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IMPLEMENTATION COMPLETION AND RESULTS REPORT

LOAN NO. 8122-CN

ON A LOAN

FROM THE INTERNATIONAL BANK FOR RECONSTRUCTION AND DEVELOPMENT

IN THE AMOUNT OF US\$100 MILLION

TO

THE PEOPLE'S REPUBLIC OF CHINA

FOR THE

SICHUAN WUDU IRRIGATED AGRICULTURE DEVELOPMENT PROJECT

November 19, 2020

Water Global Practice
East Asia And Pacific Region

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CURRENCY EQUIVALENTS

(Exchange Rate Effective: October 31, 2019)

Currency Unit = Chinese Yuan (CNY)

CNY 7.039 = US\$1

FISCAL YEAR

January 1 – December 31

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ABBREVIATIONS AND ACRONYMS

CDD	Community Driven Development
COVID-19	Coronavirus disease 2019
CPF	Country Partnership Framework
CPS	Country Partnership Strategy
EA	Environmental Assessment
EMP	Environmental Management Plan
ERR	Economic Rate of Return
FYP	Five-Year Plan
ha	Hectares
ICR	Implementation Completion and Results Report
km	Kilometers
m	Meters
m ³	Cubic Meters
mm	Millimeters
mu	Mou, or mu, equivalent to 666.5 square km
MIS	Management Information System
MTR	Mid-Term Review
M&E	Monitoring & Evaluation
O&M	Operation and Maintenance
PAD	Project Appraisal Document
PDO	Project Development Objective
PMO	Project Management Office
TTL	Task Team Leader
WUA	Water User Association

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DATA SHEET

BASIC INFORMATION

Product Information

Project ID	Project Name
P121414	Sichuan Wudu Irrigated Agriculture Development Project
Country	Financing Instrument
China	Investment Project Financing
Original EA Category	Revised EA Category
Full Assessment (A)	Full Assessment (A)

Organizations

Borrower	Implementing Agency
The People's Republic of China	Sichuan Wudu Water Diversion Management Bureau

Project Development Objective (PDO)

Original PDO

(a) to increase the coverage of irrigation services in the Project Area in order to increase agricultural production; (b) to provide water supply in bulk to small rural communities and industries in the Project Area; and (c) to introduce a community-based participatory approach in the management of water facilities and infrastructure and increase capacity of higher value agro-products in the Project Area to ensure the sustainable development of agriculture.

Revised PDO

The objectives of the Project are to: (a) increase the command area for irrigation in the project area; (b) increase bulk water supply capacity for small rural communities and industries in the project area; (c) introduce community-based participatory approach in the management of water facilities and infrastructure in the demonstration areas.

**FINANCING**

	Original Amount (US\$)	Revised Amount (US\$)	Actual Disbursed (US\$)
World Bank Financing			
IBRD-81220	100,000,000	100,000,000	100,000,000
Total	100,000,000	100,000,000	100,000,000
Non-World Bank Financing			
Borrower/Recipient	600,770,000	622,350,000	572,170,000
Total	600,770,000	622,350,000	572,170,000
Total Project Cost	700,770,000	722,350,000	672,170,000

KEY DATES

Approval	Effectiveness	MTR Review	Original Closing	Actual Closing
28-Feb-2012	10-Jul-2012	11-Apr-2016	31-Dec-2017	31-Oct-2019

RESTRUCTURING AND/OR ADDITIONAL FINANCING

Date(s)	Amount Disbursed (US\$M)	Key Revisions
28-Dec-2017	71.69	Change in Project Development Objectives Change in Results Framework Change in Components and Cost Change in Loan Closing Date(s) Change in Implementation Schedule

