Report and Recommendation of the President to the Board of Directors

Project Number: 45371-007
May 2018

Proposed Loan
India: Madhya Pradesh Irrigation Efficiency Improvement Project

Asian Development Bank

CURRENCY EQUIVALENTS

(as of 20 April 2018)

Currency Unit	–	Indian rupee (₹)
₹1.00	=	$0.0151
$1.00	=	₹66.105

ABBREVIATIONS

ADB	–	Asian Development Bank
DBO	–	design–build–operate
EIRR	–	economic internal rate of return
EMP	–	environmental management plan
ha	–	hectare
KIP	–	Kundalia Irrigation Project
KMMP	–	Kundalia Major Multipurpose Project
MMI	–	major- and medium-sized irrigation
MOM	–	management, operation and maintenance
MPWRD	–	Water Resources Department Madhya Pradesh
SSIP	–	Sanjay Sarovar Irrigation Project

NOTES

(i) The fiscal year (FY) of the Government of India and its agencies ends on 31 March. “FY” before a calendar year denotes the year in which the fiscal year ends, e.g., FY2018 ends on 31 March 2018.

(ii) In this report, "$" refers to United States dollars.

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CONTENTS

PROJECT AT A GLANCE

1. Basic Data				**Project Number:** 45371-007
Project Name	Madhya Pradesh Irrigation Efficiency Improvement Project	**Department /Division**	SARD/SAER	
Country	India	**Executing Agency**	Water Resources Department Madhya Pradesh	
Borrower	India			

2. Sector	**Subsector(s)**		**ADB Financing ($ million)**
✓ **Agriculture, natural resources and rural development**	Agricultural production		11.25
	Irrigation		363.75
		Total	**375.00**

3. Strategic Agenda	**Subcomponents**	**Climate Change Information**	
Inclusive economic growth (IEG)	Pillar 2: Access to economic opportunities, including jobs, made more inclusive	Adaptation ($ million)	42.50
		Climate Change impact on the Project	High
Environmentally sustainable growth (ESG)	Global and regional transboundary environmental concerns		

4. Drivers of Change	**Components**	**Gender Equity and Mainstreaming**	
Governance and capacity development (GCD)	Institutional development	Some gender elements (SGE)	✓
Knowledge solutions (KNS)	Pilot-testing innovation and learning		
Private sector development (PSD)	Promotion of private sector investment		

5. Poverty and SDG Targeting		**Location Impact**	
Geographic Targeting	No	Rural	High
Household Targeting	No		
SDG Targeting	Yes		
SDG Goals	SDG2, SDG6, SDG13		

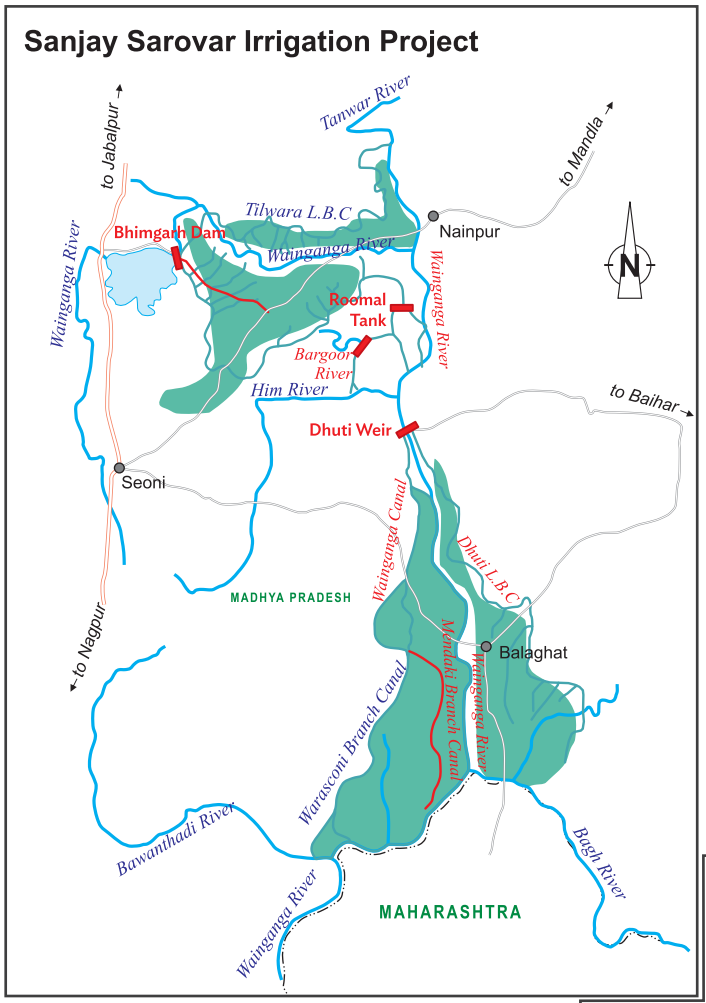
6. Risk Categorization: Complex

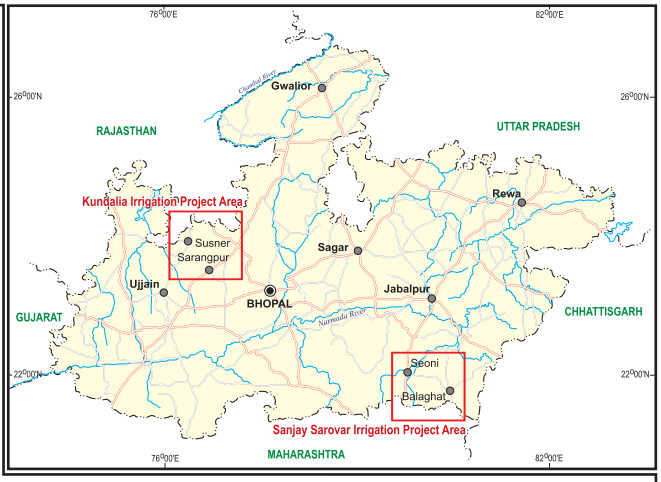
7. Safeguard Categorization **Environment:** B **Involuntary Resettlement:** B **Indigenous Peoples:** C

