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IMPLEMENTATION COMPLETION AND RESULTS REPORT  
(TF-10378)

ON AGRANT

FROM THE GLOBAL AGRICULTURE AND FOOD SECURITY PROGRAM

IN THE AMOUNT OF

US\$ 46.31 MILLION

TO THE

PEOPLE'S REPUBLIC OF BANGLADESH

FOR THE

INTEGRATED AGRICULTURAL PRODUCTIVITY PROJECT

June 22, 2017

Agriculture Global Practice  
South Asia Region

## CURRENCY EQUIVALENTS

(Exchange Rate Effective as of January 3, 2017)

Currency Unit = Bangladesh Taka

BDT 74 = US\$ 1

US\$ 1.00 = US\$1.33

FISCAL YEAR

July 1 – June 30

## ABBREVIATIONS AND ACRONYMS

ADB	Asian Development Bank	DTW	Deep Tube Well
AusAID	Australian Foreign Aid	EOP	End of the Project
BADC	Bangladesh Agricultural Development Corporation	FA	Field Assistant
BARI	Bangladesh Agriculture Research Institute	FAO	Food and Agriculture Organization
BFRI	Bangladesh Fishery Research Institute	FFS	Farmer Field School
BRRRI	Bangladesh Rice Research Institute	FG	Farmer Group
CAS	Country Assistance Strategy	GAFSP	Global Agriculture and Food Security Program
CIP	Country Investment Plan	GOB	Government of Bangladesh
CF	Community Facilitator	GRM	Grievance Redressal Mechanism
CSO	Community Service Officer	FG	Farmer Group
DA	Designated Account	FGD	Focused Group Discussion
DAE	Department of Agricultural Extension	IDA	International Development Association
DC	District Coordinator	IDB	Islamic Development Bank
DF	District Facilitator	KII	Key Informant Interview
DIFID	Department of International Development	LFS	Livelihood Field School
DIME	Development Impact Evaluation Initiative	M&E	Monitoring and Evaluation
DLS	Department of Livestock Services	MIS	Management Information System
DOF	Department of Fisheries	MoA	Ministry of Agriculture
DPD	Deputy Project Director	MOFL	Ministry of Fisheries and Livestock
DPP	Development Project Proposal	MTR	Mid Term Review

NATP	National Agricultural Technology Project	SAAO	Sub Assistant Agriculture Officer
NGO	Non-Governmental Organizations	SCA	Seed Certification Agency
NSB	National Seed Certification Board	SMF	Social Management Framework
PAD	Project Appraisal Document	TPE	Third Party Evaluation
PD	Project Director	UAO	Upazila Agriculture Officer
PDO	Project Development Objective	UFO	Upazila Fishery Officer
PM	Project Manager	ULO	Upazila Livestock Officer
PMU	Project Management Unit	UPCC	Upazila Project Coordination Committee
RF	Result Framework	WB	World Bank
RPIU	Regional Project Implementation Unit	WUG	Water User Group
QPR	Quarterly Progress Report		

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# Bangladesh Integrated Agricultural Productivity Project

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## DATA SHEET

<b>A. Basic Information</b>			
Country:	Bangladesh	Project Name:	Bangladesh Integrated Agricultural Productivity Project
Project ID:	P123457	L/C/TF Number(s):	TF-10378
ICR Date:	6/15/2017	ICR Type:	Core ICR
Lending Instrument:	SIL	Grantee:	GOVERNMENT OF PEOPLES' REP OF BANGLADESH
Original Total Commitment:	USD 46.31M	Disbursed Amount:	USD 46.23M
Revised Amount:	USD 46.31M		
<b>Environmental Category: B</b>			
<b>Implementing Agencies:</b> Ministry of Fisheries and Livestock (MOFL) Ministry of Agriculture (MOA)			
<b>Cofinanciers and Other External Partners: N/A</b>			

<b>B. Key Dates</b>				
Process	Date	Process	Original Date	Revised / Actual Date(s)
Concept Review:	12/13/2010	Effectiveness:	09/15/2011	09/15/2011
Appraisal:	06/07/2011	Restructuring(s):		07/30/2015
Approval:	08/12/2011	Mid-term Review:	04/15/2014	05/21/2014
		Closing:	09/30/2016	12/31/2016

<b>C. Ratings Summary</b>	
<b>C.1 Performance Rating by ICR</b>	
Outcomes:	Satisfactory
Risk to Development Outcome:	Moderate
Bank Performance:	Satisfactory
Grantee Performance:	Satisfactory

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

<b>C.3 Quality at Entry and Implementation Performance Indicators</b>			
<b>Implementation Performance</b>	<b>Indicators</b>	<b>QAG Assessments</b>	<b>Rating</b>
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		

<b>D. Sector and Theme Codes</b>		
	<b>Original</b>	<b>Actual</b>
<b>Sector Code (as % of total Bank financing)</b>		
Agricultural extension and research	30	30
Animal production	15	15
Crops	20	20
General agriculture, fishing and forestry sector	10	10
Irrigation and drainage	25	25
<b>Theme Code (as % of total Bank financing)</b>		
Global food crisis response	10	10
Nutrition and food security	10	10
Other rural development	50	50
Rural policies and institutions	15	15
Rural services and infrastructure	15	15

<b>E. Bank Staff</b>		
<b>Positions</b>	<b>At ICR</b>	<b>At Approval</b>
Vice President:	Annette Dixon	Isabel M. Guerrero
Country Director:	Qimiao Fan	Ellen A. Goldstein
Practice Director:	Ethel Sennhauser	John H. Stein
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Project Team Leader:	Manievel Sene	Animesh Shrivastava
ICR Team Leader:	Ramziath Adjao	
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## F. Results Framework Analysis

### Project Development Objectives (from Project Appraisal Document)

The project development objective is to enhance the productivity of agriculture (crops, livestock and fisheries) in pilot areas. These areas lie in Rangpur, Kurigram, Nilfamari and Lalmonirhat districts in the North and Barisal, Patuakhali, Barguna and Jhalokathi districts in the South.

### 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	No. of targeted farmers whose productivity has increased			
Value quantitative or Qualitative)	0	236,000		250,829
Date achieved	09/30/2011	09/30/2016		12/30/2016
Comments (incl. % achievement)	Achieved beyond target with 106% of farmers witnessing productivity increase.			
<b>Indicator 1a :</b>	No. of targeted framers whose productivity has increase in crop production			
Value quantitative or Qualitative)	0	140,000 (10% women)		152,000 (33% women)
Date achieved	09/30/2011	09/30/2016		12/30/2016
Comments (incl. % achievement)	Achieved beyond target (108.57% against baseline), including percentage of women beneficiaries.			
<b>Indicator 1b:</b>	No. of targeted farmers whose productivity has increased in fisheries production			
Value quantitative or Qualitative)	0	48,000 (25% women)		48,177 (25.19% women)
Date achieved	09/30/2011	09/30/2016		12/30/2016
Comments (incl. % achievement)	Achieved (100.37% against baseline).			
<b>Indicator 1c :</b>	No. of targeted farmers whose productivity has increased in livestock production			
Value quantitative or Qualitative)	0	48,000 (50% women)		50,652 (89% women)
Date achieved	09/30/2011	09/30/2016		12/30/2016

Comments (incl. % achievement)	Achieved beyond target (105.52% against baseline), including percentage of women beneficiaries.			
<b>Indicator 2 :</b>	Incremental increase in productivity of paddy			
Value quantitative or Qualitative)	2,200 kg/ha	2,700 kg/ha	Boro: 5,950 kg/ha T-Aus: 3,300 kg/ha Aman: 3,300 kg/ha	Boro: 6,300 kg/ha T-Aus: 4,650 kg/ha Aman: 4,560 kg/ha
Date achieved	09/30/2011	09/30/2016	4/16/2015	12/30/2016
Comments (incl. % achievement)	Revision of the baseline values, which were believed to be too low, was suggested at midterm. Furthermore, it was proposed to disaggregate this indicator to reflect the three main rice varieties. The baseline values were set at: Boro: 5,450 kg/ha, T-Aus: 2,700 kg/ha and Aman: 2,700 kg/ha). This outcome was achieved beyond target (Boro 106%, T-Aus 141% , and Aman 138% against revised target values), with productivity increase for Boro of 16%, T-Aus 72%, and Aman 69% compared with revised baseline.			
<b>Indicator 3 :</b>	Incremental increase in yield of fish			
Value quantitative or Qualitative)	2,700 kg/ha of WSA	3,400 kg/ha of WSA		5420 kg/ha of WSA
Date achieved	09/30/2011	09/30/2016		12/30/2016
Comments (incl. % achievement)	Achieved beyond target (159.41% against target value).			
<b>Indicator 4 :</b>	Incremental increase in yield of milk			
Value quantitative or Qualitative)	1 litre/day/cow	2 litres/day/cow	2.20 litres/day/cow	2.86 litres/day/cow
Date achieved	09/30/2011	09/30/2016	4/16/2015	12/30/2016
Comments (incl. % achievement)	Revision of the baseline value, which was believed to be too low, was suggested at midterm. The new baseline value was set at 1.6 litres/day/cow. The target value was also adjusted to 2.2 litres/day/cow. This outcome was achieved beyond target (130% against revised target value).			

**(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
<b>Indicator 1 :</b>	Component 1: Technology generation and adoption - Improved varieties released for farmer use in - Crops			
Value (quantitative or Qualitative)	0	14		15
Date achieved	09/30/2011	09/30/2016		12/30/2016
Comments (incl. % achievement)	Exceeded (107% against target value).			
<b>Indicator 2 :</b>	Component 1: Technology generation and adoption - Improved varieties released for farmer us in - Fish			
Value (quantitative or Qualitative)	0	9		9
Date achieved	09/30/2011	09/30/2016		12/30/2016
Comments (incl. % achievement)	Fully achieved (100% against target value).			
<b>Indicator 3 :</b>	Component 1: Improved production packages released for farmers' use - Crops			
Value (quantitative or Qualitative)	0	13	18	18
Date achieved	09/30/2011	09/30/2016	10/26/2015	12/30/2016
Comments (incl. % achievement)	Fully achieved (100% against revised target value). At design, the EOP target was 13 and the project achieved 18. The target was revised to 18 during the 2 <sup>nd</sup> revised DPP on 10/26/2015.			
<b>Indicator 4 :</b>	Component 1: Improved production packages released for farmers' use - aquaculture			
Value (quantitative or Qualitative)	0	9		9
Date achieved	09/30/2011	09/30/2016		12/30/2016
Comments (incl. % achievement)	Fully achieved (100% against target value).			
<b>Indicator 5 :</b>	Component 2 - Technology adoption - adoption of improved crop varieties by farmers			

Value (quantitative or Qualitative)	0	175,000	180,000	180,000
Date achieved	09/30/2011	09/30/2016	10/26/2015	12/30/2016
Comments (incl. % achievement)	Fully achieved (100% against revised target value). Additional 200 LFS (5,000 farmers) were formed as per the project's request. The target was revised to 180,000 during the 2 <sup>nd</sup> revised DPP on 10/26/2015.			
<b>Indicator 6 :</b>	Component 2 - Technology adoption - adoption of improved aquaculture by fish farmers			
Value (quantitative or Qualitative)	0	60,000		60,000
Date achieved	09/30/2011	09/30/2016		12/30/2016
Comments (incl. % achievement)	Fully achieved (100% against target value).			
<b>Indicator 7 :</b>	Component 2 - Technology adoption - adoption of improved breed/ husbandry practices by farmers			
Value (quantitative or Qualitative)	0	60,000		60,000
Date achieved	09/30/2011	09/30/2016		12/30/2016
Comments (incl. % achievement)	Fully achieved (100% against target value).			
<b>Indicator 8 :</b>	Component 2 - Technology adoption - certified seed processed by BADC in the new facilities			
Value (quantitative or Qualitative)	0	3,500 tons		3,546 tons
Date achieved	09/30/2011	09/30/2016		12/30/2016
Comments (incl. % achievement)	Exceeded (101% against target value) due to increased demand from DAE of an additional 46 MT of seeds. Those seeds were processed by BADC.			
<b>Indicator 9 :</b>	Component 3 - Water management - areas under improved irrigation			
Value (quantitative or Qualitative)	0	25,000 ha		27,750
Date achieved	09/30/2011	09/30/2016		12/30/2016
Comments (incl. % achievement)	Exceeded (111% against target value).			

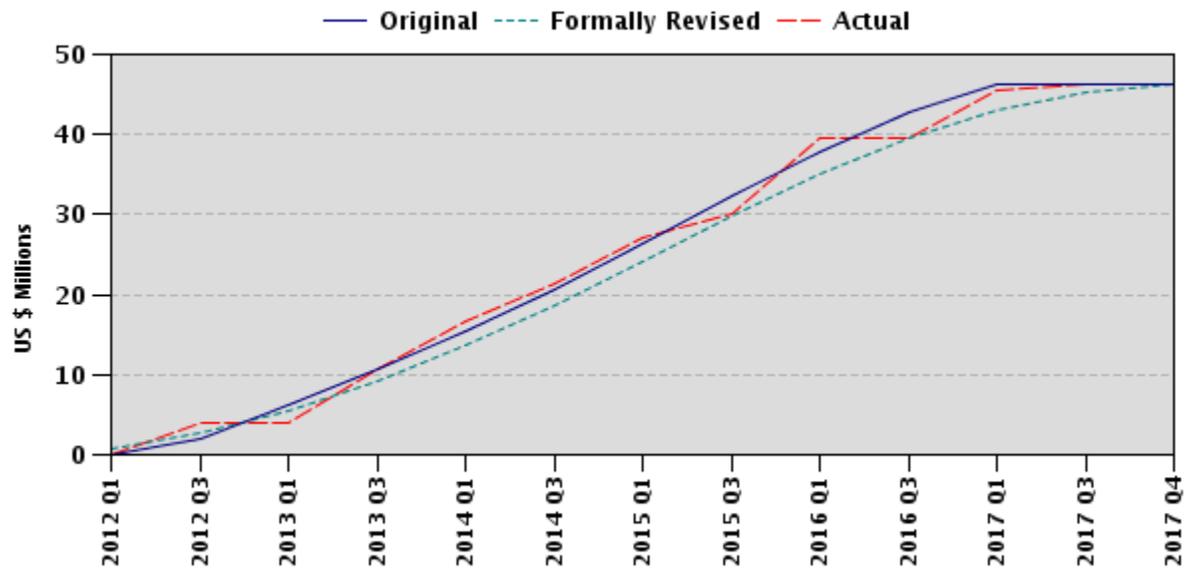
## G. Ratings of Project Performance in ISRs

	Date ISR Archived	DO	IP	Actual Disbursements (USD millions)
	04/01/2012	Satisfactory	Satisfactory	4.05
	12/11/2012	Satisfactory	Satisfactory	8.79
	05/31/2013	Satisfactory	Satisfactory	11.84
	12/09/2013	Satisfactory	Satisfactory	19.75
	06/06/2014	Satisfactory	Satisfactory	21.42
	08/31/2014	Satisfactory	Satisfactory	23.30
	06/10/2015	Moderately Satisfactory	Satisfactory	35.08
	12/23/2015	Moderately Satisfactory	Satisfactory	39.44
	06/27/2016	Satisfactory	Satisfactory	45.51
	09/20/2016	Satisfactory	Satisfactory	46.23

## H. Restructuring

Restructuring Date(s)	Board Approved PDO Change	ISR Ratings at Restructuring		Amount Disbursed at Restructuring in USD millions	Reason for Restructuring & Key Changes Made
		I	II		
07/30/2015			N	35.08	The baseline values for paddy and milk yields determined at appraisal were deemed too low for the targeted districts and were revised upward. In addition, the government requested a 3 month extension of the Closing date from September 30, 2016 to December 31, 2016 to allow for full completion of the fifth cropping cycle.

## I. Disbursement Profile



## **1. Project Context, Development Objectives and Design**

### **1.1 Context at Appraisal**

1. At appraisal, Bangladesh made considerable progress in sustaining high rates of economic growth and reducing poverty incidence by 9% between 2000 and 2005 (from 49% to 40%), and even achieved self-sufficiency in the production of its staple food - rice.

2. Despite these significant achievements, the country still faced considerable challenges: pockets of extreme poverty persisted (one-sixth of the total population of almost 150 million lived in extreme poverty); the incidence of malnutrition was one of the highest in the world; and agricultural productivity, (notably, crops, livestock and fisheries) in the North-West and the South were significantly below the national average. According to the Household Income and Expenditure Survey (HIES, 2008), the poverty rate in the North-West was 57% and in the South (Barisal region) was 52% against the national average of 40%. Moreover, the extreme poverty rate in the North was 43% compared to a national rate of 25%, and acute seasonal deprivation and famine-like conditions, locally known as *monga*, were common. In the Barisal region in the South, the rate of extreme poverty even increased from 36% in 2000 to 37% in 2005 in rural areas. There was a longstanding association between unfavorable agricultural environments and chronic poverty/food insecurity. The country was very much at risk from natural shocks and was highly vulnerable to forecast climate change patterns; and there were large areas with unfavorable agricultural environments (tidal surge prone [2 million ha], flood-prone [0.75 million ha] and drought prone [1.3 million ha]).

