area: 1.4 sq km Tank Capacity: 17.9 Mcft Present Ayacut: 151.8 acre Length of Bund: 775 m	Earth work, construction of retaining wall, CTFs; surplus course and canals; closing of breached portions
Appalaraju District: Visakhapatnam Mandal: Nakkapalli Village: Vempadu	Ayacut: 152 acres Water Spread Area: 0.2 sq Km Total Catchment Area: 3.15 sq Km Tank Capacity: 10.8 Mcft Present Ayacut: 151.8 acres Length of Bund: 1,000 m	Sluice reconstruction, bund strengthening, surplus weir repair, improvement of supply channel
Haresamudram District: Anathapuramu Mandal: Madakasira Village: Hemasundaram	Ayacut: 907 acres Water Spread Area: 184.6 Ha Total Catchment Area: 231.4 sq. Km Tank Capacity: 103.3 mcft Present Ayacut: 367.2 acres Length of Bund: 1,150 m	Bund strengthening, sluice repair, construction of retaining wall; construction of irrigation channel
Kriyasakthi Vadayar District: Anathapuramu Mandal: C. K. Palli Village: Mustikovela	Ayacut: 417 acre Water Spread Area: 0.6 sq miles Total Catchment Area: 16.7 sq. mi. Tank Capacity: 96.6 mcft Present Ayacut: 417 acres Length of Bund: 1,375 m	Earth excavation, Bund strengthening, construction of sluices and guide wall

Andhra Pradesh

At Kallepalli, the bund was expanded from 0.5 to 1.7 meters and is useful for basic transport, and three sluices were replaced. The repair of the protection wall at the Chinnapatha tank now directs water into the tank that would have otherwise gone unused. The tank saw repairs for two sluices or shutters and a weir. At the Appalaraju tank, the closing of a gap allows water to be directed into the tank. The Haresamudram tank's bund was widened but needs to be strengthened further to prevent possible erosion, while the sluice is operating smoothly after repair. The Kriyasakthi Vadayar tank had two retaining walls and sluice walls repaired.

Fisheries Activities in Tanks

Telangana

At Pentoni Cheruvu, Pedda Cheruvu (Ghanpur), and Chalimela Vagu, the fisheries cooperative societies (FCSs) reported membership of 270, 500, and 300 members, respectively. At Pedda Cheruvu (Ghanpur) the fisheries department had conducted a workshop on improved techniques covering several FCS in a wider area. Rairao Cheruvu, Pentoni Cheruvu, Pedda Cheruvu (Ghanpur), and Chelimela Vagu received free fingerlings ranging from 0.2 million to 0.9 million, which were matched or exceeded by the production from the tanks. At Chalimela Vagu, 70 two-wheelers and 4 tempos were provided. At the Chinnapatha tank, the FCS was provided with feed supply, seedlings, six two-wheelers, ice boxes, and community fishing nets. Rairao Cheurvu yields 50 kilograms of fish per day during peak season, in contrast to uncertain yields before tank rehabilitation.

Andhra Pradesh

The Chinnapatha tank reported yields of 1 to 5 tons of fish per month in the years since tank rehabilitation, while in the Kriyasakthi Vadayar tank, 30 tons of fish were harvested in the previous year. All the FCS reported periodic visits and technical support from the fisheries departments, and free fingerlings and vehicles for use in transporting and marketing their produce. Fishers from all the FCS noted. At Kallepalli, Chinnapatha, and Kriyasakthi Vadayar tanks FCS have been created or strengthened during project implementation. At Kesarasamudram government provided 40 two-wheelers and 2 tempos (small transport vans).

