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Report No: PAD2488

INTERNATIONAL BANK FOR RECONSTRUCTION AND DEVELOPMENT

PROJECT APPRAISAL DOCUMENT

ON A

PROPOSED LOAN

IN THE AMOUNT OF US$172.20 MILLION

TO THE

REPUBLIC OF INDIA

FOR THE

ANDHRA PRADESH INTEGRATED IRRIGATION AND AGRICULTURE TRANSFORMATION PROJECT

SEPTEMBER 29, 2018

Agriculture Global Practice
South Asia Region

CURRENCY EQUIVALENTS

(Exchange Rate Effective: April 15, 2018)

Currency Unit = Indian Rupees (INR)

INR 65.2 = US$1

FISCAL YEAR
April 1 – March 31

Regional Vice President: Hartwig Schafer

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ABBREVIATIONS AND ACRONYMS

AAP	Annual Action Plan
AET	Annual Actual Evapotranspiration
ANGRAU	Acharya N. G. Ranga Agricultural University
AP	Andhra Pradesh
APCBTMP	Andhra Pradesh Community-Based Tank Management Project
AP-FMIS	Andhra Pradesh Farmers Management of Irrigation System
APIIATP	AP Integrated Irrigation and Agriculture Transformation Project
BRO	Budget Release Order
CADA	Command Area Development Authority
CAG	Comptroller and Auditor General
CBP	Capacity-Building Plan
CFMS	Comprehensive Financial Management System
CHC	Custom Hiring Center
CNA	Capacity Needs Assessment
CPF	Country Partnership Framework
CRIDA	Central Research Institute for Dryland Agriculture
CSA	Climate-Smart Agriculture
CSIP	Cascade System Improvement Plan
CWB	Crop Water Budgeting
DAO	Divisional Account Officer
DBOT	Design, Build, Operate, and Transfer
DPD	District Project Director
DPMU	District Project Management Unit
DPR	Detailed Project Report
EA	Environmental Assessment
EFC	Empowered Finance Committee
EMP	Environmental Management Plan
ERR	Economic Rate of Return
ESMF	Environment and Social Management Framework
EWSA	Effective Water Spread Area
EX-ACT	Ex Ante Carbon Balance Tool
FAO	Food and Agriculture Organization
FM	Financial Management
FMM	Financial Management Manual
FPO	Farmer Producer Organization
GDP	Gross Domestic Product
GeM	Government e-Market
GHG	Greenhouse Gas
GIS	Geographic Information System
GoAP	Government of Andhra Pradesh
GoI	Government of India
GRS	Grievance Redressal System
GSDP	Gross State Domestic Product
GST	Goods and Service Tax
ICAR	Indian Council of Agricultural Research
ICDP	Integrated Cascade Development Plan

ICRISAT	International Crops Research Institute for the Semi-Arid Tropics
ICT	Information and Communication Technology
INDC	Intended Nationally Determined Contribution
INM	Integrated Nutrition Management
IPF	Investment Project Financing
IPM	Integrated Pest Management
IUFR	Interim Unaudited Financial Report
KPI	Key Performance Indicator
KVK	Krishi Vigyan Kendra
M&E	Monitoring and Evaluation
MIS	Management Information System
MLE	Monitoring, Learning, and Evaluation
NCB	National Competitive Bidding
NICRA	National Innovations on Climate-Resilient Agriculture
NPV	Net Present Value
O&M	Operation and Maintenance
PDO	Project Development Objective
PGM	Participatory Groundwater Management
PHM	Participatory Hydrological Monitoring
PIM	Participatory Irrigation Management
PIP	Project Implementation Plan
PMKSY	Pradhan Mantri Krishi Sinchai Yojana
PMU	Project Management Unit
PPP	Public-Private Partnership
PPSD	Project Procurement Strategy Document
PSC	Project Steering Committee
RFB	Request for Bids
RKVY	Rashtriya Krishi Vikas Yojana
SCD	Systematic Country Diagnostic
SDG	Sustainable Development Goal
SO	Support Organization
SORT	Systematic Operations Risk-Rating Tool
SPD	State Project Director
SMSRI	Semi-Modified System for Rice Intensification
SSCBI	Small-Scale Community-Based Irrigation
STEP	Systematic Tracking of Exchanges in Procurement
TA	Technical assistance
WB	World Bank
WBG	World Bank Group
WRD	Water Resources Department
WSA	Water Spread Area
WUA	Water User Association

BASIC INFORMATION

Country(ies)	Project Name	
India	AP Integrated Irrigation & Agriculture Transformation Project	
Project ID	Financing Instrument	Environmental Assessment Category
P160463	Investment Project Financing	B-Partial Assessment

Financing & Implementation Modalities

[ ] Multiphase Programmatic Approach (MPA)	[ ] Contingent Emergency Response Component (CERC)
[ ] Series of Projects (SOP)	[ ] Fragile State(s)
[ ] Disbursement-linked Indicators (DLIs)	[ ] Small State(s)
[ ] Financial Intermediaries (FI)	[ ] Fragile within a non-fragile Country
[ ] Project-Based Guarantee	[ ] Conflict
[ ] Deferred Drawdown	[ ] Responding to Natural or Man-made Disaster
[ ] Alternate Procurement Arrangements (APA)	

Expected Approval Date	Expected Closing Date
23-Oct-2018	31-Oct-2025

Bank/IFC Collaboration

No

Proposed Development Objective(s)

The Project Development Objective is to enhance agricultural productivity, profitability and climate resilience of smallholder farmers in selected districts of Andhra Pradesh.

Components

Component Name	Cost (US$, millions)
Component A: Improving Irrigated Agriculture Efficiency	145.90

Component B: Promoting Climate Smart Agriculture Practices	76.40
Compoent C: Post-harvest Management, Market and Agribusiness Promotion	14.00
Component D: Project Management and Capacity Building	9.20

Organizations

Borrower:	Republic of India
Implementing Agency:	Government of Andhra Pradesh

PROJECT FINANCING DATA (US$, Millions)

SUMMARY

Total Project Cost	245.90
Total Financing	245.90
of which IBRD/IDA	172.20
Financing Gap	0.00

DETAILS

World Bank Group Financing

International Bank for Reconstruction and Development (IBRD)	172.20

Non-World Bank Group Financing

Counterpart Funding	73.70
Borrower	73.70

Expected Disbursements (in US$, Millions)

WB Fiscal Year	2019	2020	2021	2022	2023	2024	2025	2026
Annual	2.07	7.79	11.20	23.93	35.62	40.05	40.83	10.69
Cumulative	2.07	9.87	21.07	45.00	80.62	120.67	161.51	172.20

INSTITUTIONAL DATA

Practice Area (Lead)

Agriculture

Contributing Practice Areas

Water

Climate Change and Disaster Screening

This operation has been screened for short and long-term climate change and disaster risks

Gender Tag

Does the project plan to undertake any of the following?	
a. Analysis to identify Project-relevant gaps between males and females, especially in light of country gaps identified through SCD and CPF	Yes
b. Specific action(s) to address the gender gaps identified in (a) and/or to improve women or men's empowerment	Yes
c. Include Indicators in results framework to monitor outcomes from actions identified in (b)	Yes

SYSTEMATIC OPERATIONS RISK-RATING TOOL (SORT)

Risk Category	Rating
1. Political and Governance	Moderate
2. Macroeconomic	Low
3. Sector Strategies and Policies	Moderate
4. Technical Design of Project or Program	Substantial
5. Institutional Capacity for Implementation and Sustainability	Moderate
6. Fiduciary	Moderate
7. Environment and Social	Moderate
8. Stakeholders	Low
9. Other	Low
10. Overall	Moderate

COMPLIANCE

Policy

Does the project depart from the CPF in content or in other significant respects?

[ ] Yes [✓] No

Does the project require any waivers of Bank policies?

[ ] Yes [✓] No

Safeguard Policies Triggered by the Project	Yes	No
Environmental Assessment OP/BP 4.01	✓	
Performance Standards for Private Sector Activities OP/BP 4.03		✓
Natural Habitats OP/BP 4.04	✓	
Forests OP/BP 4.36		✓
Pest Management OP 4.09	✓	
Physical Cultural Resources OP/BP 4.11		✓
Indigenous Peoples OP/BP 4.10	✓	
Involuntary Resettlement OP/BP 4.12		✓
Safety of Dams OP/BP 4.37	✓	
Projects on International Waterways OP/BP 7.50		✓
Projects in Disputed Areas OP/BP 7.60		✓

Legal Covenants

Sections and Description

Project Steering Committee (PSC): Andhra Pradesh shall establish and maintain a Project Steering Committee (PSC), chaired by the chief secretary of Andhra Pradesh, and comprising of secretaries or principal secretaries of government of Andhra Pradesh for finance, water resources, agriculture, horticulture and fisheries.

Sections and Description

Empowered Finance Committee (EFC): Andhra Pradesh shall establish and maintain an Empowered Finance Committee (EFC), chaired by the secretary of Water Resources Department of government of Andhra Pradesh, to manage the Project financial resources and oversee allocation and reallocation of funds.

Sections and Description

Project Management Unit (PMU): Andhra Pradesh shall establish and maintain a Project Management Unit (PMU), headed by a Project director, to provide operational management support and coordination for the Project.

Sections and Description

District Project Management Units (DPMUs) : Andhra Pradesh shall establish and maintain District Project Management Units (DPMUs) in each Project district, headed by the district Project director, to implement and monitor the Project at the district level.

Sections and Description

District Project Management Units (DPMUs) : Description of Covenant

Andhra Pradesh shall prepare, approve and adopt a Project Implementation Plan (PIP) which shall include, inter alia, the details of the Project activities, the results framework, the implementation arrangements and safeguard requirements.

Sections and Description

Safeguards: Andhra Pradesh shall ensure that the Project is carried out in accordance with all safeguards instruments.

Conditions

INDIA
AP INTEGRATED IRRIGATION AND AGRICULTURE TRANSFORMATION PROJECT

TABLE OF CONTENTS

I. STRATEGIC CONTEXT

A. Country Context

1. **India continues to be one of the world's fastest-growing economies**. The Indian economy has been registering rapid growth – rising from 5.5 percent in 2012–13 to 7.1 percent in 2016–17. This was supported by robust private consumption, a resilient services sector, and some revival in industrial activity. India has recovered from temporary disruptions caused by the twin policy events – demonetization and the implementation of Goods and Service Tax (GST) Real GDP growth accelerated to 7.2 percent in Q3 2017-18 after bottoming out at 5.7 percent in Q1. Private investment growth has experienced an uptick recently, but investment rates remain below the levels experienced before the financial crisis. Economic activity is expected to accelerate further to 7.5 percent in the near term.

2. **Since the 2000s, India has made notable progress in reducing absolute poverty.** Between 2004 and 2011, poverty declined sharply from 38.9 to 21.6 percent at the international poverty line (US$1.90 PPP/day). With over 100 million people escaping poverty, the pace of poverty reduction in India exceeded that of the developing world as well as that of middle-income countries (MICs) in this period. High economic growth, rapid rise in rural wages, greater rural-urban integration, and increased non-farm activity, especially construction, were the key drivers of poverty reduction. Since 2011, robust economic growth may have contributed to a further reduction in poverty. However, trends in the construction sector and rural wages suggest that the pace of poverty reduction may have moderated.

3. **India is now confronted by serious structural barriers to more inclusive growth and sustainable development**. It is still home to 263 million poor people—80 percent of whom reside in rural areas—who live on less than US$1.90 a day. Expansion of the economy has not generated jobs fast enough to absorb labor in rural areas, exacerbating rural-urban income disparities. In recent years the Government of India (GoI) has therefore directed its attention to accelerating rural growth, creating jobs, and improving environmental management. In the Union Budget 2017–18, the GoI articulated its goal of doubling farmer incomes in five years, setting an annual growth target of 4 percent for agriculture and allied sectors.

4. **Agricultural growth is central to India achieving its development goals.** More than two-thirds of the country's poor live in rural areas, and their chances of climbing out of poverty depend directly on how well agriculture and allied sectors perform. Today, agriculture represents 14 percent of national GDP and provides livelihoods for more than 50 percent of the population. But it must deal with decelerating productivity growth,[1] due mostly to inefficient use of resources, especially soil and water, and to unsustainable production practices. Key factors driving inefficiency include also incentives that promote dependence on rice, wheat, and other food grains rather than forwarding crop diversification; overuse of chemical inputs; failure to adopt modern agricultural techniques; insufficient investment in irrigation systems; and poorly integrated value chains.

5. **Climate change is expected to negatively affect agriculture.** Its adverse effects are expected to aggravate resource constraints and disproportionately affect the poor, and it may roll back the progress

[1] In the 1990s and 2000s, agriculture grew at about 3–3.5 percent annually but in 2013–15 its growth rate fell below 2 percent a year during 2013–2015.

made so far in poverty reduction and food security. Climate change models, such as those of the Intergovernmental Panel on Climate Change, predict that temperatures in India are likely to rise by 3°C–4°C by the end of the 21st century. Unless farmers adapt their practices and there are policy changes (current policies, for instance, promote wasteful use of irrigation water), farm incomes will undoubtedly drop. Rain-fed areas will be most affected, with potential losses of up to 18 percent of annual revenue.[2]

6. **Increasing investment in adaptation measures to reduce vulnerability to climate change is essential to economic growth.** India has been a leader in global efforts to limit the impacts of climate change and was one of the first countries to ratify the Paris Agreement on Climate Change in October 2016. Though as yet its per capita emissions of greenhouse gases (GHGs) are still among the lowest in the world (2.44 tCO_2 equivalent per capita in 2012—the global average is 5.5), they are now rising alarmingly. In absolute terms India is already one of the largest GHG emitters, with agriculture the second-largest contributor (about 18 percent of total GHG emissions). The sector has major potential for India to reduce GHG emissions and improve environmental management through enhanced soil-water conservation and climate-resilient farm management.

7. **Strategic shifts will be necessary to transform India's agriculture into a modern and resilient food system by moving it away from a traditional food security orientation.** It must transit (a) from food grain production to diversified high-value horticulture and livestock products; (b) from a focus purely on physical productivity (yields) to agricultural resilience and stability to deal with the effects of climate change and short-term weather anomalies; (c) from a unilinear focus on on-farm production to adding value in the post-harvest segments of the food value chain; (d) from a calorie-focused production structure to nutrition-sensitive agriculture; and (e) from merely supplying more irrigation water to making water use more efficient.

8. The proposed project is designed to support such strategic shifts by building up the resilience of agriculture to climate change in districts of Andhra Pradesh (AP) that are already affected by weather variability and the threats it poses to agriculture, food security, and the livelihoods of farming communities.

B. Sectoral and Institutional Context

9. **The new state of AP[3] has emerged as one of the fastest-growing regions in India.** Created on June 2, 2014, it accounts for 4.95 percent of India's land mass, 4.09 percent of its population, and 4.44 percent of its GDP. Since its creation, AP's economic growth has outstripped that of the Indian economy as a whole. For 2016–17 gross state domestic product (GSDP) at constant 2011–12 prices registered 11.61 percent growth, compared to 10 percent growth in 2015–16. However, the state's economy also typifies the national structural transformation problem: 62 percent of the workforce is employed in agriculture and related activities that contribute only 22 percent of economic output. The persistence of the rural-urban income divide also makes agriculture a high priority for the state's policy makers.

10. **Agriculture in AP is characterized by low productivity and high vulnerability to weather shocks.**

[2]Climate, Climate Change, and Agriculture - Economic Survey 2017–18. http://mofapp.nic.in:8080/economicsurvey/pdf/.
[3]The previous state of AP was bifurcated by the Andhra Pradesh Reorganization Act (the Telangana Act) into Telangana and the new AP.

The total cultivated area of 6.35 million ha is spread over a variety of agro-ecologies that produce a wide range of crops (primarily rice but also maize, ragi, small millets, pulses, castor, cotton, etc.). More than three-fourths of the producers are marginal and small farmers with landholdings of less than 2 ha. Because over 55 percent of farms are rain-fed, AP's agriculture is extremely vulnerable to rainfall variability. Along with the adverse effects of climate change, deterioration in the quality of natural resources is also a significant threat to the sustainability of AP agricultural production and farm incomes. Policy makers are coming to recognize that previous strategies for agricultural growth must be readjusted to fully exploit agriculture's potential for inclusive and sustainable rural growth.

11. **Although steps have been taken to make AP agriculture more productive, water-stressed conditions and high input costs, among other problems, have triggered widespread agrarian distress**.[4] Compared to neighboring states, for instance, yield gaps can be significant; for instance, average rice yield in AP is 20 percent lower than in Tamil Nadu and Karnataka.[5] Among factors dragging on agricultural productivity are (a) variable rainfall and inadequate management of soil health; (b) lack of knowledge/adoption of climate-resilient technologies and practices; (c) limited use of irrigation; (d) little crop diversification in the rabi season[6] in rain-fed areas; (e) lack of adequate storage and processing facilities; and (f) inefficient links to markets. A baseline survey for this project suggests that farmers are forced to be distress sellers; most farmers sold produce at the farm gate—only 10 percent carried it to nearby Agricultural Products Marketing Committee *Mandis* (official places for farmers to sell their commodities). Thus, rain-fed agriculture in AP is increasingly risky and economically nonviable; there is an urgent need for a thoughtful mix of supportive policies and investments to promote sustainable solutions to the current decline.

12. **If its potential is to be harvested, agriculture in AP must become both climate-resilient and profitable.** AP authorities recognize that climate change and rainfall variability is the new normal. It calls for an approach to sustainable growth of agriculture that is based on long-term adaptive interventions to ensure food security and build the resilience of farms to climate change (see Box 1.1). As part of Swarnandhra Vision 2029, the Government of AP (GoAP) has therefore devised a strategy to transform and ensure the sustainability of agriculture by working toward the following objectives: (a) increase productivity and promote sustainable crop intensification[7]; (b) use water conservation and micro-irrigation to mitigate the impact of droughts; (c) improve post-harvest management to reduce waste; and (d) support processing, value addition, and supply chain management. With this strategy, the GoAP intends to increase the contribution of agriculture to GSDP from INR 319,610 million in 2015–16 to INR 600,000 million by 2021–22, and to raise food grain yields from 2,641 to 4,409 kg per ha.

Box 1.1. Building Farm Resilience to Climate Change: For purposes of this project, climate resilience is defined as the ability to withstand and recover from climatic shocks, particularly droughts and excess rain. It can be achieved by adoption of climate-smart agriculture (CSA) practices and diversification in both crops grown and sources of

[4] The number of farmer suicides in the state increased from 310 in 1993–2004 to 1,943 in 2004–14 (AP state Economic Survey, 2017).
[5] The productivity of farm animals is also extremely low, e.g., cows produce only 3.15–4.55 liters of milk per animal per day (AP Economic Survey 2017).
[6] Rabi crops are those sown in winter and harvested in the spring in South Asia. The season starts in October, continues till March, and is followed by the Kharif season, which starts in April and continues into September.
[7] Crop intensification: A greater variety of crops per year in given agriculture land (It is calculated as gross crop area / net crop area X 100).

income. The project will deliver on CSA's "triple wins": (a) a sustainable increase in productivity and farm incomes (*food security*); (b) enhanced resilience to the impacts of climate change and variability (*adaptation*); and (c) reduced GHG emissions per unit of product and increased carbon sequestration (*mitigation*). This will help to (a) optimize the management of different CSA interventions, depending on local natural resources and livelihood systems (agriculture, fish, or livestock); (b) take into account the external environment (devolved governance policies, strategic plans, regulations, and markets, among others) that might influence relationships between stakeholders; and (c) encourage inclusive stakeholder consultations (e.g., water user associations [WUAs], farmer producer organizations [FPOs], support organizations [SOs], and government agencies) to build the capacity of national, state, and community institutions to enhance service delivery.

13. **As in most of India, in AP women make a major contribution to agriculture.** Yet across the state, gender-specific issues and norms limit their access to resources (productive inputs, assets, and services) and their ability to make decisions. Gender gaps identified in a comprehensive social assessment in AP mostly related to (a) governance—currently the representation of women in WUAs is minimal; (b) differential wage rates and oppressive working conditions; (c) a dearth of women-friendly technologies and techniques; (d) minimal access to agricultural extension services; (e) a lack of programs to build the capacity of women; and (f) virtually no grievance platforms for women to voice their concerns and needs. Such gaps limit what they can contribute to agricultural production, economic growth, and the well-being of their families; it can be inferred that women farmers are more at risk from climate change than men because they so often lack the means to cope with its impacts.

14. **More efficient production and more crop diversification are needed if small and marginal farmers are to meet GoAP productivity targets.** Paddy rice is the predominant AP cereal crop, grown in 89 percent of the cultivated area during the kharif season.[8] To meet the GoAP's ambitious productivity targets, improving paddy productivity and sowing non-paddy crops in a wider area are critical. In addition, expanding the area being cultivated during the rabi season from the present 38 percent, together with intensification, will enhance productivity through diversification to pulses and other high-value crops, such as vegetables. Taking these steps will require broadening the area under assured irrigation; adopting CSA to restore soil health and conserve natural resources; promoting appropriate and competitive agricultural diversification; and putting in place an inclusive market-oriented development strategy to benefit smallholder farmers through public-private partnerships (PPPs). These interventions are aligned with the GoI's commitment to doubling farmer incomes by 2022 (see Box 1.2).

Box 1.2. Growing Farm Incomes: With 2015–16 the base year, doubling the real income of farmers by 2022–23 requires annual income growth of 10.41 percent. This implies that the current rate of growth in farm income needs to be considerably accelerated. Harnessing all possible sources of income growth outside as well as within the agriculture sector will take firm measures. Within agriculture the major sources of growth are (a) higher productivity; (b) saving on the costs of production through more efficient use of resources; (c) diversification to high-value crops; and (d) an increase in cropping intensity. Among sources outside agriculture are (a) shifting cultivators from farm to nonfarm occupations and (b) improving the terms of trade and the real prices farmers receive. *Source:* NITI Policy Paper No. 1/2017.

15. **Supporting production and diversification in the rabi season is essential to make farming more profitable.** Farmers are increasingly realizing that cultivating food grains exclusively is not profitable. The state is promoting horticulture as a way to avert risk and increase profitability, thereby providing farm

[8] The kharif cropping season is from April to September during the southwest monsoon.

households with much-needed stability. Moreover, recent studies suggest that the retail market for agricultural commodities is relatively better in AP than in other states: currently AP procures 45 percent of its daily vegetable consumption from West Bengal, Karnataka, and other states. The same is true for floriculture, due to demand from the many religious centers in the state. In other words, demand in AP for agricultural products is vibrant. With 55 percent of agricultural land in AP being rain-fed, the supply side is the main GoAP concern. Therefore, a major GoAP policy thrust for improving agricultural performance is to stabilize supply-side management by emphasizing production and diversification in the rabi season. This necessitates assured irrigation, which can be achieved by rehabilitating small-scale community-based irrigation (SSCBI)[9] systems and improving their management.

16. **Water tanks have historically predominated in Indian agriculture, and SSCBI systems are still lifelines for thousands of AP villages in rain-fed regions.** The tanks, with their traditional technology and eco-friendly structures and sizes, were usually community-managed and primarily addressed village needs. Tanks have also been a source of livelihood for thousands of rural families who are fishermen, cattle-raisers, potters, and brickmakers. The 13 districts of AP now house over 41,000 minor irrigation systems. Over several decades the tanks have significantly deteriorated because no government department was responsible for their management, and O&M by villagers was ineffective. As a result, there is heavy siltation in tank beds and inflow channels, weed infestation, and damage to sluices, bunds, surplus weirs, and field channels. In 2007, the Water Resources Department (WRD) was mandated to oversee minor irrigation infrastructure, but the AP-FMIS has yet to be fully applied across the state.[10]

17. **Revitalizing the tank systems is a priority if the GoAP is to increase the area where irrigation is assured and enhance farm resilience to climate change.** For most small and marginal farmers, better water storage and management of SSCBI system hold the promise of more productive crops and cropping intensity and greater crop diversification. Because conventional irrigation cannot be extended to the entire arable area in AP due to water scarcity, environmental concerns, and high investment costs, rehabilitating existing tanks and making SSCBI systems more efficient offer the most cost-effective options for making agriculture more productive and climate resilient in rain-fed areas.[11] This aligns with both central and state government priorities.

18. **Against this background, the proposed project will support the WRD in the rehabilitation and modernization of tank systems by, e.g., identifying engineering solutions and technological innovations for more sustainable management of natural resources.** It will also support building up the community-driven institutions established by the government to deliver services related to SSCBI management consistent with the AP-FMIS, such as (a) equitable supply and distribution of irrigation water, ensuring optimum utilization for improving agricultural production; (b) systematic development of irrigation infrastructure to benefit all farmers; and (c) infrastructure O&M for effective and reliable supply and distribution of irrigation water.

[9] SSBCI systems consist of small tanks, ponds, and other water bodies within a defined catchment area.
[10] The 1997 AP Farmers Management of Irrigation Systems (AP-FMIS) Act specifically provides for conjunctive water use, participatory irrigation management (PIM), groundwater management, and monitoring of local hydrology. The act also mandates that WUAs collect fees to meet tank operations and maintenance (O&M) costs. While WUAs have helped to promote PIM, they need support and capacity building if they are to become self-sustaining managers of SSCBI systems.
[11] It is estimated that the area irrigated by SSCBI systems can be extended to more than 1 million ha of the3.2 million ha that are rain-fed.

C. Project Contributions to Higher-Level Objectives

19. **The project proposal is aligned with the Sustainable Development Goals (SDGs) and the twin World Bank Group (WBG) goals of reducing extreme poverty and boosting shared prosperity by 2030.** The project primarily seeks to (a) benefit socially and economically vulnerable small and marginal farmers in AP; (b) improve agricultural productivity and profitability by building up SSCBI systems; and (c) reinforce the resilience of agriculture and beneficiary communities to climate change. Thus, the project contributes to ending poverty in all its forms (SDG1); ending hunger, achieving food security and improved nutrition, and promoting sustainable agriculture (SDG2); and combating climate change and its impacts (SDG13). Doing so aligns it with the WBG twin goals.

20. **The proposed project not only lies at the heart of the household farm economy envisioned by the GoI and GoAP, it also reflects their long-term vision for reducing poverty and enhancing economic growth.** The GoI's vision for all-around development of India and its people prioritizes among other objectives the doubling of farmer incomes by 2022 through measures that raise farm productivity (for example, by improved access to irrigation and new production technologies and shifting to higher-value commodities) and that bring farmers remunerative prices. It also addresses sustainability concerns related to agriculture's oversized water footprint. The project is also consistent with the AP strategy of ensuring the sustainability of its agricultural production by adopting climate-resilient practices and doubling food grain yields. It supports AP's Primary Sector Mission, *Raithu Kosam*, of promoting best practices to boost smallholder productivity and livelihoods by also scaling up CSA in horticulture, livestock, and fisheries.

21. **The proposed project aligns with the Country Partnership Framework (CPF) for India (FY18–22)**. It promotes resource-efficient growth, one of the three focus areas for World Bank (WB) engagement with India in the CPF (Report Number 126667, discussed at the Board on September 20, 2018). It will specifically support promotion of more inclusive, resource-efficient, and diversified rural growth which envisages support for irrigation and drainage aimed at improving climate resilient agricultural production, leading to investment in post-harvest management. In addition, this project applies the CPF's approaches to multiply impact, particularly in leveraging private sector investment through agribusiness promotion, strengthening community level institutions and their interface with government water management systems. Eventually, the project will contribute to increasing knowledge on innovations in climate-resilient diversified agricultural production systems which can be shared with other states and countries through the Lighthouse India approach.