3. In this context, the Government of Bangladesh (GOB) at the time of project appraisal was pushing for increased use of productive technology and more intensive agricultural practices to improve food security and sustain economic growth through its National Strategy for Accelerated Poverty Reduction (NSAPR, December 2009). In support of this effort, this led to the development of an Integrated Agricultural Productivity Project (IAPP) financed by a Grant from the Global Agriculture and Food Security program (GASFP) to be managed by the World Bank as a supervising entity and the Food and Agriculture Organization (FAO) as an implementing agency for technical assistance, with focus on a selected number of poor and vulnerable districts in the North and in the South.

### **1.2 Original Project Development Objectives (PDO) and Key Indicators**

4. As stated in the Financing Agreement, and in line with the Project Appraisal Document, the objective of the Project was: “to enhance the productivity of agriculture (crops, livestock and fisheries) in pilot areas.” These areas were located in Rangpur, Kurigram, Nilfamari and Lalmonirhat districts in the North and Barisal, Patuakhali, Barguna and Jhalokathi districts in the South. They include the salt-affected tidal surge areas in the South and the flash-flood prone and drought-prone areas in the North.

5. Achievement of the PDO was to be measured by the following outcome indicators: (i) number of targeted farmers whose productivity has increased in crops and/or livestock and/or

fisheries; (ii) productivity of paddy (as representative of crops sub-sector); (iii) productivity of milk (as representative of livestock subsector); and (iv) productivity of fish.

6. The PDO was not revised. However, following a Level 2 restructuring, some adjustments were made in the Results Framework at Mid-Term Review, primarily to reflect more accurate baseline values for paddy and milk yields. Moreover, the target values for technology adoption for improved crop varieties were revised upward during the 2nd DPP (see for details Section 2.2).

### **1.3 Main Beneficiaries**

7. The project benefited primarily small and marginal farmers (i.e., 80% of the beneficiaries), focusing on the landless, poor, women and ethnic minorities owning or operating land, in ecologically constrained and economically disadvantaged areas (about 180,000 crop farmers, 60,000 livestock farmers and 60,000 fish farmers, with about 20% of intended beneficiaries being women). Development indicators for the targeted project areas in the North-West and the South were significantly below the national average. According to the Household Income and Expenditure Survey (HIES, 2008) poverty rates in the North-West was and in the South (Barisal region) were 57% and 52%, respectively, against the national average of 40%. The extreme poverty rates of 43% in the North and 37% in the South were also above the national rate of 25%. Moreover, all four targeted districts in the North suffered acute seasonal deprivation and famine-like conditions, a phenomenon locally known as *monga*.

8. In addition, a large number of researchers and extension staff of relevant research institutes (i.e., BARI, BRRI, and BFRI) and line departments (DAE, DOF, DLS, SCA, and BADC) as well as local community facilitators (CF), hired by the project, and district facilitators (DF) deputed by the GOB, benefited from the project through various capacity building activities.

### **1.4 Original Components (as approved)**

9. The project included four major components as follows:

**10. Component 1 - Technology Generation and Adaptation (US\$7.57 million, Actual Cost: US\$ 6.83 million):** The component aimed to support the PDO by adapting and making available to project farmers' the technologies and management practices that increased yields and production intensities of crops and fish. It also addressed one of the major constraints to agricultural growth in the project area, which was insufficient "supply" of relevant technologies and practices. There were three sub-components, including: (i) technology generation/adaptation for rice; (ii) technology generation/adaptation for "other" crops (viz. wheat, maize, pulses and oilseeds); and (iii) technology generation/adaptation for fish. Activities financed under this component included: evaluation and release of new/improved crop varieties; brood stock improvement and development of pure breed lines in fish; development/refinement of location-specific crop husbandry practices; adaptive trials of aquaculture technologies; and training and capacity building.

**11. Component 2 – Technology Adoption (US\$35.15, Actual Cost: US\$ 37.64 million):** This component supported the PDO by enabling farmers in the project area to sustainably adopt

improved agricultural (crops, livestock and fisheries) production technologies and management practices. This also enabled them to increase productivity as well as intensify and diversify agricultural production. This was accomplished by enhancing farmers' knowledge and skills base, improving availability of quality seed/breed at farmers' level, strengthening extension-farmer linkages and augmenting – as appropriate - their productive assets and social capital base.

**12.** This component had five sub-components, including: (i) crop production; (ii) fish production; (iii) livestock production; (iv) enhancement of seed availability; and (v) community mobilization and extension. The crop production sub-component comprised support for community seed production and for adoption of improved agronomic practices. Fish production comprised activities related to fish nursery, carp polyculture, intensive fish monoculture and cage culture. Livestock production comprised activities related to poultry, goat and dairy production as well as animal health campaigns. Enhancement of seed availability comprised activities related to seed certification and enhancement of seed distribution capacities. Community mobilization and extension comprised activities relating to supporting farmers' groups in adopting project disseminated technologies and practices, and in enabling them to further spread them through farmer-to-farmer interactions. The activities financed under this component included demonstrations, provision of seeds and inputs, community productive assets, mobilization and back-stopping of farmers' groups, trainings and exposure visits, and facilities for seed testing, processing and storage. The outputs were: adoption of improved varieties and production practices for rice and other main crops; greater availability of quality seed at farmers' level through community seed production; adoption of improved fish culture practices; adoption of improved livestock husbandry practices along with improved breed where feasible; and expansion of availability of certified seeds through formal channels in the project area and beyond.

**13. Component 3: Water Management (US\$11.71 million; Actual cost: US\$ 11.07 million):** This component supported the PDO by improving availability of irrigation water and efficiency of its use. It enabled farmers to increase cropping intensity, improve cropping patterns and reduce irrigation related risk/variability in crop production that inhibited investments in other modern technologies/inputs. The component included two sub-components: (i) conservation and utilization of surface water (including rain-water harvesting); and (ii) enhancing irrigation efficiency. Conservation and utilization of irrigation water comprised: (a) rehabilitation of (existing) natural water bodies, canals and ponds for better conservation of surface water; (b) rehabilitation of existing natural channels (in the south) to conserve tidal sweet water; (c) harvesting rain-water in rehabilitated natural water bodies and creeks including clay lining to reduce seepage losses; and (d) harvesting rain-water at homestead level for household consumption, livestock and kitchen garden use. Enhancement of irrigation efficiency comprised (a) installation of buried pipe network connections to low lift pumps (LLPs) and deep tube wells (DTWs) in appropriate locations to enhance irrigation conveyance efficiency; and (b) repairing of selected DTWs in the Northern Region. In the context of these two sub-components, a variety of training activities were supported. The outputs of this component were intended to result in expansion of irrigated areas and increase in irrigation efficiency.

**14. Component 4: Project Management ( US\$5.26 million; Actual costs: US\$ 3.38 million):** This component supported the achievement of the PDO by ensuring that: (i) interventions undertaken under the project were appropriately planned, coordinated and aligned with project design and development objectives; (ii) implementation arrangements and activities were in line

with relevant fiduciary and safeguards policies, procedures and standards; and (iii) monitoring, oversight and reporting of project implementation and the resulting outputs and outcomes. This component financed the establishment and operation of: (i) a Project Management Unit (PMU) in Dhaka and (ii) two Regional Project Implementation Units (RPIUs) - in Rangpur (North) and Barisal (South). The PMU and RPIUs coordinated, at their respective levels, the activities of various implementing agencies, including the research institutions, the line departments for extension, BADC (seeds and inputs supply), community level service providers and any CSO/NGO. Activities financed under this component included: (i) establishing and supporting project units at the overall and regional levels; (ii) providing specialized support services relating to key activities such as independent external M&E, external audit, financial accounting and procurement; and (iii) supporting training of staff involved in project implementation.

## **1.5 Revised Components**

15. No revisions were made to project components

## **1.7 Other significant changes**

16. The project underwent a level 2 restructuring in July 2015. Upward adjustments were made in the baseline and EOP targets for two of the PDO results indicators (paddy yield and milk yield) and a 3 month extension of the closing date was granted. In addition, the Government requested a 3 months extension of the closing date from September 30, 2106 to December 31, 2016 to allow for full completion of the fifth cropping cycle. The disbursement estimates were modified to reflect the 3 month extension of closing date. At the GOB's request, changes in the target of the intermediate indicator (i.e., adoption of improved crop varieties) to reflect the creation of 200 additional LFS resulted in to the reallocation of about US\$ 2.5 million from the other project components.

## **2. Key Factors Affecting Implementation and Outcomes**

### **2.1 Project Preparation, Design and Quality at Entry**

17. **The background analysis that informed project design was sound.** The background analysis identified the key challenges affecting three critical areas determining the performance of the agricultural sector in Bangladesh, including: productivity, diversification, and irrigation efficiency. Reflecting this, , the project design focused on intensification of rice-based cropping systems, diversification to high value/ less water-intensive crops, and development of non-crop agriculture (fisheries and livestock), as reflected in the PDO. The key challenges identified included: (i) widespread use of traditional, low-yielding crop varieties and breeding stock, along with outdated crop and livestock management practices; (ii) low availability of good quality seed and improved breeds of livestock/fish at the farmer level; (iii) insufficient development by the research system of “appropriate” – location and problem specific - technologies and management practices for use by farmers; (iv) inadequate extension and public services support to farmers in order to expose them to new technologies and management practices and to facilitate their adoption; (v) weak infrastructure with regard to agricultural water management, which increases rain-dependence (thereby enlarging exposure to crop-loss risk over the germination-to-harvest cycle, and potentially inhibiting investments in improved seeds and inputs); (vi) poorly developed

market linkages and a relatively constrained role for private sector; and (vii) a lack of institutions and instruments for agricultural risk-bearing and risk-sharing.

18. **The project design also incorporated lessons learned from on-going and previous projects in Bangladesh and in the Region** by recognizing that: (i) adaptive research does not produce significant impact on the ground unless it links in with a sufficient number of trained extension agents and farmers' plans; (ii) the lack of complementary inputs – especially seeds – restricts adoption of demonstrated crops/varieties (often, farmers have no access to the newer varieties demonstrated); (iii) community mobilization and preparatory activities are crucial to secure meaningful beneficiary involvement in project design and implementation; and (iv) strong M&E greatly improves implementation and enhances the attainment of the PDO. These lessons were incorporated in the project through: (i) institutional development and investment in capacities and productive assets of group and community level institutions (component 1); (ii) strengthening research-extension-farmer linkages (component 2); (iii) training and capacity building (component 1 and 2); and (iv) solid implementation procedures (component 4). Ensuring solid research-extension-farmer linkages was a key element in the design of the project by promoting adaptive research that involved farmers in participatory variety selection, frequent interactions between research scientists, extension agents and farmers, formulation of annual extension plans that formally take into account technologies developed for dissemination in the area. Moreover, the project made provisions for hiring dedicated implementation support staff who worked both at the Union level (CFs) and the district level (DFs). Demonstrations were part of phased, multi-year and demand-driven engagement at project sites. The project also emphasized capacity building activities at the research, extension and farm related institutions to ensure that these institutions could effectively carry out their mandates. Last, but not least, the design also promoted important institutional reforms including promoting a new model for implementing farmers-needs driven agriculture research through farmer groups (LFS).

19. Although **the Project Result Framework** adequately reflected the PDO, it suffered from some quality issues mainly with the formulation of baseline and target values for yields of paddy and milk, which were originally set too low. At appraisal, the design team faced time constraints to submit the GAFSP proposal in a timely manner and did not have the resources to conduct a baseline study. The baseline value for paddy yields of 2.2 tons per hectare was a national average figure taken at the time of appraisal and was too low for use in the Project as it did not reflect actual yields level in the target regions. In its place a yield increase of paddy of 23% was proposed, consistent with the percentage increase between the existing baseline and EOP targets and the indicator was disaggregated to reflect the three main rice varieties with baseline values were set at 5,450 kg/ha for Boro, 2,700 kg/ha for T-Aus, and 2,700 kg/ha for Aman. Likewise, both the baseline and EOP targets for milk were not adequately formulated. The baseline value of 1 liter per day milk yield was too low for the Project region. Given that the Project was not designed to introduce improved genetic stock, but relied primarily on better health and feeding practices, a milk yield increase of 35% was proposed leading to revising the target value from 2 to 2.2 liters/day/cow. All needed adjustments of baseline and target values of these indicators were done at Mid-Term Review.

20. **At appraisal, the objectives of the project were highly relevant to the country conditions and Government priorities.** The project was designed and prepared with the aim to

increase productivity in agro-ecologically constrained areas by strengthening and integrating the weak national research and extension systems. By design, the project has targeted areas with significant environmental stress (seasonal droughts, cold snaps and flash flood submergence in the North; varying levels of salinity, tidal and saline submergence in the South). Furthering agricultural development in these areas requires suitable varieties, and location/ problem specific technologies and production practices, which were rightfully identified at appraisal. Agriculture was a very high priority for GOB, with allocations to this sector increasing over time, especially after the food price crisis of 2008. As part of the Global Agriculture and Food Security Program (GAFSP) process, a Country Investment Plan (CIP)<sup>1</sup> was prepared which set out a coherent set of investment programs. The project, which sought to implement the core elements of the five of the CIP programs pertaining to improving food availability, was fully aligned with country need, government priorities and the overall consensus within the development community.

21. **There was strong commitment from the Government** to reforming the national agricultural technology system adopted under the project and explicit efforts were undertaken to establish partnerships with other development partners. GOB was the first country in South Asia to successfully apply for a grant under GAFSP, which financed the project with co-financing from GOB of about 27% of total project costs. Beyond the regular program of research and extension carried by the public agencies, GOB worked with development partners on a number of projects to address the sector's challenges, including re-orienting and reforming the national agricultural technology system so that it would become more pluralistic, participatory as well as demand-led agricultural research and knowledge-based approach for agricultural extension. Because of the vulnerability in the targeted districts, there was a need for technologies that improved the resilience of production systems. External partners and the Bank<sup>2</sup> believed that existing scarce mature technologies (i.e. drought/flood/cold tolerant, high yielding, shorter duration to maturity, improved breed stock), could be made more readily available by: (i) effective technology development/adaptation and dissemination processes in which the Bank had considerable experience gained from number of agricultural technology projects in the region (including NATP in Bangladesh); (ii) coordinated actions made possible under project mode across institutional boundaries; (iii) extensive community mobilization, involvement, adoption and sustainability and again the Bank's extensive experiences of community focused projects in the agriculture and rural sector.

22. **Anticipated risks** were assessed to be medium. The project document included a candid discussion of several risks to the project and associated mitigation measures. The mitigation measures identified at appraisal were adequate and included the following:

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<sup>1</sup> The CIP was endorsed in 2010 by GOB and the development partners as the main tool for investing in food security and nutrition. The CIP consisted of 12 programs which cover food availability, access and utilization.

<sup>2</sup> This project complemented existing operations, including a Bank-supported National Agriculture Technology Project (NATP), an Asian Development Bank Northwest Crop Diversification Project, and a DANIDA Agriculture Sector Program Support, Phase II, which aims to strengthen the institutions of agricultural extension, which focused on increasing service relevance and capacity of existing institutions.

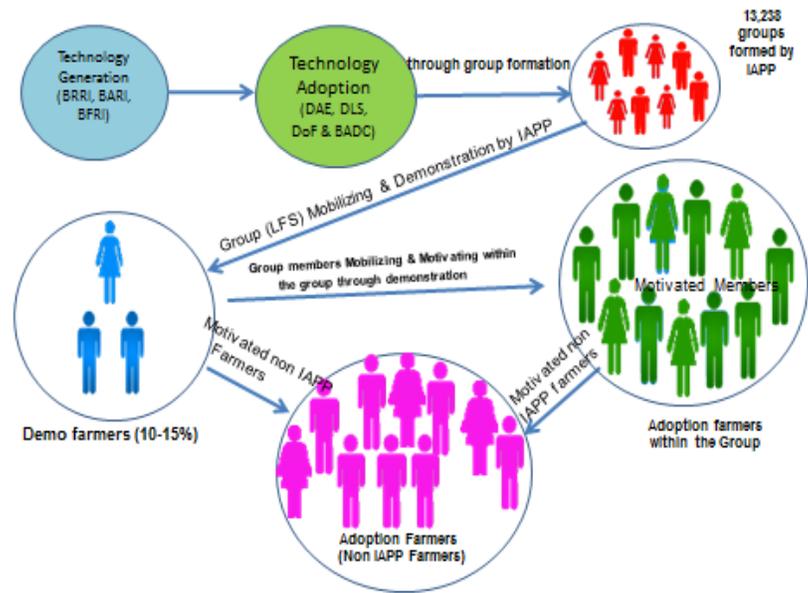
- Multiplicity of Implementing Agencies: (i) the project minimized any “critical path dependence” in the agencies’ actions; (ii) directly hired incremental staff (i.e., an entire cadre of CFs and DFs) to plug the capacity gap on the ground; (iii) provided training of existing staff.
- Project Design: CFs and DFs helped to ensure implementation of project from mobilization/formation to demonstration and adoption to further growth in the scale and scope of group activities.
- Farmer’s interest in technology adoption: (i) the project ensured farmers’ involvement at all stages from participatory variety selection to organization of demonstrations; and (ii) conducted a full financial as well as economic analysis of the planned demonstrations to demonstrate the benefits of the technologies being demonstrated.
- Elite capture and under-representation of women: the project developed clear, third-party verifiable criteria and processes for their transparent application backed up by a solid M&E system and a robust grievance redressal system.
- Sustainability: (i) the project developed of a clear eligibility criteria for selecting farmer groups to be supported; (ii) trained and strengthened the capacity of key stakeholders; (iii) helped in identifying and supporting innovative service providers who would work with farmer groups and help spur their growth; and (iv) facilitated linkage of eligible FGs with banks and other formal sources of credit.