Water Adequacy in Tanks

Telangana

In Pedda Cheruvu (Kowdipally), which has experienced its third consecutive year of low rainfall, 100 borewells have been recharged, though 400 others remained inactive. Although tail-end farmers as far as 3 kilometers away got water supply in 2014 for the first time in several years after rehabilitation works, this has decreased somewhat since then due to successive drought years. Pentoni Cherevu saw groundwater levels improve up to a 3-kilometer radius due to project rehabilitation works supplemented by water from lift irrigation. Pedda Cherevu (Ghanpur) now sees water year round compared with only a two-month period before the project, though it is noted that its water is also supplemented by a lift irrigation scheme. Chelimela Vagu has scope for covering approximately 100 more acres and has its water sources supplemented by the Godavari river lift irrigation scheme.

Andhra Pradesh

Near the Kallepalli tank, some farmers have adopted drip irrigation, and a beginning has been made in systematic water use planning. In contrast to before the project, water is available during the summer months, and there is scope for further recharging of wells in case of good rains. Surplus water from Chinnapatha, which also benefits from the Yeleru canal, goes to another downstream tank. There is no shortage of water throughout the year, in contrast to dry phases in earlier years. The area surrounding Haresamudram has seen significant borewell recharge and has the highest incidence of micro-irrigation (mainly drip irrigation) in the subregion and also benefits from water from the Srisailam reservoir. Kesarasamudram saw groundwater in its vicinity rising from a depth to 200 feet to 80 feet, and recharging has taken place up to a radius of 4 kilometers. However, tail-end farmers are not gaining as much as expected from increased tank water levels due to unchecked withdrawals of water upstream. Kriyasakthi Vadayar tank has seen borewells in its area improve water depth from a depth of 20 meters to 10 meters. The tank will also benefit from water from the Srisailam reservoir. The water user association (WUA) for this tank uses a principle of equity to ensure that tail-end farmers get a fair share of water in proportion to their land area.

Crop Productivity and Diversification at Sites

Telangana

At the Pedda Cheruvu tank (Kowdipally), a second variety of crop has become possible, and it is anticipated that in the coming years, *rabi* (winter) season paddy and groundnut can be grown in an additional 100 acres. The Pentoni Cheruvu area also supports two

crops, but there has not been much diversification from paddy. The Pedda Cheruvu tank (Ghanpur) area has expanded from one crop to two paddy crops per year, though the yield of 40 bags per acre has not changed significantly. Despite efforts to promote the system of rice intensification, there were no takers. In the Chalimela Vagu tank area, growing even one crop was difficult before the project, but now two crops are feasible, and the productivity of rice has increased to 20–25 bags per acre during the *kharif*[1] season, and 40 bags per acre during the rabi season, representing an overall 20–25 percent increase in yield. The system of rice intensification was partially adopted in this area, resulting a 40 percent increase in yield.

Andhra Pradesh

In the Kallepalli tank area, there has been diversification from millet to rice paddy as a second crop. In the Chinnapatha tank area, the ayacut increased from 120 acres to 184 acres, which yield two crops compared with only one. Yield has increased sharply form 10 bags per hectare to 20–32 bags per hectare for the first crop and 40 bags per hectare for the second crop. Tail-end farmers get 15–25 bags per acre. Of the 135 farmers, 80 are doing direct seeding. In the rabi season, half the area is devoted to seed production. There has been diversification to pulses as a summer crop and a black gram and green gram. Although further diversification to horticulture is possible, the presence of a large population of monkeys in the adjoining protected forest area, makes this transition infeasible. In the Appalaraju tank area, the first crop is paddy, and the second is pulses, taking advantage of free seed provision from the government. In the Haresamudram tank area, main crops are groundnut and maize, and fodder is additionally grown. In the Kriyasakthi Vadayar tank area drip irrigation has been taken up to some extent for horticulture (bananas, other fruit, and hybrid vegetables), which also takes advantage of government subsidies.