8. Financing

Modality and Sources	Amount ($ million)
ADB	**375.00**
Sovereign Project (Regular Loan): Ordinary capital resources	375.00
Cofinancing	**0.00**
None	0.00
Counterpart	**160.71**
Government	160.71
Total	**535.71**

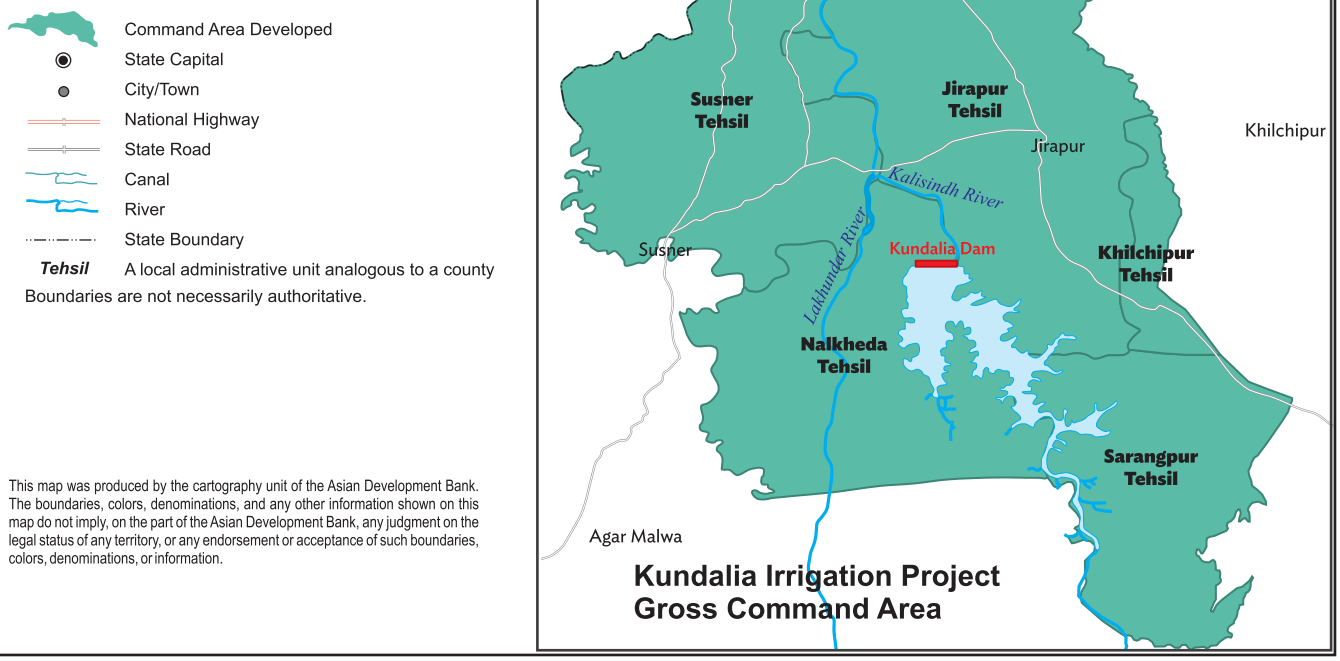
Source: Asian Development Bank





INDIA

MADHYA PRADESH IRRIGATION EFFICIENCY IMPROVEMENT PROJECT



Command Area Developed
State Capital
City/Town
National Highway
State Road
Canal
River
State Boundary

Tehsil A local administrative unit analogous to a county

Boundaries are not necessarily authoritative.

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I. THE PROPOSAL

1. I submit for your approval the following report and recommendation on a proposed loan to India for the Madhya Pradesh Irrigation Efficiency Improvement Project.

2. The project is designed to support higher irrigation efficiency and expansion of irrigation in Madhya Pradesh. It will focus on developing 125,000 hectares (ha) of new, highly efficient and climate-resilient irrigation networks and productive command area under the Kundalia Irrigation Project (KIP). It will also finance a feasibility study and detailed designs for modernizing the existing Sanjay Sarovar Irrigation Project (SSIP).[1]

II. THE PROJECT

A. Rationale

3. **India requires irrigation water use efficiency and productivity improvement.** Water plays a critical role in India's food security and welfare of the rural poor as 84% of all water withdrawals are dedicated to agriculture and 42% of all agricultural land is irrigated. India benefits from only 4% of the world's renewable fresh water but has 16% of the world's population.[2] With intense urbanization and industrialization, the need for water from the nonagriculture sector is fast increasing and water shortage is becoming a major concern for industries. At the same time, population growth and change in dietary habits require continued growth in agricultural production. By 2050, annual water availability per capita in India is expected to drop from 1,530 cubic meters to 1,140 cubic meters, indicating severe water stress.[3] The current average irrigation water use efficiency of 38% points towards the need for serious performance improvement in this sector.[4] The productivity of irrigation water is further hampered by low crop yields and cultivation of low-value crops. Therefore, most of India's utilized water not only supports activities with low economic value but is also inefficiently used. In the meantime, water shortages are constraining water-dependent power production and the development of high-value industries that are required to fuel the country's economic growth. These problems will worsen in the future with the projected impacts of population and economic growth, and with climate change, which will increase both irrigation water demand and uncertainty around the reliability of water resources.

4. **Irrigation modernization is a key strategy to reducing water wastage**. The Government of India recognizes the situation. Both the Three Year Action Agenda (2017–2018 to 2019–2020)[5] and the 2015 Pradhan Mantri Krishi Sinchayee Yojana program have acknowledged the necessity to improve water use efficiency in irrigation.[6] In 2014, the Asian Development Bank (ADB) funded the Scoping Study for a National Water Use Efficiency Improvement Support Program.[7] The study identified the following three main causes for low water use efficiency: (i) inadequate irrigation and drainage infrastructure because of faulty designs and lack of maintenance; (ii) inadequate management, operation and maintenance (MOM) of the irrigation systems; and (iii) inadequate capacity building and training services. The study highlights the need to modernize the design and management of major- and medium-sized irrigation (MMI)

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[1] The Asian Development Bank (ADB) provided project preparatory technical assistance for the Madhya Pradesh Irrigation Efficiency Improvement Project (TA 9051-IND).