## 2.2 Implementation

23. Implementation of the project largely followed the agreed design of the project. In this respect it is important to note that the actual expenditures under Components 1, 2 and 3 deviated only marginally from their allocations as agreed at appraisal. Moreover, nearly all committed funds were disbursed by closing, and the PDO and IO indicators were fully achieved or even exceeded in some instances against upwardly revised targets, indicating overall good implementation pace.

24. **The Technology Generation Mechanism**, including the development and dissemination of new technologies as well the monitoring of their adoption by farmers into a single process, contributed to effective coordination among the various and numerous implementation agencies and involved the following steps:

- BARI, BRRRI and BFRI developed new climate smart improved varieties and generated new technologies.
- These improved varieties and technologies were promoted for farmers by IAPP.
- DAE, DoF, DLS and BADC form Farmer groups. Among the group members, few farmers were selected for demonstration of varieties and technologies with input support in the 1<sup>st</sup> year. Other group members were sensitized and mobilized by IAPP exhibiting demonstration plots.
- In the 2nd year, IAPP supports others group members to adopt technologies. Also some IAPP-non supported farmers were sensitized to adopt new varieties and technologies by observing positive results of demonstration farmers.
- From 3<sup>rd</sup> year and onward, process monitoring to continue adoption and sustainability of IAPP new varieties and technologies. Some Non- IAPP farmers without support were being sensitized to adopt new varieties and technologies by observing the results of demonstration and adoption farmers.



25. The project relied heavily on community involvement, through a variety of farmer groups, for implementation, building on the growing experience with community-driven implementation in Bangladesh and in Bank projects. A salient feature of the project was the emphasis on adoption. Active participation of the stakeholders in the project activities contributed to enhance the relevance of varieties selected for cultivation, to increase adoption of new technologies and practices, and to the sustainability of both technical interventions and the local institutions supporting farmers. Farmer group structure, technical guidance from extension agencies as well as in-kind project support were all designed to help not just “demonstration farmers” but second and even third cohort of “adoption farmers” to take advantage of the disseminated technologies, and thus pioneering a new approach to ensuring rapid, sustainable spread of new technologies. The heavy emphasis on community involvement and the technology generation mechanism helped creating an environment that led to significant adoption of technologies and yield increases.

26. **Technical assistance from FAO** was also instrumental to effective implementation by: (i) strengthening the project implementation capacity of the IAPP Project Management Unit (PMU) in relation to: the preparation of the Operational Manual; setting up the M&E system; and demonstration of the financial viability of buried pipe irrigation schemes through high quality financial and economic analysis (FEA); (ii) Strengthening the capacity of the IAPP PMU and other project stakeholders on technical aspects related to seeds and nutrition, through study tours abroad (i.e., India and Indonesia), which contributed to the establishment of 216 IAPP seed villages ; and (iii) training of 473 IAPP-recruited Community Facilitators (CFs) and Field Assistants (FAs) 13 in community mobilization, M&E, troubleshooting, nutrition, and cooperation with Farmers Organizations (FOs). Training resulted in effective outreach and communications at the field level with good uptake of technologies and practices promoted through the IAPP, as confirmed by the achievement for all of the IAPP’s PDO indicators and feedback from IAPP staff during the end-of-project reflections workshop in Cox’s Bazar.

27. During the initial period of the project implementation, there was a delay in procurement and contract award, and the project had a significant number of small value contracts following

national competitive bidding, which increased the work load substantially to complete the procurement process and contract management. The client appointed a qualified procurement consultant procurement who received adequate training on strategic procurement to help ensure better value for money. The Bank and the client also took a great step to implement 100% e-tendering for NCB contracts in last two years of the project. These measures contributed to improved procurement capacity, increased competition and efficiency, and reduced change of F&C.

28. At midterm, disbursements were about 50% of commitments, reflecting the good pace of implementation. The **Midterm Review (MTR) conducted in May 2014 identified** some weaknesses regarding the quality of the data collection work at the field level and the reliability of a number of the baseline values included in the Results Framework were identified. Although data collection was generally adequate for the demonstration farmers, there was a need to improve collection of data from the adopting farmers. Moreover, the baseline value for paddy and milk production - being a national average for Bangladesh - was found to be inadequate. The MTR made some adjustments to enhance project effectiveness, including: (i) the development of a Project Management Information System (PIMS) that allowed following real time information at all levels (i.e. central, region, upazila and community group) using “input-output cards” filled out by the beneficiaries through a mobile apps; and (ii) updating of the Results Framework, primarily to reflect more accurate baseline and target values for paddy, and milk yields. The MTR also recommended to conduct a third party impact assessment to validate M&E data collection and monitoring activities.

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

29. **M&E Design.** The project’s Results Framework outlined key performance indicators, data collection methods and a timetable and responsible agency for data collection. The project used a result-based monitoring, learning and evaluation system using the following methods and tools, including: (i) a well-defined M&E strategy for project processes, information requirements, tools and methodologies for data collection, analysis and reporting; (ii) a comprehensive M&E plan with clear roles and responsibilities as they relate to indicators tracking with respect to data gathering and reporting; (iii) internal and external periodic assessments which included baseline surveys, mid-term evaluation, end of project impact assessment; (iv) a web based Management Information System (MIS); and (v) participatory community monitoring and social accountability approaches and system using Community Score Card. The Bank’s Development Impact Evaluation Initiative (DIME) was also involved in M&E activities of the project throughout the implementation period and led the impact evaluation effort of the Project. DIME carried out baseline, midline and endline studies that assessed the effect of the Technology adoption (for crops and fisheries) component of IAPP. A Third Party Evaluation (TPE) assessing the impact of the Project was also conducted by local consultants to validate the data collection and monitoring activities and compare the M&E data with DIME’s findings as a robustness check for the M&E system.

30. **M&E implementation.** At the outset of project implementation, a comprehensive Monitoring and Evaluation strategy was developed. The roles and responsibilities of each project implementing agency (DAE, DoF, DLS, BRRI, BARI, BFRI, BADC and SCA) for data collection, analysis and reporting were defined. The overall responsibility of the project M&E and reporting rested with the Project Management Unit (PMU) at the central level, while individual

implementing agencies had their own M&E unit, which was tasked to plan, monitor and evaluate the project activities and report progress on key performance indicators. During earlier days of project implementation, implementing agencies had used their own departmental human resources to collect information from field and consolidated information at the district level and then finally forwarded it to the PMU level. Based on collected information, the PMU produced quarterly progress reports providing a cumulative outlook of project interventions.

31. **M&E Data Use.** Based on project needs, a customized Project Management Information System that allowed following information in real time at all levels (i.e. central, region, upazila and community group) was developed. The project introduced an ‘input-output’ card which was the primary source of project data feeding into the system. These cards were filled out by the beneficiaries/Community Facilitator throughout the project life. To improve data quality and avoid delays in data transmission from the community to central level, a customized mobile apps was also developed and used until end of project. This PMIS system was accessible online and helped the PMU to monitor progress of project activities and had up to date information available for all key milestones of the RF. Results and recommendations of the DIME and TPE studies were used to help improve IAPP M&E reporting. Productivity estimates of the three impact studies (IAPP, TPE and DIME (interim report) came out close, thereby providing confidence in the quality of the data underlying the assessment of the outcomes of the project.

## 2.4 Safeguard and Fiduciary Compliance

32. The following environmental and social safeguard policies were triggered at appraisal:
- Environmental Assessment (OP) (BP 4.01)
  - Natural Habitats (OP) (BP 4.04)
  - Pest Management (OP 4.09)
  - Indigenous Peoples (OP) (BP 4.10)
  - Involuntary Resettlement (OP) (BP 4.12)
  - Projects on International Waterways (OP) (BP 7.50)

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

33. **Environmental safeguards.** All sub-project proposals were screened for environmental impacts. To ensure quality, the Environmental Safeguard Specialist randomly reviewed the environmental screening forms conducted by CFs on a regular basis.

34. **Social Safeguards.** Since the Project aimed to increasing agricultural productivity in ecologically constrained and economically disadvantaged areas involving the small and marginal farmers focusing the landless, poor, women and ethnic minorities owning or operating lands, it triggered Bank’s Operational Policies on social safeguards covering indigenous peoples and involuntary resettlement. The project also anticipated some social risks of elite capture and discrimination of social groups in participation. The project undertook a participatory approach involving the beneficiaries in specific farmers’ groups. The project had its SMF as guidance for socially inclusive design, and participation of farmers from all social and economic groups in technology generation, demonstration/adoption and water management activities. During the first year of interventions, activities were carried out without fully adequate social safeguard screening following the SMF. A safeguard operational manual, including social screening, assessment and

monitoring forms, were developed as of August 2013. In addition, an ethnic minority development plan was prepared for three of the eight districts having tribal communities among the beneficiaries, namely Patuakhali, Barguna and Rangpur, as stipulated under the Bank OP 4.10 on indigenous peoples.

35. Although there was no apparent private land acquisition, nor displacement from public lands, nor adverse impact on peoples who belong to the Small Ethnic Groups (SEGs -- akin to the Bank's Indigenous Peoples), the project opted to implement a Social Management Framework in order to address the potential safeguard issues, as and when they arise.

36. Owing to the approach of participatory implementation, the project did not encounter any major complaints or grievances on financial, environmental or social management. Social audit, GRM and communication strategy together upheld social accountability of the project activities. Project bill boards were used in all demonstration activities, the service providers (DAE, DLS & DOF) participated in annual agriculture fairs and few of the success stories are also covered in print and electronic media.

37. Finally, the International Waterways safeguard was triggered by the World Bank in view of the possibility that subprojects may involve waterways that drain into the Bay of Bengal (considered as an international waterway by the World Bank) or use of shared groundwater aquifers. However, in view of the low likelihood and the minor and insignificant impact on water quality and quantity going to neighboring riparians, notification exception 7(a) was granted.

38. **Financial Management.** The IAPP project team was consistently compliant in submitting acceptable IUFRRs and Audit reports as per agreed deadline throughout the implementation period. The audit opinion for all years were "unqualified", except for the fiscal year 2015-16 when the auditors expressed a *qualified audit opinion* on the financial statement of the project. However, the ground for the *qualified opinion* turned out not to be justified as the auditors erroneously disagreed with the cumulative project expenditure and opening balance of project fund in the last fiscal year. The project confirmed that this issue has been clarified and resolved with the external auditors. The project awaits to receive the audit report for FY-17, which is due on 31 December 2017. The project has been compliant to all closing requirements as per disbursement guidelines, including closing all the operational bank account and pulling back unspent money to the project's designated account. The total refundable amount as per client's DA activity statement is BDT 271.42 million.

39. **Procurement.** The procurement and financial management capacity of the project was satisfactory and posed minimal risk to fiduciary compliance. All planned procurement of goods, works and services was completed within the implementation period. Although there was a delay in procurement and contract award during the initial period of the project, the client appointed a qualified procurement consultant and procurement capacity subsequently improved. The implementing agency had introduced electronic tendering during the last two years of the project; this initiative ensured better transparency and efficiency. The Bank conducted regular procurement post review for this project. During procurement post reviews conducted during project implementation, no major procurement issues have been identified, except for a few minor issues related to procurement processing and contract management.

## **2.5 Post-completion Operation/Next Phase**

40. Upon project completion, the contract of all 375 CFs expired and all consultants' positions at PMU level were dissolved. All deputed staff from the government of Bangladesh at district and region level were re-integrated back into their original departments (DAE, DLS, DoF, BADC, SCA).

41. Given its important achievements, the Ministry of Agriculture (MoA) has expressed strong interest in engaging on a new operation to consolidate and scale-up the results of IAPP, as well as to provide support in areas that may sustain investments and results. MoA submitted a proposal in response to the Fourth Call for Proposals to GAFSP's Public Sector Window. Building on IAPP, MoA is also seeking engagement on a transformative/ more comprehensive operation with the aim to unlock the full potential of agriculture in Bangladesh in terms of productivity growth, value-addition, and employment creation, while minimizing risks and ensuring sustainability and climate resilience.

42. Sustainable intensification and diversification of agriculture through technological change requires an efficient and productive national agricultural technology system, comprising agricultural research (technology development and refinement) and agricultural extension (technology dissemination). In this respect, it is noteworthy that the Technology Generation Mechanism developed under the project is being mainstreamed in other projects, including NATP II. Moreover, IFAD has committed to financing a follow-on operation to scale-up the IAPP achievements, including (i) continuing to strengthen the capacity of the research and extension services to generate and disseminate agricultural technologies aimed at increasing farm productivity; and (ii) promoting the sustainability of existing and new farmer groups and producer organizations by strengthening their linkages with markets.

## **3. Assessment of Outcomes**

### **3.1 Relevance of Objectives, Design and Implementation**

43. Relevance of Objectives: At ICRR, the PDO remains highly relevant. The project supported a broader GoB program aimed at increasing food security and agricultural production through a revitalization of the agricultural research system. In the *2011 Bangladesh Country Investment Plan*, a sustainable and diversified agriculture through integrated research and extension had been identified as a priority area for support. Further, the National Agricultural Extension Policy and the BARC Act approved/enacted in 2012 promotes the development of decentralized, integrated, demand-driven agricultural research and extension services.

44. The project objective and scope were and continue to be in line with GOB's 7th Five Year Plan (7<sup>th</sup> FYP) for FY16-20 and the Bank's current corporate strategic goals of eradicating extreme poverty, while promoting shared prosperity at the global level and its strategic involvement in Bangladesh. The GOB's 7<sup>th</sup> FYP aims to making agriculture a profitable and commercially sustainable through enhancing production, productivity and quality with a view to ensuring food security. GOB expects that agriculture will be a key driver for Bangladesh's future GDP growth, contributing to the country's target of 7.4% average real growth per year. Agriculture features prominently in the GoB 7<sup>th</sup> FYP, and is expected to help the country to further reduce poverty and

become a middle income country by 2021. In the Bank’s Country Partnership Strategy (CPS) for Bangladesh for FY16-20, agriculture is highlighted under *Focus Area 2 (Social Inclusion) and Focus Area 3 (Climate and Environment Management)*, more specifically 2.4: *Enhanced Rural Income Opportunities for the poor* and 3.3: *Increased Adoption of Sustainable Agriculture Practices*.

45. Relevance of Design: The project design remains *highly relevant* to the current development agenda of agricultural research and extension systems in the country as it promoted high priority, pluralistic, participatory and demand-led agricultural research including institutional reforms of NARS and supported decentralized, participatory, demand-led and knowledge-based agricultural extension service delivery also supported by the National Agricultural Technology – Phase II Project (NATP-II), jointly Bank/IFAD/USAID-financed. Also, the project’s focus on improving irrigation efficiency remains highly relevant in view of increasingly important efforts to make agriculture in Bangladesh more resilient against the effects of climate change.

46. Relevance of Implementation: Project implementation was *highly relevant* by effectively responding to changing needs and circumstances. Project management exhibited a strong commitment to the objectives and success of the project. Implementation focused on performance improvements of government agencies working at Union and village levels and promoted decentralized and demand driven extension service delivery. The project exceeded even the updated targets that were revised upward at Mid-Term Review e based on newly available information at that time. Findings of various reports, including DIME, TPE and IAPP M&E indicated that the project considerably increased productivity of agricultural production and profitability on account of timeliness of operation, better quality of work and more efficient utilization of inputs. The project’s focus on ensuring that women significantly shared in generated benefits also remains highly relevant today. Moreover, several committees in relation to ensure governance and oversight arrangements were formed for (i) effective implementation, (ii) better coordination of the project, and (iii) collaboration and shared responsibility across the various line departments, agencies and their key stakeholders.<sup>3</sup>

### **3.2 Achievement of Project Development Objectives**

47. Achievement of the PDO was to be measured by the following outcome indicators, including: (i) number of targeted farmers whose productivity has increased in crops and/or livestock and/or fisheries; (ii) productivity of paddy (as representative of crops sub-sector); (iii) productivity of fish; and (iv) productivity of milk (as representative of livestock subsector). The PDO was fully achieved. All PDO level outcome indicators were achieved or even exceeded their agreed target. The key outcomes achieved under the project are summarized below, while detailed project outputs by components are presented in Annex 2.

