Document of
the World Bank

Report No: ICR00003679

IMPLEMENTATION COMPLETION AND RESULTS REPORT
(IBRD-48460; IDA-42550)

ON A

LOAN

IN THE AMOUNT OF $335 MILLION

AND A

CREDIT

IN THE AMOUNT OF SDR 99.8 MILLION
(US$ 150 MILLION EQUIVALENT)

TO

REPUBLIC OF INDIA

FOR THE

TAMIL NADU IRRIGATED AGRICULTURE MODERNIZATION AND WATER-BODIES RESTORATION AND MANAGEMENT PROJECT

March 24, 2016

Agriculture Global Practice
Sustainable Development
South Asia

CURRENCY EQUIVALENTS

(Exchange Rate Effective March 24, 2016)

Currency Unit = Indian Rupee
INR 66.93 = US$ 1
US$ 1.40 = SDR 1

FISCAL YEAR
July 1 – June 30

ABBREVIATIONS AND ACRONYMS

ABC	Agri-Business Knowledge Centres
CAS	Country Assistance Strategy
CPS	Country Partnership Strategy
DCA	Development Credit Agreement
EIMS	Enterprise-Wide Information Management System
FAO	Food and Agriculture Organization
GoI	Government of India
GoTN	Government of Tamil Nadu
ICRR	Implementation Completion and Result Report
IMTI	Irrigation Management Training Institute
IPM	Integrated Pest Management
IPNM	Integrated Plant Nutrient Management
KPI	Key Performance Indicators
M&E	Monitoring and Evaluation
MDPU	Multi-disciplinary Project Unit
MTR	Mid Term Review
O&M	Operation and Maintenance
PAD	Project Appraisal Document
PAP	Parambikulam – Aliyar Project
PDO	Project Development Objective
PIM	Participatory Irrigation Management
SMEC	M&E Consultancy Firm
SRI	System of Rice Intensification
SSI	Sustainable Sugarcane Intensification
SWaRMA	State Water Resources management Agency
TNAU	Tamil Nadu Agriculture University
TNFMIS	Tamil Nadu Farmers Management of Irrigation Systems
TNIAMWARM	Tamil Nadu Irrigated Agriculture Modernization and Water-Bodies Restoration and Management Project
WOP	Without Project

WRCP	Water Resources Consolidation Project
WRD	Water Resource Department
WSA	Water Spread Area
WUA	Water User Association

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INDIA
Tamil Nadu Irrigated Agriculture Modernization and Water-Bodies Restoration and Management Project

CONTENTS

A. Basic Information			
Country:	India	Project Name:	IN Tamil Nadu Irrig Agr Moderniz Water-Bodies Restor Management
Project ID:	P090768	L/C/TF Number(s):	IBRD-48460,IDA-42550
ICR Date:	03/24/2016	ICR Type:	Core ICR
Lending Instrument:	SIL	Borrower:	GOVERNMENT OF INDIA
Original Total Commitment:	USD 485.00M	Disbursed Amount:	USD 443.92M
Revised Amount:	USD 439.57M		
Environmental Category: A			
Implementing Agencies: Water Resources Organization, Public Worlks Department, GoTN			
Cofinanciers and Other External Partners:			

B. Key Dates				
Process	**Date**	**Process**	**Original Date**	**Revised / Actual Date(s)**
Concept Review:	11/17/2005	Effectiveness:	04/09/2007	04/09/2007
Appraisal:	11/17/2006	Restructuring(s):		02/01/2013 09/23/2014
Approval:	01/23/2007	Mid-term Review:	09/25/2009	03/05/2010
		Closing:	03/31/2013	06/30/2015

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

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

C.3 Quality at Entry and Implementation Performance Indicators			
Implementation Performance	**Indicators**	**QAG Assessments (if any)**	**Rating**
Potential Problem Project at any time (Yes/No):	No	Quality at Entry (QEA):	None
Problem Project at any time (Yes/No):	No	Quality of Supervision (QSA):	None
DO rating before Closing/Inactive status:	Satisfactory		

D. Sector and Theme Codes		
	Original	**Actual**
Sector Code (as % of total Bank financing)		
Agricultural extension and research	4	4
Animal production	2	3
Crops	15	15
Irrigation and drainage	60	70
Sub-national government administration	19	8
Theme Code (as % of total Bank financing)		
Other rural development	17	17
Rural policies and institutions	17	17
Rural services and infrastructure	33	33
Water resource management	33	33

E. Bank Staff		
Positions	**At ICR**	**At Approval**
Vice President:	Annette Dixon	Praful C. Patel
Country Director:	Onno Ruhl	Fayez S. Omar
Practice Manager/Manager:	Martien Van Nieuwkoop	Gajanand Pathmanathan
Project Team Leader:	Bayarsaikhan Tumurdavaa	Srinivasan Raj Rajagopal
ICR Team Leader:	Bayarsaikhan Tumurdavaa	
ICR Primary Author:	Benoist Veillerette	

F. Results Framework Analysis

Project Development Objectives (from Project Appraisal Document**)**
The project development objective is to assist selected sub-basin stakeholders in increasing the productivity of irrigated agriculture in the State of Tamil Nadu within an integrated water resources management framework.

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

(a) PDO Indicator(s)

Indicator	Baseline Value	Original Target Values (from approval documents)	Formally Revised Target Values	Actual Value Achieved at Completion or Target Years
Indicator 1 :	Percentage increase in value of crop production per unit of irrigated water (with respect to without project).			
Value quantitative or Qualitative)	0%	100%		51-64%
Date achieved	01/01/2007	02/01/2007		06/19/2015
Comments (incl. % achievement)	Achievement of 64% of the target.			
Indicator 2 :	Increase in area under micro-irrigation.			
Value quantitative or Qualitative)	0 ha.	100,000 ha.		53,901 ha.
Date achieved	01/01/2007	02/01/2007		06/19/2015
Comments (incl. % achievement)	Target was revised at the MTR to 40,000 ha. and cleared by the CD, but not formally revised with a RestructuringPaper.			
Indicator 3 :	Percentage increase in area under high value crops (with respect to without project)			
Value quantitative or Qualitative)	0%	30%		124%
Date achieved	01/01/2007	02/01/2007		06/19/2015
Comments (incl. % achievement)	Increase in area of horticulture crops.			
Indicator 4 :	Percentage increase in targeted farmers' incomes (with respect to without project)			
Value quantitative or Qualitative)	0%	50%		7-93%

Date achieved	01/01/2007	02/01/2007		12/31/2013
Comments (incl. % achievement)	Data measurement is for crop year 2012/13 based on increase in net returns per ha			
Indicator 5 :	Joint preparation and implementation of sub-basin development plans across relevant implementing agencies			
Value quantitative or Qualitative)	9 sub-basin development plans prepared for PY1.	Sub-basin development plans updated and implemented as scheduled.		Sub-basin development plans updated and implemented as scheduled.
Date achieved	01/01/2007	02/01/2007		06/19/2015
Comments (incl. % achievement)				
Indicator 6 :	Enhanced sustainable water resources planning capacity			
Value quantitative or Qualitative)	2 basin boards in place	At least 3 sub-basin and one basin board formed.		No additional board formation.
Date achieved	01/01/2007	02/01/2007		06/19/2015
Comments (incl. % achievement)	The 2 pre-existing basin boards have not functioned since 2004, due largely to unwieldy membership and structure.Addressing the complicated cross-sectoral and economy-wide issues is beyond the scope of IAMWARM to resolve.			

(b) Intermediate Outcome Indicator(s)

Indicator	Baseline Value	Original Target Values (from approval documents)	Formally Revised Target Values	Actual Value Achieved at Completion or Target Years
Indicator 1 :	Percentage of schemes completed within planned time and cost.			
Value (quantitative or Qualitative)	0%	100%		100%
Date achieved	01/01/2007	02/01/2007		04/30/2015
Comments (incl. % achievement)	As of the end of April, 1069 out of 1070 civil works packages completed within the revised budget allocation andimplementation plan.			
Indicator 2 :	Additional tank systems modernized (number and ha. of command area)			
Value (quantitative or Qualitative)	0 tanks 0 ha.	5700 tanks 400,000 ha.		5260 tanks 404,055 ha.
Date achieved	01/01/2007	02/01/2007		06/19/2015
Comments (incl. % achievement)	The number of tanks requiring rehab was corrected based on field verification. The number of tanks was alsoinfluenced by adjustment in sub-basins at MTR. Command area target remained unchanged.			
Indicator 3 :	Percentage increase in conveyance efficiency.			
Value	0%	25%		31-33%

(quantitative or Qualitative)				
Date achieved	01/01/2007	02/01/2007		06/19/2015
Comments (incl. % achievement)	Tests from PAP system show conveyance efficiency increased from 69% to 92%.			
Indicator 4 :	Percentage increase in area fully irrigated.			
Value (quantitative or Qualitative)	0	40%		39.3%
Date achieved	01/01/2007	02/01/2007		06/19/2015
Comments (incl. % achievement)	At project completion, fully irrigated area in the project sub-basins increased from 364,768.4 ha to 508,132.6 ha,i.e. a 39.3% increase. This represents a 98% completion rate of the target.			
Indicator 5 :	Integration of the work of different line agencies for selected sub-basins.			
Value (quantitative or Qualitative)	9 integrated sub-basin plans drafted	63 sub-basin plans developed and implemented		61 sub-basin plans developed and implemented
Date achieved	01/01/2007	02/01/2007		06/19/2015
Comments (incl. % achievement)	The number of sub-basins in the project was adjusted at the MTR.			
Indicator 6 :	Increase in crop, animal, and fisheries production.			
Value (quantitative or Qualitative)	0 m.t. crops 0 m.t. milk 0 m.t. fish	4 mil. m.t. crops 590,000 m.t. milk 25,000 m.t. fish		crops n.a. 705,410 m.t. milk 14,686 m.t. fish
Date achieved	01/01/2007	02/01/2007		06/19/2015
Comments (incl. % achievement)	Crops performance against PAD targets for yields is as follows: paddy target 5.4 t/ha, actual 6.2 t/ha;; maizetarget 3.9 t/ha, actual 6.3 t/ha; pulses target 0.69 t/ha, actual 0.62 t/ha.			
Indicator 7 :	Percentage increase in area covered by IPM/INM/Organic farming			
Value (quantitative or Qualitative)	0%	25%		reliable data not available
Date achieved	01/01/2007	02/01/2007		06/19/2015
Comments (incl. % achievement)				
Indicator 8 :	Percentage increase in value of marketing surplus/commodity arrival to markets			
Value (quantitative or Qualitative)	0%	75%		reliable data not available
Date achieved	01/01/2007	02/01/2007		06/19/2015
Comments (incl. % achievement)				
Indicator 9 :	Number of market information kiosks			
Value	0	200		0

(quantitative or Qualitative)				
Date achieved	01/01/2007	02/01/2007		06/19/2015
Comments (incl. % achievement)	Advent of SMS technology removed the logic for establishing kiosks.			
Indicator 10 :	Number of additional agricultural enterprises/value chains developed			
Value (quantitative or Qualitative)	0 enterprises 0 value chains	to be determined		targets never defined
Date achieved	01/01/2007	02/01/2007		06/19/2015
Comments (incl. % achievement)	targets were not defined at Board presentation nor subsequently			
Indicator 11 :	Percentage of targeted staff trained/members of professional associations			
Value (quantitative or Qualitative)	Fragmented trainings	100%		Training provided to all WRD and relevant project staff.
Date achieved	01/01/2007	02/01/2007		06/19/2015
Comments (incl. % achievement)	5782 staff trained.			
Indicator 12 :	Number of WUAs set up, trained, and effective			
Value (quantitative or Qualitative)	WUAs set up in 2 of the 63 targeted sub-basins	2500 additional WUA's set up in project sub-basins		2775 WUAs set up
Date achieved	01/01/2007	02/01/2007		06/19/2015
Comments (incl. % achievement)	Roughly half of all WUAs established were rated as "strong" at project closure.			
Indicator 13 :	Irrigation information management systems set up and functional			
Value (quantitative or Qualitative)	No IMS	IMS fully operational; 25% of staff able to use IMS		29 of 32 modules of IMS developed and tested
Date achieved	01/01/2007	02/01/2007		06/19/2015
Comments (incl. % achievement)	testing of 3 modules remains to be carried out			
Indicator 14 :	State Water Resources Management Agency created and strengthened			
Value (quantitative or Qualitative)	Institute for Water Studies and State Surface and GW data center in place	SWaRMA set up and functioning		SWaRMA set up and functioning
Date achieved	01/01/2007	02/01/2007		06/19/2015
Comments (incl. % achievement)				
Indicator 15 :	Basin Boards set up and strengthened for 4 additional basins			

Value (quantitative or Qualitative)	9 sub-basin development plans prepared for PY1.	At least 3 sub-basin and one basin board formed.		No additional board formation.
Date achieved	01/01/2007	02/01/2007		06/19/2015
Comments (incl. % achievement)	repeats PDO indicator 6			
Indicator 16 :	Improved knowledge base and analytical capacity development & use for IWRM			
Value (quantitative or Qualitative)	Initial GIS data collected for all basins, fragmented modeling capacity	SWaRMA, Basin Boards, and the analytical/structured stakeholder processes setup are best-practice for sustainablewater resources planning in India		SWaRMA established, IWRM data collected, basin atlases prepared, analysis available on sub-basin level
Date achieved	01/01/2007	02/01/2007		06/19/2015
Comments (incl. % achievement)				
Indicator 17 :	Multi-disciplinary Project Unit adequately staffed			
Value (quantitative or Qualitative)	MDPU setup with core staff	MDPU fully staffed		MDPU fully staffed
Date achieved	01/01/2007	02/01/2007		06/19/2015
Comments (incl. % achievement)	Largely achieved. Some weakness during implementation on staffing M&E specialist			
Indicator 18 :	All sub-basin plans appraised			
Value (quantitative or Qualitative)	9 first-year sub-basins appraised	Updated sub-basin plans managed for quality		Updated sub-basin plans managed for quality
Date achieved	01/01/2007	02/01/2007		06/19/2015
Comments (incl. % achievement)				
Indicator 19 :	Project monitoring reports of satisfactory quality submitted every six months			
Value (quantitative or Qualitative)	No project reports	Quarterly progress reports and semi-annual monitoring reports prepared.		Project monitoring reports submitted.
Date achieved	01/01/2007	02/01/2007		06/19/2015
Comments (incl. % achievement)	Reports focused in implementation progress. Data for certain PDO indicators were not available.			
Indicator 20 :	Effective project management (reporting, financial management, procurement, etc.)			

Value (quantitative or Qualitative)	Project Director in place.	Project Director in place with timely project management and quality oversight by MDPU.		Project management has been largely effective.
Date achieved	01/01/2007	02/01/2007		06/19/2015
Comments (incl. % achievement)	Single Project Director throughout. FM and procurement have been rated moderately satisfactory.			

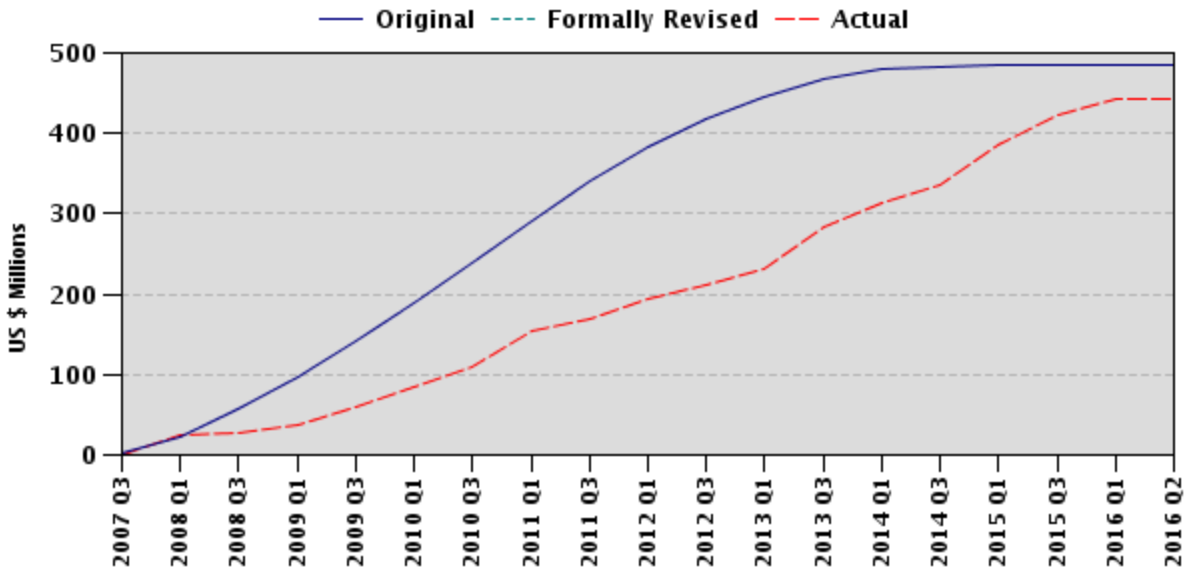
G. Ratings of Project Performance in ISRs

No.	Date ISR Archived	DO	IP	Actual Disbursements (USD millions)
1	07/20/2007	Satisfactory	Satisfactory	8.00
2	04/02/2008	Satisfactory	Satisfactory	27.29
3	12/21/2008	Satisfactory	Satisfactory	43.28
4	01/24/2009	Satisfactory	Satisfactory	53.20
5	09/01/2009	Satisfactory	Satisfactory	83.94
6	04/07/2010	Moderately Satisfactory	Moderately Satisfactory	121.42
7	11/06/2010	Moderately Satisfactory	Moderately Satisfactory	160.59
8	06/06/2011	Satisfactory	Moderately Satisfactory	177.13
9	12/12/2011	Satisfactory	Moderately Satisfactory	198.08
10	06/11/2012	Satisfactory	Moderately Satisfactory	211.30
11	12/14/2012	Satisfactory	Moderately Satisfactory	240.81
12	05/23/2013	Satisfactory	Moderately Satisfactory	284.32
13	12/14/2013	Satisfactory	Moderately Satisfactory	312.40
14	04/21/2014	Satisfactory	Moderately Satisfactory	334.75
15	11/29/2014	Satisfactory	Moderately Satisfactory	384.62
16	06/29/2015	Satisfactory	Moderately Satisfactory	440.60

H. Restructuring (if any)

Restructuring Date(s)	Board Approved PDO Change	ISR Ratings at Restructuring		Amount Disbursed at Restructuring in USD millions	Reason for Restructuring & Key Changes Made
		DO	IP		
02/01/2013	N	S	MS	252.02	Extension of Closing Date from Mar 31, 2013 to Sep 30, 2014
09/23/2014	N	S	MS	384.62	Extension of Closing Date from Sep 30, 2014 to June 30, 2015

I. Disbursement Profile


Original
Formally Revised
Actual
US $ Millions
500
400
300
200
100
0
2007 Q3
2008 Q1
2008 Q3
2009 Q1
2009 Q3
2010 Q1
2010 Q3
2011 Q1
2011 Q3
2012 Q1
2012 Q3
2013 Q1
2013 Q3
2014 Q1
2014 Q3
2015 Q1
2015 Q3
2016 Q1
2016 Q2

1. Project Context, Development Objectives and Design

1.1 Context at Appraisal

1.1.1 The project was identified in a context of growing water stress in one of the most water scarce states of India. Water scarcity in Tamil Nadu is the result of both agricultural water use and non-agricultural uses relating to urbanization and industrialization, where demand for water is increasing. On the agricultural side, the irrigation of some 2 million hectares relies on 61 major reservoirs, 40,000 tanks, and 3 million wells. The poor state of irrigation infrastructure and facilities, and of the traditional tanks in particular, was a serious constraint to agricultural growth and worsened the scarcity problem for the roughly one half of the State's 62 million people living in rural areas. Addressing these growing threats required improvements to water delivery and efficiency through: (i) the rehabilitation and modernization of infrastructure, operations and maintenance; (ii) institutional development, increased capacity, and improved coordination of water and agriculture organizations; (iii) the intensification and diversification of irrigated agriculture and (iv) strengthening water management at the sub-basin and Statewide levels. The need to stimulate agricultural growth and to ensure sustainable water use led the Government of Tamil Nadu (GoTN) to propose the project.

1.1.2 The Government's proposal built upon the World Bank – assisted Tamil Nadu Water Resources Consolidation Project (WRCP) that laid some of the foundations for this project to address the above challenges. These included: (i) a pilot, multidisciplinary approach among all constituencies to work in an integrated manner to modernize irrigated agriculture; (ii) newly developed institutions and mechanisms to strengthen water resource studies and control; (iii) relevant policies and strategies; (iv) development of river basin databases and five micro-level plans. A number of additional needs were identified at the end of WRCP, and these constituted the basis for a new project, including: (i) some institutional challenges related to water resource management, irrigation service delivery and allocation of water across sectors; (ii) the need to improve Operations and Maintenance (O&M) and participatory irrigation management (PIM); (iii) the promotion of water saving technologies, agricultural diversification and marketing to increase the productivity of water use, and; (iv) the development of a shared vision between departments through a sub-basin framework, incorporating technical, economic, social, and environmental perspectives.

1.1.3 The project was consistent with the World Bank Country Strategy for India (September 2004) since the management of water and irrigated agriculture was expected to contribute to sustainable growth and poverty alleviation. The GoTN demonstrated a strong commitment to necessary reforms of the state's water sector through its engagement with WRCP and its consistent support for a further irrigation project as a high priority for the state. The World Bank's global experience and knowledge relating to water resource management and irrigation water productivity were seen as instrumental in informing and guiding the new operation.

1.2 Original Project Development Objectives and Key Indicators

1.2. The original Project Development Objective (PDO) was defined in the Financing Agreement (FA) as: *to assist selected sub-basin stakeholders in increasing the productivity of irrigated agriculture in the State of Tamil Nadu within an integrated water resources management framework.* However, the PDO was

defined in the Project Appraisal Document (PAD) somewhat differently: *for selected sub-basin stakeholders to increase irrigated agriculture productivity in a sustainable water resource management framework.* Following the standard approach and IEG's methodology, the PDO defined in FA was used in this report.

1.2.2 Below are the project outcome indicators contained in the PAD Result Framework (RF, Annex 3):[1]

1. Percentage increase in value of crop production per unit of irrigated water supply (in comparison to without project (WOP));
2. Increase in area under micro-irrigation;
3. Increase in area under high value crops;
4. Percentage increase in targeted farmers' incomes compared to other (WOP) farmers;
5. Joint preparation and implementation of sub-basin development plans across relevant implementing agencies;
6. Enhanced sustainable water resource planning capacity (targets being 3 sub-basin and 1 basin board formed).

1.3 Revised PDO and Key Indicators

1.3.1 The PDO was not revised. The PAD was not entirely clear on how some of the key indicators were to be measured. There were also a large number of intermediate outcome indicators, some of which were vague or not clearly specified. The project indicators were discussed during the mid-term review in February and March of 2010, and a number of clarifications and one change were agreed upon. The change was to reduce the target for micro-irrigation from 100,000 ha to 40,000 ha. While this was cleared with the Country Director, there was not a formal processing of the change.