22. **The project is also fully aligned with the WBG Climate Change Action Plan, which gives priority to climate-resilient agriculture and water management in adapting to climate change in South Asia.** The project will directly contribute to the WBG commitment, in response to client demand, to increase the climate-related share of its portfolio from 21 to 28 percent by 2020. By supporting adaptation in agriculture, the project will also help India to meet its climate action commitments to the global community, which prioritize adaptation and resilience in sensitive sectors like agriculture, as articulated in its Intended Nationally Determined Contributions (INDCs).

II. PROJECT DEVELOPMENT OBJECTIVES

A. Project Development Objective (PDO)

23. **The PDO is to enhance agricultural productivity, profitability and climate resilience of smallholder farmers in selected districts of Andhra Pradesh.**

B. Project Beneficiaries

24. **The project will work with 1,000 SSCBI systems in 12 districts covering a command area of 90,000 ha.**[12] It will benefit 200,000 families: small and marginal farmers, agro-entrepreneurs, and women and other vulnerable groups, such as members of tribes.

25. **Small and marginal farmers are those working on no more than 2 ha of land.** They are expected to benefit directly from project interventions to better organize producers and improve access to knowledge and assets to enhance climate resilience—such as irrigation, drought seed varieties, and post-harvest technology—which are all expected to substantially increase production and incomes.

26. **The project will benefit existing WUAs and FPOs.** WUAs are organizations that manage irrigation facilities (water tank systems) to support agriculture; FPOs are entities that organize and promote post-harvest value-adding activities. FPOs are considered important to create an ecosystem in the state for enhancing farmers' profits. These community-driven organizations will benefit from capacity building in governance, planning, management, marketing, and support for developing value-chain infrastructure so that they can provide the services their members need in SSCBI catchment areas.

27. **By building capacity and reinforcing value chains, the project will also directly benefit local institutions and government agencies,** such as Acharya N. G. Ranga Agricultural University (ANGRAU), district agricultural research and extension services, and fisher cooperative societies. Partnering with the project in mainstreaming climate resilience in their agriculture programs will upgrade their capabilities.

C. PDO Results Indicators

28. **The following key performance indicators (KPIs) are proposed to measure project outcomes**:

(a) Farmers reached with agricultural assets or services (number), of which female beneficiaries (number)
(b) Productivity of specified crops increased (metric ton per hectare).
(c) Water productivity increased (kg per m^3)
(d) Farm income increased (household income in INR).

III. PROJECT DESCRIPTION

29. **Key problems to be addressed.** The limited performance of the agriculture sector in AP can be

[12] The rehabilitation of SSCBI systems will expand irrigation to a net area of 90,000 ha (of 112,500 ha total command area), which corresponds to an 80 percent target.

attributed to interlinked constraints: limited use of modern technology, environmental vulnerability, weak facilitating institutions, and policy-related issues. Compared to the 1980s and early 1990s, technological advances in agricultural production in AP, as in other states, seem to have slowed, as is evident from the decelerating growth in total factor productivity. For most crops there has been no significant growth in yield. The problem is aggravated by frequent droughts and an overexploitation of natural resources that will make agriculture unsustainable over time. In fact, the response of crops like rice to chemical fertilizers has declined due to the paucity of new varieties with higher yield potential and the buildup of salinity caused by poor management of irrigation and drainage.

30. **The most important policy-related issue is the decline in public investment in agriculture, especially in irrigation.** Water management and other facilitating institutions have neglected SSCBI infrastructure, and irrigation tanks are underutilized due to mismanagement and poor O&M. The result is a vicious circle of negative factors that reinforce each other, leading to, among other outcomes, low productivity and limited addition of value, continuing marginalization of many small-scale farmers, and unsustainable use of natural resources.

31. **In response, the project will support investments at critical points along the value chain to**

(a) Buffer against untimely rainfall and drought by rehabilitating and modernizing SSCBI systems and improving their performance. Beyond rehabilitation, the innovative project approach:

(i) promotes coherent cross-sectoral support to maximize results by creating a platform for interdepartmental convergence;
(ii) makes WUAs more effective in delivering water services, especially as related to sustainable O&M of the SSCBI systems; and
(iii) incorporates climate resilience as the driver for investments.

(b) Raise the productivity of major crops in selected districts, taking into account high input costs, climate variability, and the shortage of irrigation water. To do this, the project will facilitate farmers' access to improved seeds, mechanization, precision farming, and climate-resilient agronomic practices.

(c) Promote crop diversification in the rabi season (when currently 62 percent of arable land is left fallow) in association with investments in agribusiness development and market links to maximize profitability. The focus would be primarily on high-value crops (fruits, vegetables, and pulses). In addition to emphasizing the rabi season, the project also intends to incentivize farmers to shift to non-paddy crops during the kharif season now that high input costs have made paddy cultivation less remunerative.[13]

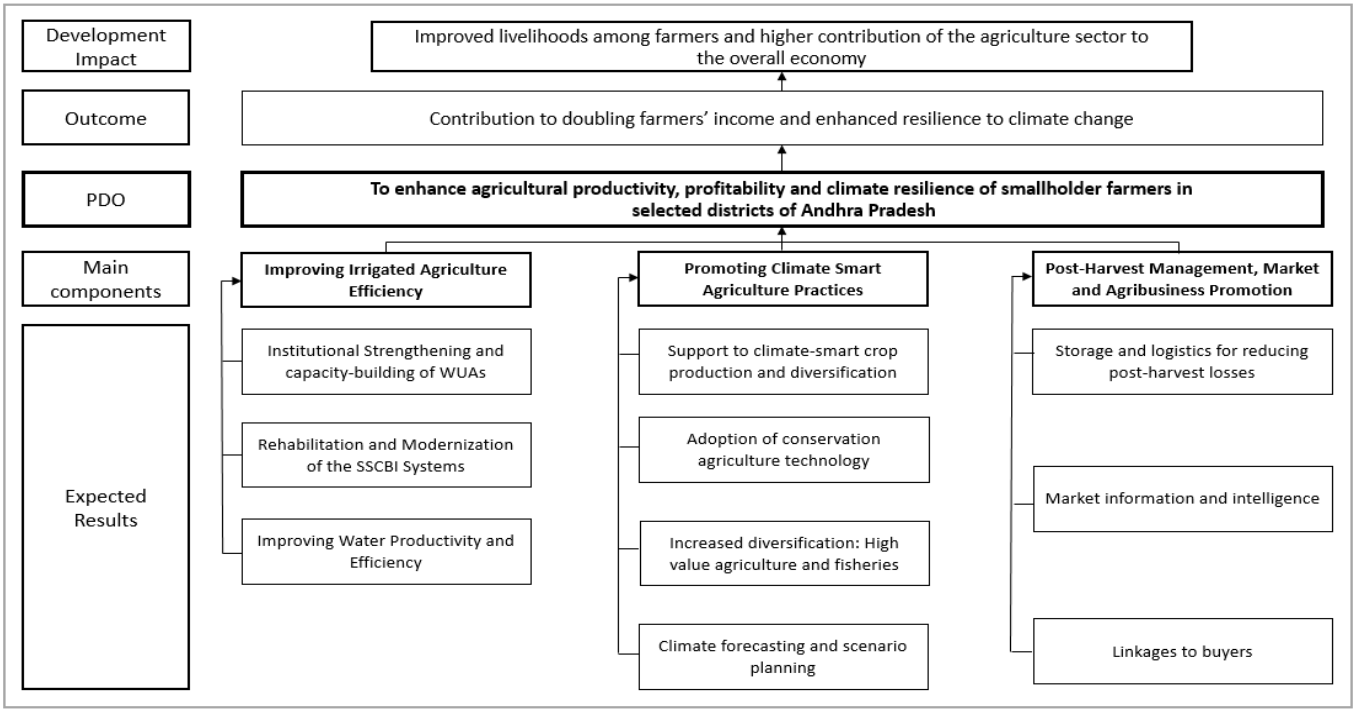
(d) Enable producers to better integrate into modern value chains, which is critical to progress on poverty reduction and inclusive growth in rural areas. This will build on existing FPOs by enhancing their capacities and provide financial support for collective investments in post-

[13] A report by the GoAP Department of Economics and Statistics indicates an average increase in per hectare cost of production of paddy of 229 percent (2013–14)—well above the minimum support price.

harvest technology and processing and improving links between producers and buyers.

32. **Because such a project involves investments by several government line departments and value-chain actors (agriculture, irrigation, farmers, WUAs, and others), the project will work to expand their cooperation** and promote convergence not only for schemes within the Agriculture Department but also with other sectors and actors supporting farmers in AP. Through convergence and collective action, farmers' livelihoods can be enhanced through more productive agriculture, value addition, and climate resilience. Figure 3.1 summarizes the project's intervention logic and results chain.

Figure 3.1. Project Intervention Logic and Results Chain



33. **Alternatives considered.** The GoAP has evaluated the results of previous initiatives to draw up a long-term strategy for making smallholder agriculture in rain-fed areas productive, profitable, and climate-resilient. The alternatives considered were (a) investing in major and medium canal-based irrigation schemes, backed by dam storage structures; (b) allowing farmers access to deep tube wells to tap groundwater; and (c) identifying, modernizing, and rehabilitating small water-holding bodies, such as SSCBI systems in defined cascades**.** After assessing the alternatives, the GoAP decided that rehabilitating and modernizing SSCBI systems would be most cost-effective.

34. **The project strategy recognizes climate co-benefits and promotes triple-win solutions.** Project investments in SSCBI systems could become a model of integrated development for both making agriculture more efficient and for better managing water use. It also builds resilience and adaptation to climate risks and can mitigate climate change through carbon enrichment of soil and biomass. In designing interventions, the project seeks to derive maximum climate co-benefits through (a) enhanced water security for farms by increasing water storage capacity in upgraded SSCBI systems, addressing on-farm water availability, and reducing the risks associated with intra- and inter-seasonal climate variability; (b)

improved soil health, through adoption of good agricultural practices to improve soil fertility and soil nutrient management and promote soil carbon sequestration; and (c) greater farm productivity and crop diversification through integrated farming systems (livestock and fisheries), post-harvest management, and inclusive value-chain development, not only to diversify income sources but also to help build resilience to market externalities. Based on these estimates the project is expected to generate 92 percent climate co-benefit as outlined in Annex E. The project will support the drafting of contingency plans to prepare farmers to cope with climate risks through advance-warning weather and agrometeorological services, backed by crop-specific contingency plans. Partnerships with National Innovations on Climate-Resilient Agriculture (NICRA),[14] the Indian Council of Agricultural Research (ICAR), and other institutions for transferring technology and global best practices will provide insights for project implementation.

35. **Recognizing the importance of women to the agriculture sector, the project will address gender gaps to facilitate their access to productive resources, extension information, modern technology, and markets.** The project design ensures not only recognition that women from farming households are farmers but also promotion of their active participation in WUA and FPO management and decision-making. Project activities also include gender sensitization campaigns and village workshops involving the implementing agencies, WUAs, and FPOs (for details, see the Gender Action Plan in the Environment and Social Management Framework [ESMF] document). The project will also ensure that the provisions in the 1997 AP-FMIS for women to be represented in WUA formation are enforced.

36. **Maximizing finance for development.** The project design explicitly acknowledges the importance of the private sector to developing agriculture and promotes a mix of interventions where the private sector can help achieve development goals. The project will improve the incentives for private producers and agribusiness investors to act by providing public goods in the form of irrigation services, pond rehabilitation, and the development of common assets for primary storage, logistics, processing, etc. Such public goods will make it possible to expand opportunities for the private sector in high-value agriculture and fisheries. These public assets, created by either the government or the project, will be managed by WUAs and FPOs in the interest of the communities. The project will also enhance market efficiency by supporting market information systems that meet the specific needs of private actors, especially producers, traders, and exporters. Finally, the project will facilitate leveraging of private funds by aggregating small producer groups and linking them with value chains and formal financial institutions.

A. Project Components

37. **The proposed project complements current GoAP agriculture policies and programs in less-favored areas and reflects lessons learned from the WBG agriculture portfolio in India and elsewhere.** It clusters activities in three technical components and a fourth component focusing on management, knowledge development, and monitoring. The components are summarized here; details can be found in Annex A.

[14] Launched in 2011, NICRA is a network project of ICAR to enhance agricultural resilience to climate change and climate vulnerability through strategic research and demonstrations of adaptation and mitigation technology in crops, livestock, fisheries, and natural resources.

Component A: Improving Irrigated Agriculture Efficiency (US$145.9 million)

38. The intent of this component is to enhance the water security of individual farms so as to reduce the risks associated with climate variability. Within a defined cascade,[15] this component will finance the following interrelated interventions: (a) strengthening community-based WUAs so they can assume more responsibility for delivering irrigation water and integrated planning and management of water resources; (b) rehabilitating and modernizing SSCBI systems to make them more resilient to climate change; and (c) improving on-farm water productivity and efficiency.

39. **Subcomponent A.1: Institutional Strengthening and Capacity Building of WUAs (US$6.8 million)**. This subcomponent will build the capacities of 1,000 WUAs for better O&M of their tank systems and better water management. It will finance (a) training for WUAs in effective O&M and fee recovery; monitoring and benchmarking of performance data; and association administration, financial management, and auditing; (b) technical assistance (TA) to prepare annual plans, such as water budgets and irrigation efficiency, annual asset management, and public outreach and communication plans; (c) as demand builds, support recruitment of a private operator to handle daily O&M, with progressive coverage of costs by WUAs; and (d) establishment of a service feedback mechanism and annual user satisfaction surveys. The TA will also help WUAs to access central- and state-supported schemes, assess the need for primary storage structures, connect with input and technology providers, and draft working arrangements with FPOs for agribusiness promotion. The project will draw up training protocols for FPOs to build their capacity to provide market intelligence and links to enhance the profitability of cascade smallholder producers. To ensure that women are appropriately represented in WUAs, the proposed training will specifically address barriers to women's participation[16] as well as to promote more women participating in leadership levels[17]. Other measures will include working with women to contest WUA elections and providing leadership development trainings and orientation on WUA roles and responsibilities to women.

40. **Subcomponent A.2: Rehabilitation and Modernization of the SSCBI Systems (US$133.5 million).** This subcomponent will modernize the irrigation infrastructure of about 1,000 tank systems[18] located in 178 cascades (485 tanks) and 515 independent tanks by adopting a competitive approach to financing the investments. Total area to be covered is about 90,000 ha.

41. Works expected to be financed by Subcomponent A.2 include (a) modernizing control structures (diversion weirs), supply channels, and cross-regulation structures; (b) de-silting feeder and supply channels; (c) strengthening and upgrading tank bunds, earthen dams, spillways, distribution canals, field channels, and drainage line treatment within the cascade; (d) installing flow measurement devices and sensors, supported by information and communication technology (ICT), and decision support systems at District Project Management Unit (DPMU) offices; (e) rehabilitating on-farm works; (f) promoting solar panels and pumps for lifting groundwater (rabi crops are already provided for in PMKSY[19] and RKVY[20]

[15] A cascade is a connected series of tanks within a micro- or meso-catchment area for storing, conveying, and utilizing water.
[16] The 1997 AP-FMIS Act calls for a minimum of 30 percent representation of women in WUA Committees.
[17] *The AP Farmers Management of Irrigation System Act, 1997, (APFMIS Act) of GoAP provisions minimum 30 percent representation of women in WUA.*
[18] Composite network or feeder channels, the storage reservoir (tank), downstream irrigation canals, and any drainage structures.
[19] Pradhan Mantri Krishi Sinchai Yojana, the GoI Integrated Irrigation and Agriculture Programme.
[20] Rashtriya Krishi Vikas Yojana.

pressurized irrigation systems); and (g) using modern quality-testing devices to determine soil compaction and the quality and durability of concrete structures.

42. For a competitive approach to financing investments, the WRD will prepare an Integrated Cascade Development Plan (ICDP) on which to base an annual surface water and groundwater budget that identifies seasonal availability of water for irrigation as a basis for assessing the technical feasibility of future investments. In parallel, WUAs, with help from SOs and the WRD and DPMUs, will prepare a Cascade System Improvement Plan (CSIP) that identifies the long-term objectives and targets that farmers aspire to meet in terms of annual cropping and water delivery plans; O&M and asset management priorities, etc.; the main technical constraints that keep WUAs and farmers from achieving their objectives; priority activities to overcome the obstacles (such as rehabilitating infrastructure and building capacity); and annual performance, for example irrigation efficiency, crop diversification, sustainability of the tank system, and O&M cost recovery. Based on the ICDP and CSIP, a Detailed Project Report (DPR) will be prepared, and will identify the next year's investments and commitments from GoAP. Investment will be linked to the previous year's performance and the ambition of the targets compared with other schemes. WUAs may opt to carry out some of the work themselves with guidance from DPMU experts. The project intends to pilot outsourcing on a performance basis and modernization of model tanks through a design, build, operate, and transfer (DBOT) model under a hybrid annuity arrangement (led by a private regulator in collaboration with the WRD). The PIP will set out a detailed process for preparing investments.

43. **Subcomponent A.3: Improving Water Productivity and Efficiency (US$5.6 million).** The goal here is not only to improve water efficiency and productivity but also to promote conjunctive water use in the tank command and its zone of influence. The subcomponent will promote physical water productivity by measuring agricultural production derived per unit of water used and will consider hydrology and conveyance efficiency in advancing crop water budgeting (CWB). This will be achieved by (a) establishing cascade monitoring and decision support systems; (b) installing sensor-based measuring devices to monitor water discharge to farms; and (c) broadening stakeholder participation in planning for and managing water resources. Taking advantage of the cascade surface water and groundwater assessment carried out under Subcomponent A.2, this activity will promote community-led management to improve groundwater conditions by, e.g., monitoring and metering consumption of water and electricity from wells, annual reporting on water use and groundwater levels, and activities to raise awareness of water use. The WRD will supervise these activities with the support of the Groundwater and Remote Sensing Departments.

Component B: Promoting Climate-Smart Agricultural Practices (US$76.4 million)

44. Component B intends to increase on-farm productivity and strengthen farmers' resilience to climate change. The expected outcome is an increase in agricultural production and farmers' incomes. This will be achieved by (a) promoting a shift from input-intensive paddy during the kharif season to more remunerative non-paddy crops and (b) providing support for judicious diversification in cropping during the largely fallow rabi season. Beyond strengthening resilience to climate change, diversification is also a means to promote high-value crops that can increase the value of farmers' produce and their income, which is key to the sustainable O&M of irrigation infrastructure supported under Component A.

45. **Subcomponent B.1: Support to Climate-Smart Crop Production and Diversification (US$60.4 million).** In response to market demand, the project will promote diversification to high-value crops like fruits and vegetables while mainstreaming climate change adaptation and mitigation measures into farm production systems. To this end, for sustainable and climate-resilient crop intensification it will finance technology dissemination and transfer by the Agriculture Department in collaboration with other national institutions,[21] the International Crops Research Institute for the Semi-Arid Tropics (ICRISAT), and other SOs. Technology dissemination will among other areas emphasize (a) high-yielding and climate-resilient germplasm production (for example, less-water-dependent crops, short-duration crops, and seeds that can tolerate climate-related biotic and abiotic stresses); (b) plant nutrition (e.g., deep placement of urea to reduce fertilizer use and GHG emissions from rice production); (c) soil and water conservation (such as the semi-modified system for rice intensification [SMSRI] and micro-irrigation) and management of organic matter; (d) pest management; and (e) mechanization for small-scale farmers.

46. Project support for diversification will mainly focus on SSCBI command areas that are sufficiently irrigated in the rabi season from both surface and groundwater sources. Among activities to be financed are (a) organization of targeted farmers into FPOs for cooperative production and marketing; (b) assessment of market demand for crops that farmers might profitably diversify into; (c) demonstration of new crops and their production technologies, such as micro-irrigation and fertigation for water and nutrient management; (d) rejuvenation of old orchards; and (e) expanding access to seeds and other critical inputs for new crops. The Department of Horticulture will oversee these activities, and SOs with experience in value-chain promotion will be contracted to provide needed advice. Women's active participation in FPOs will be important to improve their incomes and market linkages, therefore, the project will support the formation of Women Common Interest Groups within the FPOs for targeted training and market linkages, ensure that training programs for the FPOs consider women's barriers such as mobility and time constraints, and support a more focused approach for the delivery of capacity building and extension services with an aim of increasing the number of women farmers such services.

47. To help farmers complete farm operations on time—a crucial adaptation strategy given that climate change is shortening growing seasons; reduce drudgery and production costs to increase profitability, affecting women farmers in particular, and streamline production, the project will support mechanization of such farm activities as ploughing, sowing, weeding, harvesting, and drying. It will, for instance, support the establishment of farm machinery centers to lease machinery and other equipment and advise on their use. The state Department of Agriculture will support FPOs using established GoAP guidelines and cost-sharing norms, with 70 percent of funding provided by the project and 30 percent by the beneficiary group. All support to FPOs (goods, work, services – seed production, primary storage, and business planning) will be procured either by PMU or by DPMU. Since women's agriculture labor takes up a large part of the un-mechanized 'drudgery' elements of agricultural production, the project will provide them with cost efficient toolkits comprising tools and protective clothing; multipurpose shelters for shade, breaks and childcare; training and safety equipment (protective masks while spraying pesticide and fertilizer applications); modern harvesting implements/machines; and, cost effective machinery to reduce their drudgery.

[21] Including ANGRAU, Krishi Vignan Kendras (KVKs), the Agriculture Technology Management Agency, the Central Research Institute for Dryland Agriculture (CRIDA), and AP State Seeds Development Corporation.

48. **Subcomponent B.2: Support to Climate-Smart Aquaculture (US$16 million).** To further diversify the economy, this subcomponent seeks to take a climate-smart approach to improving aquaculture production and profitability.[22] Built on lessons learned from the WB-financed Andhra Pradesh Community-Based Tank Management Project (APCBTMP) and aligned with AP's strategic plan for fisheries, the project will support (a) aquaculture management approaches that address the seasonality of water in tanks; (b) improved access to good-quality fish seed and feed (for example, through support for policy reform to ensure product standards are met, for genetic breeding and brood banks in strategic locations, and for feed formulation based on local materials); (c) production of high-value species, such as freshwater prawns; (d) better dissemination of cage farming, raceway culture, and other improved production technology; (e) strengthening extension–farmer links to make aquaculture more productive; (f) biosafety and disease surveillance to enhance quality and facilitate access to export markets; (g) improvement and management of fish marketing infrastructure, such as cold chains and fish kiosks; (h) value addition, as in ready-to-cook and ready-to-eat products; and (i) efforts to comply with food safety standards like those cited in *Hazard Analysis and Critical Control Point.* The Department of Fisheries will supervise Subcomponent B.2 activities.

Component C: Post-harvest Management, Market and Agribusiness Promotion (US$14 million)

49. The goal of Component C is to enhance the profitability of farmers, both men and women, by improving access to markets and capacity to add value to what they produce. This will be achieved by (a) easing market infrastructure constraints on the processing, storage, handling, and marketing of farm produce, especially for high-value horticultural crops; and (b) facilitating linkage of FPOs and value-chain operators to local, national, and where appropriate international markets. Project interventions to be financed under Component C are based on the ICDP; among them:

(a) Upgrade rural market facilities (*Apni Mandi*) in selected locations. Depending on the needs identified in the ICDP, the project may finance their rehabilitation and expansion, including basic infrastructure, sales platforms, access to water and electricity, and cold storage facilities.
(b) Promote use of climate-smart processing, storage, packaging, and handling technologies to reduce post-harvest losses and add more value.
(c) Improve access to market information and market intelligence.
(d) Foster links among actors along the value chain, especially extending support to FPOs on cascade business plans that promote regular farm-gate buyer-seller meets.

50. The Agriculture and Horticulture Departments will implement Component C. The Horticulture Department will facilitate establishment of rural markets, integrated packing houses, low-cost storage structures, and refrigerated transport vehicles and will promote climate-smart cooling structures. The Agriculture Department will support establishment of a market link through e-NAM (an e-platform that provides all agricultural-market-related information including commodity prices), which connects FPOs with the market, and will promote information-sharing through Agri-watch.

[22] The project is expected to provide 26,000 ha of effective water spread area (EWSA) in the form of freshwater ponds.

Component D: Project Management and Capacity Building (US$9.2 million)

51. The goal of this component is effective and efficient implementation of project activities, monitoring and evaluation (M&E), and reporting of results. Component D funding will support incremental operational costs, M&E and impact assessments, financial management, communication, customized TA, and any special thematic studies identified in the course of the project.

B. Project Cost and Financing

52. The six-year project (2019–25) will be financed through Investment Project Financing (IPF) of US$245.9 million with an International Bank for Reconstruction and Development (IBRD) contribution of US$172.2 million (70 percent of the project), and a counterpart contribution of US$73.7 million (30 percent). The project cost includes physical and price contingencies of about 5 percent (Table 3.1).

Table 3.1. Project Costs by Component and Source of Financing (US$, millions)

Project Components	Project Cost	IBRD Financing	Counterpart Funding
A. Improving Irrigated Agricultural Efficiency	145.9	102.1	43.8
B. Promoting Climate-Smart Agricultural Practices	76.4	53.5	22.9
C. Post-harvest Management, Market and Agribusiness Promotion	14.0	9.8	4.2
D. Project Management and Capacity Building	9.2	6.4	2.8
Total Project Cost	**245.5**	**171.8**	**73.7**
Front-end fees	0.4	0.4	—
Total Financing Required	**245.9**	**172.2**	**73.7**

C. Lessons Learned and Reflected in the Project Design

53. The project design builds on lessons learned from similar operations in India and elsewhere. The successes and failures of community-based institutions managing water resources in AP (APCBTMP) and Tamil Nadu (Irrigated Agriculture Modernization and Water-Bodies Restoration and Management Project) suggest the need for strong government ownership, dedicated agency support, effective coordination between government entities, and active involvement of communities in planning and project execution.

54. **Clear policies for irrigation management that specify the responsibilities of farmers, WUAs, and the irrigation agency are crucial to the establishment and sustainability of WUAs.** However, in most designs the responsibilities assigned to WUAs and to irrigation departments have not been sufficiently detailed. Plans for previous operations were also too optimistic, and many projects were not effectively participatory. Thus, design assumptions about roles in planning and construction and the willingness of project implementers to hand over control of irrigation infrastructure to WUAs were often not realistic. A participatory approach that involves the community in decision making has been shown to offer the best opportunity for WUAs to succeed and results in their making more substantial contributions to scheme design, construction and rehabilitation, and O&M.

55. **Government agency support for formation and reinforcement of WUAs has been shown to be very important to their success.** Capacity building and training of both WRDs and WUAs have proved to be essential, particularly on participatory irrigation planning and management, WUA formation and

strengthening, and WUA involvement in scheme design, construction, and O&M. Sufficient personnel and resources are also necessary to ensure adequate support to WUA formation and strengthening—inadequate support undermines WUA performance. The proposed project design not only builds in adequate support for WUA training but also has a well-defined and distinct ICDP for each SSCBI system, with associated plans for supporting O&M.

56. **Successful and sustained crop diversification and adoption of CSA technologies ultimately hinge on improving market opportunities and thus farmer profitability.** Experience from the APCBTMP and from WB–financed projects elsewhere makes it clear that limited market opportunities are a serious disincentive to diversification and adoption of CSA. Reliable and favorable markets, offering reasonable prices, are necessary to justify continued farmer investment in new seed, fertilizer, labor, and the related inputs necessary to produce non-paddy crops and invest in CSA. That is why marketing activities were added to the project design (Component C). In the APCBTMP, marketing support to farmers was ad hoc; this proposal incorporates streamlined support organized around FPOs and covers the entire marketing chain—market intelligence, access to market information, storage and logistics, establishment of rural markets, and the link to e-NAM to take advantage of pan-territorial markets.