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<sup>3</sup> The committees include: (i) Project Steering Committee (PSC), (ii) Project Management Committee (PMC), (iii) Regional Project Coordination Committees (RPCCs) (one in the North and one in the South), and (iv) Upazila Project Coordination Committees (UPCCs) (one for each Upazila),

48. The assessment of project outcomes was based on three sources: IAPP M&E, TPE, and DIME. IAPP surveyed 100% of project beneficiaries during all implementation years of the project. TPE surveyed a total of 17,250 farmers at endline (i.e., about 5% of IAPP sample), comprising 8,750 crop farmers, 3,000 fish farmers, 3,000 livestock farmers and 2,500 water users, using a stratified random sampling method; a baseline study was reconstructed using a recall method. DIME focused on crop and fisheries activities and used a randomized control trial method based on a panel dataset of 1,732 households constructed from three rounds of surveys (baseline in 2012, midline in 2014 and endline in 2015). Despite some differences in estimates, which was expected due to differences in methodologies, sampling, sample size and timing, the results of all three study displayed similar trends and showed overall positive achievement of the project outcomes.

49. **PDO-level indicator (i): The number of farmers whose productivity increased** was 250,829, exceeding the agreed target of 236,000 (106.28% achievement against target), including 152,000 crop farmers (108.57%), 48,177 fish farmers (103.37%), and 50,652 livestock producers (105.52%). About one third of these farmers were women, against a target of 25%. Increases in productivity were possible through the generation and adaptation of new technologies (i.e., 10 crop varieties (110%), nine improved generations of fish seed (100%) and the dissemination of improved production packages (i.e., 18 for crop production and nine for fish production). About 3,546 tons of certified seeds of rice, wheat, maize, pulses and oilseeds were produced and supplied to BADC and seed growers against a target of 3,500 tons. As a result, the performance against yield targets was commendable with incremental increases in productivity in relation to agreed targets ranging between 106-140% for the main three types of paddy, 130% for milk production, and 159% for fish. Similarly, all intermediate outcome indicators were achieved between 100-159% against their target values. More details on increases in productivity for paddy, milk, and fish are provided below.

50. Moreover, according to the DIME report that presents endline results of the impact evaluation of IAPP, compared to farmers in control villages, (i) IAPP crop farmers were more likely to adopt the paddy varieties promoted by IAPP (19%), to diversify crop production from rice (e.g., 20% for mung and 6% for mustard), to earn higher income from crop (128%), and to commercialize greater surplus of rice (8% in Boro and 1.6% in Aman season); (ii) IAPP fishery groups had higher fish production (19%), cultivate greater pond area on average (150%), and earn greater income from fisheries (200%); and (iii) IAPP livestock groups have higher milk productivity of cows (147%), consume more milk (96%) and earn higher income from milk sales (500%).

51. **PDO-level indicator (ii): Productivity of paddy (as representative of crops sub-sector).** With respect to the first element of the PDO, the related key PDO-level and intermediate outcome indicators were: Improved varieties released for farmers' use in crops and Improved production packages released for farmers' use in crops under Component One (Technology Generation and Adaptation); Adoption of improved crop varieties by farmers and Certified seed processed by BADC in new facilities under Component Two (Technology Adoption); and Area under improved irrigation under Component Three (Water Management). Achievement of these indicators against agreed target values is presented in Table 1.

52. Crop production and productivity. The targets for increased paddy productivity were exceeded (106% Boro, T-Aus 141%, and Aman 138%), with reported yields of 6,300 kg/ha for Boro, 4,650 kg/ha for T-Aus and 4,560 kg/ha for Aman, against upwardly revised targets of 5,950 kg/ha for Boro, 3,300 kg/ha for T-Aus, and 3,300 kg/ha for Aman. New technologies and improved production packages promoting crop husbandry, land and water management practices for rice, wheat, maize, oilseeds, pulses and high value vegetables were introduced to farmers through livelihood field school (LFS) based groups. DAE established 7,246 LFS of 25 members each exceeding their target of 180,000 farmers (about 33% women).

53. About 84% of the crop farmers reported that their yield per hectare had increased compared to the period prior to joining the IAPP, exceeding the project target rate of 80% for sustainability of intervention adoption rate. Paddy productivity increased by 16% for Boro, 72% for T-Aus, and 69% for Aman. Also, some farmers who used organic fertilizer along with improved seeds reported decreased use of chemicals by up to 50% in some instances.

54. The project contributed to changing production patterns by encouraging some new crops like pulses, oilseeds, wheat, potato and maize that require less irrigation to be gradually introduced in the rice based systems. According to TPE, most IAPP farmers (93%) reported increases in production as a result of changed cropping patterns. Findings of the DIME endline survey indicated that, compared to farmers in control villages, not only were IAPP crop farmers more likely to grow one of the specific paddy varieties promoted by IAPP, but they were also more likely to diversify their production away from rice with greater adoption of mung (20%), lentil, and mustard (6% although not statistically significant).

55. Technology for rice and other crops. Although the private seed sector in Bangladesh maintains a satisfactory level of quality vegetable seed supply through domestic production and imports of mainly hybrid varieties, the quality seed supply situation remains a major problem due to insufficient quality seed production capacity in the public sector and very limited capacity of the private sector. Over the course of the project, the research institutes (BRRI and BARI) developed 15 crop varieties including five varieties of rice, four varieties of wheat, two maize hybrids, two varieties of mung bean, and one variety each of mustard and lentil exceeding their target of 14. In addition, nine improved production packages were developed and released to farmer as planned (100% achievement against target). These technology packages focused on resource use efficiency and yield gap minimization of rice-based cropping systems and diversification of the cropping system into high value crops.

56. IAPP farmers procured most of their seeds from demonstration farmers in IAPP seed villages (68.5% in Northern regions and 57% in Southern regions), followed by BADC seed dealers. DAE established 246 seed villages for promoting farmer-to-farmer seed exchange, which produced 15,059 tons (against a target of 12,960 tons), most of which were paddy seed (about 80%). SCA carried out field inspections and quality control of 40.6 tons and 50 tons of breeder seed of rice and wheat against a target of 30 and 50 tons respectively. BADC processed and distributed 3,546 MT of certified seed in new facilities (i.e. 101% achieved against EOP target of 3500 MT).

57. Training and capacity building. DAE fulfilled its commitments in terms of organizing demonstrations and training farmers. All crop farmers received some type of training during the

implementation period. 1,005 SAAO, 92 DAE officers, and 55,810 selected farmers benefited from addition capacity building. On-farm demonstrations were organized on the plots of about 42,333 LFS farmers against the agreed target of 40,415 farmers. Adoption support was provided to additional 151,125 farmer members of LFS in the crop season following organization of demonstrations. A total of 29 agricultural fairs and over 3,000 field days were organized to further disseminate technology, build awareness and deliver information to farmers. Moreover, **BRI** and **BARI**: (i) conducted over 3,000 participatory varietal selection (PVS), validation and adaptive trials both on-station and on-farm to help identify the varieties farmers preferred; and (ii) provided training to over 6,000 farmers, scientists, and extension agents, including field days, workshops, and international exposure in Malaysia, the UK, China and Thailand for selected scientists.

58. *Water management.* Improved water management increased the efficiency of water use, enabling farmers to increase cropping intensity, diversify production systems, and reduce irrigation related risks and variability in crop production. A total of 605 Water User groups (WUGs), benefiting a total of 51,690 farmers against the EOP target 50,000 were formed. The area under improved irrigation increased to about 27,750 ha against an original target of 25,000 ha. Moreover, the project reported a 49% reduction in water losses.

<b>Indicator</b>	<b>Baseline Values</b>	<b>Target Values</b>	<b>Value Achieved</b>	<b>% Achieved</b>
Incremental increase in productivity of paddy (Kg/Ha)	Boro: 5450	Boro: 5950	6,300	105.88%
	T- Aus: 2700	T-Aus: 3300	4,650	141%
	Amon: 2700	Amon: 3300	4,560	138%
Adoption of improved crop varieties by fish farmers (Number)	0	180,000	180,000 (33% women)	100%
Adoption of improved crop varieties by farmers (Number)*	0	144,000	152,000 (33% women)	108.57%
Improved varieties released for farmers' use in crops (Number)	0	14	15	107%
Improved production packages released for farmers' use (Number)	0	13	18	100%
Certified seed processed by BADC in new facilities (MT)	0	3,500	3,546	101%
Adaptive trials and demonstration for existing technologies - (Number)	0	1080	1080	100%
Adaptive trials and demonstration for new technologies (Number)	0	2206	2206	100%
Area under improved irrigation (Ha)	0	25000	27,750	111%

\*Target assumed 80% sustainability rates of intervention by adopting farmers

59. **PDO-level Indicator (iii): Productivity of fish.** With respect to the second element of the PDO, the related key PDO-level and intermediate outcome indicators were Improved varieties released for farmers' use in fish generation and Improved production packages released for farmers'

use in fish under Component One (Technology Generation and Adaptation); Adoption of improved aqua-culture by fish farmers under Component Two (Technology Adoption). Achievement of these indicators against agreed target values is presented in Table 2.

60. *Fish production and productivity.* The targets for increased fish productivity were also exceeded (159%), with reported yields of 5,420 kg/ha against a target of 5,420 kg/ha. A total of 2,433 fish culture groups benefiting 60,000 members were formed. DoF reported that 47,520 fish farmers (25.25% female) increased fish productivity in household fish ponds by over 200% (from 2,700 kg/ha to 5,420 kg/ha), with demonstration farmers exhibiting much higher yields than adoption farmers (ranging from 13% for tilapia to 50% for Thai koi). Among the group farming models demonstrated, cage and pen cultures<sup>4</sup> were identified as significantly building the economic benefit to beneficiaries, especially to landless poor fisher/farming community and women in the South. About 75 cage culture groups benefiting 750 farmers with an average productivity of 4.5 kg/m<sup>3</sup> were established alongside 12 pen culture groups benefiting 600 landless poor fishers/farmers. With reported productivity of 10.12 t/ha, which is significantly higher than pond fish culture, the pen culture production model allowed partial harvesting as well as continuous stocking. This enabled farmers to gain regular cash flow which increased their affordability to spend on the required quantities of fish feed – a major operational cost.

61. Results of the DIME endline report suggest that, compared to the control group, IAPP fish farmers had a significantly higher percentage of households with larger size or mature fish production (19%), had a greater average pond size (150%), and had overall a more efficient use of inputs to fishery pond.

62. *Technology for fish.* BFRI fulfilled its commitments by developing and releasing nine improved generations of fish seed (4 generations of Tilapia, 3 generations of Koi and 2 generations of Pangus), and disseminating nine advanced production packages to fish farmers. BFRI also supplied improved germplasm and trained staff of eight commercial hatcheries for multiplication and supply of improved generations of fish seed to fish farmers, which contributed to significantly improve fertilization, hatching, and fish fry survival. As a result, average fry production from the eight hatcheries has increased by average 152%, and fish farmers (240) directly associated with BFRI operations reported productivity increase of 26-59% with Tilapia, Koi and Pangus.

63. *Training and capacity building.* During the project period, DOF fully achieved its commitments and provided training to all 60,000 fish farmers in order to enhance farmers' skills and efficiency on commercial species culture, carp polyculture and cage/pen culture. BFRI organized three day long training programmes for 1,650 participants, including 20 scientists, 160 hatchery operators and 1,470 selected fish farmers. Moreover, 22 farmers rally and exchange visited were organized.

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<sup>4</sup> Cage and pen culture were not part of the original project design but were introduced later on despite some social and environmental concerns due to usage of public water bodies, especially for cage culture.

<b>Indicator</b>	<b>Baseline Values</b>	<b>Target Values</b>	<b>Value Achieved</b>	<b>% Achieved</b>
Incremental increase in yield of fish (Kg/ha/WSA)	2,700	3,400	5,420	159%
Adoption of improved aqua-culture by fish farmers (Number)	0	60,000	60,000 (25% women)	100%
Farmers whose productivity increased in crops (Number)	0	48,000	48,177 (25% women)	108.57%
Improved varieties released for farmers' use in Fish - BFRI (Number)	0	9	9	100%
Improved production packages released for farmers' use in Fish - BFRI (Number)	0	9	9	100%

\*Target assumed 80% sustainability rates of intervention by adopting farmers

64. **PDO-level Indicator (iv): Productivity of milk (as representative of livestock subsector).** With respect to the fourth element of the PDO, the related key PDO-level and intermediate outcome indicator was Adoption of improved breed/husbandry under Component Two (Technology Adoption). Achievement of these indicators against agreed target values is presented in Table 3.

65. *Livestock production and productivity.* The targets for increased milk productivity were also exceeded (130%), with reported yield of 2.86 l/day/cow against an upwardly revised target of 2.2 l/day/cow. Livestock LFS model adopted by the DLS on par with DAE groups was used for the groups formed during the project year 2014-15 and 2015-16.<sup>5</sup> Within the project period, DLS oriented the remaining farmers groups (formed during the previous years) on the latest husbandry practices. 3,000 livestock development groups (dairy, goat and poultry groups) were formed involving 60,000 farmers, 89% of which were women (100% achievement rate). PMU reported productivity increments (milk, live goats, eggs and live chicken) in about 50,652 farm families against a target of 48,000 farmers. Milk yields increased by 178% (against a revised baseline value of 1.6 l/day/cow).

66. Compared to non IAPP groups, milk productivity of cows in IAPP groups was reported to be 147% higher; household milk consumption nearly doubled (96% increase); and milk sales and earnings were 4 to 5-fold higher than control, respectively.

67. *Technology for livestock.* DLS focused on introducing two main improved production practices for fodder cultivation and husbandry practices. DLS fully achieved its targets by creating 54 nurseries and organizing fodder demonstration on 3,283 plots.

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<sup>5</sup> Livestock LFS model was not part of the original project design; it was introduced later almost two years after the inception of the project. In line with LFS model, the project allocated more fund on training for DoF and DLS components. They also increased the number of training provided to the beneficiaries.

68. *Training and capacity building.* Implementation of activities to be carried out by DLS such as farmers’ training (all 60,000 farmers received), demonstrations of selective animal breeding (3,283), fodder cultivation (54), improved husbandry practices, health care campaigns (3,000 activities on vaccination, deworming, infertility, and health ), regional workshops (6) and farmer rallies were carried out as per schedule (100% achievement rate).

Indicator	Baseline Values	Target Values	Value Achieved	% Achieved
Incremental increase in yield of milk (l/day/cow)	1.6	2.2	2.86	130%
Adoption of improved breed/husbandry farmers (Number)	0	60,000	60,000 (89% women)	100%
Farmers whose productivity increased in crops (Number)	0	48,000	48,177 (94% women)	100.36%
Improved varieties released for farmers’ use in Fish - BFRI (Number)	0	9	9	100%
Improved production packages released for farmers’ use in Fish - BFRI (Number)	0	9	9	100%

\*Target assumed 80% sustainability rates of intervention by adopting farmers

### 3.3 Efficiency

69. The ex-post economic analysis undertaken indicates an EIRR of 37.9% and a Net Present Value of USD 138 million. Despite using conservative estimates, the outcomes of the economic analysis compare favorably with the outcomes of the analysis done at the time of Appraisal when the EIRR for the investment was estimated to be 21.4% and the NPV US\$ 35 million. The analysis used constant 2016 prices and a discount rate of 10%. The life of the project was assumed to be 20 years and the benefits to farmers from technology adoption began only in project year three, and that they were phased in over a three-year period, beginning in project year three. An analysis of the sensitivity of the rate of return to adoption rates showed that with a 20% decline in prices the return would fall from 37.9% to 32.7%. Were output prices to decline by 20% the rate would fall to somewhat more to 30.4%. In the case of both a 20% decline in output prices and a 20% decline in adoption, the EIRR would be 26%.

70. Several economic benefits generated by the project were not quantified for inclusion in the FEA. Some of the most important included benefits to natural resources and the environment. For instance, the re-excavation of canals reduced waterlogging over an area equivalent to 4 600 ha in Rajarhat, Kurigram in 2016 alone. Investments in buried pipes contributed to ground water recharge and prevented salt water intrusion. Climate change resilience was improved by the introduction of salt and drought tolerant rice varieties. The reduction of the use of agri-chemicals by some 130 000 farmers, the adoption of vermi-composting, and the production of green manuring recommended by the project contributed to better soil health. Furthermore, the project reported that these positive externalities as well as benefits from improved productivity were also accruing outside the project area in adjacent areas and non-targeted farmers. Also, considering that actual project management costs (under Component 4) amounted to US\$3.38 million, against an allocation of US\$5.26 million, could be taken as an indication that the project was implemented in cost-effective fashion.

### 3.4 Justification of Overall Outcome Rating

Rating: Satisfactory

71. Considering that the project objectives, design, and implementation remained highly relevant throughout the implementation period and that both efficacy and efficiency were substantial, the overall outcome of the project is rated as Satisfactory.