1.4 **Main Beneficiaries** (original and revised)

1.4.1 The project's direct beneficiaries included marginal and small farmers engaged in irrigated agriculture. The PAD provided the following features of the State rural population expected to be affected by the project. Their poverty rate ranged from 20.6 to 31.8 percent. Farming accounted for about half of the household incomes of these 35 million rural people, but was proportionately much higher for the poorest segment of the population. About 90 percent of the 677,650 farmers in the project area were small farmers with an average farm holding size of 0.55 ha to support an average family size of five. Pre-project levels of irrigation coverage and productivity could support only a fifth of the families to be above poverty line. Given the importance of agriculture for the incomes of the rural poor in Tamil Nadu, growth in labor intensive agriculture could further reduce rural poverty, and provide higher yields to small producers, higher real wages to agricultural laborers, increased incomes, and employment opportunities.

1.4.2 The project's indirect beneficiaries were linked to the institutional capacity building and introduction of innovative design features. The project established the State Water Resources Management Agency (SWaRMA) and defined a new model for strengthening of Participatory Irrigation Management (PIM) in the State. The project likewise tested and began scaling up a model villages approach, in which trained line department representatives came together at the

[1] This is despite some discrepancies between Annex 3 and the main text of the PAD: some indicators in the RF are absent from the main PAD document (2, 4 and 7); other ones are worded differently (1, 3, 6 and 8).

local level to coordinate their interventions with the population and work effectively as teams. As part of the model village approach, the project also implemented the community based water management approach, which represented a more holistic treatment of water management decision making at the village level. The project further developed the capacity of TNAU to bring its formidable agricultural research capacity to the field in the form of targeted agricultural extension that has generated practical results leading to scaling up of numerous new commodity specific programs.

1.5 Original Components

1.5.1 **Component A: Irrigation systems modernization in a sub-basin framework** (US$282.83 million, 54.9 percent of the total base cost) aimed to improve bulk water delivery to irrigation systems through modernization of irrigation systems and service delivery in schemes in about 63 selected project sub-basins. Sub-basin plans represented the "integrated water resources management framework" spelled out in the PDO. Project activities were expected to be undertaken in a coordinated way by all agencies and support demand driven investment under the component. The component also aimed to finance civil works, equipment, consultancies, training, and incremental operational costs associated with the modernization of the schemes. The work was to be carried out primarily by the Water Resources Organization (that became the Water Resource Department – WRD) with the involvement of Water User Associations (WUAs). Component A included two sub-components: A1 – tank system modernization; A2 – modernization of other irrigation systems, largely canal systems.

1.5.2 **Component B. Agricultural Intensification and Diversification** (US$166.23 million, 32.3 percent of the total base cost) aimed to capitalize on the improved bulk water delivery of Component A to "increase productivity of irrigated agriculture" (PDO) through intensification and diversification. Activities under this component aimed to improve benefits to farmers, farm laborers, landless, fishermen and livestock owners, and were part of the sub-basin plans. The component financed training, goods, civil works, and incremental operating expenses associated with field based demonstrations and awareness building / training / extension programs related to intensification, diversification, sustainable agricultural practices, water conservation through farm ponds and localized irrigation systems, etc. The component had a number of activities related to crop intensification (mostly promotion of System of Rice Intensification – SRI), crop improvement and diversification (horticulture, pulses, sugar cane, groundnut, etc.), agriculture marketing, as well as interventions in the livestock and fisheries sub-sectors. It was implemented by six State technical departments [2] supported by the Tamil Nadu Agriculture University (TNAU). Component B also had two sub-components: B1 and B2 for agriculture activities on tank systems and other irrigation systems respectively.

1.5.3 **Component C. Institutional Modernization for Irrigated Agriculture** (US$52.69 million, 10.2 percent of the total base cost) aimed to improve the institutional capacity for modern, efficient, and accountable irrigation service delivery. The component included modernization of the Water Resource Department (WRD) through institutional development and capacity strengthening to better deliver services to water users and enhance its knowledge base, analytical

[2] Department of Agriculture (DoA); Agriculture Engineering Department (AED); Department of Horticulture (DoH); Department of Agricultural Marketing (DAM), Animal Husbandry Department (DoAH), and the Department of Fisheries (DoF).

work and information functions, and supported the formation and capacity development of an estimated 2,500 WUAs in the 63 selected sub-basins.

1.5.4 **Component D. Water Resources Management** (US$5.00 million, 1.0 percent of the total base cost) mainly consisted of the creation of a State Water Resources Management Agency (SWaRMA), enhancing its analytical capacity, and stakeholder involvement as a means to improve institutional arrangements and capacity for sustainable water resource management in the State.

1.5.5 **Component E. Project Management Support** (US$8.32 million, 1.6 percent of the total base cost) supported management and coordination functions, key consultancies (e.g. for M&E), procurement of civil works and goods, and reporting implemented by the Multi-Disciplinary Project Unit (MDPU).

1.6 Revised Components

1.6.1 Although project components were not revised, the breakdown between sub-components B1 and B2 corresponding to agricultural interventions in tank systems and other irrigation systems respectively, were progressively abandoned during project implementation because Component B interventions were implementing similar activities in both tank and non-tank irrigation systems in project areas.

1.7 Other Significant Changes

1.7.1 The project was extended twice. First from 31 March 2013 to 30 June 2014, and then until 30 June 2015. The main reason was the slower than expected implementation of Component A resulting from procurement difficulties and delays in obtaining Government sanctions for a number of civil work contracts. At closure, US$45 million of undisbursed funds were cancelled for four main reasons: (i) foreign exchange savings (the INR/USD exchange rate increased from 44 to 64 during implementation while most expenses were in local currency); (ii) some savings on civil works contracts; (iii) the downsizing of the micro-irrigation activities (see below), and; (iv) low disbursement of Component C due to over-budgeting for certain expenditures (e.g. infrastructure), and other savings. There were no other significant changes to the project design.

2. Key Factors Affecting Implementation and Outcomes

2.1 Project Preparation, Design and Quality at Entry

2.1.1 The **background analysis that informed project design was sound**. It emphasized the importance of water stress in Tamil Nadu, the over-use of water compared to available resources, and the consequent need to enhance efficiencies in agriculture's use of water. A hydrological survey conducted in 2004 confirmed that 36 percent of the State aquifers were in a very critical situation (use was more than 100 percent of recharge); 10 percent in a critical situation (between 90 and 100 percent of recharge volumes); and 27 percent in a semi-critical situation (70-90 percent of recharge volumes). Only 25 percent were judged to be sustainable (the remaining 2 percent were classified as saline). The analysis also emphasized the need for agricultural development as a

means to both contribute to better livelihoods and improve the effectiveness of water usage for irrigation. Lessons learned were not just drawn from WRCP but also from Bank irrigation projects elsewhere in India and abroad. World Bank experience in the sector had demonstrated that investment in irrigation rehabilitation would not achieve all anticipated benefits unless combined with:

- a substantial focus on agriculture. The Tamil Nadu Irrigated Agriculture Modernization and Water-Bodies Restoration and Management Project (TNIAMWARM) incorporated this lesson by investing 32 percent of project costs into Component B activities concerned with increasing agricultural productivity; and

- investment in improved water management and institutional development, which were the purpose of Components C and D respectively.

2.1.2 **Lessons** from other projects in India related to the need for stakeholder participation, institutional reform, and implementation effectiveness. These lessons were to be incorporated in the project through:

- the design of the sub-basin development plans,
- modernization of irrigation structures and management (Component A),
- institutional development under Components C and D, and
- solid implementation procedures under Component E.

2.1.3 The **PDO** applied the findings of the background analysis to identify the dual need to "*increase irrigated agriculture productivity*" within a larger "*integrated water resources management framework.*" As reflected in the first PDO indicator, "Productivity," was defined in the first PDO indicator as the value of agricultural production per unit of water (e.g. in INR per cubic meter of water). At the same time, it would be important to boost agricultural yields in their own right to achieve the intended project impacts.

2.1.4 The **Project Design** combined physical infrastructure (Component A), water management capacities (Component C), and institutional reforms (Component D), all in support of a diversified spectrum of agriculture interventions (component B). Project management, (component E), aimed to coordinate and ensure the integration of all activities. Intermediate objectives were worked out for each component, with responsibilities defined for each of the nine participating agencies.[3] However, while some of these intermediary outcomes were clear, others were vague and/or lacked clear targets.

2.1.5 The State Government demonstrated a strong commitment to the project throughout the identification and design stages by establishing the Multi-Disciplinary Project Unit (MDPU) during this period in order to ensure timely preparedness and ownership of the project by the nine state partner agencies. The Project Operational Manual was prepared during the second half of 2006 (before appraisal) and finalized in early 2007 ahead of project effectiveness. It provided specific guidance on integrated sub-basin planning and development, including for each stage (pre-

[3] The nine participating agencies were WRD, DoA; AED, DoH, DAM, TNAU, DoAH, DoF and SWaRMA.

planning, planning, implementation, and post implementation), a detailed list of activities, expected outputs, and responsibilities.

2.1.6 **Anticipated risks**. The complexity of coordination among the nine implementing agencies was correctly identified as a substantial source of risk, and was mitigated through such measures as the early establishment of the MDPU and integrated sub-basin development planning methodologies. The latter were also used to address the identified risk that consensus might be lacking between stakeholders. A risk of high turnover of field staff did not materialize during implementation. The lack of government priority for institutional reform was rightly identified as a substantial risk as evidenced by the delays in certain reforms and institutional changes at the beginning of the project. In hindsight, a significant shortcoming was the failure to recognize climatic disorders such as severe droughts as potential threats to the achievement of expected outcomes. As it turned out, severe droughts would lead to lower than expected agricultural performance in 2012 and 2013 (more on this below).

2.2 Implementation

2.2.1 **Internal factors** affecting implementation included: (a) effective implementation modalities; (b) procurement challenges; (c) resistance to reforms related to water management, and; (d) the World Bank MTR in March 2010.

2.2.2 **Effective Implementation Modalities**. Implementation benefitted from the establishment of effective and sometimes innovative mechanisms by the Government of Tamil Nadu to ensure the integration of project interventions at the State, sub-basin, and village levels. These interventions related to irrigation infrastructure, water management, institutional development, and agricultural development.

(i) MDPU, which coordinated and actively mobilized the required capacities among the nine partner agencies at the State level was driven by strong management and State Government commitment.

(ii) The sub-basin framework promoted joint preparation and implementation of integrated sub-basin development plans across implementing agencies. A team with members from participating agencies conducted "walk through surveys" in project areas that enabled field diagnosis combined with stakeholder consultations to identify specific project interventions in a participatory manner. "Nodal officers" (Executive Engineers, WRD) were also deployed at the sub-basin level to combine engineering, institutional, and technical interventions on the basis of these sub-basin plans.

(iii) Model villages were introduced in 400 villages during the second half of implementation. These proved a powerful instrument for integrating interventions at the community level. The villages enabled Government activities to converge into multi-departmental teams, the establishment of Single Window Information Knowledge Centers (SWIKCs), and the community water budgeting exercise as a participatory planning and management tool. These made community members

aware of the current uses of existing water resources, enabling them to develop a common vision for more sustainable management options in the future.

(iv) Development of an alternative capacity building plan that was introduced in the second half of the project where PIM cells were staffed and strengthened at the MDPU as well as within the four regional offices of the WRD. New staff were hired specifically to work closely with WUA members and to engage the Center for Excellence in Change (CEC) as the training partner in conducting joint training events in sub-regional locations. These engaged farmers and engineers in improving water management, focusing on capacity building in different levels within the department, and on changing attitudes and behaviors.

2.2.3 **Procurement challenges**. Procurement for large scale civil works scattered across 63 sub-basins and 5,260 tanks under Component A was challenging. MDPU established a procurement and implementation process that included: (i) staggering project interventions into four phases; (ii) grouping civil works into manageable packages; (iii) contracting work to the private sector and (iv) hiring a third party technical consultancy company to supervise construction. In accordance with advice from World Bank supervision missions, the project introduced an innovation known as the "OK Card" to ensure and certify the quality of work being undertaken by all the stakeholders involved, including the WUAs. The project achieved all expected outputs despite delays, in particular during 2009-2010 when disbursement dropped due to protracted delays in the issuance of administrative sanctions for procurement packages, in particular Phase III civil works and procurement of monitoring services (see section 2.3 below).

2.2.4 **Initial resistance to water management reform**. Component C suffered delays during the first half of the project, though its implementation status improved considerably towards the end of the project as a result of comprehensive reforms. The main reasons included; (i) WRD was reluctant to cede some of its authority over irrigation schemes as called for in the Tamil Nadu Farmers Management of Irrigation System Act (TNFMIS), 2000 resulting in weak engagement between WRD and WUA members for fee payments for O&M and other related activities; (ii) the resultant delays in establishing the three cells within the Chief Engineers' Office to coordinate the three sub-components under Component C: the Information Technology (IT) cell; the training cell (to train WRD staff), and the Participatory Irrigation Management (PIM) cell; (iii) the initial extensive delays in hiring Support Organizations (SOs) to assist WRD in establishing and strengthening WUAs followed by the unsatisfactory performance of Support Organizations (SOs) contracted; (iv) the lack of a comprehensive training program to train both field officers of the WRD and WUAs; and (v) the lack of ownership of WRD of the PIM process resulting in poor implementation of the TNFMIS Act, 2000.

2.2.5 On several occasions during the course of supervision missions and after the MTR in 2010, the World Bank attempted to persuade the Borrower to intervene and address these problems. Project ratings were downgraded from satisfactory to moderately satisfactory largely as a result of limited progress under the Institutional Modernization and Water Resources Management components (C and D). Despite reasonable achievement of Component A, and good progress by most C

Component B activities, the mission expressed its "disappointment" in relation to the severe delays in strengthening the WUAs, the weakness of the PIM (it noted the PIM cell had only 2 staff) and the resulting risk that the PDO may not be achieved.

2.2.6 In early 2013, the Government agreed with the Bank to end the SO program of WUA capacity building, and initiated a new model based on hiring social scientists and community-level organizers as well as investing in the strengthening of the PIM structure within WRD. From 2013 onwards, the MDPU and the Government sanctioned a new approach that fundamentally changed the way WUAs and WRD officers were trained around PIM. For every 100 WUAs, one WUA development team was assigned to be responsible for the capacity building activities. This was done for all of 2210 WUAs that had not completed the SO training program. In a further innovation, the Government agreed to bring on board the CEC as the principal training and capacity building partner in partnership with IMTI. CEC was instrumental in conducting orientation trainings for the new staff that were hired as well as training of WRD officers including CAs, Junior Engineers, Assistant and Superintending Engineers. This approach was instrumental in reducing inherent mistrust and low levels of ownership of the WUA and PIM process among WRD officers.

2.2.7 **The MTR in 2010 made some adjustments to enhance project effectiveness**

(i) Replacement of six previously selected sub-basins by three new ones (without changing the overall target of 400,000 ha area for tanks).

(ii) Reducing the target of the micro-irrigation systems from 100,000 ha to 40,000 ha though this was not subsequently followed up with formal Restructuring.

(iii) Some adjustments to the agro-marketing sub-component.

(iv) Options for the use of remaining funds (including savings) such as the Government proposal to upscale the rehabilitation of the contour canal of the Parambikulam – Aliyar Project irrigation system affecting 152,000 ha. (This did not come to pass owing to safeguards issues.)

2.2.8 In January 2012, SMEC issued a **"Mid-Term Review Report"** on achievements and challenges based on surveys of 41 sample tanks and 13 control tanks, 1,359 project households, and 409 control households. The Report assessed impacts at mid-term, reviewed progress in implementation, described disbursement and fiduciary issues, and included a thorough environmental assessment and beneficiary survey. It did not critically assess the project results framework, but it did provide a set of relevant recommendations for the second half of the project.

2.2.9 For Component A, these recommendations related to: (i) the need to improve some hardware features (repair of sluices, weir structures, strengthening of tank bunds) that were largely followed through an enhanced quality control system; (ii) the need for water users to participate in technical design; enhanced training for WUAs; and installation of water measurement equipment. While the first recommendation was largely achieved through the quality enhancement system, the second one was only partly followed as documented by subsequent World Bank aide-memoires highlighting the need for greater attention to WUA strengthening.

2.2.10 For Component B, recommendations related to the need: (i) for additional efforts to promote crop diversification (that largely improved towards the end of the project); (ii) to customize project interventions (horticulture development, SRI) to suit differing local conditions (availability of water, soil suitability, attitude of farmers, marketing facilities and social problems); (iii) to follow-up introduction of new techniques with further support to farmers to ensure sustainability and success.

2.2.11 In 2014, FAO undertook a thorough review of 4 World Bank-financed tank projects in India, including IAMWARM.[4] The comparative assessment was performed against a number of criteria including technical design, effectiveness, institutional issues, application of good practices, etc. The report noted some of the positive features in the design of IAMWARM compared to other projects, including: the substantive investment in agriculture (32 percent) being much higher than in the other projects, which allocated only 5 to 13 percent to agriculture; the central role of the TNAU in the agricultural extension work, the involvement and strengthening of the Department of Horticulture (DoH), the effective coordination and convergence of the various departments, the unique attempt to set up multi-sector water management committees and, the ambitious targets for the development of micro-irrigation as water saving investment.

2.2.12 **External factors**

- A severe drought in 2012 - 2013 in Tamil Nadu State: annual rainfall of 712 mm (22 percent below average) and with a particularly poor monsoon season affected farmers throughout the project area, preventing them from effectively capitalizing on project investments.

- A number of farmers were initially reluctant to adopt some of the agricultural practices promoted by the project, including precision farming (micro-irrigation and fertigation) and the System of Rice Intensification (SRI). The reasons included: opinions about the perceived benefits of the new techniques; costs (drip irrigation, water soluble fertilizers); the need to employ more labor, such as laborers to operate cono-weeders that required manual power. This reluctance was addressed by: (i) increasing the numbers of demonstrations and raising awareness particularly through the involvement of TNAU; (ii) raising the subsidy element of the initial cost of micro-irrigation equipment in line with Government of India subsidy levels (eventually to 100 percent for small and marginal farmers, and 75 percent for others) purchased by farmers; (iii) reducing the target for micro-irrigation coverage from 100,000 ha to 40,000 ha at the Mid Term Review (MTR, see below) given disbursement had only reached 5 percent of the target at that time.

2.3 Monitoring and Evaluation, Design, Implementation and Utilization

2.3.1 **M&E Design.** The PAD did not initially propose a clear or consistent results framework with which to fully assess outcomes and results. Some indicators were not specific, others were not consistent or vaguely formulated, while for others there was no clear methodology describing

[4] The three other projects were implemented in Karnataka, Andhra Pradesh and Orissa respectively. Draft FAO Report dated December 2014.

how values were to be measured. This was the case in particular of the first PDO indicator (water productivity).

2.3.2 **M&E implementation.** During implementation, monitoring by the various implementing agencies was regular and systematic. Data were aggregated by the MDPU and reported to the Government. The MDPU reporting included a large amount of information on the Government's Detailed Project Reporting (DPR) indicators, which tended to focus on inputs and preliminary results. An effective Management Information System was put in place, resulting in an MDPU-operated website containing project documents, annual work plans and budgets, Government Orders, sub-basin development plans, relevant procurement and bidding documents, progress reports, and communication materials for general information. A permanent GIS Specialist was also recruited at the start of implementation to produce a set of maps for each sub-basin that was used to support project planning and monitoring activities. Subsequent implementation support missions continued to emphasize the need for clear methodological explanation of reported data. The missions also stressed the need to more effectively deal with project indicators that were more difficult to measure.

2.3.3 The M&E contract was awarded, following considerable delays on 11 January 2010, almost three years into implementation. The PAD had foreseen a deadline of 31 March, 2007. Particular reasons for the delay included: (i) the large number of steps in the procurement process that started in June 2007; (ii) lengthy discussion between the Bank and MDPU on the selected short list of contractors (seven months in 2007-2008); (iii) an appeal filed by a bidder immediately after SMEC was announced as the winner (7 months in 2008-2009); (iv) a re-negotiation of the cost of the proposal that required World Bank agreement on an exceptional basis and a Government sanction (six months in 2009).

2.3.4 This delay affected impact assessment activities. A first rapid assessment ("Special studies on selected tanks") was undertaken in late 2010 and published in April 2011, but provided limited coverage. The baseline survey was only published in September 2011; the MTR report in January 2012 (covering a sample of tanks disconnected from the baseline survey); and the final impact assessment report (focussed on comparing performances between project farmers and non-project farmers) in June 2014 based on data collected in 2013. In summary, the baseline, mid-term and final impact assessment reports were concentrated in less than three years while the project duration was eight years.

2.3.5 Impact assessment activities suffered from other shortcomings, such as: (i) the absence of a full time M&E specialist in MDPU to oversee SMEC and coordinate all monitoring activities by the various departments. This was foreseen in the PAD, requested by various supervision missions, including the MTR team, but was not followed by action; (ii) the fact that SMEC, initially, did not report systematically on key performance indicators while they were focused on implementation issues; (iii) despite recommendations by the September 2012 mission to postpone the field investigations for final impact assessment in 2014 in anticipation of a possible project extension by 27 months, this was not postponed, and field interviews took place in 2013 when farmers were affected by drought (see section 3.2 below).

2.3.6 **M&E Utilization.** Despite these shortcomings, SMEC performed effectively in providing independent feedback to implementation and management teams about field activities, achievements, stakeholder perceptions, challenges leading to recommendations on potential corrective measures. SMEC reports were carefully reviewed by the MDPU and systematically discussed during joint meetings between MDPU, SMEC, and concerned agencies. These reports included monthly reports in which activities were thoroughly reviewed as well as more in-depth assessments of particular elements of the project. Quarterly reports tracked SMEC's progress in achieving its terms of reference. Project interventions were systematically reviewed in annual and biannual reports. The findings were used to formulate recommendations to the MDPU. With the exception of a number of water management issues in which the MDPU encountered difficulties in obtaining necessary action on the part of the Government, it was generally responsive to these recommendations. For instance, it took immediate action with contractors and WRD when design and quality issues were identified in construction work. The MDPU also introduced requirements under Component B to progress beyond demonstration plots into "impact areas," as well as the model village approach to integrate activities locally.

2.4 Safeguard and Fiduciary Compliance

2.4.1 The following environmental and social safeguard policies were triggered at appraisal:

- Environmental Assessment (OB/BP 4.0 1)
- Pest Management (OP 4.09)
- Cultural Property (OPN 11.03, being revised as OP 4.11)
- Involuntary Resettlement (OPBP 4.12)
- Safety of Dams (OPBP 4.37)

There were no outstanding environmental or social safeguard issues triggered by the project.

1. *Environmental Assessment.* Because the scope of the physical works entailed rehabilitation and modernization of existing irrigation schemes, no significant risk of negative environmental impacts was identified. Nor were forestry or biodiversity issues raised by a comprehensive environmental impact assessment carried out during preparation. There was generally satisfactory compliance with the environmental safeguards. MDPU appointed an environment expert to ensure that the SEMF was implemented in contract works. This involved ensuring that all sub projects had the necessary environmental safeguards and that construction contracts also had the requisite Environmental Management Plans.