57. **Collective action helps correct market imperfections, better integrates smallholder farmers into agricultural value chains, and is effective in increasing their incomes.** The project primarily targets small and marginal farmers with comparatively small plots of land who cannot produce large volumes of goods and thus get much lower prices from traders, who would pay more for larger quantities. They also cannot take advantage of the economies of scale related to inputs and output marketing. This realization informs the project decision to pursue farmer input and product marketing through FPOs to improve the market position of small and marginal farmers.

IV. IMPLEMENTATION

A. Arrangements

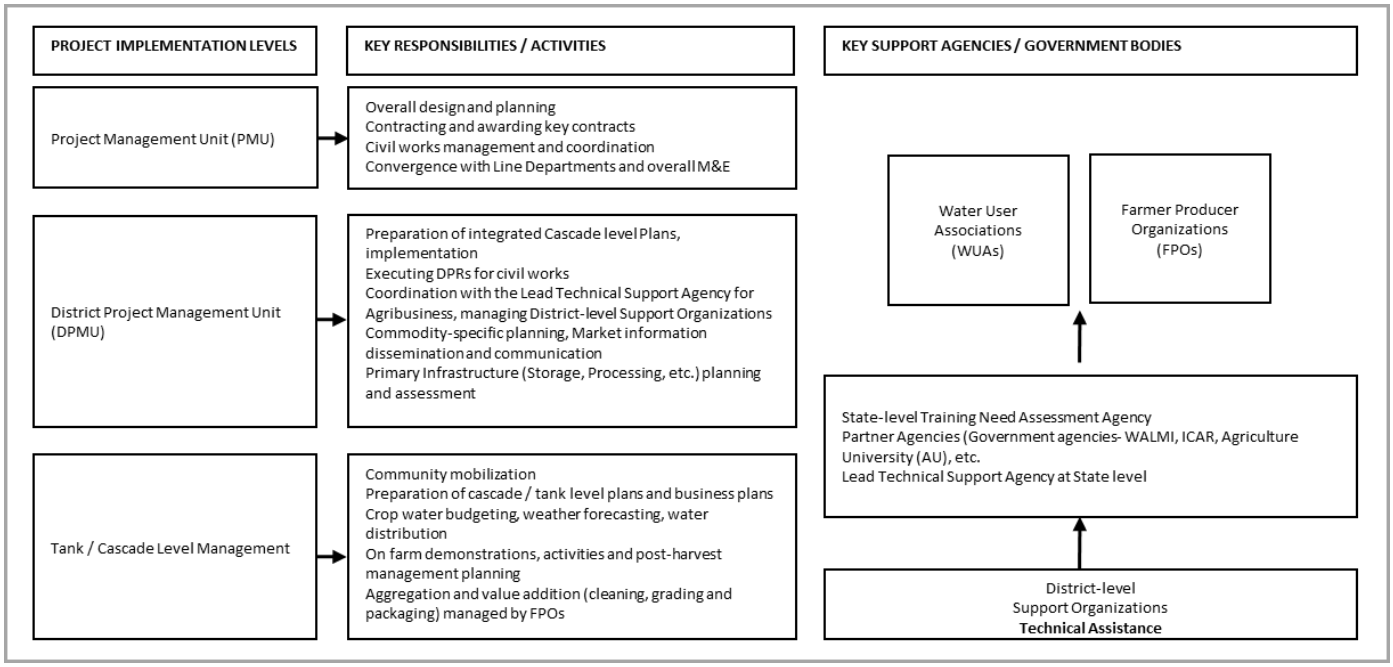
58. **The institutional and implementation arrangements for the project are fully integrated with the structures of participating state, district, and SSCBI line departments and agencies.** Four such entities will undertake interventions and activities. The administrative lead is the Principal Secretary, WRD. Associated GoAP agencies are the Departments of Agriculture, Horticulture, Fisheries and Groundwater-Water Audit. Figure 4.1 details the arrangements, which are also described in Annex B.

59. The project is organized around the following functions: (a) oversight and orientation by a Project Steering Committee (PSC); (b) management of project financial resources by an Empowered Finance Committee (EFC); (c) coordination of project activities and partners by a Project Management Unit (PMU); and (d) technical execution of project activities by specified government entities.

60. The main responsibilities of the PSC are to (a) advise the project on strategic directions and supporting activities; (b) approve the Annual Work Plan and Budget; (c) ensure that all stakeholders collaborate effectively; and (d) review PMU Progress Reports, ensure that activities are effective, and advise on any adjustments needed to the Annual Work Plan. The PSC, chaired by the Chief Secretary, will comprise the Secretaries or Principal Secretaries for Finance, Water Resources, Agriculture, Horticulture,

and Fisheries. An EFC chaired by the WRD Secretary will manage project financial resources and oversee allocation and reallocation of project funds.

Figure 4.1. Project Flow



61. Day-to-day management and operation of the project is the responsibility of the PMU, headed by the GoAP-appointed State Project Director (SPD). The PMU will provide operational management and coordination and will be represented at the district level through the DPMUs. It must ensure that (a) all project activities are planned, financed, and conducted according to the Annual Work Plan and Budget; (b) project activities conform to PIP operational guidelines; (c) procurement and financial management (FM) activities conform to the World Bank *Procurement for IPF Borrowers* (2016), project fiduciary manuals, and the Procurement Plan; and (d) the project fully complies with all applicable social and environmental safeguards. The PMU is also responsible for monitoring project activities, preparing quarterly and annual progress reports, and ensuring that all reports, financial and other, are submitted to the World Bank on schedule. It will represent all disciplines needed by the project and may include external specialists and other technical personnel deputed from line departments and agencies. Additional specialists in such areas as environment and social safeguards, media and communications, market intelligence, geographic information systems (GIS) will be recruited as needed.

B. Results Monitoring and Evaluation

62. **The project design includes a results-based M&E system to measure progress toward achieving the PDO.** Three interrelated activities constitute the primary mechanism for assessing whether the investment is effective: a baseline survey at the beginning, a midterm assessment of any needs for correction, and a comprehensive review when the project is finished. Appropriate sampling methods and a clear understanding of climate change issues will guide these assessments. A third-party M&E agency with expertise in climate change as related to water and agriculture will be contracted for this purpose.

63. **The M&E system reflects the decentralized project structure; the process for assessing progress is participatory**. Stakeholders will prepare a plan for measuring results, evaluating achievements, and learning from the project experience. The process will help build local capacity to reflect, analyze, propose solutions, and act. The typical process will encompass social audit and quality control by WUAs. Concurrently, the FPOs will be monitoring how the interventions they undertake are progressing. The M&E system will be designed to capture how climate-resilient activities are enhancing the profitability of project beneficiaries. Where possible, data will be disaggregated by gender.

64. **Having responsibility for planning and coordinating M&E will enhance the adaptive capacity of the PMU**. Numerous M&E activities will be directed to building internal PMU capacity. A robust GIS-based management information system (MIS) will track both physical results and project expenditures in real time, giving the PMU an external perspective on the work of the project. An agency not involved in the project or the PMU will conduct field-visit-based monitoring. The project may also undertake issue-and theme-based studies, as identified by joint and six-monthly reviews, on such topics as intervention processes; technical, administrative, and financial constraints; and evaluation of project results and impact. A study of sample tanks and household tracking in tank areas will cover how the project affects, e.g., job creation, economic benefits, climate change adaptation and mitigation, and changes in soil organic carbon and GHG emissions.

C. Sustainability

65. **Whether the project is sustainable will depend mainly on the following.** (a) the strength of the GoI commitment to reduce vulnerability and promote adaptation; (b) the GoAP commitment to revitalizing productive sectors through the Primary Sector Mission, fostering sustainable productivity growth, and diversification into value-added agribusinesses; (c) a solid capacity-building program so that WUAs can sustainably deliver the services farmers need; and (d) a highly participatory process of project design that brings in all groups affected. Throughout the project, interdepartmental coordination at various levels should lead to long-term organizational sustainability. This experience will also support mainstreaming of project activities within government agencies for replication. The primary sustainability objective is to ensure interdepartmental convergence and use resources more efficiently.

66. **In addition to rehabilitating and modernizing SSCBI systems, the project also supports an integrated development plan for each cascade.** The process will give WUAs (a) opportunities to participate in tertiary system planning before any construction or rehabilitation work in their area; (b) access to other production inputs and infrastructure (especially markets) needed to enhance the benefits of irrigated agriculture; and (c) substantial investments in knowledge and technology transfer to encourage use of technologies and agronomic practices that help build farm resilience. These activities are expected to have a positive financial impact on the WUAs, enhancing their capacity for O&M of the SSCBI systems and ensuring project sustainability.

D. Role of Partners

67. Partnerships are foreseen with a number of institutions and agencies, including: (a) Panchayati Raj Institutions, which will provide support for leveraging such current government schemes as the Mahatma Gandhi National Rural Employment Guarantee Scheme and PMKSY; and (b) national and

international networks, including such agencies as ICRISAT, the International Rice Research Institute, and other thematic networks for knowledge and technology transfer.

V. MAJOR RISKS

A. Risk Rating and Explanation of Key Risks

68. The Systematic Operations Risk-Rating Tool (SORT) was used to evaluate potential risks associated with the project. The overall risk rating is **Moderate** (Table 5.1).

Table 5.1. SORT Risk Assessment

Risk Category	Rating
1. Political and governance	Moderate
2. Macroeconomic	Low
3. Sector strategies and policies	Moderate
4. Project technical design	Substantial
5. Institutional capacity for implementation and sustainability	Moderate
6. Fiduciary	Moderate
7. Environmental and social	Moderate
8. Stakeholders	Low
9. Other	Low
OVERALL	Moderate

69. **The risks related to project technical design are substantial**. Because the project is so comprehensive, project activities as diverse as rehabilitation of SSCBI infrastructure, agricultural interventions promoting climate resilience, production technology transfer, aquaculture development, and marketing facilities will require close temporal and spatial coordination and careful sequencing. This will depend on a multi-departmental strategy for coordination and timely and efficient resource deployment. Although the PIP lays out an institutional structure and plan for this, compliance is a risk. In mitigation, the PIP specifies criteria for beneficiary eligibility, determination of financial terms, and prioritization of investment-ready areas of intervention. The project design also calls for extensive training to build the capacity of local staff and makes substantial efforts to create structures for interdepartmental coordination.

B. Screening for Climate Risks

70. The project has been screened for climate risks using the WB Climate and Disaster Risk Screening Tool.[23] The results were used to build up climate and disaster considerations in relation to physical

[23] https://climatescreeningtools.worldbank.org/.

components (e.g., irrigation, crop and land management) and nonphysical components (e.g., capacity building and training, institutional strengthening, and agricultural extension and research).

71. The screening found that, historically, project locations have been highly exposed to such climate hazards as extreme temperatures, extreme precipitation and flooding, drought, and cyclonic winds. The frequency and magnitude of these hazards are expected to rise: (a) relative to current conditions, the mean annual temperature in AP is projected to go up by 1.7°C–2°C by mid-century and by 2.5°C by 2080; (b) models project a rise in the inter-annual and inter-seasonal variability of monsoon rainfall and its distribution across AP; (c) between 1891 and 2009, seven of the nine coastal districts were exposed to 33 severe and 70 medium-normal cyclones[24]; (d) cyclonic rains also result in extreme rainfall, strong winds, and flooding that have severe impacts on agroecosystems, and the exposure to and severity of cyclones and periods of intense rainfall and flooding are increasing; and (e) drought has historically been a threat, especially in the Rayalaseema region—AP is the third most drought-prone state in India. The frequency and duration of droughts are expected to increase.

72. The project's focus on enhancing agricultural climate resilience is expected to lower the impact of projected extreme temperatures, extreme precipitation and flooding, strong winds, and drought. The planned scaling up of climate-resilient technologies and agronomic practices is projected to moderate their impact on project investments in irrigation and drainage, crops and land management, and post-harvest management. Similarly, the project emphasis on enhancing the capacity of water and agricultural service institutions is expected to significantly strengthen the adaptive capacity of project stakeholders.

VI. APPRAISAL SUMMARY

A. Economic and Financial Analysis

73. Cost-benefit analysis estimated the effects of project investments in modernizing SSCBI systems, WUA strengthening and capacity building, promoting adaptive and sustainable practices in both agriculture and fisheries, and promoting climate-friendly markets and agribusinesses. The analysis estimated the following benefits: (a) expansion of irrigated area as a result of tank rehabilitation, which will increase productivity and cropping intensity; (b) sustainable intensification and diversification of crop and horticulture production; (c) increased fish production through innovative and modern technology; (d) establishing alternate marketing channels to improve post-harvest management and value-addition; and (e) reduction of GHG emissions by adopting climate-friendly agricultural practices.

74. Project benefits were quantified based on crop production models of representative farms in 12 of the 13 AP districts. The returns were estimated for a 25-year period and based on 2017 constant prices and a discount rate of 12 percent. Of the 25 years, 6 were allocated to the project period.

75. The project was estimated to have a financial rate of return of 16.9 percent and a financial net present value (NPV) of about US$65.7 million. The conservative economic rate of return (ERR) was 19.5 percent and economic NPV was about US$82.4 million. Multiple sensitivity analyses tested how robust the project's incremental benefits were to unpredicted contingencies. An unexpected increase of 30 percent in total project costs could hold the ERR to 13.5 percent, and an unexpected reduction of

[24] https://climatescreeningtools.worldbank.org/.

incremental benefits by 30 percent derived from irrigation area expansion, crop intensification and diversification, fisheries, and GHG reduction lowered the ERR to 11.7 percent. That is still robust. Though delay in benefits was the most sensitive, the ERR stayed above 11 percent even with a three-year delay.

B. Technical

76. The technical aspects of the project design and its core component activities build on WB global knowledge, experience with agriculture adaptation and climate change, and lessons emerging from other projects. The rationale for the approach aligns with the GoI's commitments in its INDCs to the United Nations Framework Convention on Climate Change and conforms to local, national, and international best practices for climate-resilient agriculture.

77. The multidimensional nature of the project supports cascade-level planning and development. It proposes a range of farm, tank, and cascade interventions to enhance the climate resilience of farms through a triple-win scenario: more efficient and productive use of water, improved agricultural interventions, and more productive crops. Much of the project's climate resilience agenda is at the interface between the agriculture and water sectors. One item on that agenda is to use more surface water for agriculture and promote more sustainable management of groundwater through central government schemes for sprinklers and drip irrigation. The project has also proposed empowering WUAs to act as entrepreneurs in developing agribusiness opportunities in order to counter market monopoly practices and price fluctuations.

78. The project is starting with short-term interventions that lead to longer-term gains. It combines promotion of smart agriculture technologies, agronomic practices, automation, and use of remote sensing to heighten the efficiency of water use, with longer-term capacity development for farmers and local institutions so that climate adaptation approaches become part of future farm operations.

79. The project is designed to benefit from analysis of the impact of proposed climate-resilient interventions in generating local agriculture transformation (NICRA, for example). Through collaborative association with national and international agencies (ICAR, ICRISAT, etc.), the project will introduce new climate-resilient agricultural technologies, use of sensors, and a web-based platform to make extensive use of science-based modeling for efficient management of land and water resources to sustain productivity and ensure profitability (water efficiency technology demonstrated in Haryana by Israel, and in Australia by Murray Darling Basin project).

C. Financial Management

80. The project's FM arrangements are considered adequate to both account for and report on project spending and satisfy fiduciary requirements.

81. **Budgeting and planning.** The GoAP will budget project funds under a separate budget head for funds per defined project component. The PMU will prepare Annual Work Plans, taking into account the requirements of all components, including project management. The consolidated Annual Work Plan will be discussed and approved by the PSC, headed by the Chief Secretary, but any reallocations or modifications needed for any component must be cleared by the EFC, headed by the WRD Secretary.

82. **Fund flow.** The World Bank will make funds available to the GoAP through established on-lending arrangements with the GoI. Depending on the activity, the PMU will either use the funds to make payments or allocate them to DPMUs to do so. The State Finance Department will issue a Budget Release Order (BRO) authorizing the Commissioner of the Command Area Development Authority (CADA) to draw the funds from the state treasury. The Commissioner will then release the funds to District Project Directors (DPDs) and line departments as specified.

83. **Accounting and reporting.** Accounting will be based on the Government System of Accounting; the project will also use the Comprehensive Financial Management System (CFMS) for allocating funds and recording and reconciling expenditures. The PMU will report on project activities through quarterly interim unaudited financial reports (IUFRs), using a format agreed with the World Bank. These reports will be the basis for disbursements. The project will also prepare an annual financial statement to be audited by the statutory auditor.

84. **Financial staffing.** The FM function of the project will be led by an officer at the level of Joint Director seconded from the State Finance and Accounts Services, who will be assisted by a Superintendent and Senior Assistant Officers. At the DPMU level, a Divisional Accounts Officer (DAO) will handle FM.

85. **External and internal audit.** The AP offices of the Comptroller and Auditor General (CAG) of India will be the external auditor. The audit report will be submitted to the World Bank within six months of the close of each financial year. The project will also establish an in-house internal audit department headed by a Deputy Internal Audit Manager from the AP Audit Officer cadre, with adequate supporting staff.

86. **Disbursement arrangements and retroactive financing.** The World Bank will finance 70 percent of project spending (as reported by IUFRs) up to US$172.2 million. Up to 20 percent of the WB loan will be available for expenditures incurred in the 12 months before the signature date.

D. Procurement

87. Procurement for the proposed project will adhere to the WB *Procurement Regulations for IPF Borrowers* (“Regulations”), dated July 2016, revised November 2017. The project will be subject to the WB *Guidelines on Preventing and Combating Fraud and Corruption in Projects Financed by IBRD Loans and IDA Credits and Grants* (“Anti-Corruption Guidelines”), revised July 1, 2016. A majority of likely procurements are for improving the tank system through Requests for Bids (RFBs) through National Competitive Bidding (NCB); approaching the international market for RFBs is not envisaged. After WB clearance the project will use the GoAP e-procurement system for high-value procurements (≥ INR 6.5 million). The project will also use the online tool Systematic Tracking of Exchanges in Procurement (STEP).

88. **Procurement risk assessment.** The PMU established for the previous APCBTMP will manage the new project. Some PMU officials and staff of a few implementing departments who were involved in the previous project are familiar with WB procurement procedures and have experience in implementing projects, although procurement delays and contract management disputes and delays could be problem areas.

89. **Project procurement strategy.** As the regulations require, a Project Procurement Strategy Document (PPSD) has been drafted. The findings of market analyses for all major project activities were

used to inform recommendations on appropriate packages and lots for civil works to ensure that enough bidders participate. Consultancy contracts were also drafted based on market research, which was again used to package the scope of services and the contract periods. Based on the draft PPSD, the Procurement Plan is being prepared; it will set out methods to be followed for procuring goods, works, and both non-consulting and consulting services financed by the World Bank, which has accepted the Procurement Plan for the first 18 months of the project.

E. Social Development, including Safeguards

90. **The social assessment concluded that the SSCBI-dependent farming community can make a real contribution to planning, operating, and maintaining the tanks so that the benefits are sustainable.** Further, because water flow dynamics necessarily bind the farmers not only within a single installation but also throughout the planned cascade of tanks, community mobilization is a central strategy. Here the project builds on previous efforts to mobilize local communities into WUAs to provide a common platform for a variety of tank management-related activities. However, mobilization efforts do not necessarily take into account the heterogeneity of local communities. This project will ensure that poor and vulnerable segments of the population, such as scheduled castes and tribes and farm households headed by women, will be represented. The project provides for human and institutional development activities that address these and other factors.

91. **Project environmental and social safeguards are classified as Category B,**[25] which is expected to have substantial positive social benefits as a result of enhancement of tank-based livelihoods. Safeguard issues center on augmenting or reengineering minor irrigation tanks and the water conveyance system and associated activities to enhance agriculture and fishery production, productivity, and incomes. The intent is to bridge the gap between designed and actual irrigable areas, with the participation of local water-using communities. A major challenge is thus to mobilize group action in the community and establish links with other public and private institutions. With the help of an ESMF, the previous APCBTMP addressed this successfully. The new ESMF for this project has a detailed Social Management Plan (SMP). This project has adapted that model to the latest changes in the laws and expanded the scope of its interventions. Since the project deals only with existing irrigation tank systems, no land needs to be acquired involuntarily. However, as a backup measure, the earlier Resettlement Policy has been revised to incorporate recent legislative developments. Lastly, recognizing that the project is expected to apply in scheduled and tribal areas, a Tribal Peoples Planning Framework has also been prepared. Reports were disseminated on all these social management factors and discussed with stakeholders.

92. **The project incorporates gender equality efforts.** Women contribute to the bulk of farming operations in AP, yet they have limited access to productive inputs, assets and services. A comprehensive social assessment in the state of AP revealed that: (i) agricultural extension services and capacity building programs disproportionately reached men rather than women farmers; (ii) women received different wage rates and worked in oppressive conditions; (iii) there is a dearth of women-friendly technologies and techniques; and, (iv) women farmers are more vulnerable to climate change, as they often lack the means or capacity to cope with the impacts of climate change. Women's minimal participation in Water User Associations (WUA) and Farmer Producers Organizations (FPOs) is an important contributing factor

[25] Details of the safeguard categories are explained in the Project Implementation Plan.

to their limited access to resources, reduced productivity and limited contribution to agricultural production, economic growth and the well-being of their families.

93. **Gender and participation of women.** Considering the key role women play in the agriculture sector in the state, the project will focus on increasing women's participation in WUAs and FPOs and facilitating women's access to productive resources, extension information, modern technology, and markets. The project has made strategic and operational design efforts which will ensure not only recognizing women from farming households as 'farmers', but also promoting their active leadership in WUAs and FPOs management and decision-making processes. In addition, project activities include various gender sensitization campaigns and village level workshops, involving the implementing agencies, WUAs, FPOs (see Gender Action Plan, included as part of the Environment and Social Management Framework document, for details). The project will also ensure that the provisions outlined in the AP Framers Management of Irrigation Act, 1997 for women representation in WUA formation are enforced.

94. **The state of AP and the project entities are committed to engaging common citizens in project management** because engagement paves the way for (a) legitimized decisions; (b) appropriately designed interventions; (c) effective institutional and implementation arrangements; (d) enhanced inclusion, fewer conflicts, and common platforms for sharing knowledge and concerns and ensuring justice, liberty, and dignity; (e) local capacity-building, leading to responsible and responsive citizens; (f) better-quality outcomes; and (g) downward accountability. In effect, because of citizen engagement the project is expected to contribute to better service delivery and sustainable impacts. Annex B lists project mechanisms for ensuring citizen engagement.

F. Environment, including Safeguards

95. **The project is not expected to have any significant and irreversible negative environmental impacts.** However, certain activities, if not carried out properly and with due care for the surrounding natural and built environment, could have short to medium-term adverse impacts. Because these negative impacts can be contained, mitigated, and even reversed, the project undertook an environmental assessment (EA) through stakeholder consultations and field-based observations on a sample of tanks to be rehabilitated, farmer fields, and irrigation canals. The EA, carried out by technically qualified consultants, also reviewed how national and state laws relate to project activities. The EA results were the basis for such environmental safeguard policies as the Environmental Assessment (OP4.01), Natural Habitats (OP4.04), Pest Management (OP4.09), Physical Cultural Resources (OP4.11), and Safety of Dams (OP4.37). Similar social assessments were undertaken on selected samples and incorporated in the ESMF, covering social inclusion, community participation, and benefit sharing with detailed steps and procedures.

96. **Based on the EA findings and the environmental risks and adverse impacts identified, the WRD prepared an ESMF and formulated a template for the Environmental Management Plan (EMP) for specific tanks**. It drafted five model EMPs, based on which EMPs will be tailored for tanks where the project will invest before an RFB is issued. The ESMF spells out a range of mitigation measures to address potential risks and impacts and contains, e.g., an environmental checklist for screening subprojects and a list of clauses to include in bid documents. Because project investments could call for increased use of agrochemicals, a Pest Management Plan has also been drafted. Several tanks support biodiversity in terms of birds, amphibians, and aquatic flora which tank rehabilitation could threaten; to minimize this

possibility, WRD has also drafted a Natural Habitats Management Plan. The ESMF provides a budget for undertaking mitigation measures and details institutional arrangements for complying with the ESMF/EMP, for which the PMU will contract with an environmental expert. All environmental and social safeguard documents were disclosed in country on March 28, 2018 at 5p.m. (IST) and on the World Bank's external website on April 4, 2018 at 5p.m. (IST).

G. World Bank Grievance Redress

97. Communities and individuals who believe that they are adversely affected by a WB–supported project may submit complaints to the project itself or the WB Grievance Redress Service (GRS). The GRS ensures that complaints received are promptly reviewed; project-affected communities and individuals may also submit their complaints to the WB independent Inspection Panel, which determines whether harm has occurred or could occur because the World Bank had not complied with its own policies and procedures. Complaints may be submitted at any time after concerns have been brought directly to the World Bank's attention and Bank management has been given an opportunity to respond. For information on how to submit complaints to the GRS, please visit *http://www.worldbank.org/en/projects-operations/products-and-services/grievance-redress-sservice*. For information on how to submit complaints to the WB Inspection Panel, please visit *www.inspectionpanel.org*.

VII. RESULTS FRAMEWORK AND MONITORING

COUNTRY : India
AP Integrated Irrigation & Agriculture Transformation Project

Results Framework

COUNTRY: India
AP Integrated Irrigation & Agriculture Transformation Project

Project Development Objective(s)

The Project Development Objective is to enhance agricultural productivity, profitability and climate resilience of smallholder farmers in selected districts of Andhra Pradesh.