### 3.5 Overarching Themes, Other Outcomes and Impacts

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

72. **Poverty impacts.** Findings of both impact evaluation (DIME report) and impact assessment (TPE report) of the project suggest that project activities significantly contributed to enhance farm productivity and improved the living conditions of small and marginal farmers, including women and indigenous people, in the project area. According to the TPE, IAPP farms created an additional 30 days of employment per year on average, with new employment opportunities resulting from changes in cropping patterns, increase in cropping intensities, irrigation coverage, bringing derelict ponds into fish production, and marketing of fish and produce. The DIME study reported that over the period 2014-2016, income levels of crop and fisheries households increased by 15% and 37%, respectively, compared to non-IAPP households.

73. The project also had notable effects on nutrition. The impact assessment of the project reported that about 85% and 98% of crop and fish farmers, respectively, reported that their family food consumption improved as a result of their participation in IAPP. Also, the number of farmers buying food from the market was also significantly reduced (30% for rice and 21% for fish); and the number of crop farmers that could afford to take 3-meals a day increased by 15%.

74. Moreover, the economic and financial analysis completed at project completion revealed that the adoption of technology recommended by IAPP had led to increases in incomes ranging from 35-55%. This translated into mean income increases ranging from BDT 7 769 (US\$ 100) for 'marginal' farmers ( 0.2-0.6 ha) in the South growing only *aman* rice on plot sizes averaging 0.4 ha to BDT 19 227 (US\$ 247) for the slightly better off 'small' farmers in the North growing *boro* and *aman* rice on 0.8 ha. These increase are significant when considered in relation to the poverty line that was cited at Appraisal to be US\$ 195 in the project districts at 2011 prices.

75. **Gender.** The gender strategy of the project advocated that women constituted: (i) at least 25 % of the resource persons as well as recipients of the capacity building efforts; (ii) at least 50% of the project beneficiaries for dairy, goat, and poultry production; and (iii) at least 25 % of the committee members and other decision making positions in groups/associations formed under the project. The project focused on women empowerment by increasing their skills, technological knowledge and income through training and demonstrations support from the project. Women were actively involved in the implementation process focusing on empowerment and decision making in technology selection, production and marketing. Involvement in production activities offered the women self-reliance in economic activities, accelerated the agricultural productivity, increased access to markets for fresh and quality agricultural products marketing.

76. Overall, participation of women in group activities exceeded agreed targets (33% vis-à-vis 25%), especially in livestock activities (89%). Women membership in other LFS groups was at or above the agreed proportion of 25% (25% for fisheries and 33% for crops). Traditionally, and professionally fishing is not a sector with many women involved; hence the relatively lower participation rate in these groups compared to the other LFS. Field missions carried out reported that members of the women groups in livestock demonstration were very engaged in group activities and were confident in the way they were exercising with the project inputs for improved cattle shed, fodder preparation, vaccination, and deworming of cattle heads. Women participation in the decision making was also robust. While women were interested and concentrated in homestead based activities like seed processing, homestead gardening, fodder preparation, livestock and poultry, and pond fishery, men members were concentrated in crops, fisheries and water management.

77. ***Social Development/Inclusion.*** The design of the project was rooted in community participation and social development goals such as inclusion, equity, participation, transparency, and accountability. Most of IAPP farmers (about 80%) were small and marginalized farmers, including indigenous people and women, who hold half an acre of land or less. The project engaged with local communities and key stakeholders to ensure their inclusion and participation in the planning, implementation and subsequent management of the investments especially the vulnerable. Moreover, the implementation strategy of promoting decentralized extension services was a powerful tool in helping build and strengthen the existing local institutions that deliver benefits and empower the community.

#### **(b) Institutional Change/Strengthening**

78. The project adopted a group-based approach for the implementation of agriculture development interventions. The project anchored at the Union and village levels with the support by a Community Facilitator (CF). The project engaged with local communities and farmer groups (i.e., LFS crop groups, livestock groups, fishery groups, seed growers' associations, and water user groups) to ensure their inclusion and participation in the planning, implementation and subsequent management of the investments especially the vulnerable. To ensure sustainability, the project undertook the initiative of registering these groups with the Department of Cooperatives. About 83% of the LFS were registered and federated at Upazila and district levels. These LFS could become one of the strongest village institutions provided that they continue to receive adequate support.

79. IAPP made significant contributions to the institutional developments of these stakeholders by helping strengthen their human and organizational capacities and by promoting investments in productive assets. The project allowed the beneficiaries to collectively learn more, achieve scale, better transactions terms and organize more effectively to benefit from public services so that they deliver increased and more effective investments in agriculture, nutrition, and food security.

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

80. In addition to introducing various climate smart agricultural technologies, including saline and drought tolerant varieties, the project focused on information and entrepreneur's development.

The dissemination of seasonal agro-meteorological, soil and hydrological information relating to crop suitability using cellular phone/mobile internet network (ICT) strongly contributed to helping improving crop/animal productivity and resilience in the saline/drought regions. Moreover, farmer groups developed entrepreneurs for a number of IGAs and environmental safeguard issues, including milk, quality seed, fodder, vermi-compost, fish production (pen and cage cultures), processing, marketing and group capital formation. . This further contributed to empowering women given that women were especially involved in these sectors.

#### **4. Assessment of Risk to Development Outcome**

Rating: Moderate

81. Most of project outcomes were found to be sustainable. There are two primary risks to sustainability of the development outcome relating to the technical design of the project and to institutional capacity of LFS.

82. **Technical risks:** Throughout the project life, all IAPP farmers, seed dealers and technicians received capacity building training from the project. The large number researchers and extension specialists trained under the project continue to provide a solid basis for the sustainability of research and extension organizations. Moreover, the IAPP-TA explicitly planned to focus capacity development efforts on individuals in various ministries likely to remain in the sector in the short to medium term, and who would coordinate with existing interventions (such as the National Food Policy Capacity Strengthening Project), for the sake of sustainability of results. Additionally, many of the project activities were designed with ‘training of the trainers’ components to ensure institutional capacities beyond individuals were strengthened to share any acquired knowledge with key actors in the future. The successful adoption of technologies generated by the BRRI, BARI, BFRI and disseminated by the DAE, DOF and DLS suggested increased effectiveness of research-extension linkages. As a result, productivity of crops, fish and livestock of the IAPP farmers increased and were higher than most of the districts of Bangladesh. However, continued attention of the Government and other stakeholders needs especially focus on the governance aspect of the technology systems. An integrated approach should be continued among DAE, DOF, DLS, BADC and research organization to ensure sustainability of outcomes.

83. **Institutional capacity:** Most of the LFS appeared to be performing well: they were able to open a bank account (e.g., LFS accumulated total savings of Taka 66.75 million), and about 83% of the LFS were registered and federated at Upazila and district levels. These groups are expected to continue receiving technical backstopping after the withdrawal of Community Facilitators. These LFS could become one of the strongest village institutions provided that they continue to receive adequate support. However, they may face sustainability risks (especially the if they do not have an adequate budget to finance these vital activities.

#### **5. Assessment of Bank and Borrower Performance**

##### **5.1 Bank Performance**

###### **(a) Bank Performance in Ensuring Quality at Entry**

Rating: Satisfactory

84. Overall, the project was implemented in accordance with agreed design, while being on time and on budget. Actual expenditures under project components deviated only marginally from their allocations as agreed at appraisal, reflecting a well-designed project. Design of the IAPP benefited from international and Bank experience in designing research and extension projects. The Bank provided timely and quality support during project preparation and appraisal. The Bank team ensured that the project design incorporated key lessons from relevant projects. The diagnostics work and technical solutions identified were relevant and the rationale for Bank's intervention was well established. The project approach for strengthening pluralistic institutional structure of the research and extension service providers as well farmer organizations was relevant, and the anticipated risks and their mitigation measures were adequate

85. The lack of time and financial resources to conduct a baseline study at appraisal to meet the time window for GAFSP proposal submission prompted the Bank to make use of national average data, which were the sole information available, to inform baseline and target values of the Result Framework. However, the Bank made provisions at design stage to have DIME conduct a baseline study during the first year of project implementation. Also, FAO, as co-supervising entity, was closely involved in the implementation of the project.

(b) Quality of Supervision

Rating: Satisfactory

86. The Bank team carried out 10 review missions to support project implementation. The strong continuity in Bank task team leadership (i.e., a total of two TTLs throughout implementation, with the later one based in Dhaka) contributed to maintaining effective working relationship with the implementing agencies, while providing quick action and decision making. Considering the complexity of having different line departments and institutions implementing the project, the Bank team was able to balance their support to ensure that all components and institutions were adequately covered and supported for. The supervision missions delved into key emerging implementation issues providing practical recommendations and sound technical solutions as documented in the aide-memoires which were shared with the project teams before or during wrap up meetings. The implementing agencies were provided adequate opportunity to clarify issues raised in the aide-memoire.

87. The Bank demonstrated pro-activity in addressing and correcting issues as they arose. DIME was actively involved in M&E during implementation and conducted several surveys, including baseline study during the first year of implementation. This allowed the Bank team to identify weaknesses in the Result Framework -- the baseline value for paddy and milk production, being a national average for Bangladesh, was inadequate for the needs of the Project -- and propose adequate adjustments. At MTR the Bank team helped revise upward the baseline and target values of the PDO and intermediate indicators so that monitoring of the project was robust and realistic.

88. Moreover, during site visits, mission members regularly interacted with concerned farmer group members, community facilitators, SAAO, extension agencies involved in group

mobilization and capacity building. The Bank had also fully involved FAO in the supervision of IAPP implementation.

### **(c) Justification of Rating for Overall Bank Performance**

Rating: Satisfactory

89. Overall, the Bank did solid work at entry level and demonstrated pro-activity in addressing issues as they arose. Bring DIME on board from inception ensured objective measurement of outcomes and working closely with FAO contributed to strengthening M&E arrangements and to lowering implementations risks throughout the project life. Given Bank's performance in ensuring Quality at Entry is rated as *Satisfactory* and Bank's performance for implementation support is rated as *Satisfactory*, the Bank's overall performance is rated as *Satisfactory*.

## **5.2 Borrower Performance**

### **(a) Government Performance**

**Rating: Satisfactory**

90. GOB was fully committed to and had a strong ownership of the project both during preparation and implementation. GOB ensured full availability of counterpart funds and fiduciary aspects were respected. In addition to the GAFSP Grant of USD 46.31 million, GOB contributed USD 17.50 million (about 27%), most of which contributed to financing civil works, procuring goods and equipment, and pay salaries and allowances of deputed officers from government. Counterpart funding was also used to renovate government offices at Upazila and district level, construct seeds processing and preservation centers, and procured lab equipment and agriculture machineries.

91. GOB provided timely authorization for the legal registration of the LFS. GOB also took the initiative to make sound evidence-based revisions to some initial activities (e.g., the creation of 200 additional LFS and increased investments in the buried pipe schemes based on findings of requested studies, including Economic and Financial Analyses).

### **(b) Implementing Agency or Agencies Performance**

**Rating: Satisfactory**

92. The project was implemented by five states departments and three national research institutions guided and coordinated by a Project Management Unit (PMU) in Dhaka and two Regional Project Implementation Unit (RPIU) ( South in Barisal & North in Rangpur). The departments deployed sufficient staff at statewide and local levels to allow adequate implementation project activities. The pace of implementation was adequate despite relatively high leadership staff turnover (i.e., there was a total of Project Directors, with the last one serving nearly two thirds of the project implementation period). Moreover, the project adequately managed to coordinate and integrate the activities of the various implementing agencies by forming several

committees, including PSC, PMC, RPCCs, and UPCCs that ensured governance and oversight arrangements, which contributed to the success of the Technology Generation Mechanism under the project.

93. Moreover, most of the top level IAPP officials were very conversant about the project's strengths and weaknesses. The PMU was very responsive in addressing identified weaknesses in the collection and processing of field level data, particularly for the adoption farmers. Improvements in the data collection and management mechanism through mobile apps were introduced, and the PMU effectively responded to changing needs and circumstances. As a result, increased productivity of agricultural production and profitability on account of timeliness of operation, better quality of work and more efficient utilization of inputs were observed. The project exceeded even the updated targets that were revised upward at midline based on newly available information at that time.

### **(c) Justification of Rating for Overall Borrower Performance**

#### **Rating: Satisfactory**

94. Given the performance ratings of the Government and IAs, the overall Borrower's performance is rated as *Satisfactory*.

### **6. Lessons Learned**

95. Technology Generation Mechanism, including the development and dissemination of new technologies and the monitoring of their adoption by organized farmer groups into a single process, was an effective platform for inter-department collaboration. This innovative solution significantly contributed to improve linkages between researchers, extension agents and farmers by decentralizing extension services and by relying heavily on community involvement, through a variety of farmer groups (LFS), for implementation. Active participation of the stakeholders in the project activities contributed to enhance the relevance of varieties selected for cultivation, to increase adoption of new technologies and practices, and to the sustainability of both technical interventions and the local institutions supporting farmers. Farmer group structure, technical guidance from extension agencies as well as in-kind project support were all designed to help not just "demonstration farmers" but second and even third cohort of "adoption farmers" to take advantage of the disseminated technologies, and thus pioneering a new approach to ensuring rapid, sustainable spread of new technologies.

96. Systematic testing of the seeds produced in seed village is critical to maximize long-term impacts and effectiveness of investments. Although difficult, the farmers were able to maintain the set of congenial circumstances necessary to keep quality seeds. All produced seeds were systematically tested for quality. However, findings of the impact assessment highlighted that adequate resources to conduct these quality tests should continue to be made available to insure that the system of seed production in the seed village remain effective after the project ends.

97. Trainings, fairs and field days can positively impact the effectiveness of extension and warrant wider understanding, adoption and transmission of technology as well as promotion of local agriculture and production enhancement. Trainings, fairs and field days organized both

locally and abroad throughout the implementation of the project provided a positive expression of technology to local farmers, carried positive messages about agriculture and farming system, and established linkages among the technology demonstrators and adopters. Although farmers gained sufficient knowledge on improved husbandry practice, adoption of improvements was limited due to insufficient project resources to provide enough support.

98. A unified M&E system of a complex project such as this one is key to achieve greater monitoring, coordination, and accountability. In the earlier days of project implementation, the M&E system consisted of specific reports compiled from data provided by the various implantation agencies. However, this M&E arrangement failed to provide an integrated and holistic view of the overall project monitoring. The adoption and implementation of the Project Management Information System (PMIS) allowed flowing of real time information at all levels (i.e. central, region, upazila and group) using data from ‘Input-Output cards’ filled out by beneficiaries throughout the project life. The PMIS system was accessible online and contained up to date information available for all key milestones of the RF, which helped the PMU monitor progress of project activities. Although it had the potential to become a dynamic monitoring and management tool, the PMIS had only been used as a static exercise thus far. Thus, further analysis of the data, including time series analysis, should be conducted in a timely manner, to allow M&E data to better inform decision making.

99. Input-Output cards (I-O card) filled out by farmers along with Activity Diaries kept by Community Facilitators who assist those farmers can serve as a self-monitoring tool to achieve greater accountability in M&E. The project introduced I-O cards as the primary source of data collection. These cards were designed in a different colour for each of the three sectors (crops, livestock and fisheries) and recorded production-related information. All project farmers received training on adequately completing I-O cards, and CFs or TAs were also always available to assist farmers if needed. This monitoring tool had provided real time project information from Union level (lowest administrative unit of the local government) to central level throughout the project life. The project also introduced an Activity Diary for CFs and TAs staff that recorded the support staff’s work plan approved and signed by the Upazila Technical Officer on a monthly basis. At the end of the month, the completion of the agreed work plan is evaluated during the monthly coordination meeting.

## **7. Comments on Issues Raised by Grantee/Implementing Agencies/Donors**

### **(a) Grantee/Implementing agencies**

100. The government prepared a Borrower’s Completion Report (April 30, 2017) and provided direct input during preparation of the ICRR. The Borrower was invited to the ICRR Review meeting held on June 5, 2017 and provided comments to the draft ICRR circulated prior to the meeting. The comments and suggestions received from the Borrower are incorporated into the final ICRR and a summary of the Borrower’s Completion Report is in Annex 8.