2. *Pest Management.* Demonstrations and training have been carried out in project schemes on integrated pest management (IPM) and integrated plant nutrient management (IPNM) to motivate farmers to use fewer and lower levels of agricultural chemicals and move towards organic and biodynamic farming approaches involving the use of green manures, crop residues, vermi-compost, bio-fertilizers, and bio-pesticides.

3. *Cultural Property.* No issues were raised during the project affecting physical cultural resources.

4. *Involuntary resettlement.* The implementation of the project entailed no involuntary resettlement.

5. *Safety of Dams.* The project was in compliance with the Dam Safety policy, and work programs for each dam were implemented satisfactorily. A number of sub-projects were subjected to dam safety review as per State Dam Safety guidelines. Periodic inspections of these dams was carried out by a Dam Safety Review Panel to investigate the hydrological and geological status and structural stability of the dams, and critical identified issues were incorporated in all the sub projects and relevant mitigation measures were proposed to address these issues. Both pre- and post-monsoon inspection and assessment conducted by WRD staff were incorporated into sub-projects as needed. The Bank-funded Dam Rehabilitation and Improvement Project is currently under implementation with TN as one of the benefiting states.

2.4.2 **Financial management** arrangements for the project were largely mainstreamed around state public financial management systems. This was the first time such an extensive use of country systems was adopted in a multi sector project, involving nine line departments and over 700 Drawing and Disbursement Officers (DDOs). This included channeling bank funds through the state treasury, creating dedicated budget lines (by sub-basins) within GoTN's existing budget framework, internal controls, payments and accounting using the state's treasury and accountant general's financial reporting systems and external audit by the auditor general. Budgeting by sub-basins allowed for comparison of cost as per DPR with budget and actual expenditure using GoTN financial systems. The one exception was internal audit, wherein the services of a chartered accounting firm were used to validate internal controls, including sample physical verification of assets.

2.4.3. The financial management arrangements were largely adequate throughout the implementation phase, with timely submission of interim financial reports, which were also used as a basis for disbursement. Audit reports, due within six months of the end of the financial year, were submitted with some delays of three or four additional months. The MPDU followed up closely with line departments to resolve issues raised by the reports and to make adjustments to subsequent reimbursement claims in cases of confirmed ineligible expenditures. The areas which required close monitoring were (i) periodic reconciliation of project expenditures reported by the treasury with those of the accountant general, with adjustment for any differences; (ii) delays in the settlement of advances for project activities, especially those related to departments of agriculture, horticulture and animal husbandry and (iii) delays in reconciliation expenditures reported by DDOs and treasury with the accountant general in case of agriculture department. *Having a stable and core team of finance staff in the MDPU, headed by a professionally qualified finance official, on deputation from the state's Directorate of Treasury and Accounts was largely attributable for the adequate financial management arrangements including timely financial reporting and audit.*

2.4.4 The project had to submit the audit report for the extended period of 19 months ending on October 31, 2015.

2.4.5 **Procurement.** In general procurement was carried out in accordance with the agreed procedures, despite the highly staggered project interventions into four phases involving nine participating implementing agencies. The bidding and selection process was conducted in a fair and transparent manner. In spite of the large number of schemes undertaken, there were very few complaints, and these were promptly attended to by the project. This was likely due to the regular training opportunities in procurement management used through the implementation period. In the

initial phase of the project there were procurement delays that had slowed the procurement of civil works and consultancies. These were gradually resolved. The procurement for M&E consultancy was delayed considerably due to problems cited in para. 2.3.3. At times, disbursement dropped due to rebidding of 55 work packages and prolonged delays in the issuance of administrative sanctions for procurement packages. This was the case in particular for Phase III civil works and procurement of monitoring services. At times, not all Bank procurement procedures were strictly followed, as noted in several post-procurement reviews. These shortcomings were addressed through regular training and capacity building. Contracts management potential was also an issue that contributed to the time overruns in several cases. Overall procurement under the project was rated Moderately Satisfactory.

2.5 Post-completion Operation and Next Phase

2.5.1 Operations and Maintenance of the tanks and irrigation systems rehabilitated under the project was the main responsibility of the WRD. State budgets contain an allocation for maintenance of water structures managed by WRD and will be used for the O&M of project irrigation assets. In addition, as per the provision of the Tamil Nadu Farmers Management of Irrigation System (TNFMIS) Act (2000, rules 2002), WUAs may levy a fee ranging from INR 250 to INR 500 per hectare per year for O&M purposes. To incentivize the WUAs to collect these fees and become financially sustainable, the GoTN announced toward the end of implementation that it would provide them with a matching grant of the amount they will be able to collect. However, this program was not up and running by the end of implementation. By project end, only 561 WUAs (26 percent of those supported by the project) had collected an average of about INR 5,100 each.

2.5.2 Ensuring that WUAs were robust enough to always perform their assigned duties was a long term process requiring continuous support over five to ten years. The Government committed to sustain the participatory irrigation management (PIM) program in the State and provide continued support to the WUAs through the permanent institutionalization of the PIM cell in the office of the Engineer-in-Chief. In spite of the TNFMIS, WRD does not fully adhere to the need for a permanent PIM/WUA support program. This activity has so far only been executed by Bank-supported operations in Tamil Nadu, through organizations outside the WRD – support organizations, NGOs, and national consultants.

2.5.3 Upon project completion, the various activities under the agricultural components were mainstreamed into regular interventions of the respective departments through various programs and priority missions that were scaled up under the project. Missions are large scale Government programs (at federal or State level) involving the mobilization of human resources in relevant Government line agencies and budgets earmarked for priority objectives. A number of component B interventions were undertaken in the context of missions that were strengthened and are being sustained beyond the life of the project. The GoTN annually publishes the “Citizens Charter” of agriculture that details the conditions and eligibility for the various programs and missions undertaken by the respective departments. A particular project achievement consisted of upscaling SRI. This has become a State-wide priority program. IAMWARM also spearheaded efforts to expand both pulse and millet production, which are now being pushed State-wide by GoTN.

2.5.4 In terms of staffing, all personnel from the various departments who worked on the project, either within their department or in the MDPU, were re-integrated back into their original departments. 27 to 30 of the 64 staff who were employed during implementation were retained by the MDPU for six months after project completion to complete the ICRR, and to integrate the project's agricultural activities into more permanent State missions and programs. Following through with project activities concerning the office of the engineer in chief was also necessary. This core team was also working on the Project Concept Note for a follow-on project building on IAMWARM.

2.5.5 In a letter dated October 16, 2015, the Government of India communicated its interest in Bank support for a successor project to follow on IAMWARM. The new project would cover areas of Tamil Nadu not covered under the original project. During the Identification Mission for the new project, agreement was reached with GoTN to also continue capacity development of the weaker WUAs organized under IAMWARM. The new project will focus on crop diversification, farmer entrepreneurship, ICT based optimization, farm mechanization, and water harvesting. Its objective would be to increase crop area, crop productivity, and income.

2.5.6 During November and December of 2015, Tamil Nadu experienced severe flooding due to unprecedented levels of precipitation. Of the more than 5,000 tanks rehabilitated under IAMWARM, only a handful suffered breaches. The situation with non-IAMWARM tanks was significantly worse, with extensive damage recorded. As part of the proposed follow on project, GoTN is requesting priority assistance from the Bank in dealing with the problem with the goal being to adhere to the same design and construction quality measures as applied under IAMWARM.

3. Assessment of Outcomes

3.1 Relevance of Objectives, Design and Implementation

3.1.1 At ICRR, the **project objective** remained highly relevant to the National Water Policy issued by the Ministry of Water Resource in 2012. The Policy prioritized demand management and water use efficiency through water saving technologies in agriculture systems, and by bringing in maximum efficiency in the use of water and avoiding wastage. The PDO was relevant to the GoI's strategic objective of strengthening irrigated water resource management in its 12th Plan – which was supported by the Bank's India Country Partnership Strategy (CPS) (2013-2017) outcome 2.4: Increased agricultural productivity in targeted areas. The combination in the PDO of "increased agricultural productivity" within "integrated water resources management framework" reflects this approach.

3.1.2 As mentioned, the core principle of the **project design** was the **integration** of interventions related to (i) physical rehabilitation of infrastructure (hardware), (ii) support to a diversified set of agricultural interventions to ensure the most effective and efficient use of water, (iii) improvement of water management both at State and community levels (software), and (iv) the need for institutional reforms. This was adequately reflected in project Components A, B, C, and D respectively and the design remained highly relevant as noted in the FAO *Review of tank projects in India*, which pointed out the high share of investment in agriculture in IAMWARM. Some recent developments in irrigation rehabilitation projects demonstrate the importance of further

linking plans for improvements in agricultural productivity with the specific water management interventions being undertaken and to have this as a pre-condition for rehabilitation work. Furthermore, the project design (and implementation) were relevant to emerging new development priorities of GOI and GoTN as it produced the three key outcomes of climate-smart agriculture by improving productivity, building resilience and reducing emissions. As discussed in the next section (Outcome) in more detail, the project achieved substantial increases in yields of key crops such as paddy, maize, fruits and vegetables. The project enhanced farmers' resilience to extreme climatic events such as floods and droughts by enhancing and strengthening irrigation infrastructures (irrigation canals and tanks), the clear evidence is how the rehabilitated tanks and irrigation canals withstood the extreme flooding occurred in November 2015. Large-scale adoption of water saving technologies such as SRI, drip irrigation, and diversification from paddy into high value crops led to reduced water usage leading to reduced GHG emissions. However, given design issues related M&E framework, and ambitious objectives with regard to creation of sub-basin boards, the relevance of project design is rated as substantial.

3.1.3 **Relevance of implementation.** The ways the integrated nature of the project design were implemented was very relevant. The sub-basin development plans integrated all activities related to water and agriculture. In the water sector, the combination of effective engineering options, irrigation modernization approaches, and water management considerations, both at State and sub-basin level was clear and effective. In agriculture, the involvement of various agencies reflected the need to incorporate scarce irrigation water through intensification (Department of Agriculture and TNAU), crop diversification (Departments of Horticulture and Agriculture, and TNAU), water saving irrigation practices (Agro Engineering Department and TNAU) and the optimization of incomes per drop of water through livestock, fishery and agri-marketing departments.

3.1.4 The active involvement of TNAU in the project was essential. It was the central force in getting innovations into practice, and an effective way to successfully bridge the traditional divide between research and practical application. TNAU tested and disseminated improved practices and innovations to be further propagated by the respective departments. It was able to adapt these technologies to farm conditions in order to enhance the activities of these agencies. TNAU led the demonstration of innovations such as SRI, SSI, hybrid maize, the seed village concept and diversification efforts towards pulses, millet, groundnut and vegetables. It managed to go from the lab to the field by mobilizing some of its professors and a number of graduate students. TNAU also conducted a large number of training events targeted at Government departments and launched the innovative agricultural extension model named "e-Velanmai."

3.1.5 At completion, the implementation mechanisms put in place for effective coordination of Government agencies remain very relevant and was a major achievement for the project given the common difficulties faced by line agencies to work coherently. This achievement resulted from (i) the MDPU, at State level, working as a strong convening body of the nine concerned agencies: (ii) the sub-basin development plans integrating department representatives, elective bodies, and water users at sub-basin level, and; (iii) the model villages providing a context for agencies to work collaboratively at the community level. Government of India has expressed its interest in disseminating the experience of IAMWARM as a model for future irrigation projects nationwide. Overall, the implementation is rated as highly relevant.

3.2 Achievement of PDO

3.2.1 The PDO was built on three elements: (a) irrigation rehabilitation and modernization; (b) intensification and diversification of agriculture; and (c) an integrated water resources management framework. With respect to the first element the key indicators were: (1) rehabilitation of tank and infrastructure and total ayacut area rehabilitated; (2) expansion of fully irrigated area; (3) increase in conveyance efficiency; and (4) increase in area with micro-irrigation. With respect to the second element the key indicators were; (1) expansion of yield and production of key crops; (2) diversification into high value crops away from paddy; (3) increased milk production; (4) increased fish production; and (5) increase in targeted farmers' income. With respect to the third element the key indicators were; (1) increase in value of production per unit of water; (2) establishment of functioning WUAs; (3) establishment of the State Water Resources Management Agency; (4) joint preparation and implementation of sub-basin development plans across relevant implementing agencies; and (5) enhanced water resources planning capacity.

3.2.2 Review of the indicators with respect to **irrigation rehabilitation and modernization** shows the following. The target for tank ayacut area modernized, at 400,000 ha. was met with actual area of 404,055 ha. The total number of tanks rehabilitated under the project was 5,260 against the original PAD target of 5,700. The difference was due to an adjustment of the sub-basins participating in the Project at the time of the Mid-Term Review. Further, there were a number of tanks in the project sub-basins slated for inclusion, which upon closer inspection did not require rehabilitation work. These numbers do not speak to the quality of the rehabilitation work under the Project. During the recent extreme flooding in Tamil Nadu during November and December 2015, only a handful of the tanks rehabilitated under IAMWARM failed. This was thanks to the introduction of various improved construction techniques, and quality monitoring and assurance measures introduced under the Project. For the sub-basins outside the Project, the situation was quite different, with extensive damages occurring. The Government of Tamil Nadu has requested a follow-on Project to cover those sub-basins not included in IAMWARM, and aims to incorporate the same construction and quality assurance measures there.

3.2.3 With addition of the canal rehabilitation work, the target of total ayacut area modernized of 669,000 ha exceeded the PAD target of 617,000 ha. Within this total command area, the movement in irrigated area is presented in Table 1. The target for increase in fully irrigated area of 40% was met with an actual increase of 143,360 ha or 39%. This was achieved through a reduction of gap area by 87,000 ha. and conversion of 55,920 ha of partially irrigated area to fully irrigated. Partially irrigated area was stabilized at 102,850 ha compared to the PAD target of 92,500 ha.

Table 1 - Changes in Irrigated Area 2008 - 2014 (in '000 ha)

	Pre-Project (2008)	**Post Project (2014)**	**Project Results (in '000 ha)**	**Comments**
Fully Irrigated Area in ha	364.77	508.13	+ 143.36	Increase in fully irrigated area i.e. 39.03%

Partially Irrigated Area in ha	158.77	102.65	- 55.92	Partially irrigated area converted into fully irrigated area
Irrigated Area in ha	523.54	610.98	+ 87.44	Increase in irrigated area
Gap Area (rain-fed and fallow) in ha	145.61	58.17	- 87.44	Gap area brought under irrigation
Total Command Area	**669.15**	**669.15**		

3.2.4 The bulk of the canal rehabilitation work under IAMWARM was in the PAP (Parabmikulam Aliyar Project) system. The PAP Main Canal, with command area of 154,000 ha. accounted for roughly 60% of the command area of canal systems covered by the Project. Average conveyance efficiency of the PAP Main Canal prior to IAMWARM (2006) was 69%. Following the rehabilitation work, average conveyance efficiency was 92% -- with 98% at the head reach and 86% at the tail reach. This improved performance was confirmed by measurements in 2014 and 2015 of average conveyance efficiency of 91% and 90% respectively. This performance exceeded the PAD target for improved conveyance efficiency of 25%.

3.2.5 The target for expansion of micro-irrigation systems (drip and sprinkler) was 100,000 ha. The Project encountered some problems in the early years of implementation primarily due to lack of farmer demand for such systems. At the MTR agreement was reached to reduce this target to 40,000 ha. This was approved by the Country Director, however a formal restructuring paper was not submitted. Following enhancement of the prevailing Government of India subsidy program for micro-irrigation systems and its adoption by IAMWARM, the pace of implementation of these systems increased substantially. By the end of the Project, the area under micro-irrigation had increased by 53,901 ha., including 47,922 ha. under the AED interventions and 5,979 ha. under the TNAU precision farming interventions.

3.2.6 Review of the indicators with respect to **intensification and diversification of agriculture** shows the following. The PAD contains targets for increased area for maize, oilseeds, fruits and vegetables, and sugarcane, and conversion of traditional paddy to SRI. These targets are compared with actual area increases through the crop demonstrations and subsequent year adoption (impact) areas (Table 2). Even allowing for some slippage over time, the targets were met or exceeded in all cases except sugarcane. The PAD also contains targets for 'with project' and 'without project' yields for major crops. These are compared with actual yields from the adoption (impact) areas.[5] (Table 3) A further comparison is with data from the Final M&E Report for the Project of a representative sample of project tanks for both pre-project and post-project yields. In the case of SRI and maize, the yield targets were met. With respect to groundnuts and pulses, the yield targets are slightly underachieved. Project interventions on sugarcane were limited to testing the System

[5] These data are from crop-cutting estimates carried out by field representatives of TNAU and Agriculture Department of the adoption farmers.

of Sugarcane Intensification (SSI), developed by TNAU during the course of project implementation.

Table 2 - Increases in Crop Areas ('000 ha)					
	PAD Target [1]	**Demo Area**	**Adoption Area**	**Total**	**% of PAD Target**
S R I [2]	66,500	55,370	217,333	272,703	410
Maize	28,400	12,738	66,239	81,977	288.6
Oilseeds	29,000	9,952	53,562	63,514	219
Fruits & Vegetables	12,000	49,579	-	49,579	413
Sugarcane	10,800	902	-	902	8
1 - PAD page 71					
2 - Target is for conversion of traditional paddy to SRI					

Table 3 - Increases in Crop yields (tons/ha)				
	Without Project [1]	**With Project [1]**	**Adoption Area**	**% of PAD Target**
Paddy - SRI	4.20	5.40	6.19	1.15
Maize	2.00	3.90	6.26	1.61
Groundnut	2.00	3.00	2.60	0.87
Pulses	0.49	0.69	0.62	0.90
Sugarcane	96.50	128.00	125.00 [2]	0.98
1 - PAD page 71				
2 – Demonstration area only				

3.2.7 The PAD called for a 40% increase in fruit and vegetable yields. For the five commodities for which data are available, this target was met for tomatoes and chillies, and partially met for brinjal, bhendi and bananas (Table 4).

Table 4 - Increase in yields for fruits and vegetables (tons/ha)				
	Pre-Project M & E [1]	**Post Project M & E [1]**	**% increase**	**Project [2]**
Bananas	39.2	45.2	15.1	52.2
Bhindi	7.0	8.6	22.2	11.3

Brinjal	12.1	14.8	22.2	15.7
Tomato	13.8	20.2	46.9	18.4
Chillies, dried	1.9	2.7	42.6	n.a.
1 – SMEC Final Report p. 85				
2 – Average yield from Demo Plots				

3.2.8 In the results indicators, the PAD called for an increase in the area under high value crops of 30%, though it did not define the term 'high value crops'. Usually this refers to horticulture crops. The PAD contains a target for increase in fruit and vegetable area of 12,000 ha. Actual area expansion for fruits and vegetables was measured at 49,579 ha. This is the cumulative sum of annual area increases through the horticulture crop demonstration program. To the extent that there was slippage over time, this latter figure would be lower for end-of-project. However, given the preponderance of micro-irrigation systems for horticulture fields, slippage is not likely to be large at end-of-project. The large expansion of horticulture crop area under the Project is also reflected in the Final M&E Report. Based on a survey of project tanks, the share of cropped area devoted to horticulture increased from 5.5% to 12.3% pre- and post-project, an increase of 124%.

3.2.9 The PAD target for the increase in milk production was 590,000 m.t. By the last year of the Project this figure was exceeded with an increase in annual milk production of 705,410 m.t. reflecting the success of the project's artificial insemination (AI) program, and expansion of fodder cultivation.

3.2.10 The PAD provides two targets for increase in fish production. The Economic and Financial Analysis cites a figure of 22,500 m.t., while in the Results Framework the figure is 25,000 m.t. By the last year of the Project, fish production had increased by 14,686 m.t failing to meet the target. Chief reasons for the shortfall included inaccurate estimation of suitable water spread areas during project preparation, and inadequate fish production models at project entry. Fish production increased by 4,300 m.t. in the last year of project implementation. This indicates that with adequate identification of water spread area, the project target can be achieved within the next two to three years.

3.2.11 The PAD contains an indicator for increase in targeted farmers' incomes compared to other (without project) farmers of 50%. In the Economic and Financial Analysis figures for incremental farm income of INR 12,700 per year, and increase in income for a one hectare holding farmer of INR 11,500 per year at full development are provided. Comprehensive end-of-project data on increases in farmer income are not available. Data on per hectare returns for the main crops included in the Project for 2013 are provided in Table 5. The increase in net returns per hectare exceed the 50% target for maize, pulses, groundnut, and vegetables (bhendi, brinjal, tomato). The increase in income per hectare also generally meets or exceeds the above cited figures, in some cases substantially exceeding them. The increase in net returns per hectare for banana are 38% or INR 53,000 per hectare. The net returns per hectare of paddy (under SRI technology) by 7.5% perhaps reflecting the fact that 2013 was a drought year severely affecting paddy production. The data from the 2011, a more normal weather year, showed net returns per hectare for SRI of INR 13,340 or 41.8% increase.

Table 5 – Cost and Returns (Rs./ha) of Major Crops										
Crops	Project Tank									
	Cost of Cultivation			Total Value of Output			Net Value of Output			
	Pre-Project	Post Project	Change	Pre-Project	Post Project	Change	Pre-Project	Post Project	Change	% Change
Paddy – SRI	19,131	29,859	10,728	50,810	64,013	13,203	31,679	34,154	2,475	7.5
Maize	14,478	20,082	5,604	34,777	50,812	16,035	20,299	30,730	10,431	51.4
Pulses	11,037	12,501	1,464	24,470	33,889	9,419	13,433	21,388	7,955	59.2
Groundnut	30,201	42,224	12,023	63,090	1,01,160	38,070	32,889	58,936	25,509	77.8
Sugarcane	42,562	85,116	42,554	1,40,250	2,08,043	67,793	97,688	1,22,927	25,239	25.8
Banana	61,077	94,253	33,176	2,00,600	2,86,471	85,871	1,39,523	1,92,218	52,695	37.8
Bhendi	28,500	35,507	7,007	56,853	90,351	33,498	28,353	54,844	26,491	93.4
Brinjal	52,027	65,816	13,789	77,285	1,05,365	28,080	25,258	39,549	14,291	56.6
Tomato	68,216	95,653	27,437	1,24,029	1,82,196	58,167	55,813	86,543	30,737	55.1

3.2.12 Review of the indicators with respect to **an integrated water resources management framework** shows the following. A major initiative for improving the efficiency of water use was the introduction of SRI. A study carried out on a sample of 832 SRI demonstration fields under the Project between 2007-08 and 2010-11 showed a 64% increase in output per unit of water for SRI in respect to comparator fields under conventional paddy production technology. [6] A second major initiative for water saving under the project was the introduction of micro-irrigation systems (MIS). A study conducted on the impact of the introduction of MIS in Tamil Nadu showed a 51% increase in water productivity. [7] This aggregate figure is in line with field demonstrations showing water savings of between 38-75% depending on type of crop.