Kallepalli and Chinnapatha Tank Water User Associations

At Kallepalli, villagers have donated land and money to build a functional facility at the cost of Re 0.28 million ($3,880). The WUA regularly collects a fee of Re 100 ($1.40) per acre, which is turned over to the minor irrigation department and used for maintenance activities. However, as in the case of all WUAs, the amount collected is only a small portion of maintenance needs and is necessarily supplemented by government funds. The WUA meets regularly and maintains meticulous minutes of its proceedings. The WUA members carry out simple maintenance works such as cleaning channels and

[1] The *kharif* cropping season is from July–October during the south-west monsoon and the *rabi* cropping season is from October–March (winter).

clearing vegetation. The WUA president and other members have been sent to the International Crops Research Institute for the Semi-Arid Tropics in Hyderabad and the Department of Agriculture to get exposure and training on agricultural techniques.

Similarly, the WUA at the Chinnapatha tank has a two-level office building with good provision for meetings, meets once in a month, and keeps clear minutes and accounts. The WUA appears to function in a collegial manner and ensures that water allocation is done in an equitable manner that covers tail-end farmers. The WUA carries out basic cleaning and maintenance activities.

At each of these locations, self-ratings cards using the format introduced under the project were clearly displayed, though it is not clear whether they were being regularly updated and monitored.

Other Observations

Water use efficiency. Though the project has ensured water for irrigation in the command area, no measures were put in place for improving water use efficiency, apart from the construction or rehabilitation of field channels. The farmers appear to be continuing with the traditional practice of flood irrigation, which is especially wasteful in drought-prone areas. Evidence indicates the adoption of sprinkler and drip systems, and "rain guns" (a high-pressure, high-volume, large-diameter sprinkler irrigation system) in and around Ananthapuram district, but there is little or no such use in the project sites visited by the mission. Also, the project did not strategically promote such methods. In some of the project sites in Andhra Pradesh, project officials showed the use of piezometers for monitoring groundwater level and how local community-level village cadres are providing support to the owners of wells to understand the water availability, water discharge rate, and water recharge rate at regular intervals. But this practice does not appear to be widespread, nor does it appear to be linked to decision making for water allocation and use.

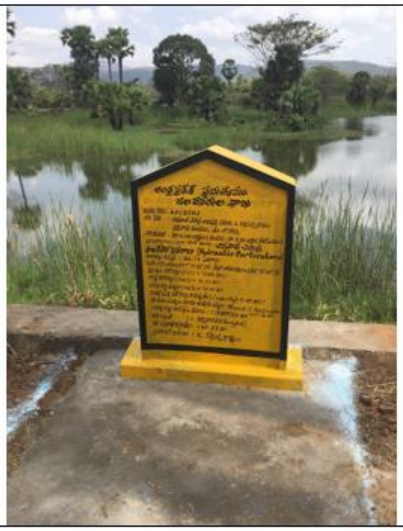
Agricultural marketing. The IEG mission was not able to get any systematic updates of the commodity interest groups. Informal feedback from officials and beneficiaries suggests that several of them may not be functioning at the level they had reached by project completion.

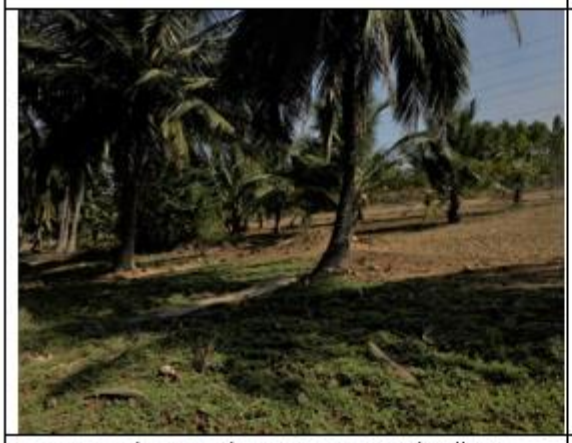
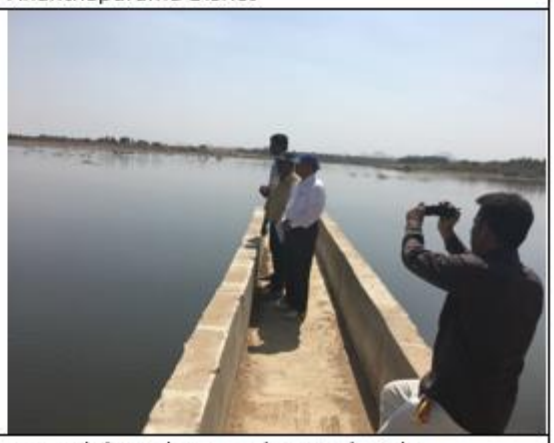
Other benefits. Tank rehabilitation has improved the availability of drinking water, livestock, and in some places, washermen (traditional laundrymen). In most of the sites visited by IEG, beneficiaries reported improved availability of drinking water in the command area and in nearby villages. This has been made possible by both enhancing the recharge of groundwater and lifting water from the tank influence area and by digging new shallow tube-wells in the tank submergence area. Some livestock farmers