### **(b) Cofinanciers/Donors**

101. N/A

(c) Other partners and stakeholders

102. N/A

## Annex 1. Project Costs and Financing

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

Components	Appraisal Estimate (USD millions)	Estimate at Restructuring (USD million)	Actual /Latest Estimate (USD millions)	Percentage of Appraisal	Percentage of Revised at Restructuring
Technology Generation and Adaptation	7.57	6.83	6.82	90.15%	100%
Technology Adoption	35.15	37.64	37.30	107.09%	99%
Water Management	11.71	11.07	10.92	94.54%	99%
Project Management	5.26	4.89	4.78	92.95%	98%
<b>Total Baseline Cost</b>	<b>59.69</b>	<b>60.42</b>	<b>59.83</b>	<b>101.23%</b>	99%
Physical & Price Contingencies	4.12	3.38	3.98	82.15%	118%
<b>Total Project Costs</b>	<b>63.81</b>	<b>63.81</b>	<b>63.81</b>	100%	100%
Front-end fee PPF					
Front-end fee IBRD					
<b>Total Financing Required</b>	<b>63.81</b>	<b>63.81</b>	<b>63.81</b>	<b>100%</b>	<b>100%</b>

### (b) Financing

Source of Funds	Type of Cofinancing	Appraisal Estimate (USD millions)	Estimate at Restructuring (USD million)	Actual /Latest Estimate (USD millions)	Percentage of Appraisal	Percentage of Revised at Restructuring
Borrower		17.50	17.50	17.50	100%	100%
GAFFSP	Grants	46.31	46.31	46.31	100%	100%

## Annex 2. Outputs by Component

The achievement of intermediate outcomes is summarized in table A2.1. All intermediate outcomes indicators have been fully achieved.

**Table A2.1: Review of achievement of intermediate results indicators according to component**

Project Development Objective: Enhanced productivity of agriculture (crops, livestock and fisheries) in selected areas							
Indicator	Unit	Original Baseline Values	Revised Baseline Values	Original Target Values	Revised Target Values	Actual Value Achieved	% Achieved
Number of targeted farmers whose productivity has increased in:							
Crops (of which women are 10%)	Number	0	-	140,000	-	152,000 (33% women)	108.57%
Fisheries (of which women are 25%)	Number	0	-	48,000	-	48,177 (25% women)	100.37%
Livestock (of which women are 50%)	Number	0	-	48,000	-	50,652 (89% women)	105.52%
Incremental increase in productivity of paddy	Kg/Ha	0	Boro: 5,450	2,700	Boro: 5,950	6,300	105.88%
			T-Aus: 2,700		T-Aus: 3,300	4,650	141%
			Amon: 2,700		Amon: 3,300	4,560	138%
Incremental increase in yield of fish	Kg/Ha of WSA	2,700	-	3,400	-	5,420	159.41%
Incremental increase in yield of milk	Liters/Day/Cow	1	1.6	2	2.2	2.86	130%

<b>Component One: Technology Generation and Adaptation</b>							
<b>1. Improved varieties released for farmers' use in (Number)</b>							
crops	Number	0	0	14	-	15	107%
BIRRI	Number	0	0	5	-	5	100%
BARI	Number	0	0	9	-	10	110%
BFRI - Fish	Number	0	0	9	-	09	100%
<b>2. Improved production packages released for farmers' use in (Number)</b>							
Crops		0	-	13	18	18	100%
BIRRI	Number	0	-	5	9	9	100%
BARI	Number	0	-	8	9	9	100%
BFRI - Fish	Number	0	-	9	9	9	100%

<b>Component Two: Technology Adoption</b>							
3. Adoption of improved crop varieties by farmers	Number	0	-	175,000	-	180,000	100%
4. Adoption of improved aqua-culture by fish farmers	Number	0	-	60,000	-	60,000	100%
5. Adoption of improved breed/husbandry farmers	Number	0	-	60,000	-	60,000	100%
6. Certified seed processed by BADC in new facilities	MT	0	-	3,500	-	3,546	101%

<b>Component Three: Water Management</b>							
7. Area under improved irrigation	Hectares	0	0	25,000	-	27,750	111%

A detailed description of the achievement of outputs by component is given below.

## **1. Component 1: Technology Generation & Adaptation**

### ***Improved technology generation for farmers use***

Key participants in the seed value chain are research institutes (BRRI and BARI) for producing breeder seeds, seed growers, and SCA for quality control and certification of seeds, and BADC for seed processing and distribution. BRRI and BARI developed 15 crop varieties including five varieties of rice, four varieties of wheat, two maize hybrids, two varieties of mung bean, and one variety each of mustard and lentil exceeding their target of 14. The improved crop varieties developed included:

**BRRI:** 5 paddy varieties: salt tolerant BRRI Dhan-61 and 67; Boro rice, short duration BRRI Dhan 62; Aman rice, high yielding BRRI Dhan 65; Aman rice, and drought tolerant BRRI Dhan 66; low land rain fed rice. The National Seed Board under the Ministry of Agriculture approved all varieties.

**BARI:** 10 varieties, including: four varieties of wheat-BARI Gom-27, BARI Gom-28, BARI Gom-29 and BARI Gom-30; three varieties of pulses; lentil- BARI Masur-8, Mungbean-BARI Mung-7 and BARI Mung-8 and one variety of oilseed Mustard- BARI Sharisha-17 & two maize varieties BARI Hybrid Maize-12 & BARI Hybrid Maize-13. The National Seed Board under the Ministry of Agriculture approved all varieties.

**BFRI** fully fulfilled their commitments by developing and releasing nine improved generations of fish seed (4 generations of Tilapia, 3 generations of Koi and 2 generations of Pangus).

### ***Improved production packages released for farmers use***

**BRRI:** The following nine production technologies (100% of EOP target) have been developed and released for increasing and sustaining rice productivity in the ecologically constrained project areas against end project targets: (i) Preventive application of fungicides for increasing aromatic rice yield: Developed by Plant Pathology division; (ii) Flexible Polythene pipe for efficient water distribution: Developed by IWM; (iii) Use of rice straw as a supplement source of K in rice production. Developed by Soil Science Division; (iv) Management Practices of direct seeded rice in dry field in Aman season to mitigate the climate change developed by BRRI R/S, Rangpur; (v) Deep Placement of NPK Briquette: Environment Friendly Technology for Rice Production for favorable and tidal submergence ecosystems developed by Agronomy Division; (vi) Weed control options for BRRI dhan56 and BRRI dhan57 for yield maximization in drought condition of Rangpur region in T. Aman season; (vii) Nitrogen management for yield maximization after de-submergence for BRRI dhan52, submergence tolerant varieties for Rangpur region in T. Aman season; (viii) Management of rice Sheath blight disease for increasing the yield of T. Aman rice (ix) Eco-friendly insect pest control with no or minimum insecticide application Scope of Technology:

**BARI:** released nine advanced production technologies (100% of EOP target) including: (i) Cultivation of mungbean in south region by escaping salinity; (ii) Hybrid maize-red amaranth intercropping; (iii) Control measures of Jassid and Thrips in Groundnut; (iv) Modern production methods of lentil in northern region; (v) Increase productivity of cowpea by adjustment of seed rate as relay crop with T. aman in saline zone; (vi) Identification of sensitive stage of wheat to irrigation; (vii) Identification of sensitive stage of maize to irrigation; (viii) Improved Cropping pattern; (ix) Yield improvement of sunflower by fertilizer management at south region.

**BFRI:** disseminated nine advanced production packages to fish farmers, including: (i) Culture technique of Monosex BFRI GIFT in ponds; (ii) Culture of Thai Koi in pond; (iii) Polyculture Pangus in pond; (iv) Polyculture of Carps with over wintered fingerlings; (v) Integrated Duck cum Fish Farming; (vi) Fish Feed Development for tilapia, pangas and Koi from indigenous ingredients and their method of application; (vii) Fish Culture in Pen; (viii) Fish Culture in cage; (ix) Improved Carp Nursery Management.

### ***Incremental breeder seed production***

**BRRI:** 40.6 tons of breeder seed have been produced against end project target of 30. After fulfilling the demand of BADC & DAE; 1.7 tones breeder seed have been distributed to the progressive farmers who are able to produce quality seeds under the IAPP- crops beneficiaries especially IAPP Seed villages farmers.

**BARI:** has been producing breeder seeds of four IAPP crops (Wheat, Pulses, Oilseeds, Maize- parental line & Maize –hybrid seed). The project took the decision to produce a fixed amount of seed 10.0 tons for wheat, 5.0 tons for oilseeds, 5.0 tons for pulses and 5.0 tons for maize (parental line 3.0 tones and hybrid seed 2.0 tons) and supply to BADC. A total amount of 124.5 metric tons seed has been produced during the project period against revised end project target of 124.5 tons.

### ***Setting of established PVS, validation, adaptive and management trials (for developing new technologies) by the Research Institutions (RIs)***

BRRI, BARI and BFRI achieved 100% of their target with respect to conducting PVS, validation and adaptive trials both under on-station and on-farm conditions (i.e., 1,810 nos for BRRI; 2,206 nos for BARI and 9 for BFRI).

### ***Organized field days***

BARI completed sixty four field days and BRRI implemented a total of 150 field days, 4 central and 7 regional workshops to disseminate advance technologies, awareness buildup of the farmers, deliver information to other organization.

### ***Training and capacity building***

Capacity building development was another fundamental issue of the project. For BRRI, a total of 3000 farmers and 860 SAAO, CF, Scientist of DAE, IAPP, and BRRI received training on Modern Rice Production, Communication and Office Management, Experimental design and Data analysis, healthy Seed production. Moreover, eight scientists received short term international training in IRRI, Philippines. BARI conducted training both locally and abroad to DAE officers and NGO personnel on seed production, and RA, CF, SAAO on crop production. About 22 scientists of BARI are now involved in IAPP. The line department scientists from BARI received foreign training from China and Malaysia. Senior scientists of BARI as well as officers from the Ministry of Agriculture and PMU participated in exposure visit program. Finally, BFRI carried out a three day long training programme for 1650 participants in 66 batches on Aquaculture, Pond Productivity, Fish Feed Formulation & Nutrition, Small Feed Meal Operation and Fish Disease Prevention

## **2. Component 2: Technology Adoption**

The implementing agencies under this sub component were the Department of Agricultural Extension (DAE), Department of Livestock Services (DLS), Department of Fisheries (DOF) & Seed certification Agency (SCA).

### **2.1. Department of Agricultural Extension (DAE):**

**Livelihood Field Schools (LFS) formation:** 7,200 LFSs, each with 25 members, have been established by Department of Agriculture Extension (DAE) against revised EOP target of 7200 (i.e. 180,000 members, including 60,000 women).

**Demonstrations:** On - farm demonstration have been organized on 42,333 farms against the EOP target 40,415 farms using different technology packages to promote the adoption of improved crop management practices for rice , wheat maize, oilseeds, pluses and high value vegetables. Most of the demonstration and adoption farmers are continuing growing these crops using the improved seeds demonstrated by the projet. Under the project, technology based production process and management of good agricultural practices has been demonstrated each year.

**Organized Agriculture Fairs and Field days:** promoted the dissemination knowledge & technologies among the farmers through the agriculture fairs (i.e., 29 events during the project period). The target for this activity was fully met (100% achievement). The main objective of fairs was to disseminate advance technologies, awareness buildup of the farmers, deliver information to other organizations. This type of event benefited the farmers through an open exchange of ideas, knowledge, and improved practices. This helped networking among the farmers in sharing knowledge on production practice, exchanging inputs and quality seeds, etc. For field days, the target was set at 3,000 days and 3,003 days were completed. Field days were mainly focused on the cultivation system, management of inputs, process and finally systematic harvesting including post-harvest management. These events were a good platform for agricultural information dissemination.

**Training & Capacity Building:** All farmers received training by the project during the project implementation period (100% achievement). In addition, 1050 SAAOs (each SAAOs attended two training courses), 92s officers of line agency and 55,810 selected farmers received additional training and participated to capacity strengthening activities in coherence with the implementation plan on training and capacity building.

**Seed Village Establishment:** DAE had planned to establish Seed village at each Upazila for promoting farmer-to-farmer seed exchange. The seed village farmers supported by the Project acquired adequate quality Foundation & Breeder seed. The project developed 246 seed villages which produced 12,960 MT of seeds against a target of 15, 0592 MT. The seeds produced included rice (around 80 %), wheat, mustard and pluses (Mung). Each seed village involved 50 farmers with 10 hectares land. The line department (DAE) established a seed storage in each district and the project provided seed preservation materials such as “IRRI cocoons” or Gunny bags with drums to the farmers for safe and secure community storage of seeds.

## **2.2. Department of Fisheries (DOF)**

**Group Formation:** The DOF had readjusted their group formation plan from the 1<sup>st</sup> DPP as well as group modality in different profession of groups such as Fish culture group (consisted of 25 members in each group), Cage Culture group (consisted of 10 members in each group), pen culture group (consisted of 50 members in each group) and Fry Trader Group (consisted of 25 members in each group). In total, 2,433 groups were formed benefitting 60,000 members (i.e., 100% achievement rate).

**Quality seed /fingerlings distribution to the grow-out farmers/group members:** The major intervention of this component was quality seed distribution to the grow-out farmers/group members. The DOF reached out to all 60,000 members (100% achievement rate).

**Farmers rally and Exchange visit:** DOF organized during the project period 22 Exchange visits. The exhibits of farmers rally and exchange visits focused on fish production, management practice, management of improved feeding & fingerlings fish farming, and integrated fish culture.

**Training & Capacity Building:** The project had a provision to enhance the skills and efficiency of the farmers regarding commercial species culture, carp Polyculture, cage/pen culture, etc. The IA had planned that a total number of 60,000 selected fish farmers of different categories will be trained at EOP in Union /Upazila level. This was fully achieved.

### **2.3. Department of Livestock Services (DLS)**

1. **Livestock group formation.** 3,000 livestock development groups (dairy, goat and poultry groups) were formed involving 60,000 farmers, 89% of which were women. PMU reported productivity increments (milk, live goats, eggs and live chicken) in about 50,652 farm families against a target of 48,000 farmers. Milk yield increased by 130%. Implementation of activities such as farmers' training, demonstrations of selective animal breeding, fodder cultivation, improved husbandry practices, and health care campaigns have been carried out as per schedule.

2. **Livestock Production and Productivity** Compared to non IAPP groups, milk productivity of cows in IAPP groups was reported to be 147% higher; household milk consumption nearly doubled (96% increase); and milk sales and earnings were 4 to 5-fold higher control, respectively.

**Farmer rally & award of rally at union level:** DLS organized 375 rallies during the project period, in addition to 108 exposure visits (100% achievements against EOP target).

**Fodder Nurseries Establishment:** A total of 54 fodder nurseries have been set up at Upazila level as demonstration purpose against the EOP target 54. In addition, 3,283 demonstration plots in cutting fodder supply were set up by project for the cow rearing groups (100% achievements against EOP target).

**Training & capacity building by DLS:** DLS organized 6 regional workshop the during the project period against the EOP target 6. In addition, 60,000 farmers distributed in 3,000 batches of 20 farmers received training on vaccination and deworming. The capacity of all Field Assistants was also strengthened through a yearly training

### **2.4. Seed Certification agency (SCA)**

SCA had the legal mandate for seed certification and performs two key roles with respect to the project operations: (i) variety testing service for varieties developed by research institutions for release to farmers; and (ii) seed quality testing service for seeds produced by institutional seed producers as well as farmers. Testing and certification by SCA was a necessary condition for seeds produced by farmers to be either traded in the market or supplied to other farmers through the BADC system.

1. Good quality seed is the key to high crop yield. Each year, Bangladeshi farmers suffers from huge yield loses due to use of seeds of below slandered quality, especially in major field crops including rice, wheat, pulses and oilseeds. Although the private seed sector maintains a satisfactory level of quality vegetable seed supply through domestic production and imports of mainly hybrid varieties, the quality seed supply situation is remaining a major problem in crop production sub-sector due to insufficient quality seed production capacity in the public sector and very limited capacity of the private sector.

2. IAPP farmers procured most of their seeds from demonstration farmers in IAPP seed villages (68.5% in Northern regions and 57% in Southern regions), followed by BADC seed dealers. BADC processed and distributed 3,546 tons of certified seeds against a target of 3,500 tons. SCA carried out field inspections of 40.6 tons and 50 tons of breeder seed of rice and wheat against a target of 30 and 50 tons respectively. DAE has established 246 seed villages, among which 87% are producing paddy seeds, representing about 18% of all the crop farms.

3. However, a number of sustainability issues pertaining to the seeds village were raised. Although SCA personnel conducted routine inspections and all seeds produced in seed villages were systematically tested for quality, it was noted that some farmers had difficulties maintaining the set of congenial circumstances necessary to keep quality seeds. While some farmer groups, both in the North and in the South, received certification from SCA that guarantee that their seeds met SCA quality standard, the TPE findings warned that the system of seed production in some of the seed villages would not remain effective after the project end unless adequate resources were made available to continue quality support. The opening of two seed testing laboratories toward the end of the project (one in the North and one in the South) operated by IAPP-SCA and recognized by NSB would significant contribute to sustainable seed testing activities

### **3. Component 3: Water Management**

1. This component has improved availability of irrigation water and efficiency use. It enabled farmers to increase cropping intensity, diversify crops, and reduce irrigation related risks and variability in crop production. The target increase area under improved irrigation was exceeded to about 27,750 ha versus a target of 25,000 ha. A total of 306 buried pipes were installed in project areas covering more than 208 km. More than 29,000 beneficiaries directly benefited from these schemes. Estimation shows: (i) 49% reduction water loss; (ii) 50% irrigation cost decrease; (iii) 123% irrigation area increase; and (iv) 60% production increase in both regions. Results were even more impressive with canal re-excavation (150 km long) with: (i) 150% irrigable land increase plus crop diversification; and (ii) more than 17,700 ha increase of irrigable land and 12,500 beneficiary farmers. Re-excavation of canal has improved conveyance system of tidal water in the south and removed water logging and more inundated land came under cultivation.