KEY RATINGS

Outcome	Bank Performance	M&E Quality
Satisfactory	Moderately Satisfactory	Modest

**RATINGS OF PROJECT PERFORMANCE IN ISRs**

No.	Date ISR Archived	DO Rating	IP Rating	Actual Disbursements (US\$M)
01	16-Jun-2012	Satisfactory	Satisfactory	0
02	01-Mar-2013	Satisfactory	Satisfactory	0
03	24-Oct-2013	Satisfactory	Moderately Satisfactory	7.69
04	18-Apr-2014	Satisfactory	Moderately Satisfactory	9.18
05	30-Oct-2014	Satisfactory	Satisfactory	19.94
06	16-Apr-2015	Satisfactory	Moderately Satisfactory	21.86
07	28-Oct-2015	Satisfactory	Moderately Satisfactory	26.38
08	22-May-2016	Moderately Unsatisfactory	Moderately Unsatisfactory	41.35
09	28-Nov-2016	Moderately Unsatisfactory	Moderately Unsatisfactory	46.33
10	17-May-2017	Moderately Unsatisfactory	Moderately Unsatisfactory	51.36
11	23-Dec-2017	Moderately Unsatisfactory	Moderately Unsatisfactory	66.41
12	20-Jun-2018	Moderately Satisfactory	Moderately Satisfactory	76.67
13	21-Dec-2018	Moderately Satisfactory	Moderately Satisfactory	87.55
14	10-Jun-2019	Satisfactory	Satisfactory	87.55
15	12-Dec-2019	Satisfactory	Satisfactory	96.23



SECTORS AND THEMES

Sectors

Major Sector/Sector	(%)
Agriculture, Fishing and Forestry	66
Irrigation and Drainage	66
Water, Sanitation and Waste Management	33
Water Supply	33
Industry, Trade and Services	1
Agricultural markets, commercialization and agri-business	1

Themes

Major Theme/ Theme (Level 2)/ Theme (Level 3)	(%)
Finance	1
Finance for Development	1
Agriculture Finance	1
Urban and Rural Development	99
Urban Development	33
Services and Housing for the Poor	33
Rural Development	66
Rural Markets	1
Rural Infrastructure and service delivery	65
Land Administration and Management	0
Environment and Natural Resource Management	0
Renewable Natural Resources Asset Management	0
Biodiversity	0
Landscape Management	0



ADM STAFF

Role	At Approval	At ICR
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I. PROJECT CONTEXT AND DEVELOPMENT OBJECTIVES

A. CONTEXT AT APPRAISAL

Context

1. At the time of project appraisal, China had an annual per capita freshwater resource of about 2,160 m³, which was unevenly distributed, both spatially and temporally. This spatial disparity did not match the distribution of China's population, arable land, and productivity, and some areas had water scarcity. Water scarcity can occur in the following situations: (a) physical scarcity when water resources are not sufficiently available to meet all water demands, including environmental flows; (b) pollution-related scarcity as a result of limited available clean water for water users, and high cost of providing safe water; and (c) economic scarcity when there was a lack of investment in water infrastructure or a lack of human, institutional and/or financial capacity to satisfy the demand for water.¹ China's general strategy for addressing the main development issues on water, as indicated in its Twelfth Five-Year Plan (FYP) (2011-2015) on Water Resources Development, was to enforce strict water resources management in all water use sectors, including construction and rehabilitation of water engineering works, particularly in irrigated agriculture.
2. Mianyang Municipality, where the Sichuan Wudu Irrigated Agriculture Development Project (the project) areas are located, is relatively abundant in water resources (with over 1,100 mm of annual rainfall and the water-rich Fujiang River flowing through the municipality). However, the project areas covering six counties in the municipality, three of which were in provincial-level poverty tagged areas, were short of water for irrigated agriculture mainly because of the relatively uneven temporal and spatial distribution of water resources. Four key development issues were identified for water resources development and utilization in the project areas: (a) main irrigation infrastructure systems and on-farm works (lateral, sub-lateral and farm ditches) needed to be constructed to increase agricultural production or rehabilitated to help recovery from the big Wenchuan earthquake in 2008; (b) water shortages and frequent droughts were impeding agricultural development, local community livelihoods and industrial development; (c) both irrigation efficiency and water use efficiency were very low (irrigation efficiency was less than 50% and water use efficiency for various crops in the rain-fed areas was much lower than in the areas with irrigation systems); and (d) sustainability of the constructed water infrastructure needed to be secured, specifically, operation and maintenance (O&M) for both main/branch systems and on-farm works (lateral, sub-lateral and farm ditches) had to be improved.
3. The Wudu Water Diversion and Irrigation Scheme (Wudu Scheme) located in the Mianyang Municipality of the Sichuan Province is a large-scale water diversion scheme developed in two phases: the first phase (Phase I), partially financed by the International Development Association, was completed in 2002 and it included the construction of the Wudu barrage on the Fujiang River, the general main canal, diversion gate, Fuzi main canal and its branch and lateral canals. It provides water to irrigate about 84,667 hectares of land in the central part of