[2] T. A. Bhat. 2014. *An Analysis of Demand and Supply of Water in India*. Journal of Environment and Earth Science. 4 (11). p. 67.

[3] Government of India, Central Water Commission. 2010. *Water and Related Statistics.* New Delhi; Government of India. 2001. *Census of India*. New Delhi.

[4] Water use efficiency is the ratio between the fraction of irrigation water used for productive crop evapotranspiration within the boundaries of the scheme and the total volume of water diverted at the intake to the irrigation system.

[5] Government of India, NITI Aayog. 2017. *Three Year Action Agenda (2017–2018 to 2019–2020).* New Delhi.

[6] Government of India, Ministry of Agriculture and Farmers Welfare. 2015–2016. *Pradhan Mantri Krishi Sinchayee Yojana*. New Delhi.

[7] ADB. 2014. *Support for the Implementation of the National Water Mission by State Governments in India: Scoping Study for a National Water Use Efficiency Improvement Support Program*. Manila.

schemes to reduce system inefficiencies and substantially improve water delivery services to farmers. It proposed a framework for assessing and improving water use efficiency on MMI schemes. Under a subsequent regional technical assistance, the framework was successfully pilot tested on such schemes within South Asia. The study also developed comprehensive modernization strategies for existing irrigation systems and recommended a tailored investment plan for the SSIP.[8]

5. **Madhya Pradesh plan to expand and modernize irrigation**. Since 2010, the Government of Madhya Pradesh has embarked on an ambitious irrigation expansion and modernization plan. New developments, infrastructure modernization and substantial management and operation improvement led to an increase in net irrigation area from 0.85 million ha in 2006 to 3.6 million ha in 2017–2018. These efforts have been rewarded by record annual agricultural growth of 20% in 2013–2016. The state plans to further increase the total irrigated area to 7.2 million ha by 2025. This will be achieved by maximizing irrigation efficiency and water productivity in both new and existing irrigation systems. It includes development of pressurized irrigation, adoption of micro-irrigation and production of high-value crops. The state has set the ambitious target of developing pressurized irrigation in 80% of all irrigated areas by 2025. The plan is estimated to cost $20 billion.

6. The Water Resources Department Madhya Pradesh (MPWRD) has requested ADB assistance to help finance this plan and, more importantly, to provide advice on developing highly efficient and sustainable model for MMI schemes that will serve as reference for future modernization investments. The KIP will include the design and construction of a highly efficient and productive new pressurized irrigation system with automated volumetric control for efficient, reliable and flexible water delivery services. The KIP will be supplied by the reservoir being built under the Kundalia Major Multipurpose Project (KMMP). Modernization being conducted under the SSIP will include (i) upgrading infrastructure to improve conveyance efficiency and flow regulation, and (ii) extending the command area and partially converting to pressurized irrigation and micro-irrigation.[9]

7. **Innovation and ADB value addition**. The project supports both technical and institutional innovations. The technical innovation involves designing and constructing a very large scale pressurized and automated irrigation system that will allow considerable gains in water use efficiency. On the institutional side, the project introduces the design–build–operate (DBO) contracting modality. There are very few examples of irrigation DBO contracts in India and none on such large systems and with such a long MOM period. The DBO approach addresses critical lessons from past projects. It aims to address recurrent public sector inefficiencies in irrigation MOM. The DBO modality will also substantially enhance irrigation service delivery to farmers and encourage contractors to build quality and efficient irrigation systems to reduce MOM costs. Value added by ADB assistance consists of providing state of the art technical support for designing the KIP and SSIP, supervising KIP construction, MOM and agriculture support services, preparing DBO bidding documents and providing support for efficient management of the DBO contracts. The current limited expertise of MPWRD with pressurized irrigation, irrigation modernization and performance-based irrigation management will be substantially enhanced through the project.

8. The project is consistent with the objectives of ADB's country partnership strategy, 2018–2022 for India.[10] It will support the country's Three Year Action Agenda (2017–2018 to 2019–

[8] ADB. 2011. *Technical Assistance for Innovations for More Food with Less Water into Regional Cooperation.* Manila. (TA 7967-REG, completed in 2015*).*

[9] Micro-irrigation is an irrigation method that is localized to the crop root zone and uses low volume of water and low pressure. Micro-irrigation systems used under the project are drippers and micro-sprinklers.

[10] ADB. 2017. *Country Partnership Strategy: India, 2018–2022—Accelerating Inclusive Economic Transformation.* Manila.

2020) (footnote 5) and the Pradhan Mantri Krishi Sinchayee Yojana program objectives (footnote 6) to increase irrigation water productivity.

B. Impact and Outcome

9. The project is aligned with the following impacts: (i) Indian farmers' income doubled by 2022 (footnote 5); (ii) India's "more crop per drop" achieved (footnote 6); and (iii) resilience of farmers in the project area to ongoing and uncertain future climate change increased.[11] The project will have the following outcome: higher irrigation efficiency, agricultural water productivity and climate resilience in Madhya Pradesh achieved.[12]

C. Outputs

10. **Output 1: Kundalia Irrigation Project infrastructure constructed.** The KIP will consist of two large pumping stations pumping water to distribution chambers from where water will be distributed by gravity pressure through a network of buried pipelines that gradually reduce in size up to end user and/or farm outlets (hydrants every 1–2 ha). The system is designed to provide pressure of 200 kilopascal at the outlet for field micro-irrigation systems.