2. The Water Users groups were well functioning, with opened savings accounts and member contributions covering the costs of regular system maintenance. However, there was a targeting issue regarding the installation of rain water harvest system. In the south where scarcity of safe drinking water was an acute problem of the communities, the project installed more than 1,600 household rain water harvest storage systems in Patuakhali and Barguna districts. A total of 8,200 people benefited from this rain water harvest system as a result of relevant adaptation in the technology. In fact, according to the project design, rain harvesting systems were to be provided to households that had roof plate so that rain water could be harvested into a water tank. However, during implementation, the project realized that most of the intended beneficiaries (i.e., marginalized poor people) did not have a house with roof plates/GI sheet. Thus, the project decided to provide rain water facilities with small roof plate and also collected rain water using the rain water harvesting system. Throughout the project life, 1,280 farmers, seed dealers and technicians received capacity building training from the project.

## Annex 3. Economic and Financial Analysis

### I. Context

The PDO of IAPP was “to enhance the productivity of agriculture (crops, livestock and fisheries) in pilot areas. These areas lie in the districts of Rangpur, Kurigram, Nilphamari and Lalmonirhat in the North and Barisal, Patuakhali, Barguna and Jhalokathi districts in the South. The key indicators of the achievement of this objective were to be the productivity of paddy, productivity of milk, productivity of fish and the numbers of farmers who had achieved productivity increases in one of these outputs. The overall project costs were estimated at US\$ 63.81 including financing from Government of Bangladesh for US\$ 17.5 million and funds from GAFSP of US\$ 46.31 million. In addition, GAFSP financing of US\$ 3.69 million was allocated for Technical Assistance to be provided, under supervision from FAO. The resources supervised by the Bank were allocated to four components with the relative base costs, as shown below.

Component	Base Cost (US\$ '000)	Percentage
1. Technology Generation	7.57	12%
2. Technology Adoption	35.15	59%
3. Water Management	11.71	19%
4. Project Management	5.26	9%

The project was designed to benefit 295 000 farmers. The benefits to those farmers were to be in the form of increased productivity that is higher yields, as the result of project investments.

### II. Methodology

Approach to the Analysis. In order to calculate the actual financial and economic benefits of IAPP for the Bangladesh economy and the affected households in the project area, crop models were developed for *boro*, *aman* and *aus* rice, for mung beans, maize, wheat and mustard. Livestock models were made for improvements to cows, goats and chick production. Models for fisheries included tilapia, pangus, koi and carp in ponds pens and cages. Fisheries and crops models were also made for when they were combined with the various water management improvement regimes resulting from IAPP investments. For investments made to improve water management, scheme models were made to estimate benefits accruing from: (i) buried pipes, (ii) canal re-excavation, (iii) pond re-excavation, (iv) pump renovation, and (v) water harvesting tanks. Using FARMOD software this resulted in a total of 26 different crop or activity models to represent the basic activities that farmers in the project districts engage where practices changed as the result of project initiatives in crops, fisheries, livestock and water management.

With those crop and activity models, 22 farm models were composed made for the farms in the districts of the northern Rangpur Division and the farms in the southern Barisal Division according to the farm size and the cropping patterns introduced by the project on the respective farm sizes in the North and South. Returns from these investments were then aggregated by sub-component and for the project as a whole. A sensitivity analysis was undertaken to determine the impact of reductions in adoption rates, output prices, or both.

The incremental financial costs and benefits ‘with’ and ‘without’ the project were analysed, including all IAPP actual costs investment costs financed by GAFSP incurred under World Bank supervision, actual Technical Assistance costs incurred under FAO supervision, costs financed by GoB and costs incurred by beneficiary farmers.

Data sources. For the most part the information and data used to undertake the financial and economic analysis for the ICR was taken from the IAPP monitoring and evaluation system. IAPP data that was used came from all eight districts included in the project. In the North these included, Rangpur, Kurigram, Nilphamari and Lalmonirhat. In the South they included Barisal, Patuakhali, Barguna, and Jhalokathi. The key parameters that came from the project M&E system were verified by checking for accuracy against several other available sources. Yield data used in the analysis were yields reported by farmers to researchers or project staff, not yields measured. The sources included: (i) local officials and beneficiaries interviewed during the ICR field visit in October 2016; (ii) the Impact Assessment of IAPP commissioned by the PIU; (iii) the baseline, mid-term and endline evaluation reports of IAPP produced by the Development Impact Evaluation (DIME) group (iv) the Third Party Validation of data Collection and Monitoring Activities of IAPP; and (v) the FAO study of IAPP in 2013 entitled ‘Financial and Economic Analysis of Buried Pipe Networks’.

Key Parameters and Assumptions. The economic rate of return was calculated using a discount rate of 10%. This downward revision from 12% to 10 % was done in the light of recent Bank guidelines on this matter, and it reflects the current view that prospects for growth, investment and consumption in the Bangladesh economy at the moment are improved over those foreseen at the time of Appraisal in 2011. The 10% rate is high in the Bangladesh context, and it has been used in other Bank project analysis recently to portray a ‘pessimistic’ scenario. This is in line with the conservative approach taken here at Completion to valuing the costs and benefits of the investment over the long term. In order to transform financial prices into economic prices standard conversion factor of 0.9 was used to adjust financial values to economic values taking into consideration import/export parity prices. In addition, slightly lower rates of 0.8 for grains and 0.7 for labour. All costs and benefits have been valued at 2016 values by adjusting actual expenditures with the Consumer Price Index of the Bangladesh Bureau of Statistics.

Available reports differ with respect to the reported yields obtained by marginal and small farmers in the eight project districts before and after infrastructure investments and farmer adoption of the practices recommended the IAPP project. Therefore, to avoid any possibility that the financial and economic analysis overstates the actual productivity gains achieved by the farmers who participated in the project, the FEA was done using the highest average value for yields obtained by farmers in the ‘without project’ scenario. At the same time it used the lowest reported average value for yields obtained in the ‘with project’ situation.

For example, for *boro* rice, the FEA ‘without project’ scenario the yields for *boro* rice were set at the higher figure of 5.450 kg/ha (from the Results Framework baseline revised at the mid-term review), rather than 5,200 kg/ha (from the yield used at the time of IAPP design), or the 2,200 kg/ha (from the baseline as set in the original IAPP Results Framework). At the other end of the spectrum, for the ICR the analysis was done using the lower reported yields for *boro* rice from among the various sources. The FEA used the 5 700 kg/ha that DIME found to be the mean yield in its endline survey, rather than the 6 300 kg/ha observed by the IAPP M&E unit and reported in the Results Framework. For *aus* and *aman* rice yield sources reporting increases of 14% were used, whereas most other sources found that these yields had increased relatively more depending on the baseline used.<sup>6</sup>

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<sup>6</sup> For reference, see attached table for showing yields used in the purpose of this FEA.

On adoption rates, the IAPP M&E system and the IAPP Results Framework report that of the total 250 000 farmers who have benefitted in some way from the some project investments about 180,000 people have adopted improved crop varieties or cropping practices promoted by IAPP. However, in order to compensate for any overly optimistic reporting on what constitutes having adopted an improved crop variety, this analysis assumed that only two-thirds of those farmers, or some 120 000 of those farmers have adopted and are getting the full benefits and have sustained production at levels recorded by the project in the various production models. In a similar vein, based on project progress reports, the analysis assumes that the project took sometime to become fully operational and to make improved seeds and other practices available to farmers. Therefore, the realization of benefits from improved practices at the farm level starts only in PY3 and then increases gradually through PY4 with full realization of improved yields only in PY5.

Farms sizes, as classified by the project are marginal, with a farm size ranging from 0.5 to 1.49 acres (0.20 to 0.60 ha) or small with a farm size from 1.5 to 2.49 acres (0.61 to 1.00).

The following table summarizes the basic assumptions on the key parameters used in the analysis.

Key Assumptions & parameters

Project life	20 years
Standard Conversion Factor	0.90
Discount rate	10%
Famers Adopting	120 000
Benefits phased over	3 years
Benefits accrue over	20 years
Marginal farm size	0.4 ha
Small farm size	0.8 ha
<i>Cost (US\$ million)</i>	
GAFSP World Bank	41.02
GAFSP FAO	3.69
GoB	17.18

### III. Expected Efficiency at Appraisal

The FEA done of IAPP as an investment during the Appraisal of the project quantified benefits that the project expected to generate from:

- (i) 12-29% increase in the productivity of major crops in 175 000 farms;
- (ii) 25-60% increase in animal productivity for milk and meat in 60,000 farms;
- (iii) 21% increase in fish productivity in 60,000 fish farms; and,
- (iv) 25 000 ha, or about 50 000 farms with improved efficiency of water use and increased irrigated area.

These benefits were to be generated primarily through improved, tested agricultural crop, livestock and fisheries technologies and practices together with improved irrigation water management. Adoption of improvements was to be subsidized and intensively propagated through a network of 10,000 demonstrations, linked to adoption groups in the project area. In addition, water management infrastructure improvements would make a significant contribution.

The analysis at Appraisal assumed that only 80% of the 175 000 targeted farmers would be directly impacted by the project and sustain their increased productivity. Overall, the project beneficiaries

were to include women (20%), landless households (HHs) (7%), agricultural labor HHs (24%) and small farm holders (81%).

Benefits that were to expected accrue to farmers outside project sites were not included in the analysis, but were predicted to be sizable, such as those that would come from the planned increase in the annual certified seed production of quality seed by 3500 MT is estimated, for instance, that would be accessible by some 400,000 farmers in the project and neighboring districts.

At Appraisal it was estimated that the overall economic rate of return (ERR) for IAPP would be approximately 21.4% with a Net Present Value of USD 35.5 million, at a discount rate of 12%, including costs and benefits from all sources. Annual financial benefits were projected to be about USD 23.7 million.

#### IV. IAPP Actual Benefits and Efficiency at Completion

At Completion, the overall economic rate of return (ERR) for IAPP is estimated at approximately 37.9% with a Net Present Value of BDT 10 277 million (US\$ 138 million). Annual financial benefits were projected to be about BDT 12 770 million (US\$ 163 million). As seen in the table below comparing FEA results at Appraisal and Completion, the efficiency of the use of the funds and the overall positive impact of the investment is quite high, especially considering that conservative data were used in FEA calculations at Completion.

	Appraisal	Completion
ERR	21.4%	37.9%
NPV	USD 35.3 million	USD 138 million
Financial Benefits	USD 23 million	USD 163 million

An analysis of the FEA results undertaken to test the extent to which the results would be sensitive to eventual changes in the output prices and adoption rates. The ERR of the project would decline to 26% in the case of reductions of 20% in both output prices and adoption rates, for example if global rice prices were to fall and if farmers were thus no longer interested in using higher yielding varieties or improved seeds were no longer available. The results of the sensitivity analysis are shown below.

Output Prices	Adoption Rates	
	Base case	< 20% Adoption
Base case	37.9%	32.7%
< 20% Prices	30.4%	26.0 %

The returns for the various sub-components within the Technology Adoption Component and for the Water Management Component are shown below. As above, approximately 59% of investment was made in Technology Adoption, about 19% in Water Management, and some 12% in Technology Generation. The relative share of resources by investment component at planned at Appraisal has remained as foreseen, hence the actual allocation remains the same at Completion.

	ERR	NPV
Technology Adoption	%	USD
• Crops	39.4%	4,856
• Fisheries	24.2%	520
• Livestock	58.1%	1,697
Water Management	50.1%	4,139

Infrastructure and technology. Among project components, rates of return were highest for investments in water management. The relative efficiency of the IAPP investments in water management at the level of the economy was derived from primarily from more efficient water use at the level of the individual farmers. As a result of improvements in water management infrastructure, less water is now being used to irrigate the same area of land, lowering financial costs to farmers. At the same time, saved water was available to irrigate additional contingent areas, resulting in the expansion of total cultivated area and in many cases moving from single cropping to double or even triple cropping. For re-excavated canals, for example, IAPP investments reduced the per hectare cost of irrigation by almost 50% from BDT 9450 (US\$ 121) to BDT 4940 (US\$ 63). This increased cropped areas by as much as 30% with the cropping rate of the typical 150 ha scheme increasing from 153% to 186%.

Income effects. In the ‘with’ project scenario farm households adopting practices or introduced technology recommended by IAPP have had led to increases in incomes ranging from 35-55% above the ‘without’ project scenario. This translated into mean income increases ranging from BDT 7 769 (US\$ 100) for what are referred to as ‘marginal’ farmers ( 0.2-0.6 ha) in the South growing only *aman* rice on plot sizes averaging 0.4 ha to BDT 19 227 (US\$ 247) for the slightly better off ‘small’ farmers in the North growing *boro* and *aman* rice on 0.8 ha. These increase are significant when considered in relation to the poverty line that was cited at Appraisal to be US\$ 195 in the project districts at 2011 prices.

Outreach and costs per beneficiary. At project completion an amount of US\$ 46.23 million equal to 99% of the US\$ 46.31 million GAFSP financing has been disbursed. These funds, that were to have resulted in productivity gains for some 236,000 farmers (that is, 80% of its 290 000 target group), actually sufficed to result in productivity increases for 250 000 farmers. Thus lowering the actual per beneficiary cost of the overall investment from US\$ 196 to US\$ 185. This is an additional indicator of the efficient management of GAFSP resources.

Other Benefits. Several additional benefits for the economy of Bangladesh are reported to have been generated by the project, but not quantified in this analysis. Among the most notable of these are benefits generated by increased food availability and improvements to the environment.

Environmental benefits include, for example, reduction of waterlogging over an area equivalent to 46 km<sup>2</sup> area in Rajarhat, Kurigram in 2016 alone as a result of canal re-excavation schemes, Re-excavation schemes have also opened up transport by small boats saving transport costs. Technologies adopted by farmers have contributed to environmental improvement through the reduction in use of agro-chemicals with integrated pest management practices have been adopted by around 130,000 farmers. Soil health has been improved by some 76,000 farmers producing vermin-compost and 36,000 farmers producing green manure. Resilience to climate change has increased as a result of the introduction of salt and drought tolerant rice varieties and more efficient water use with investments in buried pipes that have also contributed to ground water recharge and prevented salt water intrusion.

Project activities also generated benefits with respect to total availability of food and continuity of income year round as well as increased diversification of production into pulses and oilseeds. The Impact Assessment commissioned by IAPP found that crops producers, for example, that over 98% had increased overall food consumption levels as the result of the project. According to the FEA models total output of rice alone from the project area will have increased by well over 100 000 tons over the project life.

## Annex 4. Grant Preparation and Implementation Support/Supervision Processes

### (a) Task Team members

Names	Title	Unit
Toufiq Ahmed	Operations Officer	GFDRR
Mohammad Baharul Alam	Senior Executive Assistant	SACBD
Parthapriya Ghosh	Senior Social Development Spec	GSU06
Blair Edward Lapres	Economist	GTCCS
Yuka Makino	Sr Natural Resources Mgmt. Spe	GSU18
Nicole Andrea Maywah	Consultant	GEN01
Mohinder S. Mudahar	Consultant	GWA01
Jose Ramon R. Pascual IV	Senior Counsel	LEGCF
Venkatakrishnan Ramachandran	Program Assistant	GFA12
Ousmane Seck	Senior Rural Development Speci	GFADR
Animesh Shrivastava	Program Leader	ECCU8
Paul Singh Sidhu	Consultant	GFA12
Sugata Talukder	Operations Analyst	GFA06
Suraiya Zannath	Lead Financial Management Spec	GGO24
<b>Supervision/ ICR</b>		
Manievel Sene	Sr. Agricultural Specialist	GFA12
Ramziath Adjao	Agricultural Economist	GFA12
Rohan Selvaratnam	Operations Analyst	GFA12
Sugata Talukder	Operations Analyst	GFA06
Chase Palmeri	Consultant	GFA12

### (b) Staff Time and Cost

Stage of Project Cycle	Staff Time and Cost (Bank Budget Only)	
	No. of staff weeks	USD (including travel and consultant costs)
<b>Lending</b>		
FY'11	17	63,686
<b>Total:</b>	17	63,686
<b>Supervision/ICR</b>		
FY'12	8	25,571
FY'13	-	600
FY'14	-	0
FY'15	-	5,529.85
FY'16	3.45	6,193.70
<b>Total:</b>	11.45	37,894.55

## **Annex 5. Summary of Grantee's ICR and/or Comments on Draft ICR**

**Background:** In spite of achieving self-sufficient in the production of staple food –rice, Bangladesh faces considerable challenges: agricultural production in the Rangpur and Barisal regions are severely constrained in multiple ways such as on the shelf technologies, adapted to the relevant agro- ecologies, are not available of quality seeds / breeds and effective extension water management investments / practices reduce productivity, diversity and intensify of agricultural production. In view of this situation, the Ministry of Agriculture of the Government of Bangladesh took a project initially for five years in the name of Integrated Agricultural Productivity Project (IAPP).