¹ The strategic focus to address water shortage issues would be different depending on the type of scarcity experienced and on the conditions that exist. In areas with physical scarcity, the focus would be on reducing consumptive use (evapotranspiration) while still trying to increase farmer incomes, by increasing water productivity in terms of consumptive use, with the integration of water management basin-wide. For pollution-related water scarcity, the focus would be on reducing pollution discharges into water bodies, with a basin-wide participatory approach for pollution control. In areas with economic water scarcity, engineering measures for improving the irrigation infrastructure combined with agronomic measures and participatory irrigation management measures would be promoted to increase agricultural production and farmer incomes. In areas with mixed types of water scarcity, all the above measures would need to be applied.



Mianyang City and in parts of Suining City in Sichuan. The second phase (Phase II), consisting of construction of branch canals from the Wudu Reservoir, Xizi main canal, Jinfeng reservoir, Jinlong sub-main canal and 16 branch canals, as set out in component 1 of the project and partially financed by the Bank loan, was meant to provide irrigation for about 70,200 hectares of land in the project areas, as well as to provide water for urban, rural and industrial use in those same areas.²

4. This project was designated as a national key water-sector project by the Ministry of Water Resources in China's 12th FYP (2011-2015). It supported the government's strategy in such economic water scarcity areas to increase agricultural production and farmer incomes with integrated measures, which included engineering measures (construction of main irrigation systems and on-farm works), agricultural measures (agronomic and agricultural extension services) and institutional measures (participatory on-farm water management by water user associations [WUA]).
5. The project was consistent with the World Bank Group's 2006-2010 Country Partnership Strategy (CPS) for China³, which remained, *de facto*, in effect at the time of project appraisal in 2012. The project supported Pillar 2 of the CPS, "Reducing poverty, inequality and social exclusion", specifically in expanding economic opportunities for the rural poor, and Pillar 3, "Managing resource scarcity and environmental challenges" through conserving water resources, inter alia, and identifying ways to reduce water use in agriculture, for example, by shifting towards less water-intensive crops and improving the productivity of irrigation. It was also aligned with the incoming China CPS for 2013-2016⁴, which was under preparation at the time of project appraisal. (See section II.A.)

Project Development Objectives (PDOs)

6. The Project Development Objectives (PDOs), as stated both in the Loan Agreement and the Project Appraisal Document (PAD), were to: (a) increase the coverage of irrigation services in the project area in order to increase agricultural production; (b) provide water supply, in bulk, to small rural communities and industries in the project area; and (c) introduce a community-based participatory approach in the management of water facilities and infrastructure and increase of production capacity of higher-value agro-products in the project area to ensure the sustainable development of agriculture.

Key Expected Outcomes and Outcome Indicators

7. The compound PDO has been unpacked into five key expected outcomes: (1) increased coverage of irrigation services; (2) increased agricultural production; (3) water supply provided, in bulk, to small rural communities and industries [in the project area]; (4) community-based participatory approach introduced in the management of water facilities and infrastructure; (5) production capacity of higher-value agro-products in the project area increased; with the expected (longer term) impact of sustainable development of agriculture.
8. Achievement of these five outcomes was to be assessed through the following PDO-level results indicators⁵: (1) *Increased new effective irrigated area with the project*; (2) *Annual value of agricultural production per mu*⁶;

² China has 434 large-scale irrigation schemes with command areas over 20,000 hectares each. Construction and rehabilitation of the large irrigation areas are China's investment priority in terms of its food self-sufficiency policy.