3.2.13 Under the Project a total of 2775 WUAs were established. This process continued right up to the last year of implementation with the last 468 WUAs being established between October 1, 2014 and March 31, 2015. By the end of the Project, 94% had set up WUA sub-committees in accordance with the Tamil Nadu Farmers Management of Irrigation Systems (TNFMIS) Act, and 74% had opened a bank account. An assessment of WUA capacity carried out toward the end of the Project showed that roughly half had achieved a strong level of functionality in accordance with the TNFMIS Act, about 40% had achieved a middle level of functionality, and 10% were in need of substantial additional capacity building. The Project accomplished a great deal with respect to institutional creation and capacity building of the WUAs. At the same time it is clear that for a portion of the WUAs, particularly those formed late in the Project, additional time will be required to bring them up to a full level of functionality.

[6] R. Veeraputhiran, et. al., "Influence of System of Rice Intensification on Yield, Water Use and Economics Through Farmers' Participatory Approach", Madras Agriculture Journal, 99(4-6); pp. 251-254. June 2012.

[7] Kumar, D. Suresh and K Palanisami, "Impact of Drip Irrigation on Farming System: Evidence from Southern India", Agricultural Economics Research Review, Vol 23 July-December 2010, pp. 265-272.

3.2.14 The establishment of the State Water Resources Management Agency (SWaRMA) was enacted on April 2009, and it became operational on June 2011. SWaRMA advises the Government on water planning, allocation, management and development. It aims at improving coordination and institutional capacity for sustainable water resources management with a basin perspective. In order to promote inter-sectoral coordination and better planning and water allocation, SWaRMA has established a state-wide web-based Water Resources Information System (TN WRIS). The TN WRIS receives data and information from various government departments and is available to the public through an open data portal (www.tnwris.gov.in). SWaRMA through TN WRIS provides the scientific foundation for basin/sub-basin planning, monitoring and decision-making; fosters inter-sectoral cooperation on water resources data; and improves water resources governance.

3.2.15 At the basin level, top-down micro-level basin plans for 16 out of the 17 basins in the State were formulated and adopted by the Water Resources Organization, and 6 plans were updated (Kodaiyar, Vaippar, Vaigai, Vellar, Palar, and Tamiraparani). These plans aim to guide any development in the basin. Integrated development plans were prepared, updated and implemented for each of the 61 project sub-basins. Within the integrated sub-basin development plans, water resource availability and requirements were analyzed and allocations decided following an integrated water resource management approach. As a result, all specific infrastructure, institutional and technical interventions under the Project were carried out in a manner consistent with broader water management principles. At the village level, bottom-up village water plans were formulated and adopted by all water users associations and other stakeholders. Stakeholders were engaged in shared vision planning making use of simple tools with strong scientific basis such as holistic water budgeting and wall writing. Through these planning efforts, water allocation for the various users was determined and alternative water conservation options were identified to ensure sustainable use of water resources.

3.2.16 The goal of establishing Sub-Basin Water Boards was not met. The two Basin Boards that existed prior to the project have been non-functional since 2004. The problem has been unwieldy structure and membership that made effective operation and decision making virtually impossible. In this context, there was little interest in GoTN to create additional boards and it was frankly beyond the capacity of IAMWARM to address the complicated cross-sectoral and economy-wide issues and institutions involved.

3.2.17 Overall as presented below in Table 6, analysis of the three key elements of irrigation rehabilitation and modernization, intensification and diversification of agriculture, and an integrated water resources management framework shows that the PDO was achieved. Going forward these achievements will need to be solidified through continued capacity building to the weaker segment of the WUAs, and continued expansion of the area under micro irrigation at rates demonstrated during the second half of project implementation.

Table 6 – Key Indicators of PDO Achievements

Indicators	Target	Achievement	Achievement / target
Irrigation rehabilitation and modernization			

Intermediate Comp A. – Additional tank systems modernized (no. and ha.	5700 400,000 ha.	5275 404,000	 101%
Intermediate Comp A. – Increase in area fully irrigated	40%	39.3%	98%
Intermediate Comp A. – Increase in conveyance efficiency	25%	31-33%	124-137%
PDO 2. area under micro-irrigation	100,000 ha	53,901 ha	54%
Intensification and diversification of agriculture			
PDO 3. Diversification into higher value crops	30%	124%	413%
PDO 4. ("% increase in targeted farmers' incomes compared to other (WOP)[8] farmers	50%	7-93%	14-186
Intermediate Comp B. – Crop yields (tons/ha.) • Paddy • Maize • Groundnut • Pulses	 5.4 3.9 3.0 0.69	 6.2 6.3 2.6 0.62	 115% 162% 87% 90%
Intermediate Comp B. – Increase in milk production, tons	587,000	705,410	120%
Intermediate Comp B. – Increase in fish production, tons	22,500	14,686	65%
Integrated (sustainable) water resources management framework			
PDO 1. increase in value of crop production per unit of irrigation water supply	100%	51- 64%	51- 64%
Intermediate Comp. C – WUAs • Set up • Trained • Effective	 2500 2500 2500	 2775 2775 1330	 111% 111% 48%
PDO 5. Joint preparation and implementation of sub-basin developed plans across relevant implementing agencies	All Sub-basin plans updated / implemented	Achieved	100%
Intermediate Comp D.	SWaRMA created and strenthened	Achieved	

[8] Without Project

PDO 6. Enhanced water resource planning capacity	3 sub-basins and 1 basin board formed	Not achieved	
Intermediate Comp C – SWaRMA created and strengthened	SWaRMA established and best practice for India	Achieved	100%

3.3 Efficiency

3.3.1 Cost Effectiveness. At completion, upon cancellation of US$D 45 million of IBRD credit, , project expenditures reached US$ 489 million, equivalent to 86.4 percent of the appraisal estimate of US$566 million As mentioned, this cancellation resulted primarily from (i) foreign exchange savings and (ii) cost savings on civil works procurement packages as reported by MDPU. The major quantitative outputs and targets were largely achieved and therefore cost effectiveness was at least equal to the amounts planned.

3.3.2 Cost Benefit Analysis (Annex 3). IAMWARM economic and financial returns were assessed at appraisal based on a sample of nine representative sub-basins spread over three agro-climatic zones. Economic Rates of Return (ERRs) ranged between 13 and 30 percent for individual sub-basins and was estimated at 20.4 percent for the entire project. The project's ex-post economic and financial analysis focused on assessing benefits accrued from irrigation modernization and rehabilitation, and from agriculture intensification and diversification activities state-wide, based on actual aggregated data for the entire project area (61 sub-basins) made available by the participating departments.

3.3.3 Despite a conservative quantification of benefits, IAMWARM showed very satisfactory results. ICRR calculations over a 25-year period of analysis estimated the project Financial Rate of Return (FIRR) at 30 percent, or 6 percent over appraisal values. Net Present Value was about USD 251 million, or INR 16 billion. Overall Economic Rate of Return (ERR) was 21 percent, exceeded the appraisal estimate of 20.4 percent. A sensitivity analysis was conducted to test the robustness of project investments. An unexpected increase of 30 percent in future recurrent costs would maintain EIRR rates at almost the same levels (20.5%). However, a two year delay in the generation of benefits (e.g. in the case of drought) or a 20 percent decrease in these benefits would bring the EIRR near the opportunity cost of capital. This was consistent with the sensitivity analysis presented in the PAD, and underlined the limitations of a sector that was exposed to input/output price volatility and other external factors such as climate. Switching values (i.e. values beyond which the EIRR was below 12 percent, which was considered acceptable) were -25 percent for benefits and 41 percent for project costs.

3.4 Justification of the Overall Outcome Rating

Rating: Satisfactory

3.4.1 Considering that: (i) the project objective, overall design and implementation features remained highly relevant; (ii) efficacy was substantial with all three dimensions of the PDO largely met; and (iii) efficiency was high as ex-post FIRR and ERR exceeded ex-ante estimates, the overall outcome rating is satisfactory.

3.5 Over-arching Themes, Other Outcomes and Impacts

(a) Poverty Impacts, Gender Aspects and Social Development

3.5.1 PDO and project design focused on irrigated agriculture and water management and were not directly concerned with poverty, social, and gender themes, except the need for social mobilization to form WUAs.

3.5.2 **Poverty**. Project beneficiaries were primarily small and marginal farmers. The profiles of the project beneficiaries undertaken by the consultancy firm contracted by the project for Monitoring and Evaluation (M&E) activities (SMEC) as part of its baseline, mid-term and final impact assessment surveys provided further insights into the population segments of Tamil Nadu on the basis of a sample of 5,757 households: 59.5 percent of interviewees were from backward castes, 32.5 percent from scheduled castes, 7.2 percent from other castes and only 0.9 percent from scheduled tribes. The profiles confirmed the relevance of investing in agriculture as argued in the PAD as agriculture and agricultural wages contributed to 40.5 and 23.6 percent of household incomes respectively. Agricultural wages represented almost 50 percent of incomes of small and marginal farmers, hence the importance of rural employment for poverty reduction.

3.5.3 The average farm size of the representative sample was less than one hectare (0.93 ha) and the distribution was uneven: 68 percent were marginal farmers (less than 1 ha), 20 percent were small farmers (1-2 ha) while only 12(10 percent) had more than 2 ha of land. Farm assets were limited: only 14% of farmers had milch animals; 2 percent owned pumps, 2 percent owned tractors and 5 percent owned sprayers. Family expenditures were dominated by food (40 percent) followed by clothing (12 percent), education (10 percent), housing (10 percent) and health (7 percent).

3.5.4 Production system intensification and diversification generating higher yields and had a positive effect on food security. This likewise had an impact on improved nutrition through the following:

- support to diversification activities; IAMWARM contributed to increased production in 12 out of the 16 food groups as identified in FAO's Individual Dietary Diversity Score (IDDS), in particular:

- Productivity of pulses increased by 24 percent. Pulses provide a high level of fiber, protein and minerals, especially iron and zinc. Iron rich crops were critical in a State where 72.5 percent of children aged 6-35 months were anemic;

- Increased production of *Ragi* (Grain millet) and Sorghum, were promoted by the project as a complementary staple food to rice. Rice was consumption was excessive amongst most of the population which leads to critical rates of diabetes (one out of ten people in TN is diabetic and 80 percent of Tamil Nadu population exhibit abnormal lipid levels);

- The area of horticultural production increased by roughly 50,000 ha under the project, including vitamin A rich vegetables and fruits, leafy and other vegetables, and spices. A survey indicated a 27.87 percent increase in vegetable consumption and 50.32 percent increase in fruit consumption in TN from 2004 to 2010, though this cannot be attributed to IAMWARM only;

- Increased milk production of 705,410 tons directly attributable to the project as supplementary intakes of protein, calcium and magnesium can contribute to compensate part of low meats consumption in TN diets. Farm interviews during ICRR provided anecdotal evidence of increased household-consumption by farming families of their own produce.

- 65% increase in fish production including local and newly introduced varieties, low-fat high quality proteins which can help meet dietary needs

3.5.5 **Gender**. Project outcomes and outputs were not disaggregated by gender. However, ICRR mission interviews provide supporting evidence that a number of project interventions particularly benefitted women: (i) livestock interventions led to increased production and improved animal health were expected to benefit primarily women; DoAH reported that 70 percent of participants in farmer meetings were women; (ii) horticulture development (labor intensive required 5-6 persons per hectare), the development of vegetable nurseries, and Sustainable Sugarcane Intensification (SSI), were mainly targeted at women; (iii) marketing activities promoted by the Agri-Business Knowledge Centres, such as post-harvest technologies, food processing, and value addition were largely directed to women.

3.5.6 **Social development**. The strengthening and capacity development of 2,775 WUAs aimed to develop WUAs as community-owned organizations with responsibility for O&M of their local irrigation schemes. In the 400 communities in which model villages were introduced during the course of project implementation, these WUAs were part of a broader Community Collaborative Water Management initiative that included the development of a "Village vision" and water budgeting as a means to mobilize villagers into more sustainable water management practices under their own responsibility. Conflict resolution among water users was an area for development under the project and was one of the 12 criteria for assessing maturity of WUAs. In addition, through its convergence approach at village level, the project also enabled connections and synergies with social development programs such as the "blue green village movement" that aimed to improve household sanitation in rural areas.

(b) Institutional Change and Strengthening

3.5.7 The project aimed to sustainably **change institutional management of water.** Components C and D aimed to upscale the development of WUAs and the State level agency

(SWaRMA) to provide analysis and advice on state level water issues. Various cells (PIM cell, training cell) were introduced to enhance the role of WRD and increase its focus on water management. Similarly, SWaRMA represented an important improvement by combining the analytical function with the advisory function, which had previously been the responsibilities of two separate agencies.

3.5.8 On the agriculture side, a major achievement was strengthening the Government's priority programs, or "missions". **Missions** are India's main institutional tool to pursue strategic goals (e.g. food security, development of particular economic sub-sectors such as horticulture or pulses) by mobilizing human and organizational capacities, and budgeting resources in a focused and coordinated manner. The project contributed to important national and state missions (by being the vehicle of such missions in the project area) and also upscaled other missions (e.g. the horticulture and pulses missions) that were of limited scope before the project. Furthermore, some important activities developed by the project were institutionalized into new State missions, e.g. the millet mission, as a means to further promote these activities beyond the project.

3.5.9 The project also introduced a number of institutional innovations, including: (i) the **model villages** conceived as a coordination mechanism through which various Government interventions converged to optimize impact, and farmers are able to access information and support from the various departments at a single location. Model villages were implemented on pilot scale that covered about 10% of the project area (400 villages); (ii) the substantial involvement of **TNAU** enabled Government agencies to obtain knowledge about recent farming innovations (SRI, SSI) promoted by TNAU, and likewise, TNAU benefitted through direct field exposure to farmers who adopted the production techniques promoted by the university; (iii) the notion of "**impact area**" increased the intended coverage and field involvement by department staff who were held accountable for a wider adoption of newly promoted production techniques by setting specific targets for adoption beyond demonstration areas so that they needed to be pro-actively advising farmers.

(c) Unintended Outcomes and Impacts

3.5.10 **Nutritional impact.** The project generated initially unintended, but significant positive nutritional impacts on consumers through: (i) diversifying crops from rice into pulses, grain millets, sorghum, which provide high level of fiber, protein, and minerals especially iron and zinc, and (ii) increasing productions of fruits, vegetables, milk, and fish products rich in vitamins and minerals such as vitamin A, calcium, magnesium, and high quality proteins. Further details on nutritional impacts of the project are provided in para 3.5.4 above.

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

3.6.1 A first beneficiary assessment was undertaken by SMEC during its mid-term review published in January 2012 and covered 166 beneficiaries from various activities under components 1 and 2. It highlighted the good level of satisfaction by beneficiaries and quantified the main financial benefits as estimated by interviewees.

3.6.2 The final impact assessment undertaken by SMEC covered a total of 6,992 households in 180 tanks and villages spread across 55 sub-basins. Field surveys were conducted between December 2013 and February 2014. The results on farm performance reflected the effects of the successive droughts in 2012 and 2013. Yet the results also quantified positive impacts of the rehabilitation of tank systems on increase in tank storage as a result of silt removal, reduction in gap areas by 60 percent, and a by a 40 percent increase in fully irrigated area. A series of questions on agricultural activities confirmed: (i) better crop performances (yields and return per hectare) of project households compared to the control group for all crops supported by the project (SRI, SSI, vegetables, etc.); (ii) a more diversified cropping pattern illustrating crop diversification into horticulture crops, maize and pulses, sugarcane; and (iii) in contrast, no difference in farm income increases between households in tanks rehabilitated and in control tanks.

4. Assessment of Risk to Development Outcome

4.1 There are two primary risks to sustainability of the development outcome. The first is adequate O&M of the irrigation rehabilitation work. Most WUAs are not yet able to contribute the required financial assets to undertake the O&M functions that are their responsibility (e.g. distribution systems downstream of the sluice gates). An assessment of WUAs at project completion against 12 performance criteria indicated that: 48 percent of WUAs were rated A (performing well), 42 percent rated B (moderate) and 10 percent rated C (poor performance). Further capacity building in this area will be necessary, which is foreseen in the follow-on project. For maintenance of the main works, the State budget had included an annual allocation of INR. 50 crores (about US$7.5 million) for O&M of the 14,000 tanks in Tamil Nadu, which corresponds to an average of INR 480 per ha. However, WRD considered that the 5,260 tanks rehabilitated under the project should be allocated a lower share (INR 200 per ha) in view of their current good condition. During the Identification Mission for the follow-on project it was agreed that GoTN will; (i) establish functional maintenance norms, with reliable benchmarking of costs for conducting the set of required maintenance measures, (ii) determine the necessary plan of work for all tanks in the State on an annual basis, and (iii) allocate necessary budgetary funds for this purpose.

4.2 The other primary risk is Government commitment to continued institutional capacity building for water management. As noted above, the WUAs will need further interventions to bring them all up to an A rated level. It is particularly important to sanction follow up elections for WUAs whose terms for elected representatives have expired. Continuation of the special cells within WRD for PIM, IT, and training will be an important part of achieving the remaining needed capacity building. All of these actions are intended by GoTN to be covered by the follow-on project. However, a longer-term vision for PIM is needed. The process of conferring permanent legal status to SWaRMA for appropriate planning and regulatory powers also needs to be completed.

4.3 The project introduced a number of innovative quality enhancement and quality control measures for rehabilitation of both tanks and canal systems. Some important elements were professional third party monitoring of work with the use of mobile labs and introduction of techniques for appropriate side wall compaction of tank bunds. The risk to continuation of these

measures beyond the project is considered moderate given the demonstrated Government commitment not to backtrack in these areas.

4.4 The project demonstrated the advantages of teaming the capacity of TNAU with the various line departments in providing agricultural extension services to farmers. This is a practice which needs to be strengthened and expanded in the future, but which will require the allocation of sufficient Government resources. The risk to maintaining this approach in the longer term is considered moderate.

4.5 The project was implemented within the context of a broad set of Government subsidies to the agriculture sector. Project specific subsidies applied to demonstration plots, as well as seed costs for the impact areas. Given the successful expansion of crop diversification under the project, the risks of relying on the project specific subsidies are considered low. With respect to the sector wide subsidies (e.g., fertilizers, water), risks in the immediate term are considered low given strong political support for their continuation. However, the longer term risks are likely higher and difficult to foresee at this time.

4.6 The agricultural year 2012-2013 was characterized by severe drought, which adversely affected agricultural performance. Similar drought events in the future would affect project outcomes. The ICRR climatic analysis indicated that such droughts occurred on average about once every 10 years. In addition, the effective functioning of project irrigation infrastructure would be expected to mitigate some of these climatic risks. The impact in the longer term was not statistically important, and this risk could be categorized as relatively moderate. If, however, there is a trend to lower, and more concentrated, precipitation levels, as predicted by some climate change models, then these risks will clearly go up. To mitigate these risks, Government will need to push further on development of water management policies at the basin and sub-basin levels.

4.7 Given the two primary risks, the overall risk to the development outcome is considered **significant.**

5. Assessment of Bank and Borrower Performance

5.1 Bank

(a) Ensuring Quality at Entry

Rating: Moderately Satisfactory

5.1.1 The Bank provided timely and quality support during project identification, preparation and appraisal. The process between the Project Concept Note, appraisal and negotiations followed agreed upon time schedules and as a consequence project effectiveness was on time. The Bank applied its experience in providing development assistance to India and other countries to design the project, which remained relevant at completion. The Bank employed a broad range of expertise during design and appraisal, including institutional issues, legal and fiduciary matters, a range of technical areas included in the project, and the involvement of the Food and Agriculture Cooperative Program. The PAD was generally of good quality and reflected the Bank's most

recently developed approaches to combining infrastructure, water management, institutional development, and agriculture intensification and diversification in a project. In order to mitigate the risk of such a complex approach, the Bank carefully planned implementation mechanisms, a number of which were innovative in India, that were proven effective.

5.1.2 Two important shortcomings were: (i) the PAD included 13 covenants applicable to project implementation, including some with tight deadlines related to the establishment of institutions (SWaRMA, PIM cell in WRD, and a pre-defined number of WUAs to be established). Some of these covenants were not respected, as institutional development was a long-term process that required ownership by those involved; and (ii) some of the indicators in the results framework were not clearly defined or would pose significant measurement challenges. Issues with project design included development of agricultural marketing plans without adequate private sector involvement or commercial expertise and attempts to leverage an irrigated agriculture project to address ambitious economy-wide water management issues (e.g., establishment of sub-basin boards). Lastly, the delays and shortcomings in putting in place the M&E arrangements added to measurement difficulties for some important PDO indicators. Based on the above assessment, the Bank's performance for quality-at-entry is rated as Moderately Satisfactory.

(b) Quality of Supervision

Rating: Moderately Satisfactory

5.1.3 Through six-monthly implementation support missions, as well as regular shorter component-specific technical visits, the World Bank provided regular and insightful advice and guidance to the implementation team. Aide-memoires systematically included an account of achievements, implementation challenges, advice and guidance to address issues, and a list of agreed actions with deadlines and responsibilities. The support provided since 2009 by a senior engineer to enforce quality, train local engineers in quality supervision, provide guidance, guidelines and templates for quality control (the "OK Card"), and adequate maintenance contributed to component A achievements. In most missions, technical expertise was provided on water engineering, PIM, agriculture extension, livestock and fisheries. The first missions provided valuable practical guidance and training on procurement rules and requirements, and financial management, both to the dedicated MDPU staff as well as relevant staff in the respective implementing agencies. The introduction of simplified procedures for no-objections in 2010 considerably facilitated timely implementation, and as a result, disbursements accelerated. Missions also assessed and then supported the operationalization of various important innovations to enhance project effectiveness, such as the concept of an alternative model for WUA capacity building and monitoring and assessing WUA performance, impact areas to amplify adoption of technical improvements beyond demonstration plots, and the model villages initiative to institutionalize coordination and convergence of all involved departments at the village level as well as the process of community water budgeting.

5.1.4 Shortcomings included: (i) a relative lack of attention to water management issues early on. While successive missions increased emphasis on the need for the MDPU and WRD to support PIM in a substantive way, these repeated efforts only materialized later in the project life, in 2011. Beyond PIM, the provision of water management expertise, e.g. at a broader scale such as basin and State levels was insufficient, which contrasted with the support provided to the relatively

minor fisheries sub-component; (ii) support to the agri-business sub-component during the initial implementation period – beyond the social mobilization of Commodity Groups, the implementing agency -- the Department of Agricultural Marketing (DAM) lacked experience, and flawed ideas in project design, including the establishment of the ABCs, were allowed to proceed; (iii) more focused attention to M&E issues in the initial phase of the project could have ensured a more timely implementation of the M&E system, including a more clearly defined results framework. Based on these, the Bank's performance on Quality of Supervision is rated as Moderately Satisfactory.