Project Development Objective Indicators

Indicator Name	DLI	Baseline	Intermediate Targets						End Target
		2019	1	2	3	4	5	6	2026
Farmers reached with agricultural assets or services									
Farmers reached with agricultural assets or services (CRI, Number)		0.00			60,000.00				200,000.00
Farmers reached with agricultural assets or services - Female (CRI, Number)		0.00			20,000.00				50,000.00
Productivity of specific crops increased									
Productivity of specific crops increased (Metric		0.00							0.00

Indicator Name	DLI	Baseline	Intermediate Targets						End Target
		2019	1	2	3	4	5	6	2026
ton)									
a. Paddy (Metric ton)		5.00	5.00	5.10	5.10	5.20	5.40	5.50	5.50
b. Groundnut (Metric ton)		1.14	1.14	1.14	1.20	1.30	1.40	1.43	1.43
c. Chilli (Metric ton)		2.37	2.37	2.40	2.40	2.60	2.70	2.96	2.96
Farmer's household income increased									
Farmer's income increased (Text)		INR 15,722.00			INR 17,200.00				INR 19,653.00
Water Productivity Increased (kg/m3)									
Water Productivity Increased (Kg/m3) (Text)		(as given for each crop)			(as given for each crop)				(as given for each crop)
a. Paddy (Surface water) (Text)		0.33 kg/m3	0.33 kg/m3	0.33 kg/m3	0.37 kg/m3	0.38 kg/m3	0.40 kg/m3	0.42 kg/m3	0.42 kg/m3
b. Paddy (Surface + Groundwater) (Text)		0.37 kg/m3	0.37 kg/m3	0.38 kg/m3	0.40 KG/m3	0.40 kg/m3	0.40 kg/m3	0.50 kg/m3	0.50 kg/m3
c. Groundnut (Surface + Groundwater) (Text)		0.28 kg/m3	0.28 kg/m3	0.28 kg/m3	0.31 kg/m3	0.33 kg/m3	0.34 kg/m3	0.35 kg/m3	0.35 kg/m3
d. Chilli (Surface + Groundwater) (Text)		0.30 kg/m3	0.30 kg/m3	0.30 kg/m3	0.32 kg/m3	0.33 kg/m3	0.35 kg/m3	0.38 kg/m3	0.38 kg/m3

Intermediate Results Indicators by Components

Indicator Name	DLI	Baseline	Intermediate Targets						End Target
		2019	1	2	3	4	5	6	2026
Component A: Improving Irrigated Agriculture Efficiency									
Satisfaction rate related to WUAs performance (Percentage)		17.00			40.00	60.00	65.00	70.00	70.00
Area provided with new/improved irrigation or drainage services (CRI, Hectare(Ha))		0.00			65,000.00				90,000.00
Area provided with new irrigation or drainage services (CRI, Hectare(Ha))		0.00	10,000.00	20,000.00	40,000.00	60,000.00	80,000.00	90,000.00	90,000.00
Area provided with improved irrigation or drainage services (CRI, Hectare(Ha))		46,000.00	46,000.00	46,000.00	65,000.00	75,000.00	80,000.00	90,000.00	90,000.00
Component B: Promoting Climate Smart Agriculture Practices									
Area increased/decreased in the Tank Command under Paddy, Pulses, Oil seeds and Vegetables (Hectare(Ha))		0.00							0.00
a. Paddy (Hectare(Ha))		95,908.00			80,908.00				75,908.00
b. Red Gram (Hectare(Ha))		2,052.00			3,277.00				5,552.00
c. Groundnut (Hectare(Ha))		4,982.00			6,382.00				8,482.00
d. Chilli (Hectare(Ha))		627.00			2,287.00				4,777.00
Area under fishery increased (Ha EWSA) at		33.00	34.00	35.00	37.00	38.00	40.00	41.00	41.00

Indicator Name	DLI	Baseline	Intermediate Targets						End Target
		2019	1	2	3	4	5	6	2026
Full Tank Level (Percentage)									
Increment in Fish Productivity in short seasonal tanks (Tones/year)		0.36	0.38	0.40	0.43	0.46	0.50	0.53	0.53
Component C: Post-harvest Management, Market and Agribusiness Promotion									
Number of Farmers Having Access to Infrastructural Facilities Created (Number)		0.00							0.00
a. Storage Structures (Number)		0.00			3,000.00				6,000.00
b. Low Energy cool Chambers (Number)		0.00			2,000.00				5,000.00
Number of FPO activities financed through business plans (Number)		0.00	0.00	0.00	50.00	70.00	90.00	100.00	100.00
Number of women represented in WUA and FPO (Percentage)		0.00			30.00				30.00
Component D: Project Management and Capacity Building									
Beneficiary (of which 50 percent women) satisfaction rate with quality of services provided by the project (Percentage)		0.00			40.00				80.00

Indicators to be Mapped	Baseline	Intermediate Targets						End Target
	2019	1	2	3	4	5	6	2026
Farmers reached with agricultural assets or services (CRI, Number)	0.00			60,000.00				200,000.00
Farmers reached with agricultural assets or services - Female (CRI, Number)	0.00			20,000.00				50,000.00
Productivity of specific crops increased (Metric ton)	0.00							0.00
a. Paddy (Metric ton)	5.00	5.00	5.10	5.10	5.20	5.40	5.50	5.50
b. Groundnut (Metric ton)	1.14	1.14	1.14	1.20	1.30	1.40	1.43	1.43
c. Chilli (Metric ton)	2.37	2.37	2.40	2.40	2.60	2.70	2.96	2.96
Farmer's income increased (Text)	INR 15,722.00			INR 17,200.00				INR 19,653.00
Water Productivity Increased (Kg/m3) (Text)	(as given for each crop)			(as given for each crop)				(as given for each crop)
a. Paddy (Surface water) (Text)	0.33 kg/m3	0.33 kg/m3	0.33 kg/m3	0.37 kg/m3	0.38 kg/m3	0.40 kg/m3	0.42 kg/m3	0.42 kg/m3
b. Paddy (Surface + Groundwater) (Text)	0.37 kg/m3	0.37 kg/m3	0.38 kg/m3	0.40 KG/m3	0.40 kg/m3	0.40 kg/m3	0.50 kg/m3	0.50 kg/m3
c. Groundnut (Surface + Groundwater) (Text)	0.28 kg/m3	0.28 kg/m3	0.28 kg/m3	0.31 kg/m3	0.33 kg/m3	0.34 kg/m3	0.35 kg/m3	0.35 kg/m3
d. Chilli (Surface + Groundwater) (Text)	0.30 kg/m3	0.30 kg/m3	0.30 kg/m3	0.32 kg/m3	0.33 kg/m3	0.35 kg/m3	0.38 kg/m3	0.38 kg/m3
Intermediate Outcome Indicators								

Monitoring & Evaluation Plan: PDO Indicators					
Indicator Name	**Definition/Description**	**Frequency**	**Datasource**	**Methodology for Data Collection**	**Responsibility for Data Collection**
Farmers reached with agricultural assets or services		Mid-term and End of Project	PMU internal monitoring report	Sample survey by the third-party monitoring agency	PMU
Farmers reached with agricultural assets or services - Female		Mid-term and End of Project.	PMU internal monitoring report	Sample survey on actual access to farm assets by women. This survey will be assessed by the third party monitoring agency and will also be captured in PMU internal monitoring report	PMU
Productivity of specific crops increased	This indicator measures the increased crop productivity for paddy, red gram, groundnut and chili crops at farm level in metric ton per hectare.	Yearly and final impact assessment	PMU internal monitoring report .	Sample survey by the third-party monitoring agency	PMU
a. Paddy	This indicator will measure productivity of paddy per Hectare as metric ton per hectare.	Yearly	PMU internal monitoring report	Survey conducted by third party monitoring agency in sample areas and control areas and PMU internal monitoring report	PMU

b. Groundnut	This indicator will measure productivity of groundnut per Hectare as metric ton per hectare.	Yearly and final impact assessment	PMU internal monitoring report	Sample survey by the third party monitoring agency	PMU
c. Chilli	This indicator will measure productivity of chili crop per Hectare as metric ton per hectare.	Yearly and final impact assessment	PMU internal monitoring report	Sample survey by the third-party monitoring agency	PMU
Farmer's income increased	This indicator will track the annual farm income of project beneficiaries. It measures how the income of the farmers evolves with project activities, compared to the income of farmers that do not benefit from project interventions (Household income increases in INR).	Mid-term and End of Project	PMU internal monitoring report	Survey conducted by the third party monitoring agency in sample and control households.	PMU
Water Productivity Increased (Kg/m3)	This indicator will measure the annual increase in water productivity at tank command areas; it is expressed ratio of agriculture production in Kg over water consumed (in m3).	Yearly and final Impact assessment .	PMU internal monitoring report	Sample survey by the third-party monitoring agency	PMU
a. Paddy (Surface water)	This indicator will measure the annual increase in water productivity at tank	Yearly and final impact	PMU internal monitoring report	Sample survey by the third-party monitoring agency	PMU

	command areas for Paddy crop. it is expressed as a ratio of agriculture production in Kg over water consumed (Surface water) (in m3).	assessment (crop-wise, season-wise)			
b. Paddy (Surface + Groundwater)	This indicator will measure the annual increase in water productivity at tank command areas for Paddy crop. it is expressed as a ratio of agriculture production in Kg over water consumed (Surface + Groundwater) (in m3).	Yearly and final impact assessment (crop-wise, season-wise)	PMU internal monitoring report	Sample survey by the third-party monitoring agency	PMU
c. Groundnut (Surface + Groundwater)	This indicator will measure the annual increase in water productivity at tank command areas for Groundnut crop. it is expressed as a ratio of agriculture production in Kg over water consumed (Surface + Groundwater) (in m3).	Yearly and final impact assessment (crop-wise, season-wise)	PMU internal monitoring report	Sample survey by the third-party monitoring agency	PMU
d. Chilli (Surface + Groundwater)	This indicator will measure the annual increase in water productivity at tank command areas for Chilli crop. it is expressed as a ratio of agriculture production in Kg over	Yearly and final impact assessment (crop-wise, season-wise)	PMU internal monitoring report	Sample survey by the third-party monitoring agency	PMU

	water consumed (Surface+ Groundwater) (in m3).				

Monitoring & Evaluation Plan: Intermediate Results Indicators					
Indicator Name	**Definition/Description**	**Frequency**	**Datasource**	**Methodology for Data Collection**	**Responsibility for Data Collection**
Satisfaction rate related to WUAs performance	This indicator will measure the satisfaction rate related to WUAs performance, due to project intervention. This will be measured annually after the mid-term of the project.	Mid-term, annually after Mid-term till End of Project.	Field monitoring complemented by independent assessment of WUAs, consolidation at PMU level	Sample survey by the third party monitoring agency	PMU
Area provided with new/improved irrigation or drainage services	This indicator measures the total area of land provided with irrigation and drainage services under the project, including in (i) the area provided with new irrigation and drainage services, and (ii) the area provided with improved irrigation and drainage services, expressed in hectare (ha).	Mid-term and End of Project.	PMU internal monitoring report	Sample survey by the third-party monitoring agency	PMU
Area provided with new irrigation or drainage services	Measures in hectares the total area of land provided	Yearly and final	PMU internal monitoring	Sample survey by the third-party monitoring	PMU

	with new or improved irrigation or drainage services in operations supported by the World Bank.	impact assessment	report	agency	
Area provided with improved irrigation or drainage services	Measures in hectares the total area of land provided with new or improved irrigation or drainage services in operations supported by the World Bank.	Yearly and final impact assessment	PMU internal monitoring report	Sample survey by the third-party monitoring agency	PMU
Area increased/decreased in the Tank Command under Paddy, Pulses, Oil seeds and Vegetables	This indicator will measure the area increased/decreased (Hectare) in the Tank Command under paddy, red gram, groundnut and chilies, measured separately for individual crops (in Metric ton / Hectare). .	Mid-term and final impact assessment	PMU internal monitoring report	Sample survey by the third-party monitoring agency	PMU
a. Paddy	This indicator will measure the change in area cultivated under Paddy (in Hectare).	Mid term and final impact assessment .	PMU internal monitoring report	Sample survey by the third-party monitoring agency	PMU
b. Red Gram	This indicator will measure the increase in the area cultivated under Red Gram in the tank command area.	Mid-term and End of Project	PMU internal monitoring report	Sample survey by the third-party monitoring agency	PMU

c. Groundnut	This indicator will measure the increase in the area cultivated under Groundnut in the tank command area under the project.	Mid-term and End of Project	PMU internal monitoring report	Sample survey by the third-party monitoring agency	PMU
d. Chilli	This indicator will measure the change in area cultivated under Chillies in the tank command area (in Hectare).	Mid-term and End of Project.	PMU internal monitoring report	Sample survey by the third-party monitoring agency	PMU
Area under fishery increased (Ha EWSA) at Full Tank Level	This indicator will measure net fish cultivation area increased in tank water reservoir areas (Effective Water Spread Area for fishing) in percentage.	Yearly and final impact assessment	PMU internal monitoring report	Sample survey by the third-party monitoring agency	PMU
Increment in Fish Productivity in short seasonal tanks	This indicator will measure net fish productivity per effective water spread area (tones/year).	Yearly and final impact assessment	PMU internal monitoring report	Sample survey by the third-party monitoring agency	PMU
Number of Farmers Having Access to Infrastructural Facilities Created	This indicator will measure the number of farmers having access to post-harvest infrastructural facilities (Storage Structures and Low Energy Cool Chambers) created under the project.	Mid-term and End of Project.	PMU internal monitoring report	Sample survey by the third-party monitoring agency	PMU
a. Storage Structures	This indicator measures the number of farmers having	Mid-term and End of	PMU internal monitoring	Sample survey by the third-party monitoring	PMU

	access to Storage facilities created under the project.	Project.	report	agency	
b. Low Energy cool Chambers	This indicator measures the number of farmers having access to Low Energy Cool Chambers created under the project.	Mid-term and End of Project.	PMU internal monitoring report	Sample survey by the third-party monitoring agency	PMU
Number of FPO activities financed through business plans	This indicator represents number of business plans for FPO activities prepared and supported under the project (in absolute number) from year 3 onwards.	Yearly review starting Project Year 3, End of Project.	PMU internal monitoring report	Sample survey by the third-party monitoring agency	PMU
Number of women represented in WUA and FPO	This indicator will measure the percentage of women represented in WUAs and FPOs formation, and active participation in decision making process.	Mid-term and End of Project	PMU internal monitoring report	Sample survey by the third-party monitoring agency	PMU
Beneficiary (of which 50 percent women) satisfaction rate with quality of services provided by the project	This indicator measures the percentage of beneficiaries who expressed satisfaction with the quality of services provided by the project based on formal surveys (of which 50 percent should be women).	Mid-term and End of Project.	PMU internal monitoring report	Sample survey by the third-party monitoring agency	PMU

ANNEX A: DETAILED PROJECT DESCRIPTION

A. Project Development Objective (PDO), Key Results Indicators, and Beneficiaries

1. The Project Development Objective is to enhance agricultural productivity, profitability, and climate resilience of smallholder farmers in selected districts of Andhra Pradesh.

2. **The key results indicators for assessing project outcomes are:**

(a) Farmers reached with agricultural assets or services (number), of which female beneficiaries (number)
(b) Productivity of specified crops increased (Metric ton per hectare)
(c) Water productivity increased (kg per m^3)
(d) Farm income increased (household income in INR)

3. **Project Beneficiaries.** The project will work with 1,000 SSCBI systems in 12 districts covering a command area of 90,000 ha, benefitting 200,000 families, who will include small and marginal farmers, WUAs, FPOs, and other agro-entrepreneurs. Among those specifically targeted will be women and other vulnerable groups. such as tribal people.

4. Marginal farmers are those with up to 1 ha of cultivable land; small farmers own 1–2 ha. Both groups are expected to benefit directly from project activities to organize producers and improve access to knowledge and assets to enhance farm climate resilience. Among these efforts are irrigation, improved planting material, and post-harvest technology, which are all expected to substantially raise farm incomes.

5. The project will benefit community WUAs and FPOs. WUAs manage irrigation facilities (water tanks) and support agriculture; FPOs organize and promote post-harvest value-adding activities. Both will benefit from capacity-building in governance, planning, management, marketing, and support for creating value chains to allow them to provide services to their members in SSCBI catchment areas.

6. The project will also directly benefit local institutions and government agencies (for example, ANGRAU, district and sub-district agricultural research and extension services, and fisher cooperative societies) by building capacity for climate resilience and value-chain development. Governmental line departments will also benefit from strategic partnerships with the project to mainstream climate resilience in their agriculture programs.

7. **Geographical Focus.** The project covers tanks and cascades in 12 of the 13 AP districts (all except Guntur) with intensive focus on the three north-coastal districts of Srikakulam, Vizianagaram, and Visakhapatnam and on the tribal areas of East Godavari District, where agricultural productivity is reportedly the lowest in India. Tanks will be selected based, e.g., on (a) a study of the hydrological viability and feasibility of the cascade; (b) whether they are part of a cascade with less than 40 ha command area and a gap command area of more than 25 percent; and (c) isolated tanks with more than a 40 ha command area. Priority will be given to commands where the groundwater level is low and tanks require considerable repairs. However, no land will be acquired to reach tanks. Investment will be linked to the

willingness of farmers, the active participation of WUAs, and the ambition of the targets compared to other schemes.

B. Project Approach

8. **Priorities to Be Addressed.** Low and stagnant agricultural productivity; limited crop and non-crop diversification; high costs of production; and inefficient resource use have often been documented as contributing to the poor performance of agriculture in AP. Despite numerous national and state programs, yields for most crops are very low, largely because of limited adoption of modern technology. An interstate comparison, for example, shows yield gaps as high as 320 percent for groundnuts and red gram, 420 percent for castor, and 160 percent for sunflower. In addition, a recent assessment by Suseela and Chandrasekaran (2016) found dismal levels of crop diversification and even a negative diversification trend in AP between 1990 and 2015. Food grains still dominate the sector. More variable rainfall and temperature patterns in AP also weigh on agriculture. Even modest declines in winter rainfall and temperature fluctuations, for example, have been shown to depress yields, especially for rabi crops; floods, droughts, and other extreme weather events can be devastating; and climate change is expected to worsen the intensity and frequency of extreme weather. Agriculture is also the leading source of GHGs in the state; it emits 17.5 million tons of CO_2 equivalent annually (based on a decadal modelling forecast), of which about 24 percent comes from crop soils, 22 percent from rice cultivation, and 7 percent from livestock manure and burning of crop residue.

9. Addressing these agricultural challenges requires a shift in approaches to effectively integrate climate change considerations into the product mix while honoring AP's agricultural growth objectives. The proposed project is meant to support this shift, which aligns with GoAP strategic priorities:

(a) Increase the productivity of major crops, taking into account high input costs, climate variability, and limited availability of irrigation.
(b) Ensure access to local water resources to buffer against unpredictable rainfall and droughts.
(c) Diversify crops in the rabi season, when just 30–38 percent of the land is cultivated, and support development of agribusiness to maximize profitability.
(d) Heighten the effectiveness of farmers' organizations in providing the services farmers require, especially sustainable operation and maintenance of SSCBI systems.

10. The project is directed to modernizing SSCBI systems in order to increase the productivity of water use and enhance the resilience of agriculture. By upgrading cascade infrastructure, the project will integrate seasonal irrigation expansion and improved agricultural practices is a changing climate scenario. This will be achieved by building up community-led institutions in the tank areas, CWB, crop diversification, post-harvest management, agribusiness development, incentivizing efficiency improvements, improving the quality of irrigation service delivery, and modernizing irrigation assets. The project will adopt a cascade approach to improving water security and optimize the use of surface and groundwater across the cascade throughout the year.

11. Because such a project requires investment by several state line departments and value-chain actors (agriculture, irrigation, farmers, WUAs, and others), the project will expand their collaboration and promote convergence not only on schemes within the Agriculture Department but also those of other

entities and individuals supporting AP farmers. Through collective action, the project aims to improve farm livelihoods through higher productivity, value addition, and climate resilience.

12. **Participatory Irrigation Management.** Project tank improvement is not limited to physical infrastructure but also extends to water management and monitoring to make the system more efficient. The project is designed to support the 1997 AP-FMIS Act with respect to conjunctive water use practices, PIM, groundwater management, and local participatory hydrological monitoring (PHM). Better O&M of rehabilitated tank systems will be dovetailed with irrigation outreach to reduce water footprints through adaptive farming practices. O&M of irrigation infrastructure is the responsibility of both the WRD and WUAs. The DPMU executive engineer will be responsible for constructing the field channels and WUAs for maintaining them. Recognizing the importance of keeping feeder channels in good condition, the cleaning up, strengthening, and repair elements of the project will give special attention to the channels. The DPMU executive engineer will take the lead in their cleaning, in association with WUAs. The project will draft O&M manuals tailored to each SSCBI system that will detail operation of the modernized infrastructure and the schedule for inspection and maintenance. WUAs will be trained in O&M under Subcomponent A.1.

13. The project will also promote use of CWB and train the community in knowledge of, and motivation for, social regulation in groundwater and natural resources management. CWB will be based on cascade data collected through PHM to enable groundwater users to understand the resource status in the zone of influence through data they themselves collect and analyze. This will enable them to plant appropriate crops to ensure irrigation in the kharif season and augment water availability in the rabi season. The CWB will account for the availability of enough water based on rainfall, groundwater recharge and extraction, surface water availability, and so on. The crop water requirement will be computed taking into account crop acreage and the water requirements of the specific crop. The hydrological data will be collected through the PHM network and will include estimates of surface water availability.

14. Participatory groundwater management (PGM) is highly relevant to current groundwater development and related institutional and policy initiatives. Groundwater users in each tank and cascade influence zone will be organized into groups by the project SOs, with guidance from the DPMU, and group organizational capacities will be built up. This will facilitate comprehension of PHM analyses and inform collective decision making on cropping patterns and social regulation of groundwater use. Groundwater Department staff and other specialists from the PMU and DPMU will provide technical facilitation. Based on lessons learned from this experience, the project will pilot different institutional approaches to sustaining the PGM groups for effective long-term action. In a cascade, about 20 percent of the wells in the command area of each tank and its zone of influence will be inventoried. Wells will be selected based on structural features, presence and extent of aquifers, depth to water level, yield of the well, density of wells in the neighborhood and their performance, and other local hydro-geological conditions; the Groundwater Department will have primary responsibility for the assessment.

C. Project Components

15. Project activities are grouped into four components: (a) Improving Irrigated Agriculture Efficiency; (b) Promoting Climate-Smart Agricultural Practices; (c) Post-harvest Management, Marketing, and Agribusiness Promotion; and (d) Project Management and Capacity Building.

Component A: Improving Irrigated Agriculture Efficiency

16. For Component A, the project goal is to enhance farm water security to reduce the risks associated with intra- and inter-seasonal climate variability. Within a defined cascade, this component will finance the following related interventions: (a) strengthening community-based WUAs to enable them to take more responsibility for delivery of irrigation water and for integrated planning and management of water resources; (b) modernizing SSCBI systems and enhancing their climate resilience; and (c) improving the productivity and efficiency of on-farm water. These activities will be overseen by the WRD with the participation of WUAs and of SOs contracted as needed. For the first time, in the 1,000 project tanks the AP-FMIS Act provisions for PGM and PHM will be enforced.

Subcomponent A.1: **Institutional Strengthening and Capacity Building of WUAs**

17. Subcomponent A.1 will build WUA capacities in 1,000 tank systems for better O&M of SSCBI systems and better water management. It will finance (a) training of WUAs in effective O&M and fee recovery, monitoring and benchmarking performance data, administration, and financial management and auditing; (b) TA on preparing annual water budgets, irrigation efficiency plans, asset management plans, and public outreach and communication plans; (c) upon request, recruitment of private operators to handle daily O&M, including progressive cost recovery for WUAs; and (d) establishment of a service feedback mechanism and annual user satisfaction surveys. The TA will also help WUAs access central and state government support, assess the need for primary storage structures, connect with input and technology providers, and work with FPOs to promote agribusinesses. The project will formulate training protocols to enhance the ability of FPOs to provide market intelligence and links for enhancing the profitability of smallholder producers along the cascade.

18. Capacity-building interventions and other procedures to be adopted by WUAs are described in Annex F and in the PIP. These will be overseen by the WRD. Specialized SOs with experience in establishing or operating WUAs will provide training and advisory services as necessary.

Subcomponent A.2: **Rehabilitation and Modernization of the SSCBI Systems**

19. The goal here is to modernize the infrastructure of about 1,000 tank systems located in about 800 cascades by adopting a competitive approach to financing the investments. This will help to make their irrigation more efficient year-round.[26] The total area to be covered is about 90,000 ha.

20. During the modernization process, the project will adopt a cascade-system approach: the availability of water is influenced by the flow from upstream SSCBI systems, so that the flow from a tank and surplus water (including surface and ground water) can be used downstream. SSCBI inflow and

[26] This gap in irrigation supply can be caused by a combination of factors, such as design alteration after the sanction, the political economy of encroachment, poor infrastructure, or weak institutions.

outflow hydrology will be monitored by a third-party agency engaged when the project begins. Surface water and groundwater distribution need to be considered in their entirety across the cascade and throughout the year to help identify inefficiencies and promote more efficient and equitable water use than would be possible if each tank is considered separately. Cascade-level planning is also important to ensure that the needs of both structural and nonstructural interventions are appropriately addressed in making the cascade more resilient to climate variability.

21. Among works expected to be financed under Subcomponent A.2 are (a) modernization of control structures (diversion weirs), supply channels, and cross-regulation structures; (b) desilting of feeder and supply channels; (c) reinforcing and upgrading tank bunds, earthen dams, spillways, distribution canals, field channels, and drainage lines; (d) installation of flow measurement devices and sensors, supported by ICT and decision support system tools at DPMU offices; (e) rehabilitation of on-farm developmental works; (f) promotion of solar panels and pumps for lifting groundwater (for rabi crops, pursuant to provisions in PMKSY and RKVY) when pressurized irrigation systems are installed; and (g) modern quality-testing devices for DPMU engineers and selected WUAs to determine soil compaction parameters and the quality and durability of concrete structures.

22. **The project will finance investments using a competitive approach.** The WRD will prepare an Integrated Cascade Development Plan with an annual and seasonal cascade surface water and groundwater budget that identifies the availability of seasonal water for irrigation as a basis for assessing the technical feasibility of future investments. In parallel, WUAs, with help from SOs and the WRD DPMUs, will prepare a CSIP that identifies the long-term objectives that farmers aspire to (including annual cropping and water delivery plans, O&M, and asset management priorities); serious technical constraints that are barriers to WUA and farmer achievement of these objectives; priority activities for overcoming the obstacles (such as infrastructure rehabilitation and capacity building); and annual performance improvements (such as irrigation efficiency, crop diversification, and sustainability guarantees) that will trigger the proposed investments.

23. Based on the ICDP and the CSIP, a DPR will be prepared that identifies the next year's investments and commitments by the GoAP. The amount invested will be linked to the previous year's performance and the comparative ambition of the targets. WUAs may opt to carry out some of the work themselves with guidance from DPMU experts. The project will also pilot outsourcing modernization of some tanks through a design, build, operate, and transfer model under a Hybrid Annuity arrangement (a private regulator in partnership with WRD). The PIP will detail the process for preparing investment requests.

24. Finally, under this subcomponent the project will also pilot real-time monitoring of irrigation management in tanks and cascades using sensors and ICT tools, such as earth observations. These data may be combined with real-time data being collected for other projects, such as the Dam Rehabilitation and Improvement and the National Hydrology projects, to monitor tanks, rivers, climate, water quality, groundwater, etc.

Subcomponent A.3: **Improving Water Productivity and Efficiency**

25. The primary objective of this subcomponent is to promote surface water and groundwater productivity across the cascade and throughout the year by measuring agricultural production per unit of water used. This subcomponent will also consider local hydrology and conveyance efficiency to achieve

better CWB. The approach here should heighten water efficiency and increase irrigation coverage in the tank command to minimize the gap ayacut[27] areas.

26. The project proposes to enhance water productivity by (a) increasing the crop yield per unit of water used and (b) reducing water waste and loss so that beneficial use of water (water uptake [transpiration]) outstrips nonbeneficial losses (evaporation). These options should improve on-farm management of crops by applying crop management practices that use less water, decrease evaporation losses, minimize energy consumption, and improve soil conditions. Water productivity depends on measurement of yields and the amount of water applied from all sources (rainfall, surface water, and groundwater). The WRD will measure water used from all sources, and the Departments of Agriculture and Horticulture will measure the yield of specified agri-commodities. The DPMU will then compute water productivity (a) at the end of each cropping season (kharif/rabi); (b) for all crop categories cultivated in the tank command; and (c) data patterns for water use (surface water and groundwater) in the tank command.

27. For more efficient irrigation, the project will also promote micro-irrigation systems. Because drip and sprinkler irrigation has been found to improve the efficient use of both surface and groundwater resources, conjunctive water use in the rabi season will be a project priority. The project will promote such systems in the cascades upon demand, following government guidelines and the requirements of national agricultural programs (RKVY and PMKSY). It will also facilitate farmers' access to central and state subsidies for adoption of micro-irrigation technologies.