11. **Output 2: Kundalia Irrigation Project performance-based operation and maintenance established.** This output will be delivered by contracting a private sector operator under a DBO contract. The contractor will be tasked to operate and maintain the system for a period of 5 years after completion of the construction. During this period the contractor will need to meet several performance indicators related to system leakage, electricity consumption, and noninterruption of operation. The contractor will provide on-the-job training to MPWRD staff. A supervisory control and data acquisition system and a decision support system will be installed to facilitate the MOM of the system.

12. **Output 3: Farmers capacity for rapid uptake of micro-irrigation technology in the Kundalia Irrigation Project command area enhanced.** This output will be achieved by (i) establishing and building the capacity of the water users' associations, (ii) establishing micro-irrigation farm demonstration sites, and (iii) establishing farmers' service centers and conducting farmers' field schools to support adoption of micro-irrigation and productive irrigated agriculture including high-value crops. These activities will be carried out by the DBO contractor(s) in a collaborative relationship with government agencies and stakeholders. The DBO contracts include performance guarantees for the area equipped with micro-irrigation systems at year 1, 3 and 5 after commissioning.

13. **Output 4: Modernization of the Sanjay Sarovar Irrigation Project well-designed with project readiness criteria met.** This output will be achieved by (i) preparing a comprehensive SSIP modernization plan, (ii) undertaking a feasibility study and detailed design of the proposed plan, (iii) developing an institutional strategy to enhance the performance and sustainability of SSIP MOM, (iv) preparing bidding documents for the modernization works and consultant request for proposal for the ensuing project implementation and construction quality supervision, and (v) supporting MPWRD and ADB to meet the project processing requirements.

[11] Defined by the project.
[12] The design and monitoring framework is in Appendix 1.

D. Summary Cost Estimates and Financing Plan

14. The project is estimated to cost $535.71 million (Table 1).

15. Detailed cost estimates by expenditure category and by financier are included in the project administration manual.[13] Major expenditure items include (i) civil works and electro-mechanical equipment for the construction of the KIP, (ii) a project management unit including staff and recurrent expenditures, (iii) agriculture support services, (iv) environment and social mitigation for temporary and permanent land acquisition and implementation of the environment management plan (EMP) under the KIP, (v) KIP MOM, and (vi) consulting services for MPWRD capacity building and preparation of the feasibility study and detailed design for the SSIP Modernization.

Table 1: Summary Cost Estimates
($ million)

Item			Amount [a]
A.	**Base Cost**[b]		
	1.	Kundalia Irrigation Project infrastructure constructed	396.74
	2.	Kundalia Irrigation Project performance-based operation and maintenance established	19.10
	3.	Farmers capacity for rapid uptake of micro-irrigation technology in the Kundalia Irrigation Project command area enhanced	15.47
	4.	Modernization of the Sanjay Sarovar Irrigation Project well-designed with project readiness criteria met	3.57
		Subtotal (A)	**434.88**
B.	**Contingencies**[c]		**60.48**
C.	**Financing Charges During Implementation**[d]		**40.36**
		Total (A+B+C)	**535.71**

[a] Includes taxes and duties of $19.69 million to be financed in cash contribution from government resources.
[b] In October 2017 prices.
[c] Physical contingencies computed at 10% for civil works and goods. Price contingencies computed at average of 1.5% on foreign exchange costs and 4.6% on local currency costs; includes provision for potential exchange rate fluctuation under the assumption of a purchasing power parity exchange rate.
[d] Includes interest and commitment charges. Interest during construction for ordinary capital resources loan has been computed at the 5-year forward London Interbank Offered Rate plus a spread of 0.7% (including a maturity-based premium of 0.1%). Commitment charges for an ordinary capital resources loan are 0.15% per year to be charged on the undisbursed loan amount.
Source: Asian Development Bank estimates.

16. The government has requested a regular loan of $375 million from ADB's ordinary capital resources to help finance the project. The loan will have a 26-year term, including a grace period of 5 years; an annual interest rate determined in accordance with ADB's London interbank offered rate (LIBOR)-based lending facility; a commitment charge of 0.15% per year; and such other terms and conditions set forth in the draft loan and project agreements. Based on the straight-line method, the average maturity is 15.75 years, and the maturity premium payable to ADB is 0.10% per year.

17. The summary financing plan is in Table 2. ADB will finance the expenditures in relation to civil works, consulting services and trainings.

[13] Project Administration Manual (accessible from the list of linked documents in RRP Appendix 2).

Table 2: Summary Financing Plan

Source	**Amount** ($ million)	**Share of Total** (%)
Asian Development Bank		
Ordinary capital resources (regular loan)	375.00	70.0
Government of Madhya Pradesh	160.71	30.0
Total	**535.71**	**100.0**

Source: Asian Development Bank estimates.

18. Climate adaptation is estimated to cost $50 million exclusive of taxes and duties. ADB will finance 85% of this cost. This includes financing part of the structural components of the project aimed at increasing water supply during *rabi* (the dry [winter] cropping season, which lasts between November and March) and addressing the increase in uncertainty associated with water availability under a changing climate, as well as the additional adaptation measure of agricultural training and field pilot demonstrations to advance planting time of *rabi* crops and benefit from residual soil moisture from the monsoon. Details are in the project climate risk assessment and management report.[14]

E. Implementation Arrangements

19. The implementation arrangements are summarized in Table 3 and described in detail in the project administration manual (footnote 13).

Table 3: Implementation Arrangements

Aspects	**Arrangements**		
Implementation period	May 2018–September 2025		
Estimated completion date	30 September 2025		
Estimated loan closing date	31 March 2026		
Management			
(i) Oversight body	State Project Steering Committee Principal Secretary of the Water Resources Department (Chair) Representatives of Department of Agriculture, Department of Horticulture, Department of Finance, and Department of Energy, Department of Animal Husbandry, Department of Rural Development, Madhya Pradesh State Cooperative Bank, and Madhya Pradesh Water and Land Management Institute (members)		
(ii) Executing agency	Water Resources Department Madhya Pradesh		
(iii) Implementation unit	Bhopal, 371 staff		
Procurement	International competitive bidding	2 contracts	$420.245 million
Consulting services	ICS	112 person-months	$2.019 million
	Consulting Firm QCBS 80:20	170 person-months	$3.85 million
Retroactive financing and/or advance contracting	Advance contracting and retroactive financing will be used for civil works and consulting services. Retroactive financing will be considered for eligible expenditures not exceeding 20% of the loan amount incurred prior to loan effectiveness, but not earlier than 12 months before the loan agreement is signed.		
Disbursement	The loan proceeds will be disbursed in accordance with ADB's *Loan Disbursement Handbook* (2017, as amended from time to time) and detailed arrangements agreed between the government and ADB.		