reported that they do not have to go farther afield to graze or provide water to their animals. Washermen have access to water for the greater part of the year. In Mehboobnagar district in Telangana, some farmer and fisher beneficiaries reported that there is less need for migrating to urban areas for seasonal employment due to the increase in agricultural activity, which provides a greater scope for work and income.

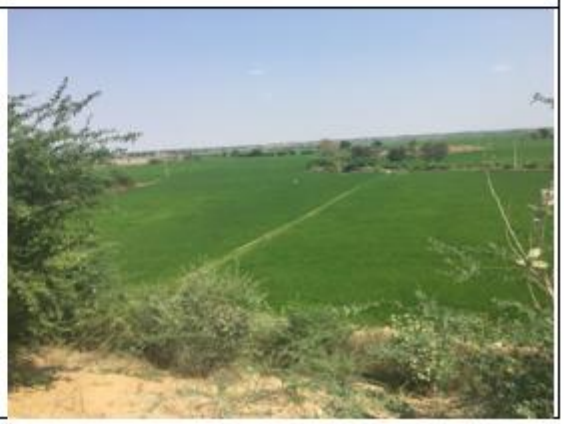
IEG visited the WUA office building in the Kallepalli and Chinnapatha tank areas in Andhra Pradesh. At both these sites, the WUA had a dedicated building with an office and facility for meetings. WUA members in both sites had meticulous records of regularly conducted meeting, and accounts for WUA fees and expenses. Both WUAs displayed WUA self-rating cards introduced under the project.

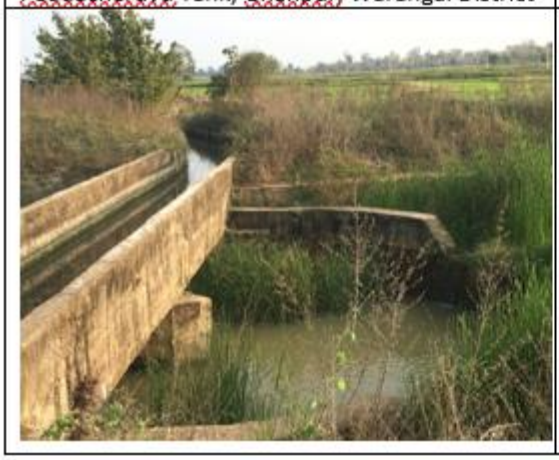
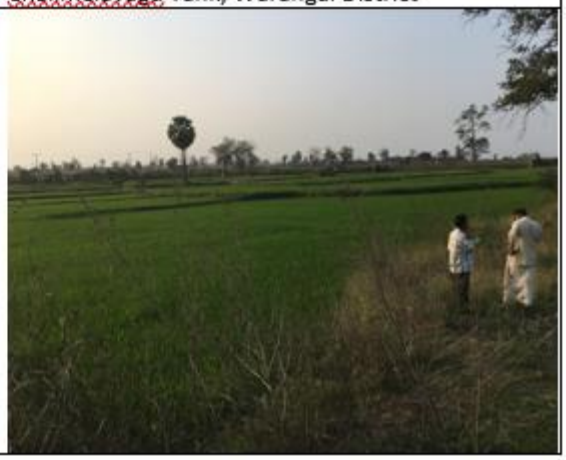
Appendix D. Photos from Irrigation Tank Site Visits