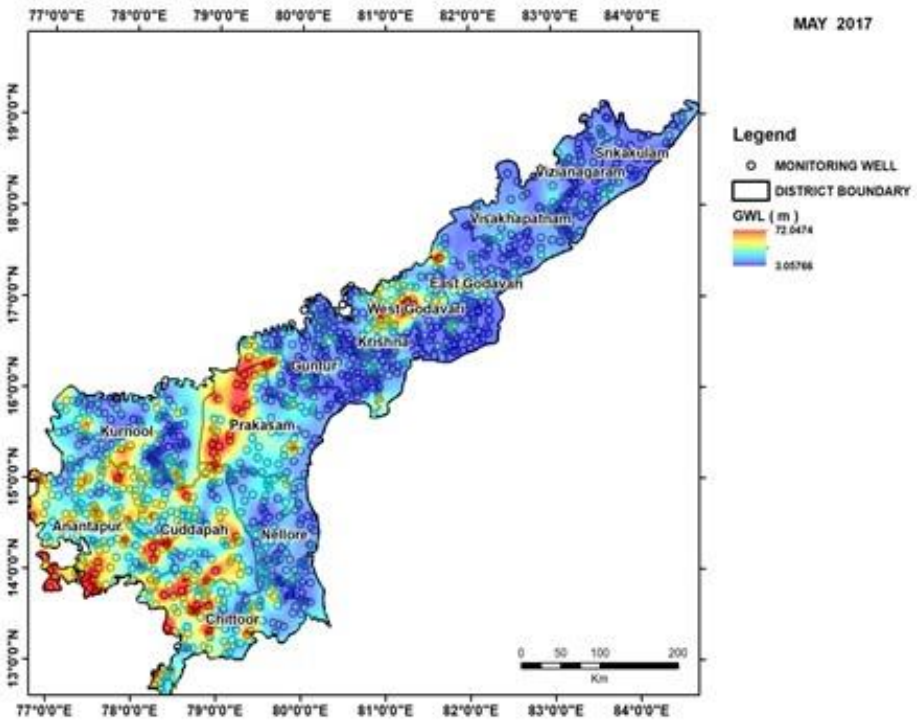
28. Pilot tanks will be selected to gather detailed data on surface and groundwater use, CWB, and water productivity. These tanks will be equipped with sensors and ICT tools for gathering all water-and crop-related data in real time. They will also be used to assess PGM activity and data sets and to evaluate the accuracy of crowd-sourced data from WUAs.

29. Figure A.1 is a groundwater map of the entire state in May 2017 (pre-monsoon). The mean annual actual evapotranspiration (AET) for the districts is presented in the form of a grid plot (Budyko) in Figure A.2. The northern districts have very shallow groundwater levels and a relatively lower AET. Planned and sustainable development of groundwater in parts of the lowland tank ayacut areas in those districts will be evaluated for their potential for subsistence irrigation in the kharif season and protective irrigation in the rabi season. This would lower groundwater levels, which will help prevent waterlogging and poor drainage, help buffer against floods, and also open up opportunities for diversifying crops from the traditional paddy in tank ayacut areas.

30. In the southern districts, groundwater has been extensively developed, especially in drier or lower-rainfall areas away from the coast, in both tank ayacut areas and the upland parts of tank catchments. Pilot tanks will be used to examine the AET in those districts, enhancing and augmenting groundwater recharge through tank and cascade rehabilitation and through conjunctive use, more efficient water use in general, and crop diversification.

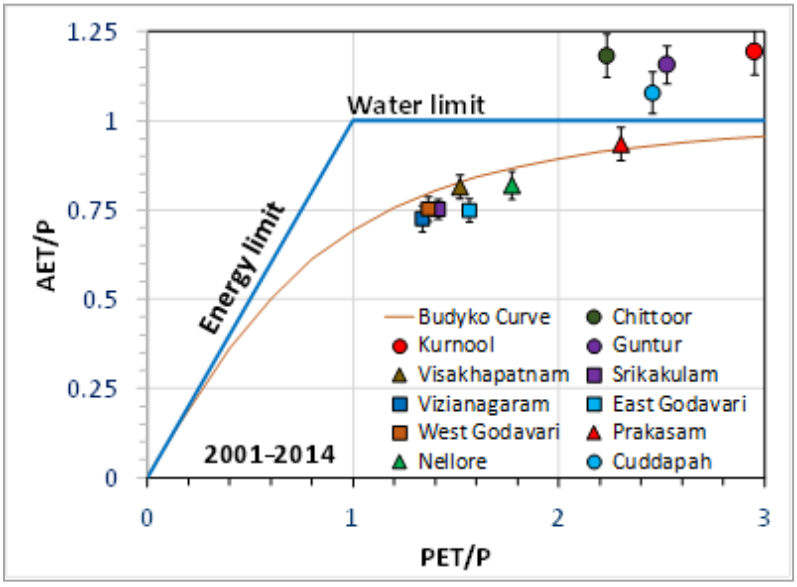
[27] A gap ayacut is a command area that is not irrigated.

Figure A.1. Depth to Groundwater from Ground Surface, Pre-monsoon



Note: In darker blue regions groundwater is relatively shallow (about 3 m); in dark red regions, it is deeper (about70 m).

Figure A.2.: Mean AET by AP District



Note: A normalized plot of the AET for mean annual district rainfall (P) is shown in relation to the Budyko curve with the upper limit of AET desired. The x-axis shows potential evapotranspiration normalized with respect to mean annual rainfall.

31. As Figure A.2 illustrates, southern districts have higher water use and evapotranspiration above the Budyko limit, but northern districts show lower evapotranspiration and are below the Budyko limit.

32. Interventions will cover command area treatment of cascade systems, including construction of group-based mini-irrigation schemes (bore wells). For drought-proofing and capturing flood waters, tanks will be linked. Robust automation systems to be demonstrated will enable spatial homogeneity in water delivery. Use of surface-and groundwater together will be coordinated with crop planning and water budgeting. Water-sharing in the cascade will be encouraged.

33. The innovative design integrates ICT tools, sensors, and remote sensing to capture data on minor irrigation systems to support CSA production systems.

Component B: Promoting Climate-Smart Agriculture

34. Building on the improved water availability and use efficiencies arising from Component A investments, Component B operates to intensify climate resilience and improve the productivity of both crops and aquaculture supported by SSCBI systems. This component will also support judicious diversification—especially in the rabi season—away from concentration in rice to high-value agriculture.

35. Two integrated subcomponents will be funded by Component B.

Subcomponent B.1: **Support to Climate-Smart Crop Production and Diversification**

36. The plan here is to facilitate a move, in response to market demand, to high-value crops like fruits and vegetables while mainstreaming climate change adaptation and mitigation measures in production systems. The project will work to increase farmers' access to better-quality seeds and to technology for sustainable and climate-resilient crop intensification; this subcomponent will be executed by the Agriculture Department, such national institutions as ICRISAT, and SOs.

37. To decentralize the production and distribution of seeds, the project will follow the "seed village" concept, in which in collaboration with ANGRAU, Community Managed Seed Systems, and Mana Vittana Kendralu, it will train groups of farmers to produce seeds of various crops for themselves and neighboring farmers at affordable cost. The project will fund breeder seed production by ANGRAU for paddy, groundnuts, millets, and pulses, among other crops; multiplication of foundation seed; training and capacity building for farmers in seed production; certified seed production by selected farmers; seed processing; seed certification by regulators; seed storage; and a mechanism for distributing seed.

38. Project support for technology demonstrations will focus on (a) high-yielding and climate-resilient germplasm, such as crops that need less water, short-duration crops, and seeds tolerant to other climate-related biotic and abiotic stresses; (b) management of plant nutrition, such as urea deep placement to reduce fertilizer use and GHG emissions from rice production, green manuring practices, and use of biofertilizers; (c) soil and water conservation through the system for rice intensification, deep ploughing, conservation furrows, conservation agriculture, and management of organic matter; (d) effective pest management; (e) inter-cropping to minimize production risk; and (f) production of pulses, oil seeds, and vegetables in rice fallows, to discourage cultivation of rice in the water-deficient rabi season). Project

support will go to materials and all operational costs related to all demonstrations, including field days and exchange visits.

39. To help farmers complete farm operations on time (an important strategy for adapting to the ever-shorter growing seasons resulting from climate change); raise profitability by reducing drudgery and production costs; and make production more efficient, the project will support mechanization where possible of such farm activities as ploughing, sowing, weeding, harvesting, and drying). To address such obstacles to mechanization as the lack of equipment and spare parts suppliers and skilled mechanics to provide maintenance services, the project will support the establishment of farm machinery centers to rent out agricultural machinery and other equipment and support their use. These activities will be led by FPOs.

40. Rental centers will each serve 400 ha to provide sufficient coverage and reduce farmer waiting times. The range and type of machinery will vary based on identified needs but are likely to include zero-till and seed drills; multi-crop planters; power and rotary weeders and Konoweeders; combine harvesters, threshers, power tillers, sprayers, rotovators for residue incorporation, sprinklers, diesel pump sets, chaff-cutting machines, line markers, and other small farm implements.

41. Project support for diversification will mainly focus on SSCBI command areas that in the rabi season have access to sufficient irrigation water from both surface and groundwater sources; this operation will be overseen by the Department of Horticulture and the SOs. The project will finance (a) mobilization and organization of farmers into FPOs for cooperative production and produce marketing; (b) assessments of market demand to inform choice of crops for profitable diversification; (c) demonstration of new crops and their production technologies, including technologies for water and nutrient management, such as micro-irrigation and fertigation; (d) support for rejuvenating old orchards; and (e) expanding the availability of and access to seeds or new crops and other critical inputs.

Sub-component B.2: **Support to Climate-Smart Aquaculture Production**

42. Taking advantage of the availability of fresh water (estimated at 26,000 ha of effective water spread area [EWSA]), support here seeks to improve aquaculture and profitability in the modernized tank systems and associated ponds. This furthers the GoAP's Vision 2029 to promote rational and sustainable exploitation and utilization of AP fisheries resources. The project will focus on three interrelated elements of support: enhancing the production system, quality control, and post-harvest handling and marketing.

43. For the first element, in collaboration with the Central Inland Capture Fisheries Research Institute, the Central Institute of Freshwater Aquaculture, the Central Institute of Fisheries Technology, and the College of Fisheries in AP, the project will support production of improved fish seed by establishing brood banks at four GoAP seed farms for pure-line breeding of inland fish species, such as tilapia, common carp, and pangasius. It will also support modernization and upgrading of hatcheries at 22 GoAP seed farms, which involves expanding hatchery nursery areas and improving water supply arrangements. The project will also fund establishment of captive nurseries to meet the increasing demand for larger fingerlings.

44. Support will also go to production technology based on lessons learned during the WB-financed APCBTMP. This is likely to include introducing cage farming and other innovative technology using local materials, pen culture, and raceway culture; promoting aquaculture management approaches that

address seasonality of the water in tanks; production of high-value species, such as freshwater prawns; and demonstration of semi-intensive and intensive production models. Where ownership and management arrangements are clear, the project will also support establishment of feed mills.

45. To advance quality control, the project will help to reinforce government structures responsible for regulating and certifying such important aquaculture as fish seed and feed. Currently, enforcement of the relevant GoAP law is undermined by capacity weaknesses in terms of both skills and infrastructure. The project will thus support enhancement of institutional quality control capacity in fish feed and seed certification by building up the knowledge and skills of staff and modernizing such facilities as Department of Fisheries feed and seed quality testing laboratories. To ensure that all fish and fishery products, whether for export or domestic consumption, satisfy quality requirements set out in "Hazard Analysis and Critical Control Points" and other protocols, the project will support application of food safety and quality standards for fish and value-added fish products through the training, storage and transport facilities, biosafety, and disease surveillance that are necessary to ensure product quality.

46. Project support to post-harvest handling and marketing will go to (a) marketing infrastructure, such as fish landing centers and kiosks; (b) storage, processing, and value addition, by funding ice boxes for fisherfolk, establishing ice plants, and production of ready-to-cook and ready-to-eat products; and (c) building the capacity of both farmers and Fisheries Department officials, based on the findings of a needs assessment to be conducted in the first year of the project.

Component C: Post-harvest Management, Marketing, and Agribusiness Promotion

47. The goal of Component C is to enhance farm profitability by improving farmers' access to markets and their capacity to add value to locally produced raw materials. This will be done by (a) easing critical market infrastructure constraints to the processing, storage, handling, and marketing of farm produce, especially high-value horticultural crops, and (b) facilitating the linkage of FPOs and other value-chain operators to local, national, and where appropriate international markets. These interventions are expected to aggregate surplus at tank command to enhance the bargaining power of farmers selling their products. It will also help to minimize price volatility and market fluctuations and create a coping mechanism through improved storage and processing facilities where value is added for grains, pulses, oilseeds, and horticultural crops.

48. Based on the ICDP drafted under Component A, the project will finance the following integrated activities.

49. **Support construction or upgrading of rural market facilities (*Apni Mandi*) in selected locations.** This will enable smallholder farmers to sell their products directly, minimizing the role of brokers. The project will finance site identification, design, and construction or upgrading. The project will not support any new construction that will require land acquisition. The support for construction will only be extended to the existing local markets as part of the upgradation. Illustrative basic infrastructure facilities that may be provided are sales platforms (yards); toilets; drinking water facilities; lighting; and small storage structures or covered sheds. The project will also foster links along the value chain, extending support to WUAs and FPOs for cascade-level business plans that promote regular farm-gate buyer-seller meets and aggregate product volumes. It will also enhance access to mobile government services through collaboration and convergence, securing the benefit of the government effort to register *Apni Mandi*

sellers. Moreover, the project will facilitate farmer access to market information platforms like e-NAM and will support provision of information on agricultural market prices through e-commerce platforms like Agri Watch and daily online reports from AP agriculture markets. The project also plans customized ICT interventions.

50. **Promote adoption of climate-smart processing, storage, packaging, and handling technologies to reduce post-harvest losses and add more value.** The project will finance the rehabilitation of 189 existing low-cost 25 ton-capacity structures for storing horticultural products. It will also support (a) establishment of modern structures close to farm-gate with facilities for sorting, grading, washing, drying, weighing, packaging, pre-cooling, and staging; and (b) low-cost storage structures for selected commodities in suitable locations, based on detailed feasibility studies and bankable proposals.

51. **Improve access to market information and market intelligence.** This will help farmers and their associations to make sales decisions based on market demand and price. The project will support creating a cascade-specific market intelligence system and a process for its dissemination. The system will broadcast daily online reports from agriculture markets throughout India and other information for FPOs and agricultural marketing agencies. The information will be accessible to FPOs registered in the project portal and to mobile users through an app-based system.

52. The key strategy for furthering Component C will be market-led and demand-driven agricultural production. WUAs and FPOs established and built up with project support will be the main vehicles for interventions. However, in project tank areas new FPOs will also be promoted where none exist, and the project will help them to prepare a comprehensive business plan dealing, e.g., with aggregation, market links, and value addition. Synergy with project activities will be built in such areas as seed production, nursery raising, input buying and selling, and packaging and sale of value-added products. The project will help FPOs to adopt transparency and accountability standards in their operations while improving institutional governance.

53. Together, the Agriculture and the Horticulture Departments will implement Component C. The latter will facilitate establishing rural markets, integrated packing houses, low-cost horticulture storage structures, and refrigerated transport vehicles and will promote climate-smart cooling structures. The Agriculture Department will work to establish market links through e-NAM, linking FPOs with the market and promoting information-sharing through Agri-watch.

Component D: Project Management and Capacity Building

54. The objective of this component is management and coordination of project administration as needed. The PMU will coordinate with participating GoAP departments in preparing for budgeted activities and readying teams at all levels for effective project action. This component will set up a monitoring, learning, and evaluation (MLE) system to monitor the results of project operations, how effective the investment was, and how to enhance the learning of stakeholders through constructive feedback. Results-based management is guiding design of the MLE system.

55. This component will also build a robust GIS-based management information system. If the PMU thinks it necessary, it will hire outside experts to do this. The MIS will automate collation of data from tanks through cascades up to district and state aggregation, tracking both physical output and project

expenditures in real time. The database will be interoperable: Officials, project staff, and experts and other personnel engaged will be able to upload data electronically to the project server in predesigned formats. The PMU MIS manager will then be able to generate location-based queries and reports as required. The MIS will be used to manage the project through a progress review system.

56. In addition to supporting continuous internal and external assessment of whether its activities are sound, the project would also undertake issue-and theme-based studies as identified by joint and six-monthly reviews. These studies are likely to relate to how activities are conducted; identify technical, administrative, and financial constraints; and estimate project output and impact. A longitudinal study of sample tanks and household tracking in tank areas will analyze how the project is affecting, e.g., job creation, climate change adaptation and mitigation, and changes in soil organic carbon and GHG emissions.

D. Consolidation and Exit Strategy

57. **Consolidation.** The consolidation strategy is based on sustainability parameters related to the PDO. Consolidation will be based on technology transfer and adaptation of climate-resilient agricultural technologies, especially those that address efficiency in irrigation. The consolidation will also consider streamlining processes that helped motivate farmers to adopt climate-resilient technologies. All inputs and processes will be consolidated to ensure that when the project ends, farmers are receiving more income. The process of consolidation may reveal areas that require further concrete attention. Consolidation will take place at the WUA, district, and state levels and across agencies partnering for different activities. It will ensure that the planned inputs are delivered and results respond to the PDO. The database and other information will be part of the process.

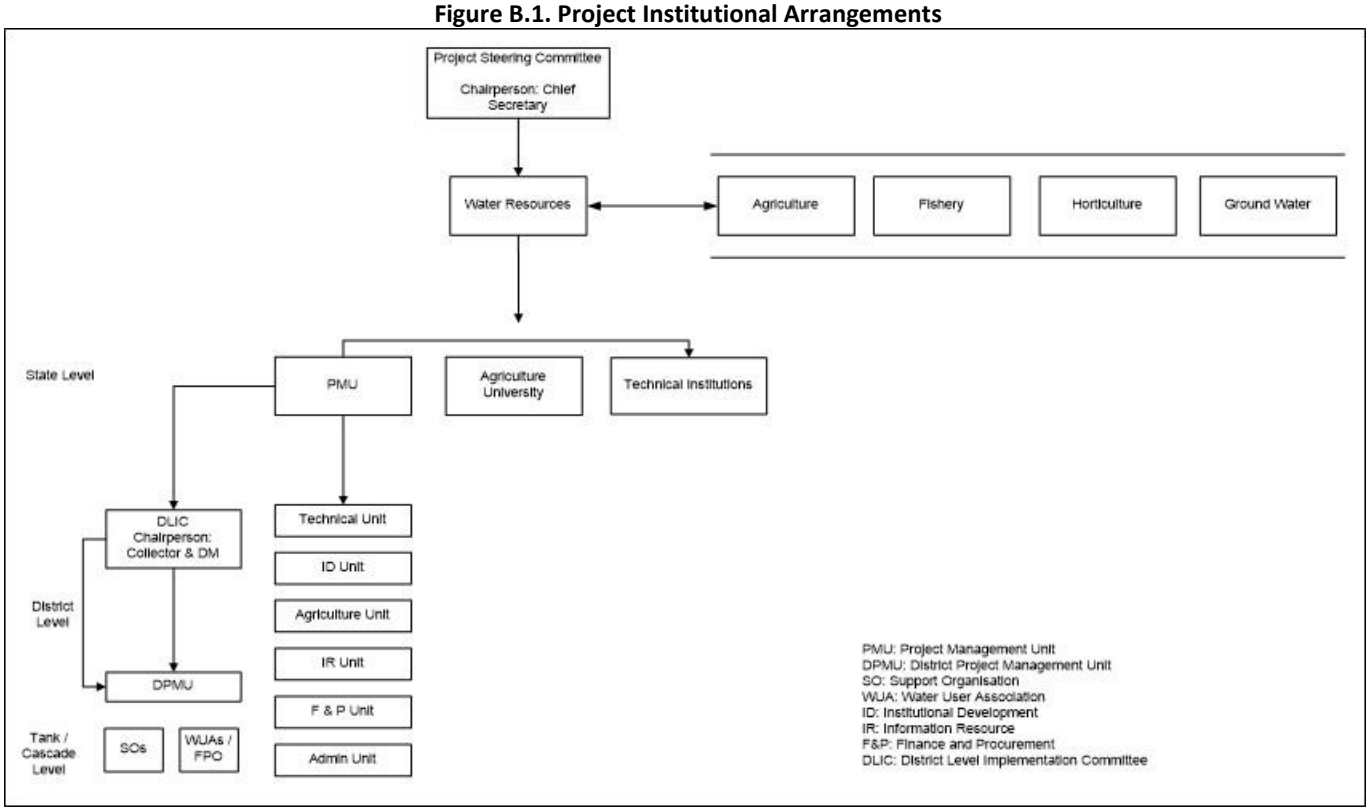
58. **Exit Strategy.** The exit strategy is implicit in the project design in that the insistence on involving community and other beneficiary institutions at the tank and cascade levels is intended to promote their ownership and the sustainability of project operations. This complements the built-in exit strategy of capacitating WUAs to take over O&M of tanks after they are rehabilitated. However, the tank systems will require WRD backstopping for engineering saturation. Since the WRD is already implementing the PMKSY, taking over responsibility for tank command areas will help expand irrigation for future sustainability. External M&E is built into the project throughout for reporting on project performance in the field, which allows for midcourse corrections to enhance project impact. This will help in scaling up innovation and promoting a paradigm shift from business-as-usual to resilience-focused planning.

ANNEX B: IMPLEMENTATION ARRANGEMENTS

A. Project Institutional and Implementation Arrangements

1. **The GoAP Water Resources Division is responsible for project planning, execution, monitoring, and reporting on progress and achievements.** The WRD State Project Director will be responsible for project-related functions; for progress review and assessment, there will be a Project Steering Committee, headed by the GoAP Chief Secretary. The project will also have an Empowered Finance Committee headed by the state Water Resource Secretary to help the Project Director with day-to-day financial management, reallocation of the budget within components, and interdepartmental coordination. Similarly, there will be an implementation committee in each project district, headed by the Collector (in a few districts Collectors are known as District Magistrates), to ensure effective coordination of project activities in the district. This is a statutory committee independent of the project that is in place in all districts for coordination. Figure B.1 summarizes the project institutional arrangements.

Figure B.1. Project Institutional Arrangements



2. **The Project Management Unit and District PMUs will have multidisciplinary teams of officials and experts to steer project execution.** The GoAP departments of Agriculture, Horticulture, and Fisheries will partner in project activities in addition to the Groundwater Department, which will be crucial to integrating the project's conjunctive water use database into its own monitoring system. It will also help the project to create decision support systems. For the execution of activities in the community, the project will partner with tank and cascade WUAs. To mobilize the community and facilitate project

activities, the project will engage SOs in each location. The project will also partner with the State Agriculture University and other state and national technical institutions for support and guidance. The responsibilities of project partners and committees are outlined in Table B.1.

Table B.1. Strategic Partners, AP Integrated Irrigation and Agriculture Transformation Project (APIIATP)

Partners	Main Area of TA to APIIATP
Agriculture Department	• Plan, design, coordinate, execute, monitor, and report on agriculture-allied activities. • Coordinate with line departments to promote climate-resilient cropping systems and practices. • Guide District Project Management Units (DPMUs) in preparing and monitoring crop water budgeting and contingency planning for each cascade development plan. • Build community capacity in agriculture, horticulture, fishery, and off-farm activities. • Draft an agribusiness plan for each cascade so that Farmer Producer Organizations (FPOs) for specific commodities, such as high-value fruits and vegetables, can link aggregation, storage, processing, and marketing to their value chains. • Promote climate-resilient seed production and farm mechanization through custom equipment rental centers. • Document best practices for replication.
Department of Fisheries	• Plan, implement, build capacity for, and coordinate project fishery production activities. • Tailor current fisheries plans to tanks and cascades. • Guide DPMUs in formulating fishery activities.
Horticulture Department	• Plan, implement, build capacity for, and coordinate state-wide horticulture activities. • Tailor current horticulture development plans to tanks and cascades. • Guide DPMUs in formulating the project horticulture component and coordinating with line departments.
AP Agricultural University	• Disseminate widely agricultural climate-resilient technologies, agronomic practices, and agrometeorological services.

3. **Each project district will have a dedicated DPMU, located in the WRD,** headed by the District Project Director (DPD), who is ranked as an Executive Engineer. The DPMU will be responsible for planning, monitoring, and implementing the Integrated Cascade Development Plan for each project cascade in the district (see Table B.2). The DPD will also coordinate and facilitate technical assistance to WUAs and FPOs.

Table B.2. DPMU Staffing

Sl. No.	Unit Name	Staff Position	No. of Staff
1	Technical Unit (Regular Division setup)	Executive Engineer	1
		Deputy Executive Engineer	3
		Assistant Executive Engineer or Assistant Engineer	10
2	Institutional Development Unit	Assistant Project Director, Institutional Development	1
3	PGM Unit	Deputy Director, Groundwater	1
		Assistant Director, Groundwater	1
		Assistant Hydrologist or Hydro-geologist	1
		Assistant Project Director, Participatory Hydrological Monitoring or Groundwater Management	1
4	Information Resource Unit	Assistant Project Director, M&E/MIS	1
5	Finance and Procurement Unit	District Accounts Officer	1

B. Financial Management

4. The project's financial management arrangements are considered adequate both to account for and report on expenditures and to satisfy World Bank fiduciary requirements. Projecting spending and accounting will comply with a *Financial Management Manual* (FMM) prepared by the project and acceptable to the World Bank. The manual specifies the responsibilities of the finance and accounts department for maintaining books of accounts, internal controls, and financial discipline at various levels. The goal is uniformity in accounting policies, procedures, maintenance of books of accounts, preparation of financial reports, project monitoring, and auditing. Any modification to FMM structures must be approved by the SPD, the PMU Finance Specialist, and the World Bank.

5. The guiding principles for project financial management are to (a) follow state and national systems in meeting essential fiduciary requirements; and (b) fulfill any additional requirements, such as those for IUFRs and internal audits. Effective and timely FM arrangements are critical to the success of the project.

6. Based on estimates from the DPMUs and line departments, the PMU will prepare an annual action plan and budget (AAP) for the works, goods, and services each WUA requires. The state already has an online system for approving budgets *www.apbudget.apcfss.in*. The AAP is used for budget planning throughout the year. After the PSC and the CADA Commissioner approve it, it will be forwarded to the Administrative Department for inclusion in the WRD Demand for Grants. The project budget will be allocated as part of the WRD budget.

7. Project funds will be routed through the state budget; a separate budget code, *4702-00-101-03 - Capital outlay on minor irrigation for externally aided projects*, has already been issued. CADA is authorized to incur expenditures up to the allocation and the Finance Department then issues a Budget Release Order (BRO) authorizing the Commissioner to draw the funds. The Commissioner releases the funds to the line department District Project Director.