ADB = Asian Development Bank, ICS = individual consultant selection, QCBS = quality- and cost-based selection.
Source: Asian Development Bank.

[14] Project Climate Risk Assessment and Management Report (accessible from the list of linked documents in Appendix 2).

III. DUE DILIGENCE

A. Technical

20. The KMMP includes three main components: (i) the 44.5-meter high Kundalia dam across the Kalisindh River, construction of which will be completed in October 2018 and is being funded by the state; (ii) the KIP; and (iii) the supply of water for potable and industrial use. The KIP was initially envisaged to cover 58,000 ha, of which 45,000 ha would have been gravity irrigation with canals and 13,000 ha lift irrigation. In 2015, MPWRD decided to convert the KIP to a 100% pumped pressurized pipeline system for spray and micro-irrigation.

21. The feasibility design for the pressurized distribution system, including pumping stations, electrical substations and power supply systems, transmission pipelines, valves, controls and associated structures, was planned under the project preparatory technical assistance. Design criteria were selected to allow delivery of reliable and flexible irrigation service with a pressurized water outlet at every 1–2 ha. The system was conceived to achieve 80% overall irrigation efficiency. With such gain in efficiency, the water balance assessment confirmed the KIP command area can be extended to 125,000 ha to provide full irrigation services in the *rabi* season and protective irrigation in the wet season. Several design options were studied. The best compromise in terms of energy consumption, construction cost and robustness to local conditions was retained as the base design. The power requirement is estimated at 63 megawatts. MPWRD initially envisaged building a solar power plant as part of the project to offset the power requirement of the KIP scheme. However, construction of the plant was deferred as Madhya Pradesh has a large excess in generation capacity that remains unutilized and for which the state pays compensation charges to private companies. In addition, the state is finalizing a 750-megawatt public–private partnership project for solar power generation. The KIP design provides a smart water management system to increase management efficiency and reduce energy consumption. This includes (i) a supervisory control and data acquisition system to monitor and control flow remotely throughout the command area, and (ii) a decision support system with an irrigation planning and scheduling database to help organize efficient water distribution.

22. The overall climate-related risk associated with the project was rated as *high* by the AWARE rapid climate screening tool, mainly because of high risks associated with temperature increase (and related evapotranspiration increase), and changes in rainfall patterns. Consequently, a climate risk and vulnerability assessment was undertaken to analyze this risk more rigorously and assess the need for and economic feasibility of potential adaptation measures. The assessment confirmed likely increase in irrigation demand in the dry season because of an increase in temperature. This increase in irrigation water demand can be met through additional groundwater pumping. The aquifer sustainable yield will only be exceeded under the most pessimistic climate change scenario. In such a case, a 1.5% reduction in area planted with high water-use crops like oranges will be required towards the end of the economic lifetime of the project. The climate risk and vulnerability assessment studied the economic feasibility of alternative measures to actively increase the availability of irrigation water. These included infrastructure investments aiming to increase the supply of irrigation water, and initiatives to reduce irrigation water demand from farmers. The only measure considered economically feasible is the provision of agricultural training and field pilot demonstrations to advance the planting time of *rabi* crops and benefit from residual soil moisture from the monsoon. This additional adaptation measure is included under the project design.

B. Economic and Financial

23. **Economic analysis.** An economic analysis was prepared for the entire KMMP.[15] The economic net present value (discounted at the assumed economic opportunity cost of capital of 9%) of the project is estimated at ₹38.5 billion indicating that the KMMP is economically feasible. The same conclusion can be derived from the project's economic internal rate of return (EIRR), which is estimated at 15.7%, well above the minimum required rate of 9.0%. Increased agricultural production is the most important source of quantifiable economic benefits, accounting for over 95% of total benefits. The development of irrigation will support change in cropping patterns from low-value crops towards high-value crops such as vegetables and oranges. It will support an increase in cropping intensity from 132% to 180%, thereby extending the harvested area by 59,500 ha. More importantly, sufficient and reliable irrigation supply will boost yields by 10%–50% depending on crop type. Benefits from increased raw water provision accounts for the remainder.

24. Sensitivity tests were conducted by varying the project's investment cost, MOM cost, and benefits. The results of the analysis indicate that the economic feasibility of the KMMP is more sensitive to unfavorable changes to economic benefits than to the investment cost. If the benefits are 43.8% lower or the investment cost is 127.5% higher than in the base case, the EIRR will fall below 9.0%. The project's EIRR is relatively insensitive to changes to the MOM cost. A Monte Carlo simulation indicates that the EIRR has a negligible likelihood of dropping below the economic opportunity cost of capital, even if benefits would be 50% lower and costs 50% higher than in the base case.[16]

25. **Financial analysis**. MPWRD is considering a gradual increase in the current tariff for pressurized irrigation from ₹1,000 to ₹10,900 (in constant October 2017 prices, per ha per year). At this much higher tariff, the financial internal rate of return of the KMMP is estimated at –5.7%, which is lower than the weighted average cost of capital (2.2%). This is mainly because the proposed incremental tariff does not include repayment of the capital costs. For projects implemented by government sector units such as MPWRD, the financial analysis focuses on the capacity to finance the incremental recurrent costs which are required for the sustainability of the investment. Despite the low financial internal rate of return the project is worth supporting based on the large economic development benefits as indicated by the high estimated EIRR, the positive impact on the state economy, and the substantial positive effect on reducing rural poverty in the KIP command area.