Kallepally Tank, Asannagudem, W. Godavari District	Kallepally Tank Water Users' Association building
	
Chinnapatha Tank, K. Kothapalle, E. Godavari District	Appalaraju Tank, Vempadu, Visakhapatnam District
	

Appalaraju Tank: Coconut Grove	Haresamudram Tank, Haresamudram, Ananthapuramu Disrict
	
Haresamudram Tank: IEG mission with village Assembly	Kriyasakthi Vadayar Tank, Mustikovela, Ananthapuramu Disrict
	
Kriyasakthi Vadayar Tank: village Assembly	
	

Telangana

Peddacheruvu Tank, Kowdipally, Medak District	Peddacheruvu Tank, Kowdipally, Weir
	
Rairao Cheruvu Tank, Narsapur, Medak District	Rairao Cheruvu Tank: Widened Bund
	
Pentoni Cheruvu Tank, Palem, Mehboobnagar District	Pentoni Cheruvu Tank: Paddy Fields
	

Kesarasmudram Tank, Nagarkurnool, Mehboobnagar District: IEG mission with Farmers and government officials	Kesarasmudram Tank: Widened Bund.
	
Peddacheruvu Tank, Ghanpur, Warangal District	Chalimelavagu Tank, Warangal District
	

Appendix E. Self-Rating Card for Water Users Associations

Rating format for Self Assesment of WUA Performance Parameters - Indicators

S. No.	Parameter Discription	Poor	Average	Good	Excellent
I	**Participation & Dialogue**				
1.	 Regularity of Management Committee Meetings	Managing Committee Meeting < 6	Managing Committee Meeting > 6	Managing Committee Meeting > 9	Managing Committee Meeting > 12
	5	1		3	5
2.	 General body meetings and % of farmers participation	General Body Meeting not conducted.	One meeting conducted < 50% farmers participated	One meeting conducted >50% farmers participated	Two meetings conducted > 50% farmers participated
	5	1	2	3	5
3.	 Transparency - Information to all members	WUA farmers not aware of financial details	Only TC members aware of financial information	Finance information displayed in common place for all WUA farmers	Details of expenses read in AGM, social audit and all WUA farmers aware
	5	1	2	3	5
II	**Performance**				
4.	 Water Use Efficiency (Acres per MCFT)	< 5	5-8	8-10	>10
	15	5	8	11	15
5.	 Area under second crop	<25%	>25 - 50%	>50- 85%	>85%
	5	1	2	3	5
6.	 Water Tax Collection	<50% of demand	51-75% of demand	76-95% of demand	>95% of demand
	10	2	5	8	10
7.	 Additional Resources Mobilization	Nil Mobilisation	Upto 20% of tax amount	21-50% of tax amount	>50% tax amount
	5	1	2	3	5
III	**Self Management**				
8.	 Updation of records	No records maintained	Records maintained occasionally	Records maintained but not updated	Records maintained and updated
	5	1	2	3	5