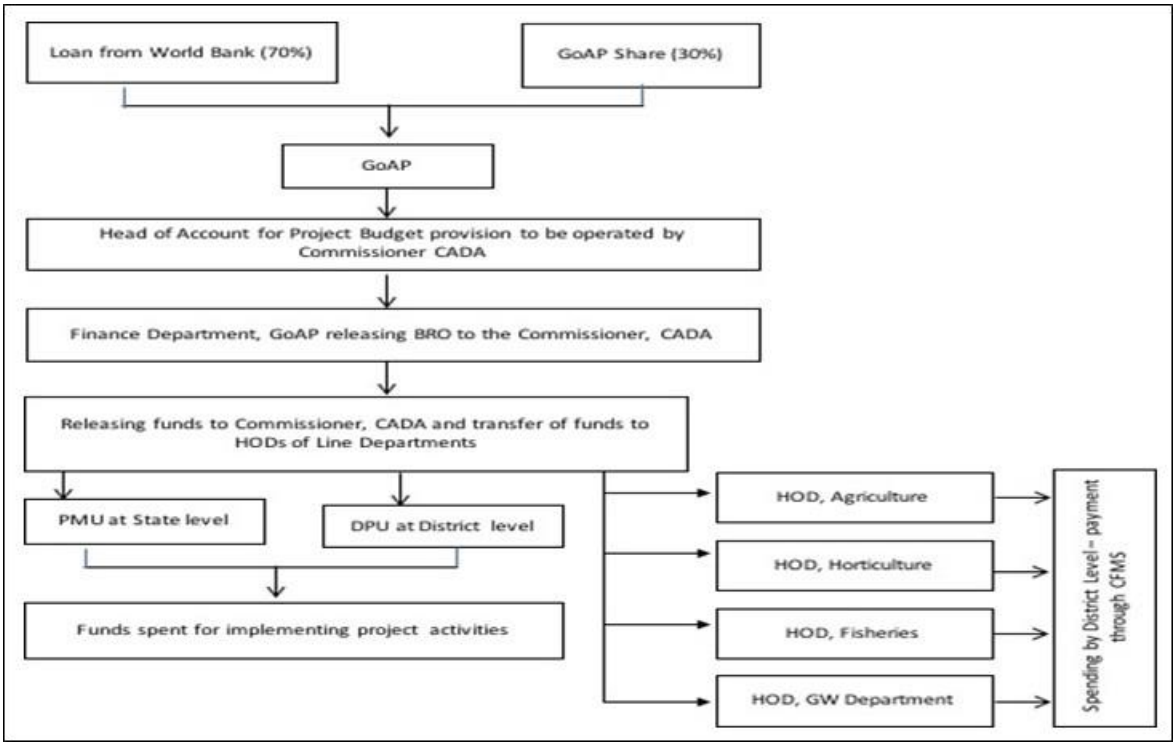
8. After receiving the BRO, Executive Engineers (DPDs, DPMU), and line departments are authorized to incur commitments up to the BRO limits by making claims on Pay and Accounts Officers, based on bills prepared per the approved AAP. These officers make payments using the Comprehensive Financial Management System now in place for all government receipts and payments. Every month an AP Audit Officer will prepare the Statement of Expense along with voucher details after reconciling expenditures with the Deputy Director's office.

9. **Flow of funds.** World Bank funds will first be made available to the GoAP through the GoI, under back-to-back arrangements between the GoI and the state. Subsequent disbursements from the Bank will be based on IUFRs and the World Bank share of eligible project spending. The IUFRs will reflect expenditures reported in monthly accounts received from Divisional Pay and Accounts Officers. Disbursements are scheduled to be quarterly but may be more frequent, depending on the pace of spending and project requirements.

10. The PMU, DPMU, and line departments will manage the budget, and the SPD, DPD (Executive Engineer), and line departments will authorize payment based on actual expenditure against the AAP. Bills

will be paid by Pay and Accounts Officers in the Finance Department Directorate of Works and Accounts. Figure B.2 shows fund flow at the state level.

Figure B.2. State Flow of Funds



11. **Accounting and reporting.** The project will use the government system of accounting. Three levels of accounting centers—PMU, DPMU, and line department—will be required to account for and record all receipts and payments made to suppliers, contractors, SOs, and staff, and other expenditures on, e.g., capacity building and project management. Significant amounts will be paid by implementing departments and thus subject to tight fiduciary controls through the CFMS and audit by the Comptroller and Auditor General. In specific cases, i.e., under component B1, procurement of goods, work, and services needed for FPOs and WUAs at the district level will be undertaken either by the PMU or the DPMU. Adequate records are to be maintained for such procurements. Implementing units will submit monthly reports by project component to the PMU for consolidation and reporting in IUFRs.

12. **Staffing and capacity building.** The FM function of the project will be led at the PMU by an officer at the level of Joint Director deputized by the State Finance and Accounts Services, who will be assisted by an Accounts Officer and Assistant Accounts Officers. At the DPMU level, a Divisional Account Officer (DAO) will handle the FM function. For smooth FM operations, a DAO for each district will be essential. FM capacity-building will also be provided to project participants like WUAs and FPOs.

13. **External audit.** Through the State Principal Accountant General, the CAG will conduct the external audit of the project. Statements of expenditures at all project levels will be submitted to the State AG by June 30 each year to allow adequate time for the audit, which will be conducted in accordance with terms

of reference agreed by the CAG for audit of WB-financed projects. Audit reports will be submitted within six months of the end of each financial year.

14. **Internal audit.** The objective is to provide project management with independent assurance that the internal controls it established were designed appropriately. The project will establish an internal audit system consisting of a Deputy Internal Audit Manager in the cadre of AP Audit Officers and two contracted Senior Assistants.

Disbursements

15. **Disbursement arrangement.** The World Bank will finance 70 percent of project spending up to US$172.2 million. Disbursement will be based on quarterly IUFRs submitted to the office of CAAA and the World Bank. Up to 20 percent of the WB loan will be available for financing eligible project expenditures incurred in the year before the Loan Agreement is to be signed.

Procurement

16. Procurement for the proposed project will adhere to the World Bank *Procurement Regulations for IPF Borrowers*, revised November 2017 ("Regulations") and will be subject to WB *Guidelines on Preventing and Combating Fraud and Corruption in Projects Financed by IBRD Loans and IDA Credits and Grants,* revised as of July 1, 2016 (Anticorruption Guidelines).

17. **Project Procurement Strategy for Development.** Based on the findings of the market analysis carried out for all major project activities, recommendations are made on appropriate packages and lots for civil works to ensure enough bidders. Consultancy contracts are also drafted based on market research and the scope of services and periods have been decided. Based on the draft Project Procurement Strategy document, a Procurement Plan is drafted to set out procedures for implementing agencies to follow in procuring goods, works, and all types of services financed by the World Bank.

18. **STEP.** The project will use Systematic Tracking of Exchanges in Procurement, a planning and tracking system, to gather data on procurements and establish benchmarks. Details in the Procurement Plan will be transferred to the STEP system. Project procurement staff have already been given Initial training on how STEP is operated.

19. **E-procurement.** The project will be using the GoAP's electronic system for all procurements of more than INR6.5 million. The e-procurement system has been assessed against the requirements of multilateral development banks, and modifications and enhancements have been recommended to make it acceptable for procurements for WB–funded projects. Using the electronic system is likely to make procurement more efficient and transparent.

20. **Procurement capacity.** The PMU established for the previous project (APCBTMP) will manage and coordinate the new project. Some officials in the PMU and other project departments also took part in the previous project and are familiar with WB procurement procedures. Possible problem areas are procurement delays and contract management disputes and delays.

21. **Procurement planning.** The procurement plans for each contract to be financed by the loan will take into account market approach options, procurement or consultant selection methods to be used, need for prequalification, estimated costs, prior review requirements, and schedules. All procurement plans of the five implementing departments, including district plans, will be processed through STEP. Agreed procurement arrangements and procurement plans for the first 18 months of the project will be uploaded to STEP.

22. **Retroactive financing.** The project has requested retroactive financing of some civil works, consultancies, and other eligible costs not exceeding 20 percent of the total loan of US$172.2 million. Payments made by the PMU during the 12 months before the contracts are signed that adhere to World Bank Procurement Regulations will be eligible for retroactive financing.

23. **Procurement training.** Key staff have been trained at the Administrative Staff College of India, Hyderabad, and the World Bank conducted training on the New Procurement Framework. The project may also make available the free Massive Open Online Course the World Bank offers on public procurement (*www.procurementlearning.org)* and the paid Professional Diploma in Public Procurement course delivered through the Charter of Public Procurement Studies.

24. **Procurement risk assessment.** Risks were rated based both on the probability of occurrence and their likely impact; the general residual procurement risk for the project was rated Moderate. The World Bank will review and update the rating periodically (Table B.3).

Table B.3. Assessed Procurement Risks and Mitigation Measures (to be updated after PRAMS is completed)

Risk Factor	Initial Risk	Mitigation Measure	Completion Date	Residual Risk
Limited capacity and inefficiencies resulting in delays in procurement and contract management	Substantial	• Use of skilled staff to handle procurement • Monitoring through the Procurement Plan and quarterly reports • Use of e-procurement and contract management tools • Participation in trainings and workshops	Continuous from year 1	Moderate
Lack of compliance with agreed procurement arrangements	Substantial	• Use of the *Procurement Manual* • Training and hand-holding provided by the World Bank • World Bank prior and post reviews • Internal and external audits	Continuous from year 1	Moderate
External interference in the procurement process	Substantial	• Disclosure of procurement-related information • Appropriate handling of complaints	Continuous from year 1	Moderate
Overall Risk	**Substantial**			**Moderate**

25. **Procurement methods.** The Procurement Plan will spell these out, along with agreed thresholds. The thresholds indicated in Table B.4 are for the initial 18 months of the contract period and may later be modified based on project procurement performance.

Table B.4. Procurement Methods

Procurement Approaches and Methods	Thresholds (US$ Equivalent)
Open international (goods, IT, and nonconsulting services)	>3 million
Open national (goods, IT, and nonconsulting services)	>100,000 and up to 3 million
National request for quotation (goods/works)	Up to 100,000
Open international (works)	>40 million
Open national (works)	>100,000 and up to 40 million
Direct selection	No threshold; For goods/works/non-consulting services: According to paragraphs 6.8–6.10 of the Regulations; For consultants: According to paragraphs 7.13–7.15 of the Regulations
Framework Agreements	For goods, works, and non-consulting services: According to paragraphs 6.57–6.59 of the Regulations
Shortlist of national consultants	Up to 800,000

26. **Procurement prior-review thresholds based on the Moderate rating.** The World Bank requires its prior review of the following types of contract:

(a) **Works:** All contracts more than US$15 million equivalent
(b) **Goods and IT:** All contracts more than US$4 million equivalent
(c) **Non-consulting services:** All contracts more than US$4 million equivalent
(d) **Consultants:** All contracts more than US$2 million equivalent for firms and US$400,000 equivalent for individuals
(e) **Direct selection:** Justification of DS for all contracts more than US$100,000 equivalent

27. The project will seek guidance from the World Bank on technical specifications and terms of reference for large-value post-review cases. The prior-review thresholds will also be indicated in the Procurement Plan, which will be updated at least annually to reflect any change in prior-review thresholds. The thresholds will be mutually reviewed during the project and modified based on the risk assessment.

28. For contracts subject to prior review, the project will seek a no-objection opinion from the World Bank before agreeing to (a) an extension of the stipulated time for performance that either increases the contract price or affects the planned completion of the project; (b) any substantial modification of the scope of work, goods, nonconsulting services, or consulting services and other significant changes to the terms of the contract; (c) any variation order or amendment (unless extremely urgent) that, singly or combined with all previous variation orders or amendments, increases the original contract amount by more than 15 percent; and (d) the proposed termination of a contract.

29. **National procurement procedure conditions.** National competition for the procurement of goods, works, and nonconsulting services will be within the thresholds and will comply with the Procurement Provisions of paragraphs 5.3–5.6 of Section V of the Regulations and the following additional provisions:

(a) Only model bidding documents agreed with the World Bank (as amended from time to time) will be used for bidding.
(b) At least 30 days before the deadline for submission of bids, invitations to bid will be advertised in at least one widely circulated national daily newspaper, or on a widely-used website or electronic portal with free national and international access in an abridged version of the advertisement published in a widely circulated national daily, giving details of the electronic portal where the full invitation to bid can be downloaded.
(c) No preference will be accorded to any bidder for price or for other terms when competing with foreign bidders, state-owned enterprises, small-scale enterprises, or enterprises from a given state.
(d) Extension of bid validity will not be allowed for contracts subject to World Bank prior review without prior WB concurrence (i) for the first request for an extension longer than four weeks and (ii) for all subsequent requests for extension of any length; concurrence will be considered only in cases of force majeure and other circumstances beyond the control of the purchaser employer.
(e) There will be no rebidding of contracts subject to WB prior review without prior WB concurrence. In this project, bids will not be rejected for being outside a predetermined range of prices.
(f) To improve the efficiency and transparency of small-value purchases in WB-financed projects, the Bank has agreed to allow the following uses of Government e-Marketplace (GeM): (i) in lieu of shopping, up to US$30,000 in catalog mode; (ii) in lieu of shopping, up to US$100,000 if there are at least three suppliers for the item on GeM and the purchaser uses the GeM Request for Quotation feature (mini-competition) to discover the final price; (iii) in both cases, borrowers will record their assessment that the price is reasonable; and (iv) GeM is not to be used in lieu of National Competitive Bidding.
(g) No negotiations are to be conducted even with the lowest evaluated responsive bidders.

30. **Domestic preference.** Domestic preference will be applied in evaluating bids in accordance with Annex VI of the Regulations.

31. **Recordkeeping.** The project will retain all records pertaining to the award of tenders, including bid notification, register of the sale and receipt of bids, bid opening minutes, bid evaluation reports, and all correspondence pertaining to bid evaluation, communication with the World Bank during the process, bid securities, and approval of invitation and evaluation of bids.

32. **Disclosure of procurement information.** The following documents are to be disclosed on the project and AP websites: (a) Procurement Plan and updates; (b) RFBs for goods and works for all contracts; (c) requests for expression of interest for selection and hiring of consulting services; (d) contract awards of goods and works procured, complying with international and national procedures; (e) quarterly lists of contracts and purchase orders placed according to shopping procedures; (f) quarterly lists of contracts following Direct Contracting; (g) monthly financial and physical progress reports of all contracts; and (h) quarterly reports of action taken on complaints received.

33. The project will send the following details to the World Bank for publishing on the United Nations Development Business and the WB external website: (a) invitations to bid for procurement of goods and works using open international procedures; (b) details of all contract awards for procurement of goods

and works using open international procedures; and (c) quarterly lists of contracts and purchase orders placed following DC procedures.

34. The project will also publish on its own websites any information required for disclosure as specified by the Right to Information Act.

35. **World Bank oversight and monitoring.** All contracts not subject to prior WB review will undergo post review during implementation support and special post-review missions, including missions by consultants hired by the World Bank. The Bank may also at any time conduct Independent Procurement Reviews of all contracts financed by the loan.

36. Any high-risk and high-value procurements will be identified for heightened contract management support and listed in the Procurement Plan. The project will develop KPIs for the contracts identified, and the KPIs will be monitored as the contract is executed. The WB team will provide additional due diligence and independent review of performance on those contracts.

37. **Frequency of procurement supervision.** Twice a year **t**he World Bank will carry out Implementation Support Missions, including review of procurement. Mission frequency may change based on project procurement performance.

Environmental and Social, including Safeguards

38. **Environment.** The ESMF details institutional arrangements and mitigation measures for effective management of possible environmental issues. The GoAP has agreed to recruit an Environmental Specialist for the PMU to oversee and manage safeguards provisions, monitoring, training and capacity building, reporting, and documentation. Twice a year the specialist will submit monitoring reports on ESMF and IPM provisions, trainings, and institutional capacity. Provision will also be made for acquiring additional staff to meet specific technical or operational requirements that may arise.

39. At the divisional level, capacity to manage environmental safeguards is built into the technical multidisciplinary team that supports the PMU Environment Specialist with field monitoring to ensure integration of safeguard requirements into each ESMF activity. The Nodal Officers at DPMU will be given any training suggested and be familiarized with the project's environmental safeguard issues (such as the IPM plan), impacts, mitigation, and other requirements for monitoring and reporting. That officer will also be responsible for facilitating and reviewing implementation of the EMPs for civil works.

40. **The ESMF comprises the following procedures.** (a) screening against lists of impermissible activities and regulatory requirements to approve activities that do not contravene national and state regulations and World Bank safeguard policies; (b) drafting provisions for identifying impacts on the basis of scale and probability of occurrence associated with activities selected for cascade plans; (c) identifying activities responding to key environmental issues and mitigation measures, best practices, and environment-friendly technologies; and (d) using EMP checklists for all civil works to ensure that entities implementing the works are given mitigation and monitoring guidance for specific stages of the project cycle. The ESMF also contains institutional arrangements, the training and capacity-building plan, mechanisms for monitoring and external environmental audit, and the budget to ensure that safeguard measures taken are effective. The project will monitor ESMF provisions as an integral part of each project

component through a management information system and periodic M&E.

41. **Social issues identified.** The social assessment conducted when the project was being prepared identified the following issues: participation, inclusion, decentralization, gender, institutional development, and information and communication. The GoAP has prepared an ESMF that contains measures to address these issues. One aspect of the implementation strategy is to mobilize farming communities for group action and to build up local stakeholders and institutions. The primary local institutions are WUAs and FPOs. The PMU Social Expert will work closely with district project units, strategic partners, and associated technical agencies to ensure that project interventions are consistent with the strategies outlined in the project's safeguards documents.

42. **Gender action plan.** The ultimate objective of the Gender Action Plan is to ensure that the project serves women's strategic and practical needs. The plan will give women an opportunity to participate in the project and make sure they are represented in planning and management structures. It also strives to minimize the social vulnerability of women arising from such project activities as construction. The PMU will closely monitor the impact of project activities on women. In particular, when monitoring overall project performance, the PMU will track the PDO indicator on farm profitability to report separately for benefits accruing to women.

43. **Citizen engagement.** The project provides for regular consultations and other interactions with stakeholders to ensure citizen feedback. Its web platform will also have a module for citizen engagement. The state of AP and project entities are committed to ensuring that citizens are engaged in management of the project, which will pave the way for (a) legitimacy in decision making; (b) designing appropriate interventions; (c) effective institutional and implementation arrangements; (d) enhancing inclusion, reducing conflicts, and establishing common platforms for sharing knowledge and concerns and supporting justice, liberty, and dignity; (e) building local capacity to encourage responsible and responsive citizenry; (f) better-quality outcomes; and (g) downward accountability. In effect, the project expects that citizen engagement will contribute to better service delivery and sustainable impacts. The project has therefore enshrined citizen engagement in the project design through (a) social assessment-centered consultations with all stakeholders during both design and implementation; (b) moving beyond consultations into consent in the tribal areas; (c) ensuring social intermediation to building the capacity of local institutions, such as WUAs; (d) sharing all plans and engaging in extensive deliberations with all stakeholders, especially poor and vulnerable communities; (e) quarterly reviews of how WUAs are functioning, and providing feedback to them through regional consensus conferences; (f) arranging for a toll-free helpline and multilayer redress of grievances; and (g) fully honoring the Indian Right to Information Act. M&E checklists contain indicators for citizen engagement.

Monitoring and Evaluation

44. Project M&E is being conducted at several levels. Although full responsibility for project monitoring, reporting, and evaluation lies with the PMU, the project is designed so that a third party carries out day-to-day M&E activities. In addition to the technicians the M&E contractor will be deploying, the PMU will be reinforcing division and district project teams that provide IT and MIS support.

45. For monitoring activity, evaluating data, and reporting on progress, the PMU will hire a specialized consulting firm to track activity throughout the project. This firm will also carry out stakeholder analysis,

baseline surveys, and the midterm and final surveys required for the end-of-project evaluation. The PMU will coordinate with the World Bank Development Impact Evaluation initiative for TA on state-of-the-art evaluation.

46. The project's integrated ICT platform will have an M&E module designed to allow real-time monitoring of progress by entering data in the field on a handheld device (e.g., a tablet or smartphone) connected to the M&E module and directly accessible in real time by the PMU.

ANNEX C: IMPLEMENTATION SUPPORT PLAN

Strategy and Approach

1. The implementation support strategy will consist of a concerted plan of technical, fiduciary, and safeguards support to ensure due diligence over the course of the project. The approach will include (a) continuous review of project activities to assess progress and identify potential bottlenecks, (b) timely advice and guidance, and (c) ensuring that financial and progress reports are submitted on time.

Implementation Support Plan

2. The World Bank Implementation Support Plan will comprise mechanisms for critical and effective review of progress toward the PDO, how project activities are advancing, and effective responses to issues as they arise. Among the review mechanisms will be (a) semiannual Implementation Support Missions, (b) short desk reviews at regular intervals, and (c) a midterm review that will comprehensively assess progress halfway through the project and will revisit project design to identify areas where adjustments might be needed.

3. The Implementation Support Plan will include visits to project sites to physically verify project-financed work. These site visits will also incorporate interaction with such project beneficiaries as farmers, FPOs, entrepreneurs, market users, and nongovernment SOs assisting with community mobilization and capacity building. Sites to be visited will be selected randomly from a district-wide list and sites identified by the complaint handling system.

4. The World Bank will (a) monitor project progress and evaluate results on the ground, (b) address the principal technical, fiduciary, environmental, and social risks, and (c) provide technical advice as needed on water management, agricultural production, and post-harvest management. The Bank will also provide regular support. Implementation Support Missions will be at least semiannual and more frequent if warranted. These will be complemented by visits by individual task team members to follow up on specific issues.

5. The World Bank will provide any required technical support through sector and institutional specialists. In addition to the Implementation Support Missions, there will be a continuous exchange of correspondence. Frequent telecommunications will allow for close coordination between the WB team and project staff. Support will also address areas where residual risk is higher, as in FM and procurement, as well as safeguards and impact M&E.

6. The Implementation Support Plan (Tables C.1 and C.2) specifies focus areas and the skill needs required for support at different points in the project. It will be reviewed regularly and updated as needed.

Table C.1. World Bank Support to Project Implementation

Time	Focus	Skills Needed
First 12 months (Year 1)	• Implementation arrangement • Validation of the PIP for year 1 • Quality control processes • Effective functioning of FM systems • Procurement adherence to World Bank Regulations • Environmental and social safeguards • Technical support on PIP specifics • M&E system and rollout of the MIS	• Water Resources Management Specialist • WUA Specialist • Construction Design Specialist • ICT Specialist • Agriculture Specialist • Fisheries Specialist • Agribusiness Specialists • Social Safeguards • Environmental Safeguards • FM Specialist • Procurement Specialist • M&E Specialist
Year 2	• Technical support for activities by component and subcomponent • Routine FM and procurement reviews • Management of safeguards and monitoring of progress on safeguards-related measures • M&E • Adjustment of plan for activities by component and subcomponent	• Water Resources Management Specialist • WUA Specialist • Construction Design Specialist • ICT Specialist • Agriculture Specialist • Fisheries Specialist • Agribusiness Specialists • Social Safeguards • Environmental Safeguards • FM Specialist • Procurement Specialist • M&E Specialist
Year 3	• Technical support for activities • Routine FM and procurement reviews • Management of safeguards and monitoring of progress on safeguards-related measures • M&E • Mid-term review	• Water Resources Management Specialist • WUA Specialist • Construction Design Specialist • Agriculture Specialist • Fisheries Specialist • Agribusiness Specialists • Social Safeguards • Environmental Safeguards • FM Specialist • Procurement Specialist • M&E Specialist

Time	Focus	Skills Needed
Years 4–6	• Adjustments to the PIP • FM and procurement reviews • Management of safeguards and monitoring of progress on safeguards-related measures • M&E	• Water Resources Management Specialist • WUA Specialist • Construction Design Specialist • ICT Specialist • Agriculture Specialist • Fisheries Specialist • Social Safeguards • Environmental Safeguards • FM Specialist • Procurement Specialist • M&E Specialist
Year 7	• Technical support for activities • Routine FM and procurement reviews • Management of safeguards and monitoring of progress on safeguards-related measures • M&E • Completion review	• Water Resources Management Specialist • Construction Design Specialist • ICT Specialist • Agriculture Specialist • Fisheries Specialist • Agribusiness Specialists • Social Safeguards • Environmental Safeguards • FM Specialist • Procurement Specialist • M&E Specialist

Table C.2. Skills Mix Required

Skills Needed	Number of Staff Weeks	Number of Trips	Comments
Task Team Leader/Agriculture Specialist	10	2	Based in New Delhi
Co-Task Team Leader/Irrigation Specialist	10	2	Based in Washington, DC
FM Specialist	4	2	Based in New Delhi
Procurement Specialist	4	2	Based in New Delhi
Agribusiness Specialist	4	2	Based in New Delhi
Agriculture Specialist	6	2	Consultant, based in New Delhi
Construction Design Specialist	6	2	Consultant, based in New Delhi
Fisheries Specialist	4	2	Consultant, based in Australia
Hydrology Specialist	4	2	Consultant, based in New Delhi
Social and Institutional Development Specialist	4	2	Based in New Delhi
Environmental Safeguards Specialist	4	2	Based in New Delhi
CSA Specialist	2	2	Consultant, based in New Delhi
Economic Analyst	2	2	FAO/World Bank CP
M&E Specialist	4	2	Based in New Delhi
Lawyer	2	1	Based in New Delhi
Operation Analyst	4	2	Based in New Delhi
Program Assistant	10	—	Based in New Delhi
Program Assistant	10	—	Based in Washington, DC

Note: CP = Collaboration Program; FAO = Food and Agriculture Organization.

ANNEX D: ECONOMIC AND FINANCIAL ANALYSIS

I. Introduction

1. Economic and financial analysis was undertaken to estimate the benefits expected from project investments, among them improved tank system performance and expanded irrigated areas, diversified agriculture and fisheries production, and promotion of markets and agribusinesses. Project investments account for 95 percent of the costs.

2. The main sources of expected benefits are (a) expansion of the area benefiting from tank rehabilitation, which increases productivity and cropping intensity; (b) sustainable intensification and diversification of crop and horticulture production; (c) larger fish catches through use of innovative technology in production, post-harvest processing, and marketing; and (d) opening of alternative marketing channels to improve post-harvest management and value-addition.

3. The cost-benefit analysis, using ex ante and ex post indicators of efficiency, is based on sample data from the baseline survey and secondary data from the GoAP. The purpose is to measure how well objectives for project benefits have been achieved.

II. Project Area

4. The project will be implemented in 12 of the 13 districts in AP and cover 90,000 ha of the registered command area.[28] Modernization, rehabilitation, and construction of irrigation infrastructure will focus on improving the bulk water delivery of 1,000 SSCBI systems. In other words, 52 percent of the registered command area (about 58,500 ha) is currently irrigated; the project will increase that to 80 percent. Thus, the project is expected to add 31,500 ha of irrigated land.

A. Project Benefits

5. The benefits will be realized progressively over the six years of the project. By the end of the first year 4.2 percent of the project area will be irrigated, by the end of the second 19.2 percent, and by the end of the third, 50.8 percent. Acreage expansion in the fourth year will be an additional 19.2 percent, in the fifth 20 percent, and in the sixth 10 percent. The main benefits are expected to come from (a) expansion of irrigated areas and the effects on the production and productivity of current crops and fish; (b) intensification and diversification from traditional food grains into higher-value-added crops; and (c) improved fish productivity and profitability through production, post-harvest handling, and primary processing.

6. The goal is to raise the incomes of beneficiaries, as measured by higher per hectare yields for agricultural produce and larger fish catches.