26. The proposed tariff was set to cover the full cost of routine MOM by 2026. MPWRD would only need to subsidize the MOM expenditure during 2021–2025 (about ₹1.2 billion in total for the 5-year period) and in 2050, the year in which hydraulic steel structures and mechanical equipment will be replaced (about ₹3.9 billion). A review of MPWRD MOM annual budgets has indicated that MPWRD would be able to cover these costs. The state government has committed to adopt the appropriate tariff scheme and to cover for any MOM budget shortfalls. This has been included as a loan covenant.

C. Governance

27. **Financial management**. A financial management assessment of MPWRD was carried out in accordance with ADB's Guidelines for the Financial Management and Analysis of Projects.[17] The overall risk assessment for the project is *moderate*. MPWRD has experience in

[15] Because the construction of the dam is needed to realize the economic benefits of the pipeline network and pressurized distribution system, the economic analysis covered the entire KMMP, and not only the component that will be cofinanced by ADB.

[16] A Monte Carlo simulation is a mathematical technique that generates random variables for modelling risk or uncertainty of a certain system.

[17] ADB. 2005. *Financial Management and Analysis of Projects*. Manila.

implementing World Bank projects, but none on ADB accounting requirements and loan disbursement procedures. Hence, MPWRD will appoint experienced accounting staff to the project. A financial management consultant will be provided under the project to prepare a detailed procedure manual and undertake trainings on ADB's policies and guidelines. MPWRD will recruit independent audit firms to undertake periodical internal audits of the project accounts. The project accounts will be audited annually by the state Controller and General Auditor.

28. **Procurement.** MPWRD organized consultation workshops and a roadshow during the project design to appraise private sector interest and capacity to undertake DBO contracts including agriculture support services. The procurement of goods and works will follow ADB's Procurement Guidelines (2015, as amended from time to time). All recruitment of consultants will follow ADB's Guidelines on the Use of Consultants (2013, as amended from time to time). A procurement capacity assessment concluded that the overall procurement risk for the project is *moderate*. International and national procurement specialists were provided as part of the project preparatory technical assistance to prepare the two DBO bidding documents, support the evaluation process and assist with the consultants' recruitment. Funds were allocated in the project to provide procurement training to the implementing agency. In addition, India Resident Mission trained MPWRD staff on ADB's procurement and consultant recruitment guidelines.

29. ADB's Anticorruption Policy (1998, as amended to date) was explained to and discussed with the government and MPWRD. The specific policy requirements and supplementary measures are described in the project administration manual (footnote 13).

D. Poverty, Social, and Gender

30. Over 40% of the population in the KIP's future cultivable command area depends on agriculture for their livelihoods. Wheat and soybeans are the two main crops followed by chickpeas (pulses), spices, oranges, and vegetables. While agricultural growth has substantially increased in the state over the last 5 years, it has stagnated in the project area because of a lack of irrigation development. The KIP is expected to improve farmers' net incomes and directly benefit about 838,262 people in 419 villages in Rajgarh and Agar Malwa districts of Madhya Pradesh. In general, it will also provide economic opportunities to improve nonfarm rural incomes, and this will indirectly contribute to development and poverty reduction. The project poverty impact ratio was estimated at 30.1%. This represents the proportion of the net economic benefits designed to go to the poor compared to total project net economic benefits. The project is classified as having some gender elements, where women will benefit from skills training for farmers in improved agricultural practices using the new irrigation systems.

31. The contractors will be required to strictly implement government requirements regarding health and safety of men and women who work at the construction sites. The contractors, in close coordination with the project management unit, will conduct awareness programs on prevention of sexually transmitted diseases and drug use. The contractor will be required to strictly implement equal pay for female and male workers.

E. Safeguards

32. In compliance with ADB's Safeguard Policy Statement (2009) (SPS), the project's safeguard categories are as follows.[18]

33. **Environment (category B).** The initial environmental examination including its EMP has been prepared. The project's initial environmental examination identified that most impacts—such as noise, dust, impacts on vegetation because of land clearing and excavation—occur during the construction periods. Mitigation measures were included accordingly in the EMP. Stakeholders have been consulted and will continue to be consulted during implementation. A grievance

[18] ADB. Safeguard Categories. https://www.adb.org/site/safeguards/safeguard-categories.

redress mechanism to address both social and environmental issues will be established prior to project implementation.

34. **Involuntary Resettlement (category B)**. Permanent land acquisition is limited for the pumping stations and distribution chambers. Most land acquisition will be temporary for laying the irrigation pipelines underground and this will affect land owners during construction. Two sample resettlement plans (land acquisition plans) were prepared. One resettlement plan was prepared for distribution pipes covering 500 ha of cultivable command area that will affect 96 households and requires 4.81 ha of land (4.78 ha of temporary acquisition, and 0.03 ha of permanent acquisition). The second resettlement plan was prepared for installing a pumping station, which will affect 25 households and require 31.14 ha of land, 2.21 ha of which is private land. For the rest of the project areas, the DBO contractors will prepare the resettlement plan(s) in accordance with the project's resettlement framework. The resettlement framework for this project was prepared to guide the preparation of the resettlement plan(s) during project implementation. The sample resettlement plans and resettlement framework were prepared in accordance with the ADB SPS, Madhya Pradesh Pipeline Act (2013), the Madhya Pradesh Consent Land Purchase Policy (2014), and the Indian land legislation on The Right to Fair Compensation and Transparency in Land Acquisition, Rehabilitation and Resettlement Act (2013).

35. Resettlement plans prepared by the DBO contractor will be reviewed and cleared by ADB. MPWRD has adequate capacity to implement the resettlement plan and environmental safeguards, since it is currently implementing projects with significant resettlement and environmental concerns. The grievance redress mechanism that has been established for MPWRD's current project will also be established for this ADB-funded project.

36. **Indigenous Peoples (category C).** There are no indigenous peoples, as defined by the ADB SPS in the project-affected areas.