S. No.	Parameter Discription	Poor	Average	Good	Excellent
III	**Self Management**				
9.	 Water Release Schedule	No plan prepared and farmers not aware of water release schedule	Preparation of plan and followed upto 50% schedule	Release schedule announced and followed with 15% variation	Release schedule announced and followed regularly
	5	1	2	3	5
10.	 Warabandi implementation	Continuous flow as per water availability	Informal arrangements for water distribution	Outlet wise schedule prepared and followed occasionally	Outlet wise schedule prepared and followed regularly
	5	1	2	3	5
11.	 Tail end issues & adequacy of water received by the tail ends	less than 50% of identified Tailend areas receive inadquate or no water	51-75 % of identified Tailend areas receive adequate water	76-90 % identified Tailend areas received adequate water	91 % or more of identified Tailend areas received adequate water
	10	2	5	8	10
12.	 Joint aumosh (Estimation of Tax Collection)	No joint aumosh and TC Members, Farmers not aware of tax demand	Joint aumosh done by Departmental staff, Farmers and TC members are not aware of tax demand	Assessment done by the Dept. Staff before harvest, Members and Farmers aware of tax demand	Joint assessment by Dept & Members before harvest, Farmers & TC Members aware of tax demand
	5	1	2	3	5
13.	 Conflict Resolution	Conflicts exist, not resolved	Conflicts exist, discussed not resolved	Conflicts exist, discussed, partially resolved	No conflicts, Managing Committee resolves all issues.
	5	1	2	3	5
14.	 O&M Works	No O&M plan, No works done	No O&M plan but works done by members	Dept. prepared the O&M plan and work done by members	WUA prepared O&Mplan and completed works before monsoon
	5	1	2	3	5
IV	**Innovation & Technology Adoption**				
15.	 Innovations & Technology Adoption	Not discussed and not implemented	New practices discussed and introduced	New practices discussed, introduced and 50% adopted	New practices discussed, introduced and 100% adopted
	10	2	5	8	10

Sub Division: _____ WUA Name: _____ Code No: _____
Division: _____ No. of Villages: _____
Circle: _____ Distributory Name/No: _____
District: _____ Project: _____

IRRIGATION & COMMAND AREA DEVELOPMENT
Andhra Pradesh

WATER AND LAND MANAGEMENT TRAINING AND RESEARCH INSTITUTE (WALAMTARI), Hyd.

Rating format for Assessing WUA Performance							
SL No	Parameter Description	Indicator description	Weightage	Marks	Category	Marks scored	Recommended activity
I	**Participation & Dialogue**						
1	No of Management Committee meetings held annually	Managing Committee Meeting < 6	5	1	Poor	2	1
		Managing Committee Meeting > 6		2	Average		
		Managing Committee Meeting > 9		3	Good		
		Managing Committee Meeting > 12		5	Excellent		
2	General body meetings and % of farmers participation	General Body Meeting not conducted.	5	1	Poor	2	1
		One meeting conducted < 50% farmers participated		2	Average		
		One meeting conducted >50% farmers participated		3	Good		
		Two meetings conducted > 30% farmers participated		5	Excellent		
3	Transparency - Information to all Members (Wall paintings, Social Audit etc.,)	WUA farmers not aware of financial details	5	1	Poor	1	1
		Only TC members aware of financial information		2	Average		
		Finance information displayed in common place for all WUA farmers		3	Good		
		Details of expenses read in AGM, social audit and all WUA farmers aware		5	Excellent		
	Sub Total		15			5	
II	**Performance**						
4	Water Use Efficiency (Acres per MCFT)	< 5	15	5	Poor	5	
		5 - 8		8	Average		
		8-10		11	Good		
		>10		15	Excellent		
5	Area under Second crop	<25%	5	1	Poor	3	1
		25-50%		2	Average		
		51-80 %		3	Good		
		>80%		5	Excellent		
6	Tax collection (self sufficiency, O&M MR)	<50%	10	2	Poor	8	
		51-75 %		5	Average		
		76-95%		8	Good		
		>95%		10	Excellent		
7	Additional resources mobilisation (higher tax rates, other means)	Nil mobilisation	5	1	Poor	3	1
		Upto 20% of tax amount		2	Average		
		21 – 50% of tax amount		3	Good		
		>50% tax amount		5	Excellent		
	Sub Total		35			19	
III	**Self Management**						
8	Updation of records	No records maintained	5	1	Poor	3	
		Records maintained occassionally		2	Average		
		Records maintained but not updated		3	Good		
		Records maintained and updated		5	Excellent		
9	Water release schedule	No plan prepared and farmers not aware of water release schedule	5	1	Poor	1	1
		Preparation of plan and followed upto 50% schedule		2	Average		
		Release schedule announced and followed with 15 %-variation		3	Good		
		Release schedule announced and followed regularly		5	Excellent		
10	Warabandi implementation	Continuous flow as per water availability	5	1	Poor	1	1
		Informal arrangements for water distribution		2	Average		
		Datewise schedule prepared and followed occassionally		3	Good		
		Datewise schedule prepared and followed regularly		5	Excellent		
	Sub Total		15			5	