(c) Justification of Rating for Overall Bank Performance

Rating: Moderately Satisfactory

5.2 Borrower

(a) Government Performance

Rating: Moderately Satisfactory

5.2.1 Overall, the Government of Tamil Nadu demonstrated strong commitment and support to the project: (i) counterpart funding was timely and fiduciary aspects respected; (ii) the early establishment of the MDPU during project design and staffing from various State departments was instrumental for the State's ownership of the project, timely development, and effective implementation of the project; (iii) the Government of TN also mobilized appropriate departmental staff to implement the project as part of their regular work activities, and the re-allocated staff from DoA to DoH and DAM in order to respond to the needs for agriculture diversification and value addition under the project.

5.2.2 A shortcoming of GoTN was the delays in issuing some administration sanctions as well as responses to some of the institutional improvements agreed upon during negotiations to ensure project effectiveness, including the establishment of SWaRMA, , and the establishment of three WRD cells for PIM, training, and IT. Some of these institutional requirements included legal covenants and GoTN was non-compliant in meeting these schedules in timely fashion. As repeatedly documented in Bank aide memoires, WRD was slow in incorporating PIM as one of its mainstream activities in order to ensure effective and sustained WUA strengthening. By the end of the project, the Department committed to institutionalizing PIM, but action on this has been tied to the proposed follow on project. Overall, the Government performance is rated as Moderately Satisfactory.

(b) Implementing Agency (or Agencies) Performance

Rating: Moderately Satisfactory

5.2.3 The project was implemented by eight State departments guided and coordinated by the MDPU. The departments deployed necessary staff at statewide and local levels to implement project activities on the basis of annual programs of work. The reporting of field activities for monitoring purposes was rigorous. MDPU included 64 staff under the strong and stable leadership of one Project Director for the duration of the project. High staff turnover was identified as a risk but did not eventuate. An important achievement was the coordination and integration of activities of the eight project agencies, which had been identified as a substantial risk. Procurement and financial management accorded to the rules, and cost savings were achieved on some civil works contracts. Progress reports to the Government and the World Bank were timely. MDPU was also responsive to recommendations from the Bank and SMEC.

5.2.4 The project's shortcomings consisted of. (i) the postponement by 27 months of the closing date of the project that resulted from a combination of factors, a number of which were outside the control of the MDPU, including delays in granting administrative sanctions, and the cumbersome compliance of both Government and World Bank procurement rules, which were not always consistent. Cost savings on some contracts implied that new activities were added to original activities, requiring more time to complete the project. The FAO review of tank projects in India indicated that (i) IAMWARM performed better than similar projects, (ii) initial lack of farmer demand for the micro-irrigation systems which made attainment of the original project target of 100,000 ha. Impossible, (iii) shortcomings on MDPU's M&E responsibilities as evidenced by the late recruitment of SMEC, its lack of capacity to propose a revised results framework, and the absence of an M&E officer in the MDPU, (iv) insufficient MDPU support provided for water management, PIM and WUA development until the project implementation model for Component C was reformed during the second half of project implementation. The overall performance of the Implementing Agency is RATED as Moderately Satisfactory.

(c) Justification of Rating for Overall Borrower Performance

Rating: Moderately Satisfactory

6. Lessons Learned

6.1 The project yielded a number of important lessons, most of which will be relevant to similar projects in India, including the follow on project in Tamil Nadu. The ICRR team formulated recommendations for a follow-up project based on these lessons.

6.2 **IAMWARM demonstrated the conditions under which the combination of (i) infrastructure; (ii) strengthening water management organizations; (iii) institutional reforms, and (iv) a wide range of agricultural interventions, can be effective in a single project**. These conditions include (i) a generally sound project design; (ii) the commitment of the State Government and the consequent engagement of all eight relevant agencies under the coordination of the MDPU; (iii) the joint preparation and implementation of sub-basin plans in which water and agriculture activities are identified and executed in a participatory manner; and (iv) model villages introduced by the project which harmonize community level activities under a

water budgeting framework; and (v) engagement of partner institutions (e.g. CEC) that lead to joint trainings with farmers and WRD officials as well as dedicated behavioral change trainings for government officers. Although uncertainties remained concerning the institutionalization of some of these coordination mechanisms in the long term, this lesson would be highly relevant to similar projects supporting irrigated agriculture worldwide.

6.3 **IAMWARM indicated the necessary mechanisms, requirements, and challenges that need to be addressed in order to undertake and institutionalize similar project results in India**. These include: (i) systematic integration of project interventions into existing priority public programs and "missions": some missions were substantially up-scaled, strengthened and in several cases promoted by the project, which paved the way for longer term public interventions; (ii) implementation of project activities by partner departments that were provided with additional resources under the project, were also exposed to innovative approaches, coordinated and guided by the MDPU; (iii) large-scale capacity development efforts by both government agencies (e.g. WRD) and community organizations (e.g. WUAs). Support to the latter, however, needs to be longer-term to ensure the permanent viability of these organizations; (iv) re-integration of most of the seconded Government staff involved in the project back into their respective departments at project completion; (v) through exposure to new innovations (see below), to TNAU approaches and expertise, and external technical assistance provided by the project, department staff involved in the project increased their technical and managerial skills; (v) necessary institutional reforms in the water management sector proved difficult: the necessary institutional development of WRD through staff training; the establishment of ICT, training, and PIM cells; and the establishment of SWaRMA required, and will continue to require, commitment to institutional change.

6.4 **Investing in innovations was one of the rationales for Bank involvement and a value addition to such projects**. Some IAMWARM innovations could become best practices for future development interventions in the water and agriculture sectors of India, including: the OK cards and the mobile quality control laboratory system in Component A; the introduction of the "impact area" as a means to substantially increase the impact of innovations beyond "demonstration" areas; and the model villages approach in Component B. The involvement of TNAU on a large scale was a major driver of technical improvement and innovation - by bridging the gap between research and academia, the agricultural extension system, and farming communities - contributed to the overall quality and consistency of project interventions. TNAU's involvement also had a positive impact on the motivation and attitudes of DoA extension workers due to the increased relevance of their technical advice to farmers. In turn, partner departments could have further benefitted from additional technical assistance in innovative areas where they lacked expertise such as, modernization of irrigation rehabilitation, Integrated Pest Management, organizational development of commodity groups and/or producer organizations. The latter were externally driven and implementing agencies considered farmers' groups more as a project delivery mechanism rather than sustainable institutions owned by community stakeholders.

6.5 **Improving water resource management**. Projects with similar PDO to IAMWARM (enhanced water productivity in a sustainable manner) have to develop coherent water management interventions by: (i) practically applying integrated and cross-sector water planning at sub-basin and basin levels. IAMWARM sub-basin development plans did not integrate sectors

beyond agriculture, and therefore may not have developed sustainable mechanisms; (ii) ensuring that capacity development of WUAs occurred early during implementation as a prerequisite for other activities in order to secure active participation and ownership of water users, suitable O&M, and appropriate design of rehabilitation work responding to the needs of water users; (iii) involving local stakeholders more actively in water management assessment and planning, including groundwater considerations in the management of water resources and project interventions. Most irrigation farmers in Tamil Nadu use groundwater to supplement their water resources, particularly in dry years and seasons, and groundwater depletion has occurred in many blocks. Projects should monitor the substitution of groundwater by water from project-rehabilitated tanks; and (iv) developing a tanks rehabilitation program consistent with the overall sub-basin water management plan. At the same time it is clear that using an irrigated agriculture intervention to leverage economy and society-wide water resource management reforms can be risky and needs to be approached carefully and realistically.

6.6 **Monitoring and Evaluation, design, and implementation are critical** not only for practical feedback to implementing agencies and managers, but also as an important means to document results. During design, define a set of specific indicators well placed in the results chain, while avoiding vaguely specified indicators such as "percentage area covered by IPM or INM or organic farming" or "number of new agricultural value chains developed" and "number of information kiosks" or "percentage of staff trained," as outcome indicators.

6.7 More explicit attention to **social matters** can further enhance project effectiveness. While stakeholders participated in basin walk-through surveys as a part of the development of the sub-basin development plans, ongoing stakeholder engagement should also be ensured periodically throughout the course of the project life. In addition to incorporating their priorities and concerns into project planning after their participation in baseline surveys, the needs of vulnerable groups need to be identified and addressed with specifically tailored measures. These vulnerable groups will include non-landowners who are dependent on tank water. Participation also needs to be built into monitoring in order to better understand potential bottlenecks and conditions under which project interventions were adopted.

6.8 **Projects investing in irrigated agriculture can contribute to enhanced nutrition by:** (i) diversifying crops, especially non-rice cereals such as millets, and other low water consuming staples, improving consumers' access to vitamin A, iodine and iron-rich and plant- and animal-sourced foods and other products rich in micronutrients previously lacking in the diets of targeted populations, especially women and scheduled tribes; (ii) focusing interventions on more vulnerable groups such as women, by providing access to gender-sensitive care services and equitable access to resources and income-generating activities (mindful of their workloads); (iii) education and awareness raising on healthy diets, hygienic food preparation techniques, specific food needs of pregnant and lactating women and young children, and healthy processing methods, in part through cooking demonstrations; (iv) introducing nutrition-sensitive indicators into the results framework.

7. Comments on Issues Raised by Borrower, Implementing Agencies and Partners

(a) Borrower/Implementing Agencies

7.1.1 No major issue was raised by the Borrower on the ICRR. The summary of Borrower's Project Completion Report is included in Annex 5.

(b) Co-financiers

7.1.2 None

(c) Other Partners and Stakeholders

7.1.3 None

Annex 1. Project Costs and Financing

Table 1: Expenditures by Component (USD)

	Appraisal estimate	Revised outlay Actual	Actual	% of revised allocation
Component A: Irrigation systems modernization in a sub-basin framework	283	395	364	92.08%
Component B. Agricultural Intensification and Diversification	166	115	103	89.15%
Component C. Institutional Modernization for Irrigated Agriculture	53	22	15	71.31%
Component D: Water Resources Management	5	1	1	96.35%
Component E. Project Management Support	8	8	6	76.63%
Sub-total base Cost	515	541	489	90.40%
Physical Contingencies	15	-	n.a.	
Price Contingencies	36	-	n.a.	
Farmers' Contribution	25	25	n.a.	
TOTAL PROJECT COST	566	566	**489**	**86.40%**

Note: up to 30.04.15

Table 2: Expenditures by Financier (USD)

	Appraisal	Actuals	**% of appraisal**
IDA	150	153	102%
IBRD	335	287	86%
Government of Tamil Nadu	56	49	87%
Farmer's contribution	25	n.a.	n.a.
Total Costs TN-IAMWARM	566	489	**86%**

Note: up to 30.04.15

Annex 2. Outputs by Component

Component A: Irrigation systems modernization in a sub-basin framework

A. Achievements of Intermediate Outcomes

1. Expected intermediate outcome for Component A was **modernized irrigation systems and service delivery and management for tank based systems** (Sub-component Al) and canal based systems (Sub-component A2). The following five indicators and associated targets were identified in the PAD document for measuring its achievement:

1) 100% scheme completed within planned time and cost;
2) 5,700 additional tanks modernized with a total command area of 400,000 ha;
3) 25% increase in conveyance efficiency;
4) 40% increase in fully irrigated area;
5) Integration of the work of different line agencies for selected sub-basins, indicated by the preparation and updating of 63 sub-basin plans, and completion of 63 sub-basin ICRs.

2. As the number of targeted sub-basins reduced from 63 to 61, based on the results of integrated sub-basin planning, the number of tanks to be modernized was revised from 5,700 to 5,298 while the total command area remained the same. As of 30 April 2015, the following achievements were reached:

3. **Implementation of civil works** Under the original budget allocation, a total of 325 civil construction packages were planned for phase I-IV, of which about 50% of the packages were completed within the scheduled time line. With the inclusion of additional works and the revised budget allocation, the project duration was extended twice, and the total number of civil construction packages increased to 1,070, of which 1,069 packages were completed.,. A total of 809.3 million INR budget saving has been achieved.

4. **Modernization of tanks** Total number of tanks to be rehabilitated was 5,298, with a total command area of 400,000 ha. Actual rehabilitation of 5,260 tanks was completed, with a total command area of 404,055 ha. The completion rate reached 99% for the number of tanks and 101% for the benefitting command area. After rehabilitation, tanks storage capacity was increased, irrigation area restored, and water delivery improved. According to the field survey at 141 tanks in 55 selected sub-basins conducted by the M&E consultant between 15 December 2013 and 28 February 2014, removing silt from the tank beds for bunds strengthening resulted in an additional storage of 2.15 million m^3.

5. **Improvement of conveyance efficiency** According to the results of field water measurement conducted by the M&E consultant at the PAP Parambikulam Main Canal (PMC) in January and February 2011, conveyance efficiency was improved from 69% to 92%, corresponding to an increase of 33%. This improved performance was confirmed by subsequent measures in 2014 and 2015 of 91% and 90% conveyance efficiency respectively. These figures are over 100% of the target. In the PAP irrigation area, tail end farmers were getting the designed discharge in time due to substantial reduction in the seepage losses and rehabilitation of the damaged portions of canal lining.

6. **Increase of fully irrigated area** At project completion, fully irrigated area in the project sub-basins increased from 364,768.4 ha to 508,132.6 ha, i.e. a 39.3% increase. This represents a

98% completion rate of the target. The gap area between ayacut area and total irrigated area was reduced by 60% from 145,615 ha to 58,170.4 ha. Detailed information on irrigated areas by sub-components is shown in Table 3. The impact could have been even better, if the project area had not been impacted by the severe drought in the recent consecutive years.

Table 3. Change in Irrigated Area (As of 30 April 2015)[9]

Sub-Component	No of Sub-basins	Registered Ayacut Area (ha)	Irrigated Area without Project (ha)			Irrigated Area With Project (ha)		
			Fully Irrigated	Partial Irrigated	Total	Fully Irrigated	Partial Irrigated	Total
A1	59	494653.5	241891.4	123851.1	365742.5	368635.1	77097.5	445732.6
A2	2	174500.9	122877	34919.9	157796.9	139497.5	25753.9	165251.4
Total	61	669154.4	364768.4	158771.0	523539.4	508132.6	102851.4	610984

7. These indicate an overall satisfactory achievement of the intermediate outcome expected from Component A. Although management of tank-based systems was also mentioned in the intermediate outcome, relevant interventions were actually covered under Component C covered below. Detailed information on the targets and achievements of intermediate outcome level indicators are summarized in Table 4.

Table 4. Intermediate Outcome Level Indicators (As of 30 April 2015)[10]

Indicators Defined in PAD			Revision		Achievements	% of Completion
Indicators	Baseline	Target	Indicator	Target		
% of schemes completed within planned time and cost	0%	100%	No revision	No revision	97%	97%
Additional tank systems modernized (number and ha)	0 (tank) 0 (ha)	5,700 tanks 400,000 ha	No revision	5,298 tanks 400,000 ha	5,260 tank 404,055 ha	99% (tank) 101% (ha)
% increase in conveyance efficiency	0%	25%	No revision	No revision	30%-33%	Above 100%
% increase in area fully irrigated	0%	40%	No revision	No revision	39.3%	98%
Integration of the work of different line agencies for selected sub-basins	9 integrated sub-basin plans drafted	63 sub-basin plans updated and 63 sub-basin ICRs completed	No revision	No revision	61 sub-basin plans updated and ICRs completed	100% as per modified project design

8. In addition, improvement of tanks storage and delivery systems and construction of artificial groundwater recharge wells also increased the chances for groundwater recharging. Although relevant benefits are yet to be fully realized due to late implementation of these interventions and the impacts of consecutive droughts in recent years, observations at 53 sample tanks pertaining to groundwater covered under additional schemes found that during 2014 pre-

[9] Data quoted from WRD ICR Report.
[10] Data quoted from the PAD document and WRD ICR Report.

monsoon season and 2015 pre-monsoon season, the groundwater table levels adjacent to 40 tanks showed different rises, ranging from 0.3-4.8 meters.

B. Key factors affecting the implementation

9. **Prolonged processes of procurement** and government administrative sanction delayed the implementation of civil construction works. Under the original budget allocation, a total of 325 civil construction packages were planned for phase I-IV, of which only about 50% of the packages were completed within the original scheduled time line. Implementation of some additional works was also delayed. This resulted in the extension of the project duration by 27 months and impacted timely realization of the project benefits.

10. **Insufficient inclusion of M&E requirements in system designs** caused difficulty in water measurement. Although water measurement devices were added latter on below the tank sluice gates, effective water measurement remains a challenging goal in the Indian context. As an additional indication, the monitoring of canal conveyance efficiency was sporadic rather than continuous. These limited the evaluation of water productivity and efficiency.

11. Severe droughts occurred in the project area in recent years, which impacted project achievements, especially in fully irrigated area. Out of the 25 project districts, 14 districts received less rainfall than normal in 2009. In 2012 and 2013, the majority of the districts received less rainfall than their respective normal. The deviations from normal rainfall were more than 20% in about half of the project districts in 2012, which was continued in about one third of the districts in 2013. This impacted water storage in tanks and area irrigated. During the ICRR mission, it was found that some tanks have not received water supply for consecutive years.

COMPONENT B: Agricultural Intensification and Diversification

Component B1* - *Tamil Nadu Agricultural University Component (TNAU)

12. *Crop Demonstrations:* TNAU conducted **large scale demonstrations** on farmers' fields as the main extension methodology, whereby improved agronomic packages were demonstrated and incremental inputs up to 100% subsidized. Such packages included for example improved seeds, line planting, single seedling planting in SRI-paddy, simple farming tools, bio-fertilizers and compost making for INM etc. These were accompanied by farmers' field days, farmers' training events and exposure visits amongst others.

13. *Review of Technologies and Crops Promoted*

(a) Paddy & System of Rice Intensification (SRI):

- As per TNAU definition, complete **SRI consists of seven elements**, namely (1) a reduced seed rate of 7.5 kg/ha, (2) raising mat nursery, (3) transplanting young seedling (14-15 days old), (4) square and single seedling transplanting per hill in wider spacing (25 x 25 cm), (5) mechanical weeding 4 times (10, 20, 30 & 40 DAT), (6) limited irrigation through alternate wetting and drying, and (7) nutrient management by using Leaf Color Charts (LCC).
- TNAU initiated an "**SRI quality control**" in the form of the SRI monitoring committee, which was headed by an SRI specialist. The committee traced the progress of SRI, inspected the SRI fields, collected feedback from farmers as well as from technical staff

and made recommendations for fine tuning or refining the technologies to suit local conditions. SRI increased the average productivity of paddy by 26% (1,265kg/ha) when comparing average yields of impact areas (6,192kg/ha) with average yields of control plots (4,927kg/ha).[11] SRI demonstrations were conducted on 18,956ha, with an impact area of 68,111ha.

(b) Crop diversification

- TNAU contributed to crop diversification by promoting improved techniques, demonstrations and the supply of improved inputs for a range of crops that **increase value addition and nutritional value per drop of water**.
- Hybrid Maize. TNAU promoted hybrid maize demonstrations which increased the average productivity of maize by 31% (1,467kg/ha) when comparing average yields of impact areas (6,259kg/ha) with average yields of control plots (4,792kg/ha). [12] Hybrid maize demonstrations were conducted on 1,624ha with an impact area of 8,487ha.
- Pulses. Improved production technologies resulted in an average productivity increase of 24% (118kg/ha) when comparing average yields of impact areas (615kg/ha) with average yields of control plots (497kg/ha). [13] Pulses demonstrations were conducted in 21,655ha with an impact area of 66,404ha.
- Groundnuts. Crop demonstrations with improved productive technologies were mainly conducted in the tail end areas of the ayacuts and resulted in an average productivity increase of 21% (443kg/ha) when comparing average yields of impact areas (2,595kg/ha) with average yields of control plots (2,152kg/ha). [14] Groundnut demonstrations were conducted in 3,365ha with an impact area of 13,559ha.
- Sugarcane. A promising technology promoted by TNAU is the **Sustainable Sugarcane Initiative (SSI)** which has potential of increasing sugarcane productivity by about 35%[15] and reducing water requirement by 30-55%[16] in addition to improving fertilizer use efficiency and sugar recovery. TNAU and farmers reported to the ICRR Team of around 50% water savings and 35-40% increase in yield of sugar cane (SSI 125-140mt/ha versus conventional 90-100t/ha[17]) through drip fertigation.

14. The principles that govern SSI are: (a) raising a nursery using single-budded chips from canes, (b) transplanting young seedlings (25-35 days old), (c) maintaining wide spacing (5 to 9 X

[11] Based on calculations from data provided by DOA and TNAU to the ICRR Team in Excel Format. The ICRR Team decided to average the yield achievements under DOA and TNAU and to calculate the increase in yield by comparing the yields from impact areas to control areas in order to eliminate the distorting effect of optimized conditions on guided demonstration plots.

[12] Based on calculations from data provided by DOA and TNAU to the ICRR Team in Excel Format. The ICRR Team decided to average the yield achievements under DOA and TNAU and to calculate the increase in yield by comparing the yields from impact areas to control areas in order to eliminate the distorting effect of optimized conditions on guided demonstration plots.

[13] Ibid.

[14] Ibid.

[15] TNAU (June 2015); ICR Report, p.15

[16] http://www.agritech.tnau.ac.in/SSI/ssi_technology_eng.html

[17] The figure for conventional yield compares well with the Seasonal Crop reports published by the Department of Economics and Statistics which reports 108mt/ha for 2007/08 and 104mtmt/ha in 2013/14.

2 ft) in the main field, (d) providing sufficient moisture and avoiding flooding of fields, (e) encouraging organic methods of providing nutrients, plant protection and other intercultural practices, and (f) practicing intercropping for effective utilization of land and maintaining ground cover.[18]

15. After analyzing the success of SSI technology SSI was introduced in governmental programs for large scale adoption. Presently SSI is being promoted by Govt. of Tamil Nadu in all the schemes under sugarcane[19].

(c) Integrated Nutrient Management (INM), Integrated Pest Management (IPM) and Organic Agriculture

16. As part of promoting INM, IPM and elements of organic agriculture, TNAU provided training on organic farming to 314 beneficiaries, good agricultural practices to 200 beneficiaries, and INM to 199 beneficiaries. TNAU also introduced and up-scaled the production and use of vermicompost using silpaulin bags by training 9,265 farmers.

17. Specific measures on INM included the use of green manure (e.g. Dhaincha and sun hemp) crop rotation with pulses, and increased use of cattle manure in SRI. Another innovation in SRI was the use of so called Leaf Color Charts (LCC)[20] by which the farmer can assess the timing and quantity of nitrogen fertilizer application. Other measures, mainly for the production of vegetables such as muskmelon, watermelon, bhendi and tomato, included application of bio-fertilizers containing nitrogen fixing bacteria such as Azospirillum or Phosphobacteria, as well as humic acid fertilizers and micronutrient sprays.

(d) Capacity Building & Outreach:

18. TNAU was particularly strong in combining a variety of extension and IEC methodologies to **create awareness on the need of water saving**, to change the traditional mindset towards rice cultivation, and to strengthen capacities and boost adoption rates of demonstrated technologies among farmers. This included on-farm field demonstrations, class room and hands-on training, exposure visits, field visits, Gram Sabha meetings, leaflets, announcements in leading daily newspapers, FM radio stations and on All India Radio (AIR), demarcation of SRI fields by special SRI-flags, and last not least by using the "IAMWARM on Wheel Propaganda Trucks" for creating awareness about SRI and other improved technologies through posters, video shows and discussions in the villages. In addition TNAU published several booklets and guidelines such as for SRI. A special feature for SRI farmers was the use of text messages to remind farmers of timely weeding or provision of "pest forecasts".