³ Report No. 35435.

⁴ Report No. 67566-CN, discussed by the World Bank Board of Executive Directors in November 2012.

⁵ There are slight differences in the wording of the PDO indicators in the PAD main text and PAD annex 1 but they are not material.

⁶ Mou, or mu, is a Chinese unit of land measurement that varies with location but is commonly 0.165 acre, or 666.5 square meters.



(3) Annual amount of industrial and domestic water supply; (4) Number of farmers (and female farmers) benefiting from the supplementary irrigation; and (5) Number of O&M plans prepared and implemented for both main and on-farm systems.

Project Components⁷

9. **Component 1: Construction of Main Irrigation Systems (estimated cost US\$691.03 million, of which Bank financing US\$97.41 million; actual cost: US\$662.40 million, of which Bank financing US\$97.49 million).** The construction and operation of the second phase of the Wudu Scheme included irrigation services and water supply to urban and rural areas, as well as to industries in the project area, under two systems:
 - (a) Construction of branch canals from the right and left segments of the Wudu Reservoir to irrigate areas directly under the said reservoir; and
 - (b) Construction of a new main irrigation system consisting of:
 - (i) construction of Xizi Main Canal with a total length of about 108 km to divert water from the Wudu Reservoir to irrigate areas in the project area and consisting of numerous structures including tunnels, aqueducts, siphons, gates and other structures;
 - (ii) construction of a reservoir at Jinfeng with intake from the Xizi Canal with a total storage capacity of 98 million m³ consisting of tunnels, aqueducts, siphons, gates and other structures including an asphalt concrete core sock-fill dam with a height of 88 m and a chest length of 454.87 m, an irrigation intake and a tunnel to supply and regulate the supply of water to the irrigation system that was to be constructed; and
 - (iii) construction of Jinlong sub-main canal and 16 branch canals consisting of numerous structures including tunnels, aqueducts, siphons, gates and other structures to divert water to irrigate areas covered under the Xizi Main Canal, to be constructed under (a) above.
10. The World Bank was to finance the first section (23 km) of Xizi Main Canal, Jinlong sub-main canal (24 km) and 10 branch canals (228 km), accounting for about 14% of component 1 costs. The rest of the main systems were to be fully financed by government.
11. **Component 2: Development of Community Driven Development (CDD)-based On-farm Works in Demonstration Areas (estimated cost US\$4.49 million, of which Bank financing US\$0.90 million; actual cost: US\$3.36 million, of which Bank financing US\$0.80 million).** It comprised:
 - (a) Construction of on-farm works including one lateral canal and three sub-lateral canals with a total length of about 48 km;
 - (b) Establishment and development of WUAs and enhancement of producer co-operatives based on a community demand driven approach around the lateral/sub-lateral canal areas in each demonstration area to organize and implement the construction, operation and maintenance of on-farm works; and
 - (c) Provision of an integrated package of agricultural inputs (agronomic technologies, pesticides, fertilizers, seeds, etc.) and supporting services (institutional arrangements to support the WUAs, agricultural mechanics, and government policies, etc.) in each demonstration area to smallholder agricultural producers and farmer groups to maximize the benefit of irrigated water delivered to the field and help increase

⁷ Financing shown excludes front-end fee and interest during construction. See annex 3 for full breakdown.