37. **Associated facility.** The water required for the irrigation network constructed under the proposed project will be supplied from the KMMP reservoir. Therefore, the KMMP reservoir is considered as an associated facility. Due diligence was undertaken to assess the suitability of measures undertaken under the KMMP in addressing the environmental impacts. The due diligence found that the KMMP planning and construction followed the guidance provided in the environmental impact assessment and EMP that was approved by Ministry of Environment, Forest, and Climate Change in January 2015. The environmental impact assessment and EMP for the KMMP has comprehensively addressed its environmental impacts and is in line with ADB SPS requirements. MPWRD has allocated adequate resources to implement the EMP and other associated plans. Therefore, no corrective action or additional actions need to be adopted under the KMMP.

F. Summary of Risks Assessment and Risk Management Plan

38. Significant risks and mitigating measures are summarized in Table 4 and described in detail in the risk assessment and risk management plan.[19]

Table 4: Summary of Risks and Mitigating Measures

Risks	Mitigating Measures
Benefits of the project will be reduced if water management is not improved and if a significant majority of the farmers do not adopt micro-irrigation.	The DBO contractor will be tasked to provide farmers support services including WUA strengthening and extensive agricultural support program component, with field demonstrations and experiential training. Payment to the contractor will depend on achievement of performance targets.
MOM of the pumping stations and pipeline distribution system is technically complex and unfamiliar to MPWRD.	The DBO contractor will be responsible for MOM during a 5-year operation service period, including meeting specific performance guarantees.

[19] Risk Assessment and Risk Management Plan (accessible from the list of linked documents in Appendix 2).

Risks	Mitigating Measures
KIP power consumption increases operation and maintenance budget requirement of MPWRD and recurrent expenditures of the Government of Madhya Pradesh.	The Government of Madhya Pradesh is committed to increase budget to MPWRD as per requirement and to implement cost recovery from farmer beneficiaries through gradual increase of water tariff. A loan covenant is prepared for this purpose.
External interferences affect the performance of the DBO contractors	A project participation and communication strategy was prepared to enhance communication with farmers and politicians on the project design, benefits and progress.
Input prices (fertilizers, pesticides, electricity) increase sharply and affect farmers' capacity to invest in pressurized irrigation and intensive agriculture.	MPWRD and the DBO contractors will organize farmers to improve bargaining power for purchase of farm inputs.
Future climate change impact exceeds projections which may reduce the benefits of the project.	If the climate change impacts exceed the projections used for the CRVA, the Government of Madhya Pradesh will need to consider building the Lakundar diversion and groundwater recharge ponds.

CRVA = climate risk and vulnerability assessment, DBO = design–build–operate, KIP = Kundalia Irrigation Project, MOM = management, operation and maintenance, MPWRD = Water Resources Department Madhya Pradesh, WUA = water users' association.
Source: Asian Development Bank.

IV. ASSURANCES AND CONDITIONS

39. The Government of India, Government of Madhya Pradesh and MPWRD have assured ADB that implementation of the project shall conform to all applicable ADB policies including those concerning anticorruption measures, safeguards, gender, procurement, consulting services, and disbursement as described in detail in the project administration manual and loan documents.

40. The Government of India, Government of Madhya Pradesh and MPWRD have agreed with ADB on certain covenants for the project, which are set forth in the draft loan and project agreements.

V. RECOMMENDATION

41. I am satisfied that the proposed loan would comply with the Articles of Agreement of the Asian Development Bank (ADB) and recommend that the Board approve the loan of $375,000,000 to India for the Madhya Pradesh Irrigation Efficiency Improvement Project, from ADB's ordinary capital resources, in regular terms, with interest to be determined in accordance with ADB's London interbank offered rate (LIBOR)-based lending facility; for a term of 26 years, including a grace period of 5 years; and such other terms and conditions as are substantially in accordance with those set forth in the draft loan and project agreements presented to the Board.

Takehiko Nakao
President

10 May 2018

DESIGN AND MONITORING FRAMEWORK

Impacts the Project is Aligned with

a. Indian farmers' income doubled by 2022 (The Three Year Action Agenda, 2017–2018 to 2019–2020)[a]

b. India's "more crop per drop" achieved (Pradhan Mantri Krishi Sinchayee Yojana)[b]

c. Resilience of farmers in the project area to ongoing and uncertain future climate change increased[c]

Results Chain	Performance Indicators with Targets and Baselines	Data Sources and Reporting	Risks
Outcome Higher irrigation efficiency, agricultural water productivity and climate resilience in Madhya Pradesh achieved	By 2026 a. 125,000 ha new irrigated area made climate resilient[d] under KIP with an irrigation efficiency of at least 80% (2017 baseline: 37,300 ha irrigated from groundwater with average efficiency of 50%) b. Wheat water productivity increased by 25% in KIP command area. (2012–2017 average baseline: 0.84 kg/m^3) c. Area cultivated with citrus orchard in KIP command area increased to 15,000 ha (2017 baseline: 8,000 ha)	a. KIP DBO contract third party audit performance reports b. MPWRD remote sensing water productivity report c. Department of Horticulture annual statistical report	Input prices (fertilizers, pesticides, electricity) increase sharply and affect farmers' capacity to invest in pressurized irrigation and intensive agriculture. Future climate change impact exceeds projections which may reduce the benefits of the project.
Outputs 1. Kundalia Irrigation Project infrastructure constructed	By 2022 1a. Two large pumping stations installed and commissioned (2017 baseline: 0) 1b. 350 km pressurized main pipeline distribution system built (2017 baseline: 0) 1c. 4,000 outlets with volumetric controls installed (2017 baseline: 0)	1a–c. Project quarterly progress reports	External interferences affect the performance of the DBO contractors
2. Kundalia Irrigation Project performance-based operation and maintenance established	By 2018 2a. DBO contract signed with 5 years operation and maintenance period (2017 baseline: none) By 2025 2b. Plant operation interruption limited to no more than 30 minutes in a day during irrigation season (2017 baseline: not applicable)	2a. DBO contract agreements 2b–e. DBO contract third party audit report	