19. TNAU conducted a **large amount of training events** and meetings, in total 14,948, such as training of 750 DOA Field Officers on improved crop production technologies, or, in order to overcome the lack of special skills and knowledge required for planting SRI-seedlings (single seedlings, line planting, square planting, usage of marker, mechanical weeding by conoweeders, etc.), 3,291 farm laborers. Training was also delivered to rural artisans on production and servicing

[18] AgSri, March 2012; "SSI-Sustainable Sugarcane Initiative – Producing more with less"
[19] TNAU (June 2015); ICR Report, p.15
[20] The LCC had been jointly developed by International Rice Research Institute (IRRI) and Philippines Rice Research Institute from a Japanese prototype, for the purpose of measuring the required quantity of nitrogen to be applied in Rice field and thereby to get a maximum productivity.

of conoweeder (a rotary weeder) and SRI markers. Additionally many crop specific trainings were held for farmers.

(e) Agricultural Extension Services: e-Velanmai

20. The **innovative agricultural extension model named "e-Velanmai"** ("velanmai" means "agriculture" in Tamil) was pilot tested under the guidance of TNAU and up-scaled through an action research process with the support of IAMWARM project. 'e-Velanmai' combines both personal and ICT based advisory services by using Field Coordinators (FC) and ICT tools (internet, tablets, mobile phones, etc.). At the end of the IAMWARM project "e-Velanmai" was moved to DOA.

21. Farmers can participate in the scheme by paying a nominal annual **membership fee** ranging from INR.50 -150 depending on the farm size owned by the farmer. "e-Velanmai" was successfully upscaled in 26 sub basins of Tamil Nadu during 2011-2013. About **10,500 farmers have joined as paying members**. The extension model drastically reduced the time lag in dissemination from research to client. The turnaround time taken to disseminate the technologies ranged between 0.5 - 2.0 hours on the same day. The ratio between the number of farmers' queries and adoption was calculated at 84.6% while the success rate of the adopted farmers was measured at 91.1%.

Component B2 - Agriculture Activities - Department of Agriculture (DOA)

21. *Crop Demonstrations:* DOA conducted **large scale demonstrations** on farmers' fields as the main extension methodology, whereby improved agronomic packages were demonstrated. Such packages included for example improved seeds, line planting, single seedling planting in SRI-paddy, simple farming tools, bio-fertilizers and compost making for INM etc. These were accompanied by farmers' field days, farmers' training events and exposure visits amongst others.

22. *Review of Technologies and Crops Promoted*: DOA largely contributed to crop intensification (in particular on rice) complemented by large scale efforts to support diversification of field crops, including maize, pulses, groundnut and sugar cane.

(a) Paddy & System of Rice Intensification (SRI):

- DOA applied the SRI methodology promoted by the TNAU including its seven elements. SRI increased the average productivity of paddy by 26% (1,265kg/ha) when comparing average yields of impact areas (6,192kg/ha) with average yields of control plots (4,927kg/ha).[21] SRI demonstrations by DOA were conducted on 36,414ha, with an impact area of 149,222 ha.
- In addition DOA demonstrated improved cropping cycles, namely "green manure in the form of dhaincha (*Sesbania aculeata*) or sunhemp – SRI - rice fallow with pulses" which improves soil fertility and increases productivity.

[21] Based on calculations from data provided by DOA and TNAU to the ICRR Team in Excel Format. The ICRR Team decided to average the yield achievements under DOA and TNAU and to calculate the increase in yield by comparing the yields from impact areas to control areas in order to eliminate the distorting effect of optimized conditions on guided demonstration plots.

(b) Crop Diversification:

- Hybrid Maize. DOA promoted crop diversification with hybrid maize demonstrations under its "Intensive Maize Mission" which increased the average productivity of maize by 31% (1,467kg/ha) when comparing average yields of impact areas (6,259kg/ha) with average yields of control plots (4,792kg/ha). [22] Hybrid maize demonstrations were conducted in 11,114ha with an impact area of 60,200ha.

- Pulses. The intensive production technology in pulses has captured many of the farmers under the "Converged Pulses Mission" and resulted in an average productivity increase by 24% (118kg/ha) when comparing average yields of impact areas (615kg/ha) with average yields of control plots (497kg/ha). [23] Pulses demonstrations were conducted in 17,038ha with an impact area of 60,004ha.

- Groundnuts. Crop demonstrations with improved productive technologies were mainly conducted in the tail end areas of the ayacuts and resulted in an average productivity increase of 21% (443kg/ha) when comparing average yields of impact areas (2,595kg/ha) with average yields of control plots (2,152kg/ha). [24] Groundnut demonstrations were conducted in 6,587ha with an impact area of 40,003ha.

(c) Capacity Development:

- In order to create awareness on water saving and improved production technologies the project organized "**capacity building and change management" trainings**. 18,500 farmers, in 185 batches of 100 participants each, and 3,750 extension personnel, in 125 batches of 30 participants each, were trained. Also, in order to facilitate the adoption of SRI-paddy, 30,000 agricultural laborers were trained for one day on SRI technologies in all the 61 Sub-basins in 300 batches of 100 laborers per batch.

Component B3* - *Horticulture Activities – Department of Horticulture (DOH)

23. *Crop Demonstrations:* One of the main purposes of the DOH activities was to assist farmers in diversifying from **paddy to high value crops** using less water, thereby contributing to better value addition and nutritional value.

24. DOH conducted **large scale demonstrations** on farmers' fields as the main extension methodology, whereby improved agronomic packages were demonstrated. Such packages included for example improved seeds (mainly vegetable hybrid seeds), quality fruit tree grafts, simple farming tools, bio-fertilizers, micro-nutrients, and compost making for INM.

25. In the case of improving **banana production tissue culture** (TC) banana seedlings were produced under lab condition and distributed to beneficiaries to ensure disease free planting material with uniform growth and fruit qualities.

26. *Capacity Development:* Besides familiarizing the target farmers with improved horticultural technologies through pre-season crop production trainings, distribution of printed

[22] Ibid.

[23] Based on calculations from data provided by DOA and TNAU to the ICRR Team in Excel Format. The ICRR Team decided to average the yield achievements under DOA and TNAU and to calculate the increase in yield by comparing the yields from impact areas to control areas in order to eliminate the distorting effect of optimized conditions on guided demonstration plots

[24] Ibid.

material on production technologies, field demonstrations, and field days, DOH also raised awareness and promoted so called "community nurseries" for seedling production and sale. The nurseries are protected by shade nets and use the "pro-tray" technique (plastic trays for raising seedlings). A total of 55 units of shade nets and 15,660 "pro trays" for community nurseries were distributed.

27. *Other Project Activities:* Other activities implemented under DOH included the introduction of mulching technology on a total of 2,323 ha, and the procurement of 43,892 plastic crates for safe handling and transport of sensitive horticultural produce. Under its plantation crops activities DOH in some areas also introduced high yielding cocoa varieties, quality cashew grafts, as well as high yielding casuarina species (*Casuarina Junghuhniana*).

***Component B4* - Agriculture Engineering Activities – Agriculture Eng. Department (AED)**

28. *Drip & Sprinkler Irrigation Systems:* In collaboration with the other line departments AED contributed the establishment of the **physical structures for micro-irrigation schemes (MIS)**. The project followed GoI subsidy guidelines available through other programs. A total of 36 different crops were targeted including fruit and multipurpose trees, cash crops as well as spices, flowers and fodder amongst others. The main thrust however was on coconut, sugarcane, vegetables, tapioca, mango, banana, turmeric and arecanut, much in line with the projects aim of intensification and diversification.

29. *Farm Ponds:* DAE assisted in the construction of 2,691 farm ponds which serve the dual purpose of providing additional irrigation at critical stages of the crop development and the possibility of fish pond culture. In collaboration with DOF out of this 2,691 farm ponds 831 were brought under aquaculture. It was reported that the impact of farm ponds was well appreciated and the Government of Tamil Nadu had embarked on a massive Farm Pond Program across the State.

30. *Capacity Development:* Keeping in mind the emerging professional requirements of AED Engineers, particularly in scaling up micro-irrigation systems and understanding the nuances of sub-surface conveyance of water, agricultural mechanization, pioneering institutions within India were selected as training providers (e.g. Water & Land Management Institutes (WALMI) in Maharashtra, Gujarat, and Hyderabad; Indian Agricultural Research Institute, New Delhi; Central Farm Machinery Testing and Training Institute, Budni; Jain Hi-tech Agri Institute Jalgaon, Maharastra etc.). A total number of **430 junior and mid-level officers** were trained. The Agricultural Engineering Training Centre at Trichy coordinated the capacity building interventions. Farmers were trained in the usage of the various machineries provided as well as in the management and maintenance of the drip irrigation systems (including maintenance of the sand and screen filters).

***Component B5* - Agriculture Marketing Activities – Department of Agricultural Marketing and Agribusiness (DAM)**

31. *Post-harvest and marketing infrastructure:* In order to facilitate drying, bulking, storage, marketing logistics and agro-processing of agricultural produce DAM established various structures such as drying yards, storage sheds, collection centres and agribusiness centres and provided some small equipment.

32. *Commodity Group Formation & Market Transaction:* DAM facilitated the formation and/or supported a total of 6,577 commodity groups (CG) each consisting of an average of 15-20 farmers. Marketing contacts were established and resulted in a total of 6,483 Memoranda of

Understanding. On average these MoUs resulted in an additional INR 1.7 profit per kg of agricultural produce sold by the farmer. However the actual additional profit achieved through MoUs differed widely between INR 0.2 – 13.2 according to location and crop, as for example **fruits and vegetables are more rewarding when sold through marketing agreements than the main staple crops such as paddy or maize**. As per the Table below an average additional profit of INR 1.7 per kg sold and an average benefit of INR 3,777 per farmer can be calculated.

Commodity Groups formed and supported by DAM								
Commodity	Marketing MoUs signed (nos.)	Quantity of produce transacted (mt)	Value of produce transacted (INR. in lakhs)	Additional income (INR. in lakhs)	Farmers benefited (nos.)	Value of produce (INR./ kg)	Add. Average income (INR./ kg)	Additional average profit per farmer (INR.)
Paddy	1320	90354	11255	632	35370	12.5	0.7	1,787
Maize	1552	102649	13565	813	41115	13.2	0.8	1,977
Pulses	688	17440	8980	260	15035	51.5	1.5	1,729
Oil Seeds	798	38636	17723	772	24202	45.9	2.0	3,190
Cotton	249	2348	990	57	3293	42.2	2.4	1,731
Fruits	233	39151	5049	1502	7157	12.9	3.8	20,986
Vegetables	918	65083	7689	1647	34314	11.8	2.5	4,800
Coconut	108	16465	8811	820	7157	53.5	5.0	11,457
Flowers	11	77	200	6	633	259.7	7.8	948
Others	606	8147	757	41	5146	9.3	0.5	797
Total	**6,483**	**380,350**	**75,019**	**6,550**	**173,422**	**19.7**	**1.7**	**3,777**

33. *Capacity Development:* DAM contacted various kinds of capacity development programs for farmers in the form of technical trainings (418), exposure visits inside (206) and outside (101) of the state, interface workshops between farmers and traders (236), as well as awareness campaigns (11) and commodity group trainings (25). The Department also organized trainings for about 625 technical staff, as well as refresher training for 95 technicians. The training included storage technologies, market extension, computer skills, food processing and value addition.

Component B6 - Fisheries Activities – Department of Fisheries (DOF)

34. *Farm Ponds:* A total of 831 farm ponds, each 0.1ha in size, thus covering a WSA of 83.1 ha were brought under aquaculture, producing at an average rate of 4.5mt/ha while the KPI target was 6mt/ha. Expansion in the area of farm ponds was constrained by drought conditions in the latter half of the project.

35. In 2014-15, the farms produced a total of 373 mt of fish valued at INR.27.98 million. The estimated annual income per farm pond during 2014-15 was between INR.20,000 (fish production) and INR.374,000 (fish seed farming).[25]

36. *Irrigation Tanks:* The project covered 804 tanks representing a WSA of 64,418ha of irrigation tanks by stocking with fish seed/fingerlings. As per PAD's EFA the total proposed area

[25] DoF (June 2015); ICR Report, p.15

to be covered under the project was 77,880ha of WSA, but only 65,700ha were found suitable for fisheries and actual implementation was done on 64,418ha.

37. *Fish seed production:* Activities in this area consisted of building hatcheries and nurseries and produced standard fingerling worth INR. 133.5 Million against the PAD's EFA target of 40 million which is a 333% achievement in terms of fingerling production. The project investment in fish seed rearing units was crucial to ensure sustainability of continued fish production.

38. *Capacity Development:* **5000 agriculture farmers** in the sub basins were trained on scientific aquaculture techniques of them 2000 are women. The training included exposure visit to inland aquaculture centres like fish farm, fish seed rearing centre, ornamental fish culture unit and class room training besides interaction with successful farmer. Special training to Fish Kiosk beneficiaries on improved marketing strategies and preparation of value added product were also conducted.

39. To strengthen capacities of DOF staff 10 departmental staff were sent to Vietnam and 9 departmental officials were sent to China for training program in various new technologies such as cage culture, intensive fish culture in ponds, GIFT Tilapia culture, intensive Pangasius culture, integrated fish culture and hygienic live fish marketing.

Component B7 - Livestock Activities – Animal Husbandry Department (AHD)

40. *Artificial Insemination (AI)*: AHD performed 2,061,515 million AI over a period of 7 years with an overall conception rate of 51.7% (1.9 AI / pregnancy) against the pre-project conception rate of 42% and the national average of 35%, and a calving rate of 46.3% (2.2 AI / calf). The project supported AI Services resulted in total to the birth of 481,832 male and 476,786 female calves.[26] The total number of government veterinary institutions was increased by 86% reaching 2,579 units in 2013-14. To further ensure the availability of AI services the government converted all its stationary AI centres into mobile AI units.

41. *Fodder Development*: AHD did a large scale promotion of **fodder cultivation**, covering around 14,477 ha (against the target of 6,500ha as per PAD's EFA), in order to reduce the gap between the requirement and availability of green fodder in the project area. AHD demonstrated this program with annual fodder varieties like Maize, Sorghum, Cow Pea and perennial fodder species like Napier hybrid (CO-3, CO-4), hedge Lucerne and Sesbania tree fodder. The continuity of fodder production seems to be high, especially with perennial fodder varieties and horizontal expansion from farmer to farmer is evident.

42. *Infertility cum Health Camps*: Under IAMWARM a mass outreach program in the form of 9,011 "**infertility cum health camps**" were conducted to improve preventive animal health care and to tackle infertility problems. In the camps vaccinations were provided, 2,846,500 sheep and 367,800 heifer calves were de-wormed, and minor animal surgeries were carried out. The incremental weight gained by each animal due to de-worming is assessed as 2kg at a rate of INR. 250/kg.[27]

43. To overcome the infertility problem 16,010 infertile animals were treated under an **oestrus synchronization protocol** with a success rate of 74%. 117,300 animals were provided with

[26] The difference between the number of animals conceived and the number of calves born is due to the conceived animals having been sold or having migrated to other areas.

[27] AHD (June 2015); ICR Report, p.7 (Table: "Impact")

mineral mixture to further improve fertility, and 55,790 calves which were deficient in minerals were provided with mineral licks.

44. *Capacity Development:* IAMWARM conducted 4,981 "**farmers' interactive meetings**" and about 81,000 farmers received advice on improved animal husbandry of which 32% belonged to the Scheduled Casts (SC)/Scheduled Tribes (ST) category, and 63% of all participants were female. Apart from those meetings and direct interaction with farmers in the context of the "fertility cum health camps", the project used exposure visits to successful farmers in neighboring villages.

Farmers Training - Participants								
# Male Farmers			# Female Farmers			# Total Farmers		
SC/ST	Others	Total	SC/ST	Others	Total	SC/ST	Others	Total
9,414	20,938	30,352	16,210	34,438	50,648	25,624	55,376	81,000
31%	69%	100%	32%	68%	100%	32%	68%	100%

Intermediate Outcome Indicators for Component B

44. **Increase in crop, livestock and fisheries production.** This indicator was expressed in tonnage terms for crops, milk, and fish production. Compiling reliable tonnage data across crops proved difficult, particularly with the inclusion of fodder crops. The PAD EFA Annex contains yield targets for major crops consistent with the crops tonnage forecast. For major crops these are: paddy, 5.4 tons/ha.; maize, 3.9 tons/ha.; and pulses, 0.69 tons/ha. Against these targets the project achieved the following; paddy, 6.19 tons/ha.; maize, 6.26 tons/ha.; and pulses, 0.62 tons/ha. The target for increase in milk production of 590,000 m.t. was met and exceeded with increased production of 705,410 m.t. The target for increased fish production of 22,500 m.t. by the last year compares with the actual figure of 14,686 m.t.

45. **Percentage of area covered by IPM / INM / Organic Farming**. This indicator covers three different aspects of good agricultural practices, namely integrated pest management (IPM), integrated nutrient management (INM), and "organic farming". These encompass a variety of integrated agricultural interventions, as well as a verification and certification process. TNAU, DOA and DOH are promoting bio-fertilizers, the use of *Trichoderma viride*, *Pseudomonas fluorescens* and *Azospirillu*, the production and use of vermicompost, neem cake and especially for cotton, the use of pheromone traps. No comprehensive data on IPM/INM or organic agriculture were collected or reported to the ICRR Team.

46. **Percentage increase in value of marketable surplus:** The indicator was never defined with respect to data sources or baseline value. Values were not reported by the project.

47. **Market kiosks:** Due to the widely available and adopted method of receiving market information through mobile phone apps, the installation of market kiosks became irrelevant.

48. **Value chains** – This indicator was not defined, with values in the Results Framework marked "to be determined". These were subsequently never determined.

Component C: Institutional Modernization for Irrigated Agriculture

Main Achievements and Outputs:

a. *Provision of consultant and training support and funding of staff salaries and allowances for incremental specialist positions required in the Engineer-in-Chiefs office for the:*

- *Information Technology Cell*
- *Training Cells*

49. As mentioned above, the project proposed to institutionally strengthen the WRD by establishing an **Information Technology (IT) Cell and a Training Cell in the E-in-C office**. The respective 2 Cells are headed by an Executive Engineer each, supported by an Assistant Executive Engineer each and 2 Assistant Engineers each.

50. The main **task of the IT Cell** is to (i) plan, coordinate and monitor implementation of the computerization of the WRD offices; (ii) designing, develop and make operational the WRD enterprise-wide information management system; and (iii) train the WRD staff in use of both these facilities.

51. The main **task of the Training Cell** is to plan, coordinate and monitor implementation of training programs for the WRD staff through courses and study tours, in-house training and seminars and change management efforts to modernize the functioning of the WRD.

52. It is envisaged in the project that these two Cells **should be institutionalized** into the E-in-C office permanently to continue supporting the listed tasks even after the completion of the project. Financing of these cells beyond the project is proposed for inclusion in the follow on project.

b. *Training of engineers through courses and study tours, in-house training and seminars*

53. The Training Cell has been organizing a wide range of training programs on technical topics, IT use, PIM and WUA support for the WRD staff under the project. Between 2007-08 and 2015-16 a total of 320 training programs have been conducted providing training to 5782 WRD staff. The year wise details of the training programs conducted and the number of WRD staff trained is given below[28]

Sl. No.	Year	No. of Training Programs	No. of WRD Staff Trained
1	2007-08	9	145
2	2008-09	22	346
3	2009-10	57	1308
4	2010-11	60	1066
5	2011-12	62	1103

[28] Include 3 training programs conducted for WUA Support Organization in which 90 SO staff was trained.

6	2012-13	37	612
7	2013-14	32	574
8	2014-15	37	561
9	2015-16	4	67
	Total	320	5782

The various types of trainings conducted and the number of WRD staff trained is given below[29]

Sl. No.	Type of Trainings	No. of Training Programs	No. of WRD Staff Trained
1	Technical Training	179	3408
2	IT Training	89	1253
3	International Training	6	34
4	National Study Tour	6	127
5	Study Tour within the State	11	236
6	PIM Competent Authority	26	634
	Total	317	5692

c. Creation of modern technical, financial, and operational management capacity using computer-based MIS and implementation of enterprise-wide information management system (EIMS)

54. The project has a provision to fund the development and operationalization of an enterprise-wide **information management system (EIMS)** for WRD. The IT Cell in the E-in-C office has sort the technical assistance of Electronics Corporation of Tamil Nadu (ELCOT) in designing and developing the EIMS for WRD. The IT Cell along with ELCOT has constituted an Administrative Committee (AC) to guide and review implementation of the EIMS. ELCOT has procured the services of the Consultant M/s Tech Mahindra to design, develop, operationalize the said EIMS and train WRD staff in its use and provide technical back up support. The contract period is for 5 years starting June 2011.

55. At the time of the ICRR Mission, the IT Cell reported that the consultant has completed the following deliverables:

[29] Training topic wise number of training programs and WRD staff trained is given in Annexure 1.

- Preparation of the **Inception Report** – analyzing information needs at different levels of WRD; documenting the access control rights and data and information security requirements at all levels; data organization, data access and reporting; need for specialized team of MIS specialists (with IT and/or functional area background) within WRD and setting up an appropriate MIS organization, including infrastructure, resources, and maintenance strategy; training strategy and plan for inducting EIMS; and the hardware configuration required;
- Design of **Quick Win Activities** - Web Site / Portal design and development for technical sanctions, budget requisition and allotment, issue of LOC, reporting (including routine progress / periodical reporting), leave sanctions, initiation and approvals of requests for proceeding on temporary duties, initiation and approvals for tendering of projects and procurement of tracking system (beginning with IAMWARM procurement at WRD);
- Completion of Quick Wins - Quick win product developed and installed on TNWRD / ELCOT provided servers and rolled out;
- Design and Development of **32 Modules** – 16 modules developed and approved by the AC; 13 modules completed but not yet approved by AC; and 3 modules still under development;

Modules approved by Administrative Committee			
1.	Asset Management	9.	Water User Association
2.	Asset Inventory	10.	Environment Management
3.	Spatial Knowledge Base	11.	Human Resource Management System
4.	Irrigation Water Management System	12.	APQRM, RTI, CM Cell
5.	Flood Control Management	13.	WRD Intranet & External Website
6.	Dam Safety Monitoring	14.	Electronic Document Management System
7.	Mechanical Works	15.	Information Technology Management
8.	Research and Development	16.	Office Administration
Modules to be approved by Administrative Committee			
17.	Complaints Management	24.	Planning & Investigation
18.	Procurement & Tender	25.	Management of Resources & Milestone Tracking
19.	Grievance Management	26.	Complaints Management
20.	Design of Works	27.	File Tracking
21.	Library Management	28.	Social land Acquisition

Modules approved by Administrative Committee			
22.	Litigation Management	29.	Contract and Contractors Management
23.	Construction of Projects		
Modules under development			
	Finance and Accounts		
	Budget Planning and Monitoring		Monitoring and Evaluation

- Design and Development of Training Manuals – training manuals developed for all 32 modules.