7. **Expansion of irrigated areas.** The improvement in physical infrastructure, water management,

[28] Command area as here referred to is the net irrigated area that will receive water supply after the tank systems are rehabilitated.

and PIM will increase the areas that can be irrigated. About 44 percent of the tanks to be rehabilitated are in the districts of Srikakulum, Vizianagaram, and Visakhapatnam on the northern coast. Assuming a similar cropping pattern in the expanded irrigation area, incremental benefits are quantified for different commodities based on sample and secondary data. Current productivity for each crop and per-hectare net profit are used to capture the expected impacts of expanding irrigated areas. The crop budget for 21 commodities—paddy, maize, red gram, green gram, black gram, jowar, groundnuts, and finger millet and higher-value mango, banana, papaya, lemon, tomato, grass, castor, cotton, oil palms, chili, sugar cane, sunflower, and okra—was analyzed, and per hectare net profit calculated for each commodity.

7. **Crop intensification and diversification.** Agricultural interventions through the cascade-area production system promote change in the commodity structure. In the project areas, more than 84 percent of the cultivable area is allocated to paddy production. Groundnut production occupies 4.4 percent, followed by maize and pulses, such as red grams. Thus, close to 94 percent of the land is allocated to traditional commodities; allocations for such high-value-added commodities as fruits, vegetables, and spices are quite small. It is estimated that after the project the paddy area will drop from 84 to about 67 percent. In the project scenario, cultivable areas allocated to certain value-added commodities will rise from 0.5 to 4.2 percent for chili, from 4.4 to 7.4 percent for groundnuts, from 1.8 to 4.9 percent for red gram, and from 0.2 to 3.7 percent for tomatoes. Also, cropping intensity is expected to improve by 30 percent, which will bring in an additional 27,000 ha of cultivable land during the dry season. Incremental benefits generated by diversification from paddy and intensification of high-value-added commodities in irrigated areas are quantified.

8. **Fisheries.** The expected benefits from fishery activities are generated from higher productivity, improved irrigation tanks, and use of innovative technology in production. Additional benefits for fisheries arise from better post-harvest handling and marketing linked to better access to markets. The project introduces four types of aquaculture, each with incremental benefits. Intensive and semi-intensive pond aquaculture is one such practice, for which 1,000 ha of WSA is allocated. Some 25,000 ha of WSA generated from irrigation tank improvement will be allocated to aquaculture in perennial, short-seasonal, and long-seasonal tanks.

9. **Greenhouse gas co-benefits.** The economic analysis incorporates carbon externalities. Net carbon reduction is calculated using the annual shadow price of carbon (US$ /tCO_2e) multiplied by annual GHG emissions (tCO_2e). This analysis uses carbon prices from the High-Level Commission on Carbon Prices with a range of US$38–131 per ton of CO_2e over 20 years, which include the project period. The annual reduction of GHG emissions per hectare is –1.3 tCO_2e (Annex E).

B. Project Costs

10. Total base project cost is expected to be about US$245.9 million, of which the World Bank will finance about 70 percent, US$172.2 million, through an IBRD loan, and the GoAP will finance US$73.7 million. Recurrent costs after the project is completed are assumed to be about 0.5 percent of the total project costs.

11. About US$6.8 million will be allocated to reinforcing institutions and building WUA capacity. Nearly 57 percent of the total cost will go to improving tank systems and thus water productivity and

efficiency. The project cost for Component A will be about US$145.9 million, 59.5 percent of the total.

12. About 31.1 percent, US$76.4 million, of total project cost is for improving agricultural practices, with US$60.4 million allocated to climate-smart diversified agricultural production. The fisheries subcomponent will absorb about 6.5 percent, US$16 million, of the total cost.

13. Activities for climate-friendly market and agribusiness promotion will cost about US$14 million, 5.7 percent of the total; and US$9.2 million, 3.7 percent, will support project management and building PMU capacity.

14. In estimating rates of return on project activities, both investment and recurring costs are taken into account while the project is active, as are O&M costs post-project.

Table D.1. Project Cost by Component and Sub-Component

Components	INR (In Crore)	US$ (In Million)	% of the Total Proposed Project Cost
Component A: Improving Irrigated Agriculture Efficiency	**950.9**	**145.9**	**59.5**
A1. Institutional Strengthening and Capacity Building of WUAs	44.2	6.8	2.8
A2. Rehabilitation and Modernization of the SSCBI Systems	869.7	133.5	54.3
A3. Improving Water Productivity and Efficiency	37.0	5.6	2.3
Component B: Promoting Climate-Smart Agricultural Practices	**498.3**	**76.4**	**31.1**
B1. Support to Climate-Smart Crop Production and Diversification	394.0	60.4	24.6
B2. Support to Climate-Smart Aquaculture	104.3	16.0	6.5
Component C: Post-harvest Management, Market and Agribusiness Promotion	**91.0**	**14.0**	**5.7**
Component D: Project Management and Capacity Building	**59.8**	**9.2**	**3.7**
Total	**1600.0**	**245.5**	**100.0**

*A front-end fee of US$0.4 million is included in the loan amount

C. Financial Analysis

15. Financial analysis was conducted for eight agricultural commodities (paddy, maize, red gram, green gram, black gram, groundnuts, finger millet, and jowar [millet] and 13 horticultural (mango, banana, papaya, lemon, tomato, castor, grass, cotton, oil palms, sugarcane, sunflower, chili, and okra). The analysis also covered fishery activities.

16. Tables D.2 and D.3 show before-and-after crop yield differences. Project irrigation system modernization and new CAS practices are expected to heighten yields considerably.

Table D.2. Yield Increase Assumptions for Main Agricultural Commodities (tons per ha)

Main Agriculture Crops	Without Project	With Project	Increase in %
Paddy	5.00	5.50	15%
Maize	4.09	5.11	25%
Redgram	0.70	0.81	15%
Greengram	0.41	0.49	20%
Blackgram	0.63	0.76	20%
Jowar	1.54	1.85	20%
Groundnut	1.14	1.43	25%
Finger Millet	1.34	1.67	25%

Table D.3. Yield Increase Assumption for Horticultural Commodities (tons per ha)

Main Horticulture Crops	Without Project	With Project	Increase in %
Mango	8.3	10.8	30%
Banana	19.3	25.0	30%
Papaya	82.0	106.6	30%
Lemon	9.4	11.7	25%
Tomato	16.4	19.7	20%
Castor	1.0	1.2	25%
Cotton	1.4	1.8	25%
Grass	1.5	1.9	25%
Oil Palms	16.8	21.0	25%
Chili	2.4	3.0	25%
Sugarcane	81.2	101.5	25%
Sunflower	1.0	1.3	25%
Okra	12.8	16.0	25%

17. Based on the productivity changes shown in the tables, net per hectare financial benefit (gross margin) for each commodity was calculated using constant 2017 prices (Tables D.4 and D.5). According to the Baseline Survey and GoAP secondary statistical data, the average AP farm is smaller than 1 ha. Gross margin and net profit for each crop are calculated per hectare. Average labor costs relative to total production and operating costs are about 43 percent, and gross margin was calculated without labor costs. Net profit is gross margin minus labor costs.

Table D.4. Financial Results for Main Agricultural Commodities, per Ha

		Paddy		Maize		Redgram		Finger Millet	
		INR	US$	INR	US$	INR	US$	INR	US$
Gross Margin	WOP	33,766	478	25,683	364	23,085	327	15,238	216
	WP	45,082	639	35,035	496	27,799	394	20,919	296
Net Profit	WOP	6,888	98	5,109	72	10,908	155	6,475	92
	WP	18,204	258	43,759	620	15,622	221	9,631	136

		Greengram		Blackgram		Jowar		Groundnut	
		INR	US$	INR	US$	INR	US$	INR	US$
Gross Margin	WOP	17,531	248	19,226	272	16,972	240	67,248	953
	WP	21,477	304	24,907	353	21,534	305	86,466	1,225
Net Profit	WOP	14,147	200	6,999	99	4,968	70	48,930	693
	WP	18,093	266	12,680	180	9,530	135	68,148	965

Note: WOP=Without project, WP=With project.

Table D.5. Financial Results for Horticultural Commodities, per Ha

		Mango		Banana		Papaya		Lemon	
		INR	US$	INR	US$	INR	US$	INR	US$
Gross Margin	WOP	32,886	466	553,989	7,848	55,174	782	67,678	959
	WP	80,383	1,139	769,944	10,908	122,114	1,730	133,380	1,890

		Tomato		Castor		Cotton		Grass	
		INR	US$	INR	US$	INR	US$	INR	US$
Gross Margin	WOP	36,237	513	16,672	236	14,722	209	6,594	93
	WP	59,699	846	25,564	362	22,402	317	9,262	131

		Oil Palms		Chili		Sugarcane		Sunflower	
		INR	US$	INR	US$	INR	US$	INR	US$
Gross Margin	WOP	58,273	826	49,137	696	68,923	976	14,938	220
	WP	90,131	1,277	65,432	927	128,144	1,815	25,278	372

		Okra	
		INR	US$
Gross Margin	WOP	103,250	1,463
	WP	145,133	2,056

Note: WOP=Without project, WP=With project,

18. A goal of Project Component A is to make more bulk water available by improving tank systems throughout AP. The 1,000 SSCBI systems to be rehabilitated will ensure that 90,000 ha of cultivable land will be fully irrigated. The analysis incorporates the aggregate annual increase in irrigated areas; new areas for each commodity and phasing of irrigated area expansion for each would be included at a later stage.

19. Incorporating irrigated area expansion by commodity, the analysis calculated incremental benefits for each commodity. Tables D.6 and D.7 show incremental benefits in U.S. dollars for agriculture and for horticulture products. Expansion of irrigated area will expand cultivated areas for all targeted products.

Table D.6. Annual and Incremental Benefits of Expanded Irrigation Area for Primary Agricultural Products

Total Incremental Benefits (in USD)	2018	2019	2020	2021	2022	2023	2024-onwards
Paddy	107,752	495,657	711,161	495,657	517,208	258,604	2,586,038
Maize	1,927	8,862	12,715	8,862	9,247	4,624	46,236
Red Gram	3,650	16,791	24,091	16,791	17,521	8,760	87,603
Green Gram	387	1,779	2,552	1,779	1,856	928	9,282
Black Gram	159	729	1,047	729	761	381	3,806
Jowar	501	2,302	3,303	2,302	2,402	1,201	12,012
Groundnut	39,749	182,847	262,346	182,847	190,797	95,398	953,984
Finger Millet	161	739	1,060	739	771	385	3,855
Yearly Benefits	**154,284**	**709,706**	**1,018,274**	**709,706**	**740,563**	**370,282**	**3,702,816**
Incremental Benefits	**154,284**	**863,990**	**1,882,265**	**2,591,971**	**3,332,534**	**3,702,816**	**70,353,501**

Table D.7. Yearly and Incremental Benefits of Expanded Irrigation Area Increased for Primary Horticulture Products

	2018	2019	2020	2021	2022	2023	2024-onwards
Mango	**1,415**	**6,509**	**9,340**	**6,509**	**6,792**	**3,396**	**33,962**
Banana	**42,067**	**193,509**	**277,643**	**193,509**	**201,922**	**100,961**	**1,009,611**
Papaya	**559**	**2,570**	**3,687**	**2,570**	**2,681**	**1,341**	**13,407**
Lemon	**1,028**	**4,728**	**6,784**	**4,728**	**4,934**	**2,467**	**24,668**
Tomato	**1,105**	**5,084**	**7,295**	**5,084**	**5,305**	**2,653**	**26,526**
Castor	**84**	**388**	**557**	**388**	**405**	**203**	**2,026**
Cotton	**2,813**	**12,938**	**18,563**	**12,938**	**13,500**	**6,750**	**67,500**
Grass	**17**	**77**	**110**	**77**	**80**	**40**	**401**
OilPalm	**19,492**	**89,663**	**128,647**	**89,663**	**93,561**	**46,781**	**467,806**
Chili	**3,660**	**16,834**	**24,154**	**16,834**	**17,566**	**8,783**	**87,832**
Sugarcane	**5,574**	**25,640**	**36,787**	**25,640**	**26,754**	**13,377**	**133,772**
Sunflower	**3,054**	**14,048**	**20,156**	**14,048**	**14,659**	**7,329**	**73,294**
Okra	**2,052**	**9,437**	**13,540**	**9,437**	**9,847**	**4,924**	**49,237**
Yearly Benefits	**82,918**	**381,425**	**547,261**	**381,425**	**398,008**	**199,004**	**1,990,041**
Incremental Benefits	**82,918**	**464,343**	**1,011,604**	**1,393,029**	**1,791,037**	**1,990,041**	**37,810,780**

20. Secondary incremental benefits arise from crop intensification and diversification (Component B). Incremental benefits are shown for the main agriculture crops, horticulture crops, and fishery activities (Tables D.8 and D.9). With diversification, the net incremental benefits become negative due to the shrinkage of paddy area. However, this decrease is compensated for by the benefits from allocating land to higher-value-added commodities.

Table D.8. Incremental Benefits from Crop Intensification, 2018–24 and Beyond

Total Incremental Benefits (in USD)	2018	2019	2020	2021	2022	2023	2024-onwards
Paddy	200,110	920,506	1,320,727	920,506	960,528	480,264	4,802,642
Maize	10,127	46,584	66,838	46,584	48,609	24,305	243,047
Red Gram	9,708	44,658	64,075	44,658	46,600	23,300	233,000
Green Gram	919	4,225	6,062	4,225	4,409	2,205	22,045
Black Gram	533	2,454	3,521	2,454	2,561	1,280	12,803
Jowar	1,783	8,202	11,768	8,202	8,558	4,279	42,792
Groundnut	102,815	472,947	678,576	472,947	493,510	246,755	2,467,551
Finger Millet	444	2,041	2,928	2,041	2,130	1,065	10,648
Yearly Benefits	**326,439**	**1,501,618**	**2,154,495**	**1,501,618**	**1,566,906**	**783,453**	**7,834,528**
Incremental Benefits	**326,439**	**1,828,057**	**3,982,552**	**5,484,170**	**7,051,076**	**7,834,528**	**148,856,040**

	2018	2019	2020	2021	2022	2023	2024-onwards
Mango	6,424	29,548	42,396	29,548	30,833	15,417	154,166
Banana	108,579	499,464	716,622	499,464	521,180	260,590	2,605,899
Papaya	2,296	10,562	15,154	10,562	11,021	5,511	55,106
Lemon	3,762	17,305	24,829	17,305	18,057	9,029	90,286
Tomato	3,382	15,555	22,318	15,555	16,232	8,116	81,158
Castor	240	1,106	1,586	1,106	1,154	577	5,768
Cotton	13,641	62,750	90,032	62,750	65,478	32,739	327,389
Grass	44	200	287	200	209	104	1,045
OilPalm	55,990	257,552	369,532	257,552	268,750	134,375	1,343,752
Chili	12,319	56,665	81,302	56,665	59,129	29,564	295,644
Sugarcane	19,246	88,530	127,022	88,530	92,379	46,190	461,897
Sunflower	9,598	44,149	63,345	44,149	46,069	23,034	230,344
Okra	5,356	24,635	35,346	24,635	25,707	12,853	128,533
Yearly Benefits	**240,874**	**1,108,022**	**1,589,771**	**1,108,022**	**1,156,197**	**578,099**	**5,780,986**
Incremental Benefits	**240,874**	**1,348,897**	**2,938,668**	**4,046,690**	**5,202,888**	**5,780,986**	**109,838,739**

Table D.9. Incremental Benefits from Crop Diversification, 2018–24 and Beyond

	2018	2019	2020	2021	2022	2023	2024-onwards
Banana	43,667	200,868	288,202	200,868	209,602	104,801	1,048,009
Blackgram	165	757	1,086	757	790	395	3,950
Castor	88	403	578	403	421	210	2,103
Chilli	76,362	351,264	503,987	351,264	366,536	183,268	1,832,680
Cotton	2,919	13,430	19,269	13,430	14,013	7,007	70,067
Grass	116	535	768	535	558	279	2,792
Greengram	401	1,847	2,650	1,847	1,927	963	9,635
Groundnut	124,128	570,987	819,242	570,987	595,813	297,906	2,979,063
Jowar	1,484	6,828	9,797	6,828	7,125	3,563	35,627
Lady Finger	2,130	9,796	14,055	9,796	10,222	5,111	51,110
Lemon	1,067	4,908	7,042	4,908	5,121	2,561	25,606
Maize	13,979	64,305	92,263	64,305	67,101	33,550	335,503
Mango	1,469	6,757	9,695	6,757	7,051	3,525	35,254
Oilpalm	20,233	93,073	133,539	93,073	97,119	48,560	485,597
Paddy	44,882	206,456	296,220	206,456	215,433	107,716	1,077,164
Papaya	580	2,667	3,827	2,667	2,783	1,392	13,917
Ragi	167	767	1,100	767	800	400	4,001
Redgram	22,259	102,393	146,912	102,393	106,845	53,422	534,225
Sugarcane	9,092	41,823	60,007	41,823	43,642	21,821	218,208
Sunflower	3,170	14,582	20,922	14,582	15,216	7,608	76,081
Tomato	71,210	327,566	469,987	327,566	341,808	170,904	1,709,042
Yearly Benefits	**439,568**	**2,022,013**	**2,901,149**	**2,022,013**	**2,109,926**	**1,054,963**	**10,549,632**
Incremental Benefits	**439,568**	**2,461,581**	**5,362,730**	**7,384,743**	**9,494,669**	**10,549,632**	**200,443,017**

21. The project promotes tank system aquaculture in about 25,000 ha of WSA and intensive pond aquaculture in 1,000 ha. The analysis assumes that incremental benefits are generated from three types of tank aquaculture (short-seasonal, perennial, and long-seasonal). Because the analysis also assumes that in target WSAs, aquaculture is equally distributed among the three types of practices, 8,333 ha of WSA is allocated to each. Furthermore, intensive pond aquaculture will be introduced in 1,000 ha of WSA. Benefits will be generated from (a) enhancements in input and product quality; (b) introduction of climate-resilient fish production; and (c) improved post-harvest technology and enhanced marketing opportunities.

22. Table D.10 summarizes the estimated benefits from various fishery practices. The analysis assumes that the project will be generating about US$5 million by the time it ends.

Table D.10. Incremental Benefits from Fisheries

Prodution System	Area (Ha)	Gross Margin per Ha (US$)		Incremental Benefits per Ha (US$)	Total Incremental Benefits (US$)
		Without Project	With Project		
Short seasonal model	8,333	63.3	127.4	64.1	534,047
Perennial model	8,333	62.6	127.4	64.9	540,420
Long seasonal model	8,333	75.4	170.2	94.8	789,552
Pond Model	1,000	-	3,142.6	3,142.6	3,142,647
TOTAL	**26,000**	**201.4**	**3,567.7**	**3,366.3**	**5,006,666**

23. Finally, returns for the entire project over a 25-year period were calculated using 2017 constant prices and a discount rate of 12 percent. (Of the 25 years, 6 are attributable to the project period.) The estimated financial rate of return for the base case is 21.98 percent, with a net present value (NPV) of about US$81.9 million.

D. Economic Analysis

24. Prices for traded agricultural inputs and commodities were converted to economic prices at import and export parity. Prices of nontraded goods, such as the costs of agricultural labor, and commodities were converted to economic prices using a standard factor of 0.9. The assumptions for estimating benefits were the same as for the financial analysis. Total financial project costs were converted to economic costs. The analysis for the 25-year period, including the 6 project years, used 2017 constant prices. For the economic analysis, taxes, duties, and price contingencies were removed and the shadow exchange rate of INR70.59 to US$1 was applied.

25. The economic benefits from GHG reduction were incorporated into the analysis, and the incremental benefits (Table D.11) were added to the economic analysis. Both low- and high-price scenarios are calculated.

Table A.11. Incremental Benefits from Reduction of Greenhouse Gases, 2018–27, US$

	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027
GHG Benefit (L)	185,303	874,825	1,287,367	919,687	983,081	503,244	5,149,470	5,266,503	5,383,536	5,500,570
GHG Benefit (H)	375,482	1,749,649	2,574,735	1,839,375	1,966,161	1,006,487	10,181,906	10,415,973	10,650,039	11,001,140
	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037
GHG Benefit (L)	5,617,603	5,734,637	5,851,670	5,968,703	6,085,737	6,202,770	6,319,804	6,436,837	6,553,870	6,670,904
GHG Benefit (H)	11,235,206	11,703,340	11,937,407	12,288,507	12,522,574	12,756,641	13,107,741	13,341,808	13,692,908	14,044,008

26. The project's ERR for the 25-year period without the benefits of GHG reduction is 16.4 percent

for the base scenario, with an estimated NPV of US$36.73 million. When GHG reduction benefits are added at a low estimated shadow price of carbon, the ERR rises to 19.0 percent with an NPV of about US$59.0 million, discounted by 12 percent. With a high estimated shadow price of carbon, the ERR reaches 21.5 percent with an NPV of about US$81.8 million.

E. Risk Analysis

27. Sensitivity analysis tested the robustness of the project. Nine scenarios were analyzed: cost increases of 10, 20, and 30 percent over the base scenario; benefit decreases of 10, 20, and 30 percent; and benefit delays of 1, 2, and 3 years.

28. The project maintains economic returns above 12 percent even when total project cost goes up by 30 percent. At a cost increase of 10 percent, the return is 17.0 percent. A 20 percent cost increase still brings an estimated return of 15.1 percent and a 30 percent increase still returns 13.9 percent. The ERR response is slightly more sensitive to decreases in benefits than to increases in costs. After a benefit reduction of 20 percent, the ERR is still above 14 percent, but a 30 percent reduction pushes it slightly below 12 percent.

29. Delays in benefits, which are the most sensitive of the risks, have a larger impact on the ERR. It does stay above 12 percent when there are delays of up to 2 years, but with a 3-year delay, it closes in on 11 percent.

Table D.12. Summary of Sensitivity Analysis

	Base Case (10%)	Costs Increase			Decrease in Benefits			Delay of Benefits		
		+10%	+20%	+30%	-10%	-20%	-30%	1 year	2 years	3 years
Internal Rate of Return (IRR)	19.0%	17.0%	15.1%	13.5%	16.8%	14.2%	11.7%	15.8%	13.4%	11.2%
Net Present Value (in USD)	$59,054,310	$47,905,592	$32,178,062	$16,450,531	$41,542,279	$19,451,437	(2,639,405)	$38,133,238	$15,365,484	(9,541,680)

ANNEX E: GREENHOUSE GAS ACCOUNTING USING EX-ACT

1. Ex ante quantification of expected GHG emissions from project activities is essential to manage and ultimately reduce emissions, especially since agriculture is a major source of GHG emissions; however, it also provides ample opportunity for mitigating climate change and building resilience.

2. The goals of APIIATP, the Andhra Pradesh Integrated Irrigation and Agriculture Transformation Project, are to enhance the climate resilience, productivity, and profitability of small and marginal farms in semi-arid regions of AP. It proposes to use, among other options, improved agronomic and horticultural practices, water management, and nutrient management to build resilience while reducing GHG emissions and enhancing carbon stocks.

Accounting Methodology

3. The World Bank has adopted the Ex-Ante Carbon Balance Tool (EX-ACT), created by the FAO in 2010, to estimate how lending for agricultural investment affects GHG emissions and carbon sequestration. EX-ACT, a land-based system for assessing net carbon balance with and without project activities, captures APIIATP activities in five modules: (a) land use change; (b) crop production and management; (c) grassland and livestock; (d) inputs and further investment; and (e) fisheries and aquaculture. It estimates changes in carbon stocks (emissions or sinks), expressed in equivalent tons of CO_2 per hectare and per year. The project covers 90,000 ha net cultivated area and 114,000 ha of gross cultivated area. In its modelling the GHG estimation looks at gross cultivated area. The primary sources of data were the baseline survey and secondary data from the GoAP.

General Observations about the Calculations

4. Estimates include proposed interventions for the kharif and rabi cropping seasons. The total period is 20 years: 6 years of project activity and 14 years for the capitalization phase. The EX-ACT Tier 1 method (details of tier methods are outlined in the Project Implementation Plan) is adopted due to lack of data on emission and sequestration coefficients for all crops and resilience interventions. However, the monitoring phase could adopt the Tier 2 method. The area for the “start” and “without” project scenario is assumed to be the same. No clear trend of area under different crops could be observed due to highly variable annual monsoon rainfall.

Project Activities Relevant to the Analysis

5. **Project Area.** The proposed six-year project will cover about 114,000 ha of AP agricultural land and 1,000 SSCBI systems. On average, only 52 percent of a tank’s command area is irrigated because recurrent droughts reduce water availability. Cropping pattern is dominated by paddy (95,908 ha, 84 percent), followed by oilseeds (4,982), maize (2,314), pulses (2,052), perennial tree crops like mango, papaya, and banana (1,140), and vegetables (809).

6. **Project Activities.** Several proposed APIIATP interventions to promote climate resilience are likely

to have carbon implications. The interventions proposed are organized according to the five EX-ACT modules:

a. ***Land use change***

- Reduce paddy cultivation area in both kharif and rabi cropping seasons by 20 percent (about 20,000 ha) and introduce pulses, oil seeds, grains, and high-value horticultural crops, increasing the expanse where they are cultivated from 10,157 to 30,157 ha.
- Expand the area for perennial tree crops by 525 ha, from 1,140 to 1,665 ha.
- By modernizing tank systems, cover 80 percent of tank command areas with irrigation. With this water available, cultivation of grass and fodder will be promoted on 2.5 percent of command area on the outskirts of the tank commands. Due to lack of irrigation, variable rainfall, and recurrent droughts, these lands have degraded over time.

Table E.1. Land-use Change With and Without the Project

Initial Land Use	Initial Area (Ha)	Final Land Use	Area Transformed (Ha)
Flooded rice	95,908	Flooded rice	75,908
		Annual crops	20,000
Degraded land*	3,375	Grass/fodder	2,850
		Perennial tree crops	525

*Cropland near the boundaries of tank commands has been considered degraded.

b. ***Crop production and management***

- Promote improved agronomic practices: integrated nutrition management (INM), integrated pest management (IPM), water management, manure application, and retention of crop residue in all major cropping systems, including rice.
- Promote no-till practice for maize cultivation.
- Convert 20 percent (20,000 ha) of area under paddy cultivation to other field and horticulture crops. These parcels predominantly use medium-duration cultivars (120 days) with intermittent flooding and a nonflooded period of more than 180 days before cultivation. Green manure is the usual organic amendment.
- For other rice systems:
  - Organic amendments and the percentage area they will cover (Table E.2), based on which the area under different rice systems was estimated.

Table E.2. Organic Amendments and Percentage Area Covered, Adoption Rates

Organic Amendment Applied	Baseline, Percent Adoption Rate	Project Percent Adoption Rate -
Green manure	40	20
Straw incorporation long before cultivation	20	30
Farmyard manure	15	40
Compost	5	10

  - The cultivation period is assumed to be 120 days for all types of organic amendment with a nonflooded pre-season longer than 180 days.
  - In the without project (baseline) scenario (37,548 ha), the 40 percent of area remaining under paddy is assumed to be continuously flooded with green manure as an organic

amendment. With the project, after diversification to other field crops (20,000 ha), if a business-as-usual scenario is assumed, the area for continuously flooded paddy would be 30,363 ha. However, the project aims to reduce this by 50 percent, to 15,182 ha, and bring it under a regime of intermittently flooded water to enhance water productivity and water use efficiency.

- The other three paddy systems categorized, based on organic amendments applied (straw long before cultivation, farmyard manure, and compost), are assumed to have intermittent flood water even in the baseline due to lack of enough irrigation water from tank systems. However, it is assumed that the area under these systems will increase by 19,111 (58 percent) with the promotion of INM practices.