**Objectives:** The overall objective of the IAPP is to enhance the productivity of agriculture (crop, livestock and fisheries) in specific agro-ecologically constrained and economically depressed areas. These include the salt-affected and tidal surge areas in the south and flash- flood prone and drought-prone areas in the north. The main objectives include productivity increase in selected crops, fish and livestock; increased cropping/production intensity; and diversified production and food consumption base for the targeted households. These objectives are expected to be achieved through interventions that lead to release of improved/adapted varieties at the farm level, greater availability of quality “seed” (for crop, fisheries and livestock) at the farmer level, better agronomic and husbandry practices, improved plant and animal health regimes, formation of productive assets and skill among the beneficiaries through group methods.

The specific Component wise objectives of the project are:

- 1: Technology Generation and Adaptation Component: to develop and release improved varieties, relevant technologies and management practices for farmers use in the selected project areas;
- 2: Technology Adoption Component: to enable project area farmers to adopt improved varieties / breeds and management practices for crops, livestock and fisheries;
- 3: Water Management Component: to increase the availability of irrigation water and efficiency of its use by project area farmers;
- 4 : Technical Assistance (TA) and capacity Building Component: to develop public sector capacity for programme development in agriculture and food security to build implementation capacity of key agencies through training and institution building support and enable effective implementation of the project, and
- 5: Project Management Unit Component: to coordinate project planning, implementation, monitoring and evaluation, in line with the relevant fiduciary and safeguards

**Project Location:** The project covers two regions. The south Barisal Region includes Barisal, Jhalokathi Patuakhali and Barguna district; and the north Rangpur Region includes Rangpur, Kurigram, Nilphamari and Lalmonirhat district. It covered 54 upazilas and 375 unions of the 8 districts of the project area.

**Implementation period:** Initially the implementation period was 5 years but finally It was extended upto 5.75 years. It was started on 1 July 2011 and closed on 31 March 2017.

**Project Components:** The project has 5 interrelated components. The interrelated components are: Component-1: Technology Generation: (a) Bangladesh Rice Research Institute (BRRI), Ministry of Agriculture (MOA), (b) Bangladesh Agricultural Research Institute (BARI), MoA, (c) Bangladesh Fisheries Research Institute (BFRI), Ministry of Fisheries and Livestock (MOFL); Component-2: Technology Adoption (a) Department of Agriculture Extension (DAE), MoA, (b) Bangladesh Agricultural Development Corporation (BADC), MOA. (c) Seed Certification Agency (SCA), MOA , (d) Department of Fisheries (DOF), MOFL (e) Department of Livestock Services

(DLS), MOFL (f) Community Mobilization, MoA; and; Component-3: Water Management: Bangladesh Agricultural Development Corporation (BADC), MOA; Component -4: Technical Assistance and Capacity Building Component: Food and Agricultural Organization (FAO) of UN and Component-5: Project Management: (a) Project Management Unit (PMU), MOA and (b)Regional Project Implementation Unit (RPIU), MOA.

### Project Cost and Financing:

Total project cost was US\$ 67.50 million, jointly financed by the Government of Bangladesh (GoB) 17.50 million, and the Global Agriculture & Food Security Programme (GAFSP) US\$ 50.00 million:(RPA US\$ 46.31 million and DPA US\$ 3.69 million) .

### Budget and Expenditure:

Component wise budget and expenditure are given below:

Components	Budget as per RDDP (US\$ Million)	Budget as per RDDP (in lac BDT)	Expenditure (In lac BDT)
Component1:Technology Generation and Adaptation (BRRI,BARI & BFRI)	7.57	5398.35	5273.58
Component 2: Technology Adoption (DAE, DLS, DOF, SCA CM & BADC (Seed)	35.15	29719.39	28826.09
Component 3: Water Management (BADC)	11.71	8489.98	8438.71
Component 4 : Technical Assistance (TA) and capacity Building (FAO)	3.69	2831.79	2826.89
Component 5: Project Management (PMU & RPIU)	5.26	5406.21	3694.94
Physical & price contingencies	4.12	-	-
Total Project Cost	67.50	51845.72	49060.20
Co-financing, Recipient	17.50	12950.00	12615.06
GAFSP Financing:			
RPA	46.31	36063.92	33618.25
DPA	+ 3.69	+2831.79	+2826.89
Total	=50.00	= 38895.72	=36445.14

**Number of beneficiaries:** The actual number of agency wise beneficiaries are: DAE total: 180000 of which 60000 female; DOF Total: 60000 of which female 12288; DLS Total: 60000 of which 53397 female; BADC Total: 51690 of which 7130 female.

**Achievement:** The efficiency as per result frame work and achievement at the end of the project are summarized below:-

**Varietal development and performance of modern variety of rice:** Five varieties viz., BRRI dhan61, BRRI dhan67 (saline tolerant boro varieties) BRRI dhan62 (short duration T. Aman with moderate Zinc content), BRRI dhan65 (moderately drought tolerant broadcast Aus variety) and BRRI dhan66 drought tolerant Aman variety) have been released by BRRI. Three hundred fifty up scaling demonstrations were conducted at farmer's fields for the existing technologies. In total, 1460 PVS (Participatory Variety Selection), adaptive, validation, demonstration and other management trials of different categories have been conducted. BRRI produced and supplied about

38 metric tons of breeder seed to BADC for seed multiplication and DAE for distribution to the farmers.

**Yield performance of modern variety of rice:** Crop productivity of paddy (Boro yield 6730 Kg/ha), T. aus yield 5187 Kg/ha and T. aman yield 4660 Kg/ha against EOP Target 4560, 3300 and 3300 Kg/ha, respectively).

**Varietal development and performance of wheat, pulses, maize and mustard:** BARI has developed 10 crop varieties viz., wheat (4), pulses (3), maize (2) and mustard (1) during the project period. BARI Gom 27 (Drought and heat tolerant), BARI Gom 28 (highly tolerant to heat), BARI Gom 29 (Heat tolerant & rust disease resistant), BARI Gom 30 (Heat tolerant & rust disease resistant), BARI Sharisha 17 (short duration), BARI Masur 8 (resistant to blight & rust), BARI Mung 7 (Short duration), BARI Mung 8 (short duration & YMV resistant), BARI hybrid Maize 12, BARI hybrid Maize 13. BARI produced 124.5 MT breeder seed and handed over to BADC during the project period (Wheat 50.00 MT, Oilseed 21.00 MT, Pulses 24.50 MT and Maize 29.00 MT).

**Development of Improved generation of fishes:** Nine Improved generation; BFRI GIFT 4 (F-4, F-5, F-6 & F-7), Thai Koi 3 (F-1, F-2 & F-3) and Thai Pangus-2 (F-1 & F-2) were developed for disseminating of these improved generations for IAPP farmers use in greater Rangpur and Barishal region. Average fish productivity 5420 Kg/ha against EOP target 3400 Kg/ha.

**Increase Productivity of crops and changes in cropping pattern:** Productivity of rice increases: 15 -57% depending on of crop type and variety and reduced poverty. Rice based cropping pattern became dominant where some new crops like pulses, oilseeds, wheat, vegetables, potato, maize and cucumber were gradually introduced in the cropping patterns. An emerging cropping pattern is cucumber- aman- potato, being practiced in Northern region. Wheat production was increased tremendously by replacing boro in both Southern and Northern region. Besides, vegetable cultivation on homestead was 1.2 decimals in 2011-12, which increased steadily to 2.9 decimals.

**Formation of LFS:** 7246 no of Livelihood Field School (LFS) has formed by DAE throughout the project period for Demonstration and technology adoption. Adaptation of improved crop varieties by farmers was DAE-180000 i.e. achieved 102.85 %, an additional 200 LFS of 5000 farmers were formed).

**Seed village and Seed processed centre:** A total number of 246 seed villages had been established by which 12,000 MT seed is distributed in community level. Certified seed processed in new facilities by BADC was 3546 MT i.e. 101% achieved against EOP target 3500 MT.

**Use of high yielding variety of seeds:** At the baseline year (2011) of the project, most of the farmers (81.87%) used seeds of local varieties of crops and no seed village was formed. Due to project interventions, users of local seeds had been drastically reduced at 5.37% in the end line (2016) with the decrease of 93.44% over baseline year. Conversely, the proportion of farmers using HYV seeds had been increased at 62.21% at the end line (2016) with the increase of 576% over baseline year (2011).

**Use of Machineries by LFS:** The highest 50% LFS members received power tiller from DAE component of the project, which was followed by shallow tube well (STW) and low lift pump (LLP) as reported by 13% for both and the lowest 14% LFS members received power thresher. On the other hand, about 19% LFS members received other machineries such as sprayer, weedier, electrical weighing machine, rice reaper etc.

**Demand of labour increases:** Considering the overall average of the IAPP areas, about 38.82% additional demand of day labor in others' agriculture field had been created. In this case, about

42.06% crop farmers involved as day laborer in others' agriculture farms in the baseline year (2011), which was increased 57.78% in the end line (2016) with the increase of 37.37% over the baseline year.

**Income increase by fish culture:** Considering the overall average of the IAPP areas, about 97.28% annual income from fish culture had been increased over baseline year (2011) of IAPP. In this case, the annual income for fish farmers in the baseline year (2011) was about Taka 72,188/ ha, which was increased at Taka 1,42,418/ha in the end line (2016) with the increase of 97.28% over baseline year.

**Milk productivity increase:** Milk productivity achieved 2.86 litres / day / cow against EOP 2.2 litre /day/cow i.e. increased 130%.

**Improved irrigation system:** Total irrigation area expands 27750 hectar by implementing various type of activities, where 7995 nos. of farmers involved with modern irrigation technologies. By construction of 306 nos. (207.64 km) of buried pipe line improved irrigation water distribution system. Improved tidal water conveyance system and reduce of ground water use by re-excavation of 150 km canal and 130 nos. pond. A total nos. of 1640 Rain Water Harvesting (RWH) system established for harvesting rain water for drinking and households consumption. After completion of all activities, irrigated area increases 20 % and reduced irrigation cost 55%. Area come under improved irrigation is 27750 ha i.e. 111% achieved against EOP target 25,000 ha.

**Cost / Benefit Analysis:** The efficiency of IAPP has been measured both quantitatively and qualitatively. The quantitative efficiencies are reported in the outputs/ achievements were validated by the economic and financial analysis conducted for the project. Increase in crop productivity, decrease in Agricultural production variability, reduced production cost and increase milk, egg and fish productivity as well as income of the target farmers have been increased and achieved as per EOP achieved.

Name of the crop	NPB (Taka)	IRR (%)	BCR
Boro	239914	52	1.65
Aus	160023	36	1.96
T.aman	165023	39	2.11
Wheat	189989	30	1.61
Maize	354098	50	2.47
Mungbean	236697	52	2.60
Mustard	137590	31	1.65
<b>Name of the fishes</b>			
Telapia	1989276	35	1.25
Pagas	1660966	36	1.29
Thai-koi	1256337	44	1.38
Carp	1250279	38	1.37

**Development of Entrepreneurship:** Entrepreneurship has developed in milk, quality seed, fodder, vermi-compost, fish production, processing and marketing. Women are especially involved in these sectors.

**Stakeholders benefited by training:** 93% of stakeholders have been benefited from trainings, tours, guidelines and tools on sectoral planning and strategy provided by the project.

**Preserve food in household increases:** On an average of the IAPP areas, the days to preserve food in household was 190 days in baseline year (2011), whereas it was increased at 267 days after completion of the project (2016) with the increase of approximately 40.34% over baseline year.

**Knowledge and skill of farmers increase:** A large number of extension activities i.e. technology based training, technology demonstration, exposure visit, field day, technology fair, vaccination & de-worming campaign, artificial insemination program, etc were implemented at farmers level. As a result of these activities, the knowledge and skill of farmers group on modern improved varieties of crops and fishes, modern production technologies, rearing practices of livestock have been increased.

**Empowered the rural women:** Through the developed technologies in the areas of crops, livestock and fishery helped greatly in motivating the women for adopting home gardening, seed preservation and processing, cattle, goat and poultry rearing, fish culture, vermin- compost and fodder production, which enhanced participation and empowered the rural women and proved their services as profitable investment. The project focused on women empowerment by increasing their skills, technological knowledge and income through training and demonstration support from the project. On an average, 33.33% crops (60,000), 20% of fisheries (12288), 89% livestock (53397) and 14 % of water uses group members (7130) are women farmers. They are actively involved in the implementation process of project activities focusing on empowerment and establishing rights on decision making in technology selection, production process and influence the decisions to market their products. Involvement in production activities offered the women self-reliance in economic activities; accelerated the agricultural productivity, increased access to markets for fresh and quality agricultural products. Due to identification and implementation of women need based technologies, providing training, exposure visits, demonstration, study tours and mobilization of group formation and special training on seed production, processing and preservation in poly-lined sacks with proper tag; women farmers in different groups have been storing rice, pulses, wheat, mustard and vegetable seed from demonstration plots as well as their own crops seeds through these activities. Women empowerment has been established through their income generation, farm decision making and utilization of their own income.

**Environmental impact:** IAPP activities with environmental implications include: promotion of increased production of selected annual crops and livestock associated with pesticides use and waste management issues, water management activities, minor construction and refurbishing. Project environmental impacts may include soil and water quality changes from use of agro-chemicals, vermi-compost, FYM; change in cropping pattern, and crop production; changes to aquatic ecosystem from excavation / de-siltation activities, increased usage of surface water; conversion of fallow land to agricultural usages; loss of native biodiversity; and minor construction impacts. These activities are not expected to cause any significant negative or irreversible changes in the environment.

Boro rice is a water loving crop. For production of 1 Kg Boro rice, requires about 3200 litres of irrigation water. Most of the cases, underground water used for irrigation boro rice field. Excessive use of ground water for irrigation accelerates depletion of ground water table and leads to desertification. Moreover, huge Methane (CH<sub>4</sub>) gas produces from submerged boro rice field, which is very much harmful to damage ozonosphere as well as environment. In project area, especially, in the north and south regions, boro area is reduced and replaced by wheat, maize, potato, mustard, mungbean and vegetables, which requires less water for irrigation. These help to preserve ground water, hinders depletion of ground water table as well as desertification, and save environment. Re-excavation of canals helps to conserve water, which is used for crop production, duck rearing, fish culture, and domestic needs. It supplies water for plants and animals and create

green vegetations as well as favourable environments for living beings. In some cases, it is used as drainage channels and leads to remove water logging. Thus helps to improve and save environment.

**Social Impact:** In the project areas, construction of seed storage go down, re-excavation of ponds and canal, construction and repairing of village road on the bank of the canals, construction of milk selling centre's, already been done. In these cases, Government khas land is used, and in case of private land, the lands are handed over to authority and LFS groups by deed. So, no land litigation exists in these project activities. Even there is less probability of land litigation in future. It creates a long term positive social impact in the project areas.

**Sustainability of the project:** Sustainability is the continuation of best activities/practices of the project that generate positive results after termination of the project. Capacity building of the LFS in the form of skills, knowledge, group managements and communication with extension service providers has been improved. 3000 Common Groups comprising 60,000 livestock farmers, 2292 group of fishery farmers with 60,000 members, 605 water user group with beneficiary 43650 were registered. DAE,. DOF,DLS, BADC have regular setup for take over the responsibilities to provide technical assistance, co-operation and monitoring LFS farmers will get financial support (Credit) from Pally Sanchaya Bank. These will helpful for sustainability of the LFS groups activities.

**Alleviate / reduce poverty and sustained economic growth:** The development of agricultural new technology packages on crops and fishery, skilled human resource with improved facilities, and research management would have important role in augmenting agricultural production and productivity. Increase in productivity of crops, livestock, fishes, vermi-compost. Quality seeds and marketing of these products increase the income of the farmers. Women participation and involvement in production and creation of new work opportunities also leads to increase income and reduce poverty. The continued improvement in agricultural productivity could play a complementary role to the GOB efforts to alleviate/reduce poverty and sustained economic growth. Due to implementation of the project, the productivity of crop, fishery and livestock commodities has been increased substantially and the household income of project targeted farmers also increased over baseline. The increase of productivity and income created a substantial impact on poverty reduction.

## **Annex 6. List of Supporting Documents**

1. Project Appraisal Document
2. Aide Memoires and ISRs after implementation of support missions
3. Management letters after implementation of support missions
4. Bangladesh Country Assistance Strategy FY2006-09
5. Bangladesh Country Partnership Strategy FY2011-14 (extended to FY2015)
6. Bangladesh Country Partnership Framework FY2016-20
7. Bangladesh Country Investment Plan, 2011
8. Financial Management Manual
9. Environmental and Social Management Framework
10. Government project completion report
11. Annual reports of M&E (PMU)
12. DIME Baseline Report (WB)
13. DIME Midline Report (WB)
14. DIME Endline Report (WB)
15. Impact Assessment of M&E and DIME (Consultant)

# MAP