56. An issue that remains to be resolved is procurement of Servers for roll out of EMIS. Earlier it had been proposed that WRD procure its own Servers, but later it was changed to hiring the Servers from a service provider (BSNL, which is a public sector Telecom Company). These costs will have to be borne by the State Government itself.

57. The IT Cell assured the ICRR Mission team member that this and all other pending works related to EIMS such as full roll out of the EIMS, warranty and annual technical support will be carried out by seeking state funds after closure of the project.

d. Support computerization with network connectivity for all the offices of the WRD; LAN and WAN connectivity

58. The following items have been procured under the project to support computerization of the WRD and establish an IT enabled environment in its offices.

Sl. No.	Items	Type of Equipment	Quantity
1	Computers and Peripherals	Desktop Computers	1565
		Laptop Computers	330
		Printers	1137
		Computer Furniture	922
2	Office Equipment	Photocopiers	158
		Fax Machines	146
		Digital Cameras	252
3	Networking of WRD Offices	LAN Equipment and Devices	142 WRD offices

e. Irrigation Research Fund (IRF) to foster research in irrigation development and management

59. An Irrigation Research Fund (IRF) with a corpus of US$ 3 million (INR 133.77 million) was set up in the E-in-C's office WRD to be used to foster research in irrigation development and

management. It was proposed that the research be conducted by private sector, academia and department staff on a competitive grant basis. During the project period a total of 7 studies have been funded under IRF with a total cost of INR 15.3 million (US$ 0.34 million). A reason for the underspending in this category was the lack of quality proposals coming forward.

f. WUA Formation:

60. The Phase-wise details of the WUAs formed under Component C and reasons for those not formed is given in the Table below:

Sl. No.	Phase	No. of Sub Basins	No. of WUAs Delineated	No. of WUAs formed	Command Area in ha	Remarks
1	Phase I	9	1008	1004	289,498.47	17 WUAs left out due to Temple land, non-cooperation, etc.
2	Phase II	16	325	320	67,206.21	
3	Phase III	30	1028	1020	182,119.18	
4	Phase IV	6	454	431	130,330.56	12 WUAs Election could not be conducted due to urbanization; 1 WUA comes under Temple Land; 10 WUAs Election to be conducted
	Total	61	2815	2775	669,154.42	A total of 40 WUAs could not be formed

61. Initially WUAs were formed with the support of **SOs**, which achievements are summarized in the following Table:

Sl. No.	Region	Name of the SOs	No. of WUAs Delineated	No. of WUAs Formed	No. of WUA Sub-committees Formed	No. of WUA Bank Account Opened
1	Trichy Region	CHERU	127	127	127	117
2	Trichy Region	RAESO	141	141	140	59
3	Chennai Region	GREDS	234	234	223	96
4	Madurai Region	HKCAL	244	244	203	192
5	Madurai Region	HKCAL	70	70	60	24

6	Madurai Region	Coodu Trust	92	92	91	85
7	Madurai Region	Coodu Trust	70	70	70	52
	Total		978	978	914	625

62. Subsequently, the **Alternate Model** was put in place, which achievement is summarized below.

Sl. No.	Name of Region	No. of WUAs Delineated	No. of WUAs Formed	No. of WUA Sub-committees Formed	No. of WUA Bank Account Opened
1	Coimbatore	323	323	319	321
2	Trichy	363	363	345	335
3	Madurai	344	340	289	309
4	Chennai	1174	1167	1123	759
	Total	2204	2193	2076	1724

63. Altogether, out of the total number of WUAs formed under the project, 94% had set up a WUA sub-committee and 74% had opened a bank account.

64. An important development related to WUA formation is that the **term of all elected representatives of the WUAs formed under Phase I, II and III of the project is complete** at project completion and until new elections are organized. .

Sl. No.	Project Phase	No. of WUAs	Status of Terms of Management Committee
1	Phase I	1008	Term of all WUA Management Committees completed between June and December 2014
2	Phase II	325	Term of all WUA Management Committees completed between June and December 2014
3	Phase III	1028	Term of all WUA Management Committees completed between February and March 2015.
	Total	2361	

65. This issue was flagged during the Project Implementation Support Mission in September 2014 during which time it was discussed and agreed that the E-in-C office in conjunction with the PIM cell at the E-in-C office would submit a proposal to the Government of Tamil Nadu to conduct WUA elections for 1333 WUAs under Phase I & II of the project by January 2015. However, at the time of the ICRR Mission in June 2015 it was learnt that not only have the elections to the Phase I and II WUAs not been conducted so far, the term of the Phase IIII WUA Management Committees have also completed.

g. WUA Training:

66. The **Participatory Irrigation Management (PIM) Cell** was established as a separate unit in the E in C Office of the Water Resources Wing to undertake the following activities: formation and strengthening of the WUAs; coordination of the member registration processes; election of the elected representatives of the WUAs, capacity building assessment needs, training programs required for awareness and capacity building and monitoring the effectiveness of WUAs. The PIM Cell functions in collaboration with the Irrigation Management Training Institute, Trichy and Centre of Excellence for Change, Chennai in developing and imparting trainings to the WUAs first through the SO Model and then through the Alternate Model.

67. The projects WUA Training Program was divided into 2 parts: 2 days focused on introduction of PIM and WUA functions, which is followed by a 1 day on the management of the Irrigation System servicing the WUA.

68. While the WUA training program has been completed in Madurai and Coimbatore regions, 19 WUAs in Trichy region (5.2%) and 113 WUAs in Chennai region (9.8%) were yet to receive training. There will be a need for refresher training of WUAs beyond the life of the project which will be the responsibility of the PIM cell.

h. Community Collaborative Water Management:

69. The objective of Community Collaborative Water Management was to **empower the community to plan and implement demand side management actions** for water resources both at times of surplus or deficits resulting in community ownership and sustainability of water resources.

70. Community Collaborative Water Management (CCWM) provided an approach to sensitize the community about the water situation and enable them to draw up a community level action plan for sustainable use of water in their village for all water uses such as agriculture, domestic and others. The various steps in CCWM are:

- Awareness creation about water resources and the need for water conservation;
- Water walk through in the village with the villagers;

- Development of a "**Village Vision**" including preparation of a base map incorporating all the water bodies in the village by conducting a PRA and chalk out a village water management strategies taking the ideas, observations, priorities of the villagers into consideration;
- **Water Budgeting**: assessment of water resources available in the village, water demand for various uses and matching them to arrive at a water balance status;

- Suggesting alternative strategies related to crop intensification, crop diversification, micro irrigation techniques etc. to overcome the water deficit in the village; and
- Preparation of an **operational plan** for water management in the village and its implementation

71. The expected outcomes of CCWM are that the people will be united around water, collective decision making and promotion of women participation on water issues will be facilitated, water will be equitably shared for irrigation; crop diversification and water use efficient techniques and methods will be adopted for sustainability, farmer incomes will be enhanced and community's capacity to resolve water issues will be strengthened.

72. At project close, the CCWM exercises have **been carried out in the 400 model villages** in the project. Going forward, one improvement should be made in the methodology. That would be to include a water budgeting scenario where deficit rainfall becomes the new norm rather than relying strictly on assumptions of long-term normal rainfall going forward.

73. Overall, the CCWM and the participatory water balance calculation exercise has been an effective way to **create awareness** among the community on the need for sustainable water management and for collective action for planning and implementing it.

74. **Intermediate Indicators:** The interventions under the staff-training, irrigation information management systems and WUA Strengthening sub-components clearly contribute significantly in achieving the IOIs of Component C of:

- 100% WRD staff trained for modern, efficient, and accountable irrigation service delivery;
- Effective Irrigation Information Management Systems made fully functional with 25% of WRD staff trained to use it; and
- Number of WUAs setup, trained and effective.

During the project period a total of 320 training and study tour programs were organized providing training to a total of 5782 WRD staff.

75. The **target number of WUAs** to be setup, trained and made effective in the PAD is given as **2500 WUAs**. At the time of the ICRR Mission the PIM Cell reported formation and training of **2775 WUAs** spread across the 4 regions and 61 sub-basins.

76. An Enterprise Information Management System (**EIMS) of 32 Modules** has been designed, developed and tested for WRD with technical assistance of an IT consulting firm. Its roll out had not been completed at project close and will require Government financing.

Component D: Water Resource Management

77. **Main Achievement:** Creation of a State Water Resources Management Agency (SWaRMA) and providing it legislative backing to give it appropriate planning and regulatory powers. Government of Tamil Nadu has established the State Water Management Agency through G.O. (Ms.) No. 58 dated 13.04.2009 with the following members:

- The Chairperson: The Hon'ble Minister for Water Resources Department (Public Works Department)
- Vice Chairman: The Principal Secretary, Water Resources Department (Public Works Department)
- Member: Engineer-in-Chief, Water Resources Department & Chief Engineer (General)
- Member: Chief Engineer, (State Ground and Surface Water Resources Data Centre), Water Resources Department
- Member: Chief Engineer, (Plan formulation), Water Resources Department
- Member Secretary: Chief Engineer & Director, (Institute of Water Studies) Water Resources Department

78. The SWaRMA shall also have on its panel five specialists possessing adequate knowledge, experience and proven capacity in dealing with the problems relating to engineering, agriculture, geology, drinking water, industry, law, economics, commerce, social aspects, GIS, remote sensing, modeling, communication, water consumers etc. who will be invited to assist whenever required depending upon the agenda in discussion. Further inducting experts as permanent members representing the core departments in the water sector shall be considered by the SWaRMA in due course if necessary.

79. The G.O. lists the **following objectives for SWaRMA**:

- To improve the institutional arrangements and capacity for sustainable Water Resources Management in the State; and
- To develop and manage the water resources of the State in a holistic way in a river basin framework.

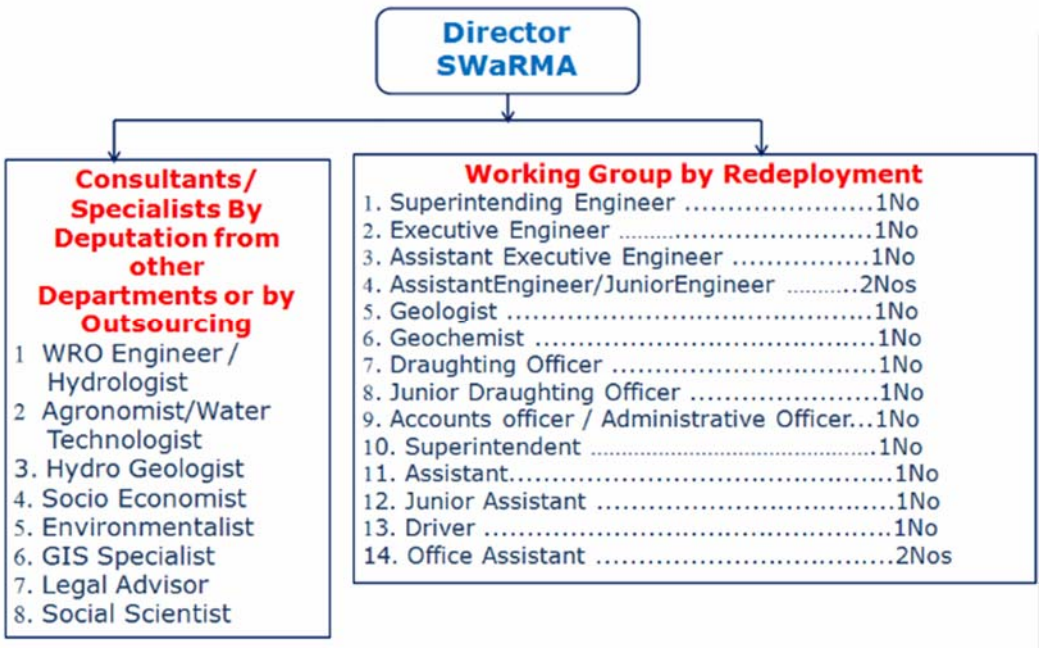
80. The **functions of SWaRMA** as per the G.O. are:

- To advise the Government of Tamil Nadu in water policies for the State including resource development, regulation and management in a holistic river basin/sub-basin framework;

- To advise the Government in formulating a water tariff system, to fix the criteria for water charges at sub-basin, river basin and State level after ascertaining the views of the beneficiary public, based on the principle that the water charges shall reflect the full recovery of the cost of the irrigation management, administration, operation and management of water resources projects in the State.
- To advise the Government on interstate interests involved in water resources projects proposed at the sub-basin and river basin level, so as to ensure that any such proposal is in conformity with Integrated State Water Plan and also with regard to the economic, hydrologic and environmental viability;
- To advise the Government on any other inter-state issues;
- To facilitate the development, dissemination, and use of a comprehensive water resources knowledge base and analytical tools (including GIS and Decision Support Systems) along with structured stakeholder consultations, so as to develop sustainable and optimal resource development and management plans in a river basin/ sub-basin framework; conduct special studies as required to estimate available resources and evolving demands, improve holistic water management in the State; facilitate multi-disciplinary applied research and awareness-building on key issues and options relating to water management; facilitate access to water resources database and analytical resources by various Government Departments and Private sector users as well as individual citizens.
- To establish a planning and management framework for water resources in the Hydrological Boundaries of Water Resources Department (including management objectives, principles, criteria, indicators, and procedures for allocation of appropriate water quantity of adequate quality to different sectors and regions, as well as incentives and enforcement arrangements for compliance) and also to work in line with the compendium of rules in existence or to suggest modifications in the compendium of rules;
- To advise in regulating water allocation for bulk users (greater than 1mgd) by using suitable instruments to improve optimal water utilization and water conservation incorporating environmental, social, and economic objectives and in conformity with the State Water Policy;
- To develop a State Water Allocation data base that shall clearly record all bulk allocations issued for the use of water within the State, any transfers of allocation and a record of deliveries and uses made as a result of those allocations;
- To prepare an annual Water Audit for each river basin in the State and to publish the same;
- To review and approve State and river basin master plans, appraise all surface water resources in the hydrological boundaries, development projects to be taken up in the State either through Government Departments / Agencies or through non governmental entities using technical, economic, social, legal and environmental criteria;
- To develop appropriate approaches to resolve water-related conflicts arising from policies, plans, projects, and agreements including interstate agreements and to advise Government accordingly;

- To establish and facilitate the work of Basin / Sub-basin Agencies (e.g Development and Management Boards or other suitable institutional frameworks) in the State; facilitate their becoming fully operational through provision of technical assistance; integrate the work of these agencies and promote synergies;
- To encourage appropriate-public partnerships to improve and sustain water productivity;
- To advise on all related matters in accordance with the State Water Policy as amended from time to time;
- To support and aid the enhancement and preservation of water quality within the State in close coordination with the relevant State Agencies and suggest accordingly in future planning;
- To suggest the Government for ensuring effective resource availability to the tail end areas in the River Basin;
- To recommend clearance for formulated projects in the context of River Basin plans based on availability of surface water; and
- To oversee management and use of Water Resources Research Fund (WRRF) set up in Institute of Water Studies under the WRCP / Irrigation Research Fund (IRF) in IAMWARM Project.

81. The technical unit of SWaRMA is headed by a Director who is supported by a two categories of staff, namely Consultants / Specialists and Working Group. The staff structure of SWaRMA is given in the figure below.



82. The **major activities of SWaRMA** until project completion have been the following:

- Support the preparation of the basin and sub-basin development plans and atlas through information and data management support;

- The design and preparation of the Tamil Nadu Water Resources Information System and establishment of TN-WRIS web portal;
- Technical and information support to State Water Committee, State Water Advisory Committee and State Water Policy Committee; and
- Training to WRD staff on Arc GIS and other water resources data management open source software.

83. An area of concern related to establishment of SWaRMA is that it has been established as an institutional arrangement to the project and therefore subject to uncertainty after completion of the project. The envisaged process of conferring an institutionalized legal status to SWaRMA for appropriate planning and regulatory powers through a legislative process is yet to be undertaken by GoTN. During the ICRR Mission SWaRMA Director informed that a proposal for continuing activities of SWaRMA with state funds has been submitted to GoTN for consideration.

84. Effective use of Information for Water Resources Planning and Management: To manage water resources optimally in the state, SWaRMA has developed a GIS based web enabled e-tool with inter-sectorial common database, namely the Tamil Nadu Water Resources Information System (TN-WRIS). TN-WRIS has been constructed to help in decision making for efficient integrated water resources management and regulation for better service delivery in the state. It is a comprehensive data base for accessing water data and is capable of geo-visualization that will help in planning and management of water resources in the river basins and sub-basins in the state.

85. TN-WRIS collated data from many departments and presented it as maps and other non-spatial data related to many themes and parameters on a centralized and common platform for use by all concerned. It is expected that TN-WRIS will keep all stakeholders abreast with the latest information on the state's water resources and provide services such as data query, charting and visualization and analytical data for use by the public at large.

86. Currently, SWaRMA is maintaining the **TN-WRIS web portal** on the BSNL server as a restricted domain and has provided a few line departments will login facilities to access its services. The home page of TN-WRIS non-spatial and spatial data is given in the figure below:

87. *Preparation of sub-basin development plans:* WRD in cooperation with concerned line departments and local communities prepared an integrated development plan for each sub-basin included under the project. In each sub-basin plan, specific irrigation interventions were identified based on local water resources condition, development needs and social-economic background. Physical and financial targets and operational plan were also prepared. A participatory process was adopted for identification of specific interventions at tank and canal level, including organization of village meetings and walkthrough surveys along with the community representatives.

88. *Strengthening the Framework for Sustainable Water Resources Management with drafting of an appropriate policy framework:* GoTN had formulated and issued the **State Water Policy** in 1994. After GoI issued the revised National Water Policy 2012 GoTN decided to also formulate a revised Water Policy for the state. To finalize the revised Tamil Nadu State Water Policy, GoTN has constituted a committee, vide G.O. (D) No. 323 dated 14.08.2013 with the following members:

- Chairman: Chairman, CTC
- Member Secretary: CE & Director, WRD, IWS
- Member: E-in-C, WRD
- Member: Director, SWaRMA
- Member: CE, WRD – Chennai Region
- Member: CE, WRD – Trichy Region
- Member: CE, WRD – Madurai Region
- Member: CE, WRD – Coimbatore Region

89. An **updated draft Tamil Nadu State Water Policy** has been circulated to the committee members for finalization during its third meeting on 24.06.2014.

90. **Intermediate Outcome Indicators**: The Intermediate Outcomes Indicator (IOI) of the project relating to Component D are:

- State Water Resources Management Agency created and strengthened;
- Basin Boards set up/ strengthened for 3 sub basins and 1 basin by end of project; and
- Improved knowledge base and analytical capacity development and use for water resources management

The state government has established the **SWaRMA** through a government order as a separate agency without amalgamating the Institute of Water Studies and the State Surface and Ground Water Data Center into it.

As noted previously in this Report, no additional basin or sub-basin boards were set up under the project due to the failure of previously established boards to function.

SWaRMA has established a Tamil Nadu – Water Resources Information System (TN-WRIS) collating water resources related data from various sources and developed spatial and non-spatial web based data records and reports.

Annex 3. Economic and Financial Analysis

A. Purpose

1. The purpose of this ex-post Economic and Financial Analysis (EFA) is to assess the extent to which the project benefits have been achieved as anticipated, by comparing ex-ante and ex-post indicators of efficiency. It consists of re-undertaking the Cost Benefit Analysis that was performed at appraisal by using actual results documented in this ICRR.

B. Methodology and assumptions

2. IAMWARM economic and financial returns were assessed at appraisal based on a sample of 9 representative sub-basins spreading over three major agro-climatic zones and for which sub-basin plans had been developed before appraisal. This ex-post EFA assesses benefits accruing on the entire project area having benefitted from project interventions, i.e. on 61 sub-basins.

3. Key assumptions related to the main sources of benefits remain the same as in the PAD. They are derived from *Component A: Irrigation systems modernization in a sub-basin framework,* and *Component B. Agricultural Intensification and Diversification*. Results from *Component C. Institutional Modernization for Irrigated Agriculture, Component D: Water Resources Management* and *Component E. Project Management Support* are of a more intangible nature. However, they are key for enabling the realization of project achievements, attainment of Project Development Objectives, and future sustainability of benefits.

4. Returns from agriculture intensification and diversification activities supported by the different line departments in the project area have been calculated on the basis of 12 production models. These models assess incremental productivities, gross margins and returns to labor for agricultural and horticulture crops and some livestock activities (milk production). They compare IAMWARM beneficiaries and a control group over the life of the project, i.e. estimating the "difference in differences". All models use constant 2015 prices and have been built on data provided by the MPDU and line departments in their respective ICR reports as well as resulting from specific requests by the ICR team. Key assumptions on productivity increases are extracted from the values reported in the Results Framework Analysis of this ICRR.

5. The time frame used for both financial and economic analyses is 25 years, including 7 years of project implementation and 18 years of future projections. Economic prices have been derived from Import-Export parity prices for major tradable commodities, and a Standard Conversion Factor has been applied to non-tradable commodities, including labor. More details on methodological aspects are provided in the following sections as well as in the enclosed excel files that provide further information.

C. Production models

6. In the PAD, 11 crops models and two activity budgets (livestock and fisheries) were prepared, serving as the basis to perform the ex-ante EFA. Three major sources of benefits were identified: (i) area expansion; (ii) agriculture intensification; and (iii) agriculture diversification. For the ICRR ex-post analysis, 11 crops models and one activity budget (milk) have also been prepared and organized into three activity groups: (i) agricultural crops; (ii) horticultural crops; and (iii) milk production. The crops were selected to be the most representative ones adopted by project beneficiaries, including "demonstration" and "impact" farmers.

7. The Tables below summarize a set of indicators that reflect incremental benefits in terms of outputs, incomes and returns to labor of IAMWARM beneficiaries compared to a control group, the latter being defined as neighboring farmers with similar conditions but not having benefitted from improved irrigation and technical improvement. As a conservative measure, average yield data on impact areas have been used as considered by the ICRR team more realistic than the "demo" yield data. Therefore, incremental yields have been calculated as the difference between impact area farmers and control farmers, on average during the 2007-2014 period.

8. Yield increases accruing from interventions in agriculture crops are: 26% for paddy, 31% for maize, 24% for pulses, 21% for groundnuts and 4% for sugarcane. Incremental outputs values per hectare are significant for SRI, improved maize and oilseeds. The models show that the large scale introduction of SRI bring substantive financial returns to the farmers with growth incomes increasing by 70% as a result of both yield increases and reduced production costs. Incremental net margins (including family labour) range between USD 127 for pulses and USD 497 for sugarcane. Incremental returns to labour are highest for sugarcane, on account of input and costs savings from adopting Sustainable Sugarcane Intensification (SSI) techniques, including drip fertigation.