Table E.3. Area under Different Rice Systems With and Without the Project

Rice Systems	Baseline Scenario	Project Scenario
Total Area under Paddy	*95,908 ha (percent)*	*79,908 ha (percent)*
Rice-120-CF-NFP>180-GM	37,548 ha (40)	15,182 ha (20)
Rice-120-IIF-NFP>180-SIL>30	19,182 ha (20)	22,772 ha (30)
Rice-120-IIF-NFP>180-FYM	14,286 ha (15)	30,363 ha (40)
Rice-120-IIF-NFP>180-Compost	4,792 ha (5)	7,591 ha (10)

Note: Rice-120-CF-NFP>180-GM = Rice – 120 days cultivation period – Continuously flooded water regime – Nonflooded period > 180 days – Green manure (organic amendment). IIF: Irrigated intermittently flooded; SIL >30: Straw incorporated long before cultivation (> 30 days); FYM: Farmyard manure.

c. ***Grassland and livestock***

- The PMU reported grasslands covering 0.25 percent of total gross cultivated area (285 ha) in the baseline. With more water available in tank commands, area under grass and fodder crops is expected to increase by 2.5 percent (2,850 ha).

d. ***Inputs and further investment***

- Current fertilizer application rates were compared to the rates proposed (INM). Because cultivation of other annual crops is likely to increase, it is expected that fertilizer use will also go up, but per ha application rates are expected to decrease due to INM practices.

Table E.4. Current and Proposed Fertilizer Application Rates

Major crops	Current Application Rate (kg per ha)[29]			Proposed Fertilizer Application Rate (kg per ha)[30]		
	N	P	K	N	P	K
Paddy	127	60	44	80	80	40
Groundnut	42	39	13	24	45	45
Red gram	59	49	10	20	50	0
Maize	130	57	20	100	50	40

- The current and the proposed pesticide application rates were compared for paddy, the main crop. Reducing the area under paddy cultivation and promoting IPM techniques will reduce

[29] Estimated using data from the Input Survey, http://inputsurvey.dacnet.nic.in/.
[30] Proposed fertilizer rates were compiled based on crop-specific rates proposed by KVKs within the project area.

pesticide applications by at least 20 percent.

- Electricity usage for irrigation is expected to drop by 12.6 percent due to promotion of less-water-intensive crops (conversion of 20 percent of irrigated paddy area to other annual crops), micro-irrigation, and soil moisture conservation techniques.[31]
- The project plans to promote micro-irrigation (e.g., hand sprinklers, rain guns, drip irrigation) in 60 percent of the area for vegetables (5,376 ha), 80 percent of the area for perennial crops (1,332 ha), 60 percent of the area for groundnuts (5,089 ha) and maize (4,299 ha), and 80 percent of the area for red gram (4,441 ha), for a total of 20,537 ha.
- The proposal is for 20,000m^2 of agricultural storage space.

e. ***Fisheries and aquaculture***

- 26,000 ha of WSA is proposed for aquaculture in suitable tanks and ponds. Current fish production systems yield about 9,256 tons/year, but with newer techniques like cage culture and semi-intensive and intensive production models, yields of short-seasonal fish production are expected to go up to 13,884 t/year. The project also proposes feed development of 9,000 t/year.

Table E.5 compares gross results for the with- and without-project scenarios. Tier 1 coefficients are used throughout, and linear dynamics of change is assumed.

Table E.5. GHG Accounting for APIIATP (EX-ACT methodology)

Components of the Project	Gross GHG Fluxes over 20-year Project Period (tCO_2e)			GHG Balance per Year (tCO_2e per year)		
	Without	**With**	**Balance**	**Without**	**With**	**Balance**
Land use changes						
Other land use changes	0	9,36,248	9,36,248	0	46,812	46,812
Agriculture						
Annual	61,369	−6,88,808	−7,50,177	3,068	−34,440	−37,509
Perennial	−7,524	−67,642	−60,118	−376	−3,382	−3,006
Rice	74,02,269	49,07,209	−24,95,059	3,70,113	2,45,360	−1,24,753
Grassland and livestock						
Grassland	0	−1,10,576	−1,10,576	0	−5,529	−5,529
Inputs and investments						
	85,94,153	73,43,495	−12,50,658	4,29,708	3,67,175	−62,533
Fishery and aquaculture						
	1,46,504	2,08,769	62,264	7,325	10,438	3,113
Total	1,61,96,771	1,25,28,695	**−36,68,075**	8,09,839	6,26,435	**−1,83,404**
Per hectare	119	92	**-27**	—	—	—
Per hectare per year	5.9	4.6	**−1.3**	5.9	4.6	**−1.3**

Note: Negative values (-) indicate net GHG benefits or CO_2 sequestration; positive values (+) indicate net GHG or CO_2 emissions.

7. **Results of the GHG Balance Analysis.** The EX-ACT model used for Tier 1 ex ante evaluation of GHG emissions in APIIATP is shown to be negative, meaning that the project will contribute to net GHG

[31] Based on data collected by the APCBTMP's PGM program.

mitigation and sequestration:

- The major project sources of GHG emissions will be changes in land use (conversion of paddy areas to annual crops) and aquaculture.
- The results of the model indicate that there will be a 20-year net negative GHG balance of 3,668,075 tCO_2eq.
    - The annual reduction in GHG emissions is estimated to be 183,404 tCO_2eq; thus, when the project ends after six years, the total reduction is expected to be 1,100,423 tCO_2eq.
    - GHG reduction of 27 tCO_2eq per ha is observed for the 20-year period, a reduction from 119 tCO_2eq per ha in the baseline to 92 tCO_2eq per ha: 111 tCO_2eq per ha after 6 years. This translates into annual GHG mitigation r of 1.3 tCO_2eq per ha.

8. EX-ACT shows that APIIATP interventions to build the resilience of agriculture will also reduce net GHG emissions or net CO_2 sequestration over the baseline, the "without project" scenario. Clearly, the project will help to mitigate the effects of climate change.

9. **Sensitivity Analysis.** In addition to the project scenario, two scenarios with lower adoption rates (each is 20 percent lower than the preceding scenario) were considered to assess the implications for the GHG balance. Scenarios and associated adoption rates are given in Table E.6 and the estimates in Table E.7.

- In the project scenario (scenario 1), the total net GHG balance over 20 years for the total project area was estimated to be –3.668 million tCO_2eq, leading to an annual per hectare net GHG benefit of 1.3 tCO_2eq per ha.
- The total net GHG balance in scenario 2 was estimated to decline to –3.390 million tCO_2eq, which translates to an annual net GHG benefit of 1.2 tCO_2eq per ha.
- In scenario 3, the total net GHG balance was estimated to be –2.828 million tCO_2eq, leading to an annual net GHG benefit of 1.0 tCO_2eq per ha.

Table E.6. Sensitivity Analysis Details

Project activity	Scenario 1	Scenario 2	Scenario 3
Reduction in flooded rice area, conversion to other annual crops[a]	20,000 ha	16,000 da	12,000 ha
Conversion of degraded lands to grass and fodder crops	2,850 ha (2.5 percent of total area)	2,280 ha (2 percent of total area)	1,710 ha (1.5 percent of total area)
Conversion of degraded lands to perennial tree crops[b]	525 ha	525 ha	525 ha
Reduction in electricity usage[c]	12.6 percent	9.45 percent	6.3 percent
Irrigation systems (area covered by micro-irrigation) [d]	20,737 ha	16,694 ha	12,494 ha
Aquaculture: fish production [e]	13,884 t/year	12,958 t/year	12,003 t/year
Aquaculture: feed production	9,000 t/year	8,100 t/year	7,650 t/year

Note: Scenario 1 is the optimum project scenario, assuming 100 percent adoption of project activities; Scenario 2 assumes 80 percent adoption; and Scenario 3 assumes 60 percent adoption.

[a] The project has set a maximum conversion of 20,000 ha of paddy area. Distribution of this area to different crops has not been directly captured, because area expansion of these crops will be seen together with improved water availability by reducing the gap ayacut areas. The expansion of area for other crops was calculated by considering the past three-year trend in area for selected crops and is as follows: 7.4 percent in area for groundnut, 6.3 percent for maize, 4.9 percent for red gram, and 7.9

percent for vegetables (chili and tomato). This was assumed to arrive at a constant area of 106,066 ha for these crops (including paddy) in the baseline and project scenarios.
[b]Assumed to remain the same in all scenarios because investment in expanding the area for perennial tree crops is low.
[c]Assumes conversion of paddy area by 20 percent in scenario 1, 15 percent in scenario 2, and 10 percent in scenario 3.
[d]The project, which assumes that 20,537 ha will be micro-irrigated, proposes to cover 60 percent of the groundnut and maize area and 80 percent of red gram and pulses area with sprinklers and 60 percent of vegetable and 80 percent of perennial areas with drip irrigation.
[e]Assuming fish production increases 50 percent in the project scenario, 40 percent in scenario 2, and 30 percent in scenario 3.

Table E.7. Sensitivity Analysis for APIIATP GHG Accounting, EX-ACT Methodology

GHG Balance	Scenario 1	Scenario 2	Scenario 3
Net total (tCO_{2eq})	-3,668,075	-3,390,213	-2,820,239
Per hectare (tCO_2eq per ha)	-27	-25	-21
Per hectare/year (tCO_2eq per ha per year)	-1.3	-1.2	-1.0

Note: Scenario 1 is the optimum project scenario, assuming 100 percent adoption of project activities; Scenario 2 assumes 80 percent adoption; and Scenario 3 assumes 60 percent adoption.

Table E.8. Climate Co-Benefits of the AP Integrated Irrigation & Agriculture Transformation Project

Sector	Water Resources, Agriculture, and Resilience
Brief project description	The Project Development Objective is to enhance the agricultural productivity, profitability, and climate resilience of smallholder farmers in selected districts in Andhra Pradesh. Specifically, the project aims to (1) increase the productivity of selected major crops by propagating high-yield, pest-, disease-, drought-, and flood- resistant varieties and corresponding precision farming practices; (2) increase cropping intensity by 30 percent in selected tank command areas; (3) enhance water productivity by 25 percent by modernizing and rehabilitating tanks and diversifying from paddy, a water-intensive crop, to higher-value crops; (4) reduce net GHG emissions by scaling up adoption of climate-resilient, low-carbon agriculture, livestock, and pisciculture technologies and management practices; (v) increase the area covered by new or improved irrigation; and (5) Increase fish productivity in short-seasonal tanks by 50 percent.
Climate vulnerability	In general, agriculture in India accounts for 18 percent of GHG emissions. [a] There is currently no GHG emissions inventory for AP. However, impact assessments show that climate change is expected to exacerbate rainfall variation during the monsoon season and increase the frequency and magnitude of droughts. Several other climatic fluxes have been projected to impact agriculture, among them rising temperatures, heat waves, and more frequent and larger floods and cyclones. These weather anomalies are known to imperil crop production and productivity. [b]
Statement of purpose or intent; and activities eligible for climate mitigation or dual benefit financing	• Only 58 percent of a tank's command area is irrigated during the kharif season due to recurrent droughts and low tank productivity. Irrigation during the rabi season is abysmally low. For the goal of doubling farmer incomes and to ensure food security, priority will be given to enhancing cropping intensity—expanding rabi crop area by modernizing tanks to supply more irrigation; using CWB to make water use more efficient, as well as conjunctive groundwater usage; reducing energy use by promoting energy- and water-efficient irrigation technologies; and increasing diversification from water-intensive paddy crop to higher-value crops. • Climate change is projected to worsen the frequency and magnitude of droughts, rainfall variation, and heat and moisture stress during both cropping seasons. To enhance the resilience of agriculture and lower GHG emissions from agricultural production within tank commands, the project will propagate high-yield, pest-, disease-, drought-, and flood-resistant varieties of crops and promote low-carbon, precision farming practices to enhance the productivity of the crops selected. • Weather anomalies like delayed or untimely rainfall, heat stress, droughts, floods, and cyclones are already visibly impacting agriculture in AP. Real-time crop advisories and contingency plans for adapting to extreme weather will be circulated within project areas. • CO_2 GHG emissions from agricultural practices and technologies will be reduced, focusing on (1) intensifying cultivation of low-carbon paddy and diversifying away from paddy production; and (2) propagating precision, low-carbon practices for other field crops through robust IPNM (Integrated Pest and Nutrition Management) strategies. • Income sources will be diversified by promoting integrated systems for crop production, livestock, and fisheries. Among auxiliary activities will be fodder and agro-forestry development. • Lower post-harvest losses, aggregation of farms, agro-processing start-ups, storage facilities, value chains, and public-private partnerships will all enhance market links and profitability.
Link to project activities	The model employed in this project will holistically address low crop productivity, cropping intensity, water use efficiency, and crop and income diversification and will build market links to lessen the vulnerability of small and marginal farmers within tank command areas to climate shocks. It will invest in rehabilitating tanks and irrigation systems to make more irrigation water available during both kharif and rabi cropping seasons; demonstrate climate-resilient agriculture practices and provide training and extension services to scale up adoption of these practices; integrate and enhance the productivity of livestock and fisheries; and give priority to post-harvest management, processing, and value chain development.

Type of financial instrument	Investment loan
Calculation of climate co-benefit finance	Of the US$245.5 million total project (component) cost, US$12.27 million, 5 percent, is set aside for contingencies, leaving US$233.23 million for project activities. Of this, US$211.93 million, 90.87 percent, is earmarked for adaptation activities and US$13.20 million, 5.38 percent, for improving water productivity, water use, and energy efficiency, and promoting low-carbon agronomic practices, fodder, and agro-forestry development, which have dual benefits of adaptation and mitigation.

Component	Subcomponent	Activities	Adaptation Finance (US$ Million)	Dual-benefit Finance (US$ Million)	Total (US$ Million)
Improving the Efficiency of Irrigated Agriculture at the Farm Level	Institutional Strengthening and Capacity Building	WUA capacity building	6.55	-	145.9
		SOs			
	Improving SSCBI System Performance and Resilience	Tank bund strengthening and aligning (installation, head regulator and sluice repair); catchment treatment of cascades; construction, rehabilitation, and repair of main canal system and tributaries	125.64	-	
		Surface water assessment of tanks; inflow hydrology management; quality assurance			
		Sensor-based automation equipment, district lab equipment			
	Improving Water Productivity and Efficiency	Ground assessments; drilling of piezometers; automated data recorder (with telemetry); pipelines for sharing water	5.52	-	
		Participatory hydrological monitoring (PHM): setting up PHM equipment; support to data centers for updating groundwater modelling software; support to water quality labs			
		Workshops to build capacity in and create awareness of crop water budgeting (CWB); farmer field days			
Adaptive Sustainable Agriculture Practices	Climate-Smart Diversified Agriculture Production Systems	Enhancing productivity through crop diversification and intensification: seed and varietal replacement (breeder seed, foundation seed, and certified seed production); soil health management (supply of green manure seed); distribution of nutrient-solubilizing bacteria; demonstrations on crop diversification and intensification; weed management; efficient water use (supply of water-lifting devices and water pipes, micro-irrigation); water conservation measures (moisture conservation by deep sub-soil ploughing, conservation furrows)	45.64	13.20	76.4
		Infrastructure development**:** provide financial assistance to farmer groups; infrastructure support—modern seed processing plants; paddy threshing floors; equipment for primary processing, cleaning, and dehulling; custom rental centers; pivotal irrigation systems: drones for spraying, upgrading bio labs, auto-analyzers for nutrient analysis; training			

		and capacity building.			
		Expansion of horticulture areas; protection cultivation; rejuvenation of orchards; canopy management; adoption of water-soluble fertilizers; ICM and integrated nutrient management (INM); permanent pandals; capacity building.			
	Innovation and Technology Transfer for Fishery and Small Ruminant Production	Augment quality fish seed production: brood banks for pure-line breeding of inland species, modernization and upgrading of existing hatcheries and seed farms, captive nurseries.	17.89	-	
		Enhance fish production: cage culture, pen culture for seed-rearing; stocking fresh-water prawn juveniles; supply boats and coracles with nets, raceway culture, feed production units, aqualab facilities			
		Post-harvest and market access and links: supply cycles and two-wheelers with ice-boxes, fish mini-processing units, cycle-cart units, ice plank units, fish vending kiosks, fish landing centers; capacity building.			
Post-Harvest Management and Agribusiness Promotion	-	Strengthening farmer producer organizations (FPOs); commodity-wide entrepreneur development; business plan preparation; incubation	13.48	-	14.00
		Development of alternate market links, market transformation, and value addition: establishment of farmers markets (*Apni Mandi*); tie-up with private and national markets through e-NAM; providing market intelligence, supply and value chain analysis; construction of secondary processing units, dehydrators, and a price stabilization fund.			
		Improved post-harvest management: establishing integrated packing houses; low-cost storage structures; refrigerated transport vehicles; and evaporative low-energy cooling chambers			
Project Management and Capacity Building	-	Capacity building for the PMU	-	-	9.2
		Project M&E and promotion of a PMU learning culture			
		Documentation of project processes and experience			
		Contracting with an external M&E agency			
Total (US$ Million)			**223.08**	**13.20**	**245.5**
Percentage of total financing			**90.87%**	**5.38%**	**100%**

Note: [a]India - Second National Communication to the United Nations Framework Convention on Climate Change, 2012, http://unfccc.int/resource/docs/natc/indnc2.pdf.
[b] State Action Plan on Climate Change for Andhra Pradesh, 2012, http://www.moef.nic.in/sites/default/files/sapcc/Andhra-pradesh.pdf

Annex F: WUA and FPO Roles and Capacity-Building Support

1. The project has as partners community-level and community-driven institutions, the WUAs and FPOs. WUAs bring together all water users who own land in a given area and may also engage local non-landowning water users. Similarly, FPOs are collectives of producers, especially small and marginal farmers, seeking access to investments, technology, inputs, and markets. In Andhra Pradesh FPOs are important to creating an ecosystem for enhancing farmer profits. Experience elsewhere has shown that farmer groups that are financially robust, capable of adopting diverse business models, and connected to technology, markets, banks, and other infrastructure facilities can bring enormous economic benefits to their members.

2. Both these types of organizations are important elements of the project; in addition to ensuring community participation and ownership of project interventions, they validate state policy and facilitate execution of the project. The AP-FMIS Act stipulates that WUAs be formed in all tank systems having a command area of more than 40 ha have representation from the entire command area. Further, the 2016 *Farmer Producer Organization Promotion Policy of the Govt. of Andhra Pradesh* emphasizes promotion of FPOs in agriculture and allied sectors to enhance farmer incomes. The project perceives climate resilience to be part of its intervention strategy as it deals with building up irrigation infrastructure and promoting agriculture and related agribusinesses—all of which require significant numbers of farmers to participate. The two types of community-based organizations are vital to project success.

3. WUAs will facilitate enhancement of water productivity, crop water budgeting (CWB), water regulation and management, and O&M of small irrigation structures. FPOs will be concerned with such post-harvest aspects as supply chain management, value addition, product aggregation, and links with produce markets. The WUA role is confined to a specific command area; FPOs cover more ground because they emphasize business expansion. However, FPOs can also be formed by prompting producers from the WUA to take up agribusiness activities and add value to agricultural commodities. As a natural progression, FPOs will also link with both government and the private sector for supply change management, input trading, farm mechanization, logistics, and crop storage. Together, these organizations will cover the entire chain, from production to market.

Building WUA Capacity

4. Building the capacity of WUAs is integral to the project. They will be trained in such areas as effective participation in planning, implementation, monitoring, and evaluation of project activity at the tank and cascade level. The general objective of building the capacity of WUAs is to improve their skill and knowledge base so that their tank systems can achieve their production potential; specific objectives are to (a) improve how WUAs function as institutions and their governance; (b) strengthen participation in the rehabilitation, restoration, and management of cascades and tanks; (c) facilitate management of water and land resources, (d) improve local skills in CWB, irrigation scheduling, and monitoring water use; and (e) enhance knowledge about climate-resilient practices in agriculture and allied sectors.

5. Each WUA will prepare a capacity-building plan (CBP) based on a capacity needs assessment (CNA)

that has identified critical gaps in terms of the project and the AP-FMIS Act. The PMU, DPMUs, and SOs will facilitate the CNA and preparation of the CBP. The PMU, in consultation with the DPMUs and SOs, will draft a comprehensive CNA tool. The CNA will profile the individual as well as the organizational capacity needs of the committees managing WUAs, their subcommittees, and other workers. A WUA may also choose to do a CNA of the general membership. Based on the capacity-building needs identified, line ministries associated with the project will design training modules for use by WUAs.

6. Though a CNA will identify specific capacity requirements for WUAs and subcommittees, as part of capacity-building WUAs will receive some basic training when the project is launched. Capacity building (CB) for different WUA stakeholders would be organized in two categories, general and specific. General CB would cover (a) participatory irrigation management; (b) WUA responsibilities; (c) keeping financial accounts and managing financial resources; (d) supervising civil works and O&M; (e) drafting and implementing the WUA Annual Action Plan; (f) water audits and crop planning; (g) water distribution and sharing; and (h) community-based monitoring of WUA activities. Table F.1 spells out specific CB measures.

Table F.1: WUA Committee and Subcommittees Responsibilities

WUA Managing Committee	WUA Subcommittees	Beneficiaries
1. Participatory rural appraisal 2. Preparation of the Cascade Development Plan 3. Preparation of the WUA operational strategy and plan 4. Supervision of civil works 5. Participatory irrigation management and WUA 6. Responsibilities of WUA 7. Responsibilities of WUA management committee members 8. Keeping WUA record books and accounts 9. Group norms, group revitalization, and conflict resolution 10. Preparation and implementation of the Annual Action Plan (AAP) 11. Estimating and collecting water charges 12. Planning, operating, and maintaining the irrigation system 13. Resource mobilization 14. Water audit 15. Crop water budgeting (CWB) and crop planning 16. Water distribution and sharing 17. Community-based monitoring of WUA activities.	1. Responsibilities of the WUA 2. Responsibilities of the sub-committee 3. Keeping WUA record books and accounts 4. Preparing and working through the WUA AAP 5. Estimating and collecting water charges 6. Planning, operating, and maintaining the irrigation system 7. Mobilizing resources 8. Conducting water audits 9. CWB and crop planning 10. Water distribution and sharing 11. Community-based monitoring of WUA activities.	1. Water management in different cropping systems 2. Improved cropping systems and farm mechanization 3. Integrated Development crops / organic farming 4. Climate-resilient agricultural practices 5. INM, IPNM, and IPM 6. Composting / vermi-compost 7. Water use efficiency and water productivity (drip and sprinkler use) 8. Post-harvest processing and value addition 9. Agribusiness development 10. Value addition (agriculture, horticulture, fisheries) 11. Fishery development 12. Horticultural plantations.

Note: Beneficiaries are those WUA members who are enrolled in different project interventions through associated departments. They may be farmers, fishermen, and other primary stakeholders who are provided project support, directly or indirectly. They include farmers identified for demonstration activities, FPO members, farmers identified for micro-irrigation system development, protective farming, nd support for fishery promotion like tricycles, pushcarts, and nets.

7. Apart from the members, WUA para workers (other farmers who help a WUA perform its work) will also be trained for activities like (a) community mobilization, (b) WUA management and maintenance of association records, books, and accounts, (c) water management, and (d) fishery development.

8. WUA trainings will usually be organized locally to ensure maximum participation in the learning process. SOs will be providing CB inputs. As needed or appropriate, some WUA members will be trained at the mandal, district, or state level. While experienced SO and APD personnel will conduct local training, district and state training may draw on external resource persons. Some training sessions will also be facilitated by SPU and DPU experts.

Building FPO Capacity

9. Collectivizing producers, especially small and marginal farmers, into producer organizations has emerged as one of the most effective ways to address agricultural challenges; it has especially improved access to technology, inputs, and markets. The rationale for creating a focused strategy for FPO promotion in AP can be found in GoAP 2016, GO 928, 13.12.2016[32] :

a. Large numbers of farmers (in agriculture, horticulture, vegetables, fisheries, dairy, meat, flowers, and other commodities) are not organized.
b. Several departments of the state government need to coordinate in promoting FPOs. It is important to avoid duplication of efforts and to recognize synergies among these departments for promoting and nurturing FPOs.
c. ICT tools and applications, financial inclusion processes, and web- and mobile-based tools could offer new means and opportunities for creating farmer collectives. Without compromising on FPO fundamentals. this may take considerable experimentation.
d. Strengthening FPOs requires stewardship and partnership at multiple levels. Various categories of agencies need to join hands to orchestrate the common effort.

10. FPO capacity can be built through a combination of such activities as workshops, training, and site visits. CB will be done in two phases: when FPOs are being organized, and when they take up each business venture they have planned. In the first stage, FPO members should be introduced to (a) the FPO's objectives and its functional range; (b) its role and specific functions; (c) support for organizing share capital and generating equity and debt capital; (d) training in statutory functional norms; and (e) information about keeping records and related activities. When FPOs enter the functional phase, CB would be concerned with such areas as (a) preparing business plans; (b) business management; (c) crop aggregation, segregation, processing, and value addition; (d) marketing and market links; (e) supply chain management; (f) product-costing principles; and (g) financial management.

11. Different training modules will be developed for WUAs and FPOs based on the needs identified. In addition to the SOs, government partners, the PMU, and the DPU, the project will also seek trainers from such state and national institutions as ICRISAT, CRIDA, the Indian Institute of Vegetable Research,

[32] For GoAP guidelines for FPO promotion, see G.O.RT. No. 398, A&C Department Dated: 02.06.2016; G.O.RT. No. 928, A&C Department Dated: 13.12.2016 & G.O.RT. No. 140, A&C Department Dated: 09.03.2016.

the State Agriculture University, WALMI, and KVKs.

Annex G: Project Team

Name	Role	Specialization	Unit
Ranjan Samantaray	Team Leader (ADM responsible)	Task Team Leader	GFA12
Kazuhiro Yoshida	Team Leader	Task Team Leader	GWA03
Anupam Joshi	Environmental Safeguards Specialist	Environment	GEN06
Balagopal Senapati	Procurement Specialist (ADM Responsible)	Procurement	GGOPZ
Fokke Fennema	Agricultural Specialist	Agriculture	GFA12
G. Srihari	Social Safeguards Specialist	Social Development	GSU06
Ijsbrand Harko de Jong	Lead Water Resource Management Specialist	Water	GWA06
Jacqueline Julian	Team Member	Operations Analyst	GFA06
Kumudni Choudhary	Team Member	Operations	SACIN
Raadhika Gupta	Counsel	Legal	LEGES
Rohan G. Selvaratnam	Team Member	Operations Analyst	GFA12
Suryanarayana Satish	Social Safeguards Specialist	Social Development	GSU06
Tanuj Mathur	Financial Management Specialist	Financial Management	GGOIS
Victor Manuel Ordonez Conde	Finance Officer	Finance Officer	WFACS

Extended Team

Name	Title	Organization	Location
Martin Kumar	Fisheries Specialist (FAO)	World Bank	Australia
Paul Sidhu	Senior Consultant, Agriculturist	World Bank	New Delhi,India
R. K. Malhotra	Senior Consultant, Structures	World Bank	New Delhi,India
Saumya Srivastava	Consultant, Agriculture and Agribusiness	World Bank	New Delhi,India
Sekhar Muddu	Senior Hydrology Consultant	World Bank	Bangalore, India
Sudhirendar Sharma	Consultant, M&E	World Bank	New Delhi,India
Tashina Esteves	Consultant, GHG Estimation	World Bank	Bangalore, India
Vanitha Kommu	Consultant, Environmental Safeguards	World Bank	Hyderabad, India
Yanoma Yukitsugu	Economist	FAO	Bangkok, Thailand

Annex H: MAP of the Project