SL No	Parameter Description	Indicator description	Weightage	Marks	Category	Marks scored	Recommended activity
11	Tail end issues & adequacy of water received by the tail ends	less than 50% of identified Tailend areas receive inadequate or no water	10	2	Poor	8	
		51-75 % of identified Tailend areas receive adequate water		5	Average		
		76-90 % identified Tailend areas received adequate water		8	Good		
		91 % or more of identified Tailend areas received adequate water		10	Excellent		
12	Joint azmoish (estimation of tax collection)	No joint azmoish and TC Members, Farmers not aware of tax demand.	5	1	Poor	1	1
		Joint azmoish done by Departmental staff, Farmers and TC members are not aware of tax demand.		2	Average		
		Assessment done by the Dept. Staff before harvest, Members and Farmers aware of tax demand		3	Good		
		Joint assessment by Dept & Members before harvest, Farmers & TC Members aware of tax demand		5	Excellent		
13	Conflict resolution	Conflicts exist, not resolved	5	1	Poor	2	1
		Conflicts exist, discussed not resolved		2	Average		
		Conflicts exist, discussed, partially resolved		3	Good		
		No conflicts, Managing Committee resolves all issues.		5	Excellent		
14	O&M works	No O&M plan, No works done	5	1	Poor	3	1
		No O&M plan but works done by members		2	Average		
		Deptt. prepared the O&M plan and work done by members		3	Good		
		WUA prepared O&Mplan and completed works before monsoon		5	Excellent		
	Sub Total		25			14	
IV	Innovations & Technology adoption						
15	Innovations in water management, water sharing,Conjunctive use, Water Audit, Collective action,Cropping practices(SRI, ID,Horti) etc.,	Not discussed and not implemented	10	2	Poor	2	1
		New practices discussed and introduced		5	Average		
		New practices discussed, introduced and 50% adopted		8	Good		
		New practices discussed, introduced and 100% adopted.		10	Excellent		

In the recomended activity column, if the WUA gets poor and average then put 1 other wise don't write any thing leave as it is.

For the purposes of quantifying the level of performance of WUAs the marks to be awarded as shown against the weightage column and the category corresponding.

SlNo	Criteria for Grading of the WUA		Weightage	Marks scored	Grade
	Participation& Dailogue&Innovation & Technology				
I	> 17	A+	25	7	B
	13 - 17	A			
	9 - 12	B+			
	7 -9	B			
	< 7	C			
II	Performance				
	>23	A+	35	19	A
	15-23	A			
	10-14	B+			
	7-9	B			
	<7	C			
III	Self-Manangement				
	> 26	A+	40	14	B+
	20 - 25	A			
	14 - 20	B+			
	10 -13	B			
	< 10	C			
	Consolidated grade		100	40	BAB+

Sub Division: Bander
Division:____ Kc division
Circle :_____ Vijayawada
District:_____ Krishna

WUA Name:__ Pamarru, 161
No. of Villages 5
Distributory Name/No Bander Canal
Project :_____ Krishna Delta Sysytem