Results Chain	Performance Indicators with Targets and Baselines	Data Sources and Reporting	Risks
	2c. Electricity consumption of maximum 30 kWh/m^3 not exceeded (2017 baseline: not applicable) 2d. Continuous discharge and pressure monitoring at both every 300 ha and 30 ha with 1% flow measurement accuracy established (2017 baseline: not applicable) 2e. 112 MPWRD staff capacity to undertake MOM of the KIP increased (2017 baseline: 0)		
3. Farmers' capacity for rapid uptake of micro-irrigation technology in KIP command area enhanced	By 2025 3a. 250 WUAs (with at least 20% women members) registered with MPWRD (2017 baseline: 0) 3b. Micro-irrigation system demonstration established on 1,250 ha (2017 baseline: 0) 3c. Eight farmers' service centers established (2017 baseline: 0) 3d. At least 50,000 farmers (with at least 20% women) with increased knowledge and skills of micro-irrigation technology (2017 baseline: 0)	3a. MPWRD registers 3b–d. DBO contract third party audit report	
4. Modernization of the Sanjay Sarovar Irrigation Project well-designed with project readiness criteria met	By 2020 4a. SSIP Modernization feasibility study and detailed designs approved by MPWRD and ADB (2017 baseline: not approved) 4b. 30% SSIP Modernization civil works contract awarded. (2017 baseline: not awarded)	4a. MPWRD and ADB approved report 4b. Signed contract agreements	
Key Activities with Milestones 1. **Output 1: Kundalia Irrigation Project infrastructure constructed** 1.1. Finalize DBO bidding documents and award contracts for design and construction (Q2 2017–Q4 2018) 1.2. Supervise detailed design preparation (Q2 2018–Q2 2019)			

Results Chain	Performance Indicators with Targets and Baselines	Data Sources and Reporting	Risks
1.3. Supervise construction (Q4 2018–Q3 2021) 1.4. Commission scheme and monitor technical performance (Q1 2021–Q3 2022)			
2. **Output 2: Kundalia Irrigation Project performance-based operation and maintenance established** 2.1. Design and install SCADA (Q3 2018–Q3 2021) 2.2. Develop irrigation planning decision support system and prepare irrigation plan (Q3–Q4 2020) 2.3. Develop an MOM manual (Q4 2020) 2.4. Train MPWRD staff on MOM (Q1 2021–Q4 2025) 2.5. Supervise contractors' MOM performance (Q1 2021–Q4 2025)			
3. **Output 3: Farmers capacity for rapid uptake of micro-irrigation technology in the Kundalia Irrigation Project command area enhanced** 3.1. Promote formation and capacity building of water users' associations (Q2 2018–Q1 2021) 3.2. Establish farmers service centers and conduct farmers field schools (Q2 2019–Q1 2024) 3.3. Establish micro-irrigation demonstrations sites over 1% of the command area (Q1 2019–Q4 2025) 3.4. Monitor and evaluate the performance (Q1 2019–Q1 2026)			
4. Output 4: Modernization of the Sanjay Sarovar Irrigation Project well-designed with project readiness criteria met 4.1. Recruitment of PDPC SSIP Modernization preparation consulting services (Q2–Q4 2018) 4.2. Develop SSIP Modernization plan (Q1 2019) 4.3. Prepare feasibility study and detailed design (Q2 2019–Q2 2020) 4.4. Prepare bidding documents and award 30% civil works contract (Q1–Q3 2020)			
Project Management Activities Recruit the implementation support and capacity building consultants (Q1–Q2 2018) Set up financial management system (Q1 2018) Set up project performance monitoring system (Q2 2018) Undertake midterm review (Q2 2021) Prepare project completion report (Q1 2026)			
Inputs ADB: $375.00 million (OCR regular loan) State Government of Madhya Pradesh: $160.71 million			
Assumptions for Partner Financing Not Applicable			

ADB = Asian Development Bank, DBO = design–build–operate, ha = hectare, kg/m^3 = kilogram per cubic meter, KIP = Kundalia Irrigation Project, km = kilometer, kWh/m^3 = kilowatt-hour per cubic meter, MOM = management, operation and maintenance, MPIEIP = Madhya Pradesh Irrigation Efficiency Improvement Project, MPWRD = Water Resource Department Madhya Pradesh, MT= metric ton, PDPC = project design and procurement consultant, SCADA = supervisory control and data acquisition, SSIP = Sanjay Sarovar Irrigation Project, WUA= water users' association.

[a] Government of India, NITI Aayog. 2017. *Three Year Action Agenda (2017–2018 to 2019–2020)*. New Delhi.

[b] Government of India, Ministry of Agriculture and Farmers Welfare. 2015–2016. *Pradhan Mantri Krishi Sinchayee Yojana*. New Delhi.

[c] Defined by the project.

[d] Climate change is expected to increase (i) crop water requirements as rising temperature increases evapotranspiration; (ii) variability of rainfall within and between seasons; and (iii) frequency and intensity of dry spells and droughts. The KIP design will improve the reliability of irrigation supply under a changing and uncertain climate by providing highly efficient water conveyance, distribution and field application supported by reservoir storage.

Source: Asian Development Bank.

LIST OF LINKED DOCUMENTS

http://www.adb.org/Documents/RRPs/?id=45371-007-3

1. Loan Agreement
2. Project Agreement
3. Sector Assessment (Summary): Agriculture, Natural Resources and Rural Development
4. Project Administration Manual
5. Contribution to the ADB Results Framework
6. Development Coordination
7. Economic and Financial Analysis
8. Country Economic Indicators
9. Summary Poverty Reduction and Social Strategy
10. Risk Assessment and Risk Management Plan
11. Initial Environmental Examination
12. Land Acquisition Plan (Pipelines)
13. Land Acquisition Plan (Pumping Stations)
14. Land Acquisition Framework

Supplementary Documents

15. Financial Management Assessment
16. Procurement Capacity Assessment
17. Climate Risk and Vulnerability Assessment Report
18. Project Climate Risk Assessment and Management Report
19. Poverty and Social Analysis
20. Economic Assessment