9. **Horticulture production** models illustrate project interventions in vegetable production, mainly tomato, brinjal (eggplant) and bhendi (okra), spices (turmeric and chillies) and fruits (banana). Incremental benefits have been calculated with the same methodology as agricultural crops. Yield increases are estimated at 31% for tomato, 36% for brinjal, 45 % for bhendi, 26 % for chillies, and 36% for banana. Gross and net margins are remarkably high for banana cultivation with the adoption of tissue culture, followed by turmeric. Among vegetables, tomato is the most profitable option, with USD 791 net margin per hectare. Incremental values for vegetables and chillies are quite similar across the 5 crops.

10. **Livestock** interventions were designed to increase feed availability, improve delivery of veterinary services, provide de-worming, and enhance farmer's awareness of improved animal husbandry practices and market linkages. These interventions had an impact on mortality rates, animal body weight and milk productivity. The activity model focuses on estimating incremental gross and net margins per liter of milk, assessing whether additional milking days and productivity per animal would make up for the considerably higher feed costs and additional cost of veterinary services. The conclusion is that net margins per liter would be reduced from about INR. 5.19 to INR. 1.87 if farmers had to bear in full the costs of new husbandry practices. However, this is not the case given that many of these costs were provided by IAMWARM. Nevertheless, this decrease in margin is compensated by an absolute increase in milk production.

Table 1: Agriculture Crop models: Control Group and Project Beneficiaries (RS. and USD per hectare)

		Control Group					Project Beneficiaries				
	Unit	**PADDY - Traditional**	**MAIZE - Traditional**	**SUGARCANE (traditional irrigation)**	**PULSES (Traditional) Black Gram)**	**OILSEEDS (Traditional) Ground Nut**	**PADDY - SRI**	**MAIZE - Improved**	**SUGARCANE SSI**	**PULSES (Blackgram)**	**OILSEEDS (Ground nut)**
Yield	Kg	4,927	4,792	106,000	497	2,152	6,192	6,259	110,000	615	2,595
Incremental Yield	%						26%	31%	4%	24%	21%
Total output value	RS.	75,876	55,731	280,900	26,077	95,226	95,310	74,098	291,500	32,883	114,829
Total output value	USD	1,197	879	4,431	411	1,502	1,503	1,169	4,598	519	1,811
Labour costs/output	%	42%	44%	21%	70%	35%	36%	39%	16%	59%	31%
Materials/output	%	36%	38%	18%	31%	32%	28%	29%	14%	18%	22%
Gross margin (incl. hired labour)	RS.	27,250	18,961	194,353	6,545	44,142	46,394	35,173	222,778	15,035	68,761
Gross margin (incl. hired labour)	**USD**	430	299	3,065	103	696	732	555	3,514	237	1,085
Incremental Gross Margin	%						70%	85%	15%	130%	56%
Return to labour	RS./p-d	280	273	778	192	388	373	369	1,085	275	518
Return to labour	**USD/p-d**	4	4	12	3	6	6	6	17	4	8
Return to family labour	RS./p-d	518	445	1,956	206	764	831	701	2,692	447	1,095
Return to family labour	**USD/p-d**	8	7	31	3	12	13	11	42	7	17

Table 2: Horticulture crop models: Control Group and Project Beneficiaries (RS. and USD per hectare)

		Control Group						Project Beneficiaries					
	Unit	**Tomato**	**Brinjal**	**Bhendi**	**Chillies (Green chillies)**	**Turmeric**	**TC Banana**	**Tomato**	**Brinjal**	**Bhendi**	**Chillies (Green chillies)**	**Turmeric**	**TC Banana**
Yield	Kg	15,800	10,900	9,200	7,800	3,320	36,900	20,700	14,800	13,300	9,800	3,840	50,300
Incremental Yield	Kg							31%	36%	45%	26%	16%	36%
Total output value	RS.	79,000	43,600	46,000	62,400	166,000	221,400	103,500	59,200	66,500	78,400	192,000	301,800
Total output value	USD	1,246	688	726	984	2,618	3,492	1,632	934	1,049	1,237	3,028	4,760
Labour costs/output	%	32%	55%	47%	38%	17%	14%	24%	35%	29%	28%	16%	9%
Materials/output	%	15%	27%	20%	17%	54%	8%	19%	30%	27%	26%	33%	11%
Gross margin (incl. hired labour)	RS.	51,899	17,548	24,075	37,873	59,589	185,458	69,394	28,973	36,979	44,860	109,622	251,415
Gross margin (incl. hired labour)	**USD**	819	277	380	597	940	2,925	1,095	457	583	708	1,729	3,966
Incremental Gross Margin	%							34%	65%	54%	18%	4%	36%
Return to labour	RS./p-d	550	275	351	457	548	1,335	694	413	512	542	856	2,035
Return to labour	**USD/p-d**	9	4	6	7	9	21	11	7	8	9	14	32
Return to family labour	RS./p-d	1,157	413	620	882	1,191	3,245	1,522	787	1,055	1,130	2,028	5,184
Return to family labour	**USD/p-d**	18	7	10	14	19	51	24	12	17	18	32	82

D. Project Costs

11. All actual project costs (including the Project Management Support Component cost) have been included for the calculation of economic and financial indicators. According to the latest data made available by the MDPU (April 2015), total project costs were INR. 26,564 million, or about USD 489 million using an average exchange rate for the implementation period of 54.32 INR./USD. In addition to capital and management costs, O&M costs for the maintenance of the 5,260 tanks rehabilitated by the project have been included, at the rate of 480Rs./ha, for the 420,000 ha of command area.

E. Financial Analysis

Table 3: Phasing of Component A benefits (RS. and USD).

Phasing of benefits in the new fully irrigated area	Unit	2008-09	2009-10	2010-11	2011-12	2012-13	2013-14	2014-15 *
Total Incremental Irrigated Area	ha	10,731	11,740	37,247	56,049	48,909	103,641	93,171
New area under rice production	ha	10,328	10,972	36,831	55,242	48,433	102,964	92,457
New area under horticulture production	ha	403	768	416	806	476	677	714
Total Incremental Rice Production	Tons	57,418	57,843	183,516	276,152	240,976	510,639	459,051
Total Incremental Benefits from Paddy (Net Margin)	RS.	264,384,357	191,821,738	608,584,693	915,788,840	799,137,287	1,693,405,003	1,522,328,197
Total Incremental Benefits from Paddy (Net Margin)	USD	4,170,100	3,025,579	9,599,128	14,444,619	12,604,689	26,709,858	24,011,486
Total Incremental Benefits from Horticulture	RS.	32,418,660	59,511,397	32,187,098	61,871,122	37,887,930	52,619,675	52,895,344
Total Incremental Benefits from Horticulture	USD	511,335	938,666	507,683	975,885	597,601	829,963	834,311

* average area

12. At aggregate level, project benefits arise from an increase in fully irrigated areas resulting from component A and intensification and diversification of crop production resulting from component B. Based on the ICRR result analysis, **Component A** improved bulk water delivery to irrigation systems in 61 sub-basins. Despite some implementation delays, physical targets were fully reached, with 5,260 tanks rehabilitated with total command area of 404,055 ha. As a result, fully irrigated area in the project sub-basins increased by 39.3%, from 364,768.4 ha to 508,132.6 ha, reducing the gap area between ayacut area and total irrigated area by 60%. For the purpose of this analysis, aggregated annual increments over the baseline values for fully irrigated areas have been considered for the years 2008-2014, and average 2008-2014 figures were used for future projections. The realization of benefits from this component has been affected by the severe droughts in 2012-2013 as shown in Table 3. However, at completion, results remain positive if average increased irrigated area over the years is used. Average net margins were applied to calculate benefits from the newly irrigated area, with the underlying assumption that most of the new area would be cultivated with paddy, and only marginally with horticulture crops.

13. **Component B** increased productivity of irrigated agriculture in the 61 project sub-basins for tank-based and canal-based systems, as reflected by the various intermediary outcomes linked to the various sub-components implemented by 8 different line agencies. These were mainly linked to water savings, higher production and productivity levels, and increases in farmers' incomes, that were achieved by introducing or scaling-up modern production technologies (agriculture intensification) and promoting a shift from low to higher value crops (agriculture diversification), as well as supporting fisheries and livestock production activities and enhancing market linkages. At project completion, initial targets have been mostly achieved.

14. Incremental benefits for component B have been derived from the three sets of activity models above on (i) agricultural crops, (ii) horticultural crops and (iii) livestock. For the aggregation of agricultural and horticultural benefits at project level, the combined "demo" and "impact" areas reported by TNAU, DoA and DoH have been multiplied by the respective incremental net margins for each crop. A key assumption for component A is that 70% of this benefitting area has benefitted from intensification of existing cropping patterns, 15% from diversification, and 15% from expansion to new areas, the latter already accounted for in Component A. Benefits from livestock activities are defined as the differential net margin per liter of milk, multiplied by the total increase in milk production attributed to the project as reported by DoAH in its ICRR and reviewed by the ICRR mission. To be conservative, results from other livestock activities, such as de-worming of small and large ruminants, have not been included in the benefit stream, as some of them are considered to contribute to the above increase in milk production. This analysis also excludes benefits from fisheries production and marketing activities, due to a lack of sufficient and/or consistent data. It is therefore important to bear in mind that the real impact of IAMWARM may be somewhat understated, owing to these conservative assumptions. The aggregation of component B benefits is shown in Table 4.

Table 4: Phasing of Component B benefits (RS. and USD)

Incremental Benefits

Agriculture TNAU + DOA		**2007-08**	**2008-09**	**2009-10**	**2010-11**	**2011-12**	**2012-13**	**2013-14**
SRI	USD	1,620,636	9,550,421	16,640,886	30,365,008	43,044,568	54,592,219	43,747,103
Maize	USD	1,395,949	8,518,309	8,086,189	8,274,778	7,797,935	8,541,574	7,747,711
Sugarcane	USD	95,440	175,768	279,798	278,871	325,991	275,048	-
Pulses	USD	730,875	3,827,992	5,641,438	7,550,979	10,961,926	13,167,628	11,146,178
Groundnut	USD	1,044,619	5,104,562	7,015,786	9,714,330	11,816,458	14,387,109	34,001,322
Horticulture		**2007-08**	**2008-09**	**2009-10**	**2010-11**	**2011-12**	**2012-13**	**2013-14**
Tomato	USD	84,605	288,208	419,127	575,791	629,872	646,900	1,246,087
Brinjal	USD	60,914	120,625	168,484	224,635	228,751	252,538	310,507
Bhendi	USD	224,686	470,689	491,368	678,775	629,466	655,074	833,683
Chillies	USD	55,166	255,480	224,680	395,800	403,310	486,786	356,120
Turmeric	USD	73,392	160,781	139,634	156,900	144,718	144,198	203,950
T.C.Banana	USD	323,396	509,591	594,666	742,156	854,840	927,595	701,231
Livestock		**2007-08**	**2008-09**	**2009-10**	**2010-11**	**2011-12**	**2012-13**	**2013-14**
Increase in Milk Yield	USD	18,530	3,521,968	11,233,635	20,100,959	30,064,392	38,369,284	41,607,278

15. The **financial analysis combines Component A and B benefits streams**. As mentioned in previous sections, Components C, D and E do not yield quantifiable benefits *per se*, but are key to the achievement of Component A and B objectives. In addition to actual project investment costs, maintenance costs of rehabilitated tanks, which are borne by the Government of Tamil Nadu, have been added to the overall cost stream.

16. Incremental net benefits were calculated over a **25-year period**. The Financial Rate of Return (FIRR) is calculated at 30%, and the Net Present Value with a 12% discount rate is USD 251 million or about RS. 16 billion. Both financial indicators are above appraisal values, when a 23% FIRR and a RS. 12.4 billion NPV were anticipated. Possible reasons underneath these better results are: (i) the total incremental land area brought under fully irrigated conditions was larger than the incremental area predicted at appraisal, despite a prevalence of droughts during 2 project years[30]; and (ii) the appraisal projections had largely underestimated the extension of land that would be converted into SRI, which is a major source of project benefits[31].

F. Economic Analysis

17. Assumptions for estimating economic benefits were the same as those used for the financial analysis. Financial prices were converted to economic prices by derivation of import-export parity prices for tradable commodities – i.e. import parity prices for fertilizers and export parity prices for rice, maize and groundnuts. Other agricultural produce that is largely meant for internal consumption not usually traded has been treated as 'non tradable' and their prices converted to economic values by applying a Standard Conversion Factor of 0.9, which was also applied to labor costs.

18. Despite a conservative quantification of benefits, IAMWARM shows satisfactory results. Overall **Economic Rate of Return (ERR) is 21%,** very close to the 20.4% estimated at project design, as an average between EIRRs for 9 individual sub-basins, ranging from 13% to 30.2%. Net Present Value is about USD122 million, or RS. 7.8 billion. The lower economic results as compared to financial indicators are due to the fact that some of the commodities in the agricultural sector is heavily subsidized, in particular rice.

19. A sensitivity analysis was conducted to test the robustness of project investments. An unexpected increase of 30% in future recurrent costs would maintain EIRR rates at almost the same levels (20.5%). However, a two year delay in the generation of future benefits or a 20% decrease would bring the EIRR near the opportunity cost of capital of 12%. This is consistent with the sensitivity analysis presented in the PAD, and underlines that the agriculture sector is highly exposed to external factors such as climate irregularities or input/output price volatility. Switching values (defined as those values beyond which the EIRR is reduced below the opportunity cost of capital of 12%) are -24% for decreases in benefits and 38% for increases in project costs.

[30] Total increase in irrigated area (fully and partially) at appraisal was projected to be 215,830 ha, of which 123,330 ha would be fully irrigated, whereas the actual increase in fully irrigated area was 364,768 ha.

[31] It is estimated that project interventions under IAMWARM contributed to the expansion of SRI in 267,837 ha, a much larger area that the 66,500 ha foreseen in the appraisal EFA.

Annex 4. Bank Lending and Implementation Support/Supervision Processes

(a) Task Team Members

Name	Title	Unit	Responsibility/ Specialty
Bank Staff			
Anupam Joshi	Sr. Environmental Specialist	GENDR	Environmental safeguards
Atin Kumar Rastogi	Procurement Specialist	GOGDR	Procurement
Deborah Lee Ricks	Sr. Program Assistant	SASDO	Program assistance
Edward C. Cook	Sr. Agriculture Economist	GFADR	TTL
Gennady Pilch	Sr. Legal Counsel	LEGEC	Legal
Grahame Dixie	Adviser	GFADR	Agriculture marketing
Anju Gaur	Sr. Water Resources Specialist	GWADR	Water management
Sitaramachandra Machiraju	Sr. Water&Sanitation Specialist	GWASP	Agriculture marketing
Javier Zuleta	Sr. Water Resources Management Spec.	GWADR	Water management
Krishna Pidatala	Sr. Operations Officer	GTIDR	ICT
Geeta Alex	Program Assistant	SACIN	Program assistance
Leena Malhotra	Program Assistant	SACIN	Program assistance
Jurminla Jurminla	Procurement Specialist	GGODR	Procurement
Mohan Gopalakrishnan	Sr. Financial Manag. Specialist	GGODR	Financial management
Nagaraja Rao Harshadeep	Lead Environmental Specialist	GENDR	Co-TTL
Philip Beauregard	Sr. Legal Counsel	LEGMS	Legal
Rabih Karaky	Operations Advisor	LCROS	TTL
Sarita Rana	Sr. Program Assistant	SACIN	Program assistance
Shankar Narayanan	Sr. Social Devel. Spec.	GSURR	Social safeguards
Srinivasan Raj Rajagopal	Lead Water Resources Specialist	SASAR	TTL
Sushil Kumar Bahl	Sr. Procurement Specialist	SARPS	Procurement
Syed I. Ahamed	Lead Legal Counsel	LEGMS	Legal
Thao Le Nguyen	Sr. Finance Officer	LOAG2	Financial management
Venkatakrishnan Ramachandran	Program Assistant	GFADR	Program assistance
Vinayak Ghatate	Livelihoods Specialist	SASSD	Livelihoods
Wilhelmus G. Janssen	Lead Agriculture Specialist	GFADR	Agriculture

Winston Yu	Sr. Water Resource Specialist	GWADR	Water management
Sashank Ojha	Sr. e-Government Specialist	GTIDR	ICT
Consultants			
R K Malhotra	Construction Design Specialist		Irrigation works
Anil Borwanker	Construction Design Specialist		Irrigation works
Benjamin O'Brien	Agriculture Specialist		Agriculture
Paul Sidhu	Agriculture Specialist		Agriculture
Ranu Sinha	Social Specialist		Social specialist
Martin Kumar	Fisheries Specialist		Fisheries
Mudnakudu Nandeesha	Fisheries Specialist		Fisheries
M Swaminathan	Livestock Specialist		Livestock
Dhirendra Kumar	Procurement Specialist		Procurement
S Selvarajan	Economist		EFA
Jagdish Anand	IT Specialist		ICT
Cossio Ferdinando	Horticulture Specialist		Horticulture

(b) Staff Time and Cost

Stage of Project Cycle	**Staff Time and Cost (Bank Budget Only)**	
	No. of staff weeks	**US $ thousands (including travel and consultant costs)**
Lending		
FY06	46.44	229.23
FY07	76.04	391.13
Total	**122.48**	**620.36**
Supervision / ICR		
FY07	17.65	101.93
FY08	47.00	247.72
FY09	53.28	261.26
FY10	53.56	257.32
FY11	60.03	213.74
FY12	20.74	141.63
FY13	22.80	128.52
FY14	12.14	91.91
FY15	15.29	109.15
FY16	4.83	29.76
Total	**307.32**	**1582.94**

Annex 5. Summary of the Borrower's Project Completion Report and Comments on the Draft ICR

1. The borrower prepared three types of Implementation Completion Reports that were made available to the ICR team.

a. 61 sub-basin ICRs produced by SMEC and that collate the achievements of the entire set of activities undertaken in each sub-basin and that had been foreseen in the sub-basins development plans.

b. Each participating Government Department prepared its own ICR providing the necessary details on implementation features, achievements and likely impact.

c. MDPU produced a summarized ICR for the entire project, which can be considered the main Borrower's completion report.

2. **Sub-basin ICRs** were produced in four phases upon completion of the four respective project phases. These provide an account of achievements at the time (e.g. 2011 for phase 1 sub basins), but not at project completion. The reason was that the project was phasing its interventions from one phase to another (usually focusing attention during about 3 years in each phase with overlapping between the phases) and aiming to aggregate achievements after each phase. However, as a result, some recent data related to the earlier schemes (such as actually irrigated areas at project completion) were not available from these reports and had to be updated through an additional exercise.

3. The **Department ICRs** did not follow a specific format. They provided a detailed description of interventions by the respective departments and their physical achievements. They were largely used by the ICRR mission to document achievements of intermediary outcomes and outputs.

4. The **MDPU consolidated ICR** did not follow the World Bank structure of ICR and consists of a 58-page document containing the following sections:

- (2-5) a brief overview of the project including its aim, scope, disbursement figures and a map;

- (6-27) a short summary by component and sub-component (for the agriculture component involving 7 departments and agencies) extracted from the department ICRs. The summaries include an account of physical achievements by component as well as data to document the achievement of objectives based on performance indicators. However, the data are presented in a way that further discussion and clarification. Physical achievements are often compared to DPR targets that represent Government internal targets (i.e. not directly connected to the PAD targets) that have been progressively set during implementation for the purpose of

annual budgeting exercises so that as a result the level of achievement often perfectly equals targets;

- (28-34) an executive summary of the SMEC impact assessment report published in June 2014;

- (35-38) The revised result framework according to MDPU. This represents the interpretation of the PAD result framework that was revised following various interactions with the World Bank;

- (39-41) areas of the registered command areas (ayacut) covered by the project both by district and sub-basin;

- (42-45) Registered ayacut and fully irrigated area both without and without project. Given its critical importance for assessing project impact and efficiency (financial and economic analysis), the latter Table in pages 43 and 44 (actually fully irrigated area with project compared to the before project situation) was extensively discussed during the ICR and complemented (within one month after ICR mission) by up-to figures for the years 2012 to 2015 that was missing due to the fact that one of the sub-basin ICRs dated back in 2012 to 2014;

- (46-54) detailed data on procurement packages, contracts and expenditures (in Indian Rupees);

- (56) A summary note on “model villages” introduced under the project (further described in Annex 2);

- (57) A calendar of World Bank Implementation Support Missions;

- (58) Photographic illustrations of “convergence in action” showing the integration of various project activities.

Annex 6. Comments of Co-financiers and Other partners/Stakeholders

Annex 7. List of Supporting Documents

World Bank Documents

- Project Appraisal Document (December 2006)
- Loan and Credit Agreement
- Implementation Support / Supervision Aide-memoires (17)
- Mid Term Review Aide-memoire (May 2010)
- Country Partnership Strategy for India (2013-2017)

SMEC Regular Monitoring and Evaluation Reports:

- Monthly reports in which monthly activities were detailed and recommendations made;
- Quarterly Reports in which SMEC activities during the quarter were reported against its ToRs;
- 6-monthly reports in which the project interventions were systematically reviewed, leading to a set of findings and recommendation for the attention of the MDPU;
- Annual reports corresponding to the India fiscal Year (April to March) where of similar formats as the 6-monthly reports

SMEC Impact Assessment Reports

- *"Special Studies of Selected Tanks"* (a "rapid assessment" of 8 selected tanks in 8 sub-basins) (April 2011)
- "Base Line Survey Report" (September 2011)
- *"Mid Term Review Report"* (January 2012) (1359 households in 41 sample tanks in 7 sub-basins against 409 control HHs in 13 control tanks in the same sub-basins);
- *"Dynamics of IAMWARM Project Interventions under Component-B – An Empirical Assessment of their Impact"*2013)
- "*Final Impact Evaluation Report*" (June 2014) (5,757 HHs against 1,235 control HHs)

Government Implementation Completion Reports (see Annex 7)

- MDPU Implementation Completion Report
- 8 Department Implementation Completion Reports:
    - Water Resource Department
    - Department of Agriculture
    - TNAU
    - Horticulture and plantation crops
    - Agri marketing and agri business
    - Agricultural Engineering
    - Livestock
    - Fisheries

- 61 sub-basin Implementation Completion reports

Independent Assessments

- "*Rapid Assessment of the Impact of TN-IAMWARM in Upper Vellar Sub-Basin*" by the Institute of Sustainable development (India) (February 2010)
- "*Analysis of Values Shift Induced by the Change Management Training Programme*" by Values Technology (USA) (31 March 2012)
- "*Review of tank projects in India*", FAO Draft report, December 2014

Communication Material

- "*Roots and Shoots – Transformation from the Field*" (6 "impact stories" on the basis of qualitative field interviews undertaken in 2014 by the MDPU communication officer)
- "Journey of TN-IAMWARM – Water, the Elixir of Life (project video)
- Tamil Nadu Water Resources Information System (leaflet)
- Remote Sensing & GIS Applications in TN-IAMWaRM Project (leaflet)

Other Documents

- National Water Policy (2012)

MAP: TAMIL NADU IRRIGATED AGRICULTURE MODERNIZATION AND WATER-BODIES RESTORATION AND MANAGEMENT PROJECT