Appendix F. List of Persons Met

Government of Telangana

Dr. G. Malsur	Commissioner CADA, Water Resources Development (WRD)
Mr. K. Shyam Sunder	Chief Engineer-Minor Irrigation, WR Department
Ms. K. Sneha	Dy. Project Director, CADA, WRD
Mr. M. M. Sajid	Executive Engineer, CADA, WRD
Ms. Brahmini	Asst. Executive Engineer, CADA, WRD
Mr. Zuber Ahmed	Dy Ex Engg, ICMARD, WRD
Mr. K. Ramesh	Sup. Engg, Warangal Circle, ICMARD, WRD
Mr. Srawan Kumar	Executive Engineer, Warangal Circle, ICMARD, WRD
Mr. Prasad	Dy Ex Engg, ICMARD, WRD
Mr. P. Malaya	Ditrict Engg Consultant, Medak
Mr. B. Yesieh	Exe Engg, IB Division, Medak
Mr. R. Srinivas Rao	Dy Ex Engg, IB Subdivision Narsapur, Medak
Mr. C. Nagaraja	Asstt Engg, Kowdipalli, Medak
Mr. G. Manbhushan	Astt Engg, Narsapur, Medak

Government of Andhra Pradesh

Mr. P. S. Ragahaviaiah	Project Director, Andhra Pradesh Integrated Irrigation and Agriculture Transformation Project (APIIATP)
Mr. A. G. Mallikarjuna Reddy	Chief Engineer, WRD
Mr. U. Arun Kumar	Asst. Project Director (ID), APIIATP
Mr. D. Gnanabhaskar Dev	Asst. Project Director (M&E/MIS), APIIATP
Mr. K. Ramesh Babu	Asst. Project Director (Participatory Groundwater Management), APIIATP
Mr. Masthan Rao	Agri-business expert, APIIAPT PMU
Mr. Gopala Krishna	ID expert, APIIAPT, PMU
Mr. Joseph Plakkoottam	M&E expert, PMU
Mr. L. Makbul Saheb	SE & DPD, DPMU
Ms. Kajeswaramma	ADA, PMU Vijayawada
Ms. Ch Shashi Kiran	ID and CB expert, PMU
Mr. Gopinadh	EE, CADA, SPMU
Mr. V. Prabhakar	Executive Engineer, Ananthapuramu district,
Mr. Manohar Naidu	APD (M&E), DPMU
Mr. Ram Bhupal Reddy	APD (ID), DPMU
Mr. Prashad	Agriculture Officer, Department of Agriculture, Ananthapuramu district
Mr Reddaiah	Horticulture Officer, Department of Horti, Ananthapuramu district, Government of Andhra Pradesh
Mr Lakshminarayana	FDO, Department of Fisheries, Ananthapuramu district
Mr Ramesh Babu	Asst. Hydrologist, Groundwater Department
Mr Rajendra Prasad	APD, Groundwater Department
Mr A Suresh	Dy. Chief Engg., Minor Irrigation
Mr D. V. Ramagopal	EE, YI division, WRD
Mr Narayana Rao	Dy. EE, CADA
Mr T. Jaya Raju	Dy. EE, Prathipada, WRD

Mr Chandra Sekhar	AD, Department of Ag
Mr A. V. Rajesh	AO, Department of Ag
Mr Srirama Krishna	FDO, Department of Fisheries
Ms Smeetha	MPFEO, Department of Fisheries
Mr G. Gopal	Exe. Engineer, West Godavari Irrigation Division
Mr Peddi Babu	Asst. Director, Dept of Fisheries, West Godavari district
Mr N. Rambabu	Executive Engineeer, CADA, WRD
Mr S. Jagadiswar Rao	Dy. Exe Engg., Vishakapatnam division, WRD
Mr D. J. Kameswara Rao	Dy. Exe Engg., Araku division, WRD
Mr D. Rajeswara Rao	Dy. Exe Engg., Paderu division, WRD
Ms N. Rupa	Agriculture Officer, Department of Ag
Mr A. Appalaraju	WUA President, Appalaraju Tank
Mr Amarvadi Rambabu	WUA President, Chinapatha Tank
Mr K. Satyanarayana Raju	WUA President, Venkayya Tank

World Bank

Mr. Ranjan Samantaray	Senior Agricultural Specialist
Mr. Yoro Sidibe	Water Resources Management Specialist
Kazuhiro Yoshida	Senior Irrigation and Drainage Specialist