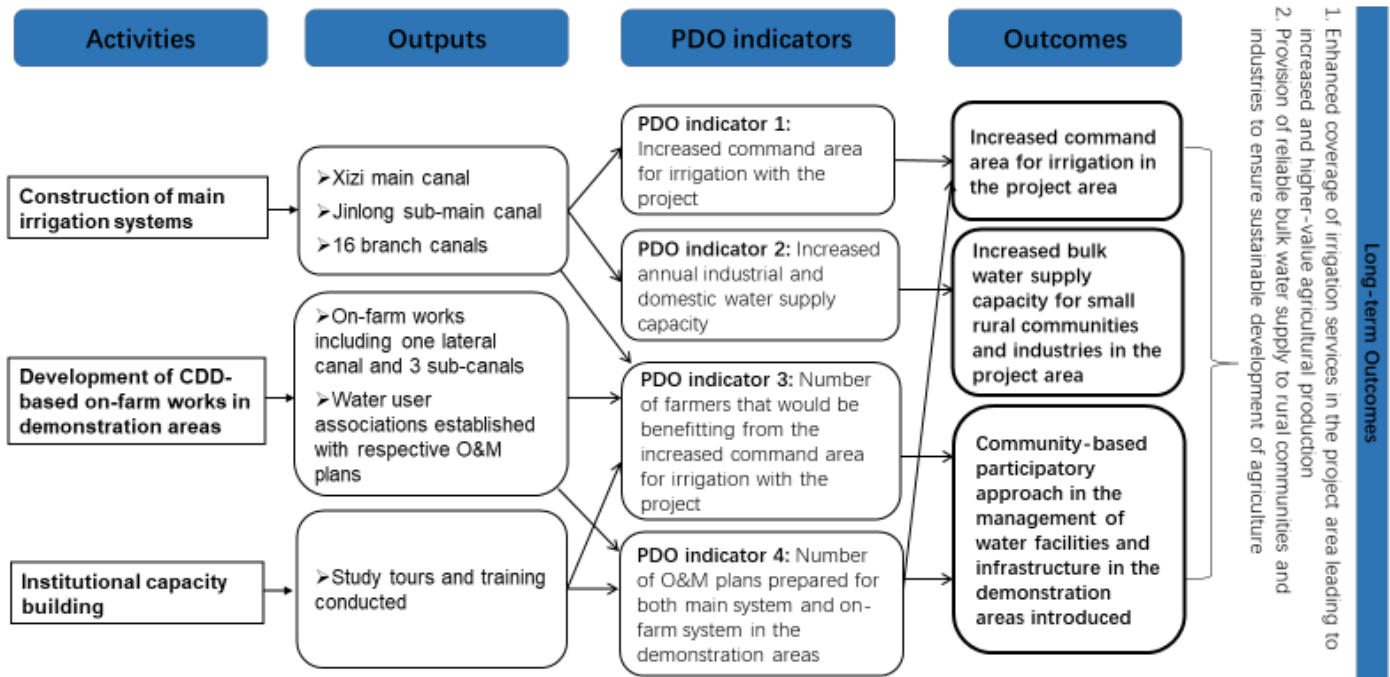
farmer’s production and income.

- 12. **Component 3: Institutional Capacity Building and Project Management Support (estimated cost: US\$1.44 million with 100% Bank financing; actual cost: US\$1.46 million).** This component was to provide technical assistance for institutional strengthening, including capacity building through study tours and training, consulting services and office equipment, and acquisition of vehicles to provide necessary technical support for implementing the activities under components 1 and 2.

Theory of Change (Results Chain)

- 13. The Theory of Change diagram below illustrates the results chain of the project. It captures the activities and outputs as described in the PAD, but for the reasons explained in sections I.B and III.A, reflects the outcomes and PDO as in the restructured project.

Figure 1: Theory of Change





B. SIGNIFICANT CHANGES DURING IMPLEMENTATION

Revised PDOs and Outcome Targets

14. The PDO was revised in December 2017 through a level-2 restructuring⁸ to: (a) increase the command area for irrigation in the project area; (b) increase bulk water supply capacity for small rural communities and industries in the project area; (c) introduce community-based participatory approach in the management of water facilities and infrastructure in the demonstration areas.

Revised PDO Indicators

15. The following changes were made to the original PDO indicators:

- *Increased new effective irrigated area with the project* was changed to *Increased command area for irrigation with the project*;
- *Annual value of agricultural production per mu* was dropped;
- *Number of farmers (and female farmers) benefiting from the supplementary irrigation* was changed to *Number of farmers (and female farmers) that would be benefitting from the increased command area for irrigation with the project*;
- *Annual amount of industrial and domestic water supply* was changed to *Annual industrial and domestic water supply capacity*;
- *Number of O&M plans prepared and implemented for both main and on-farm systems* was changed to *Number of O&M plans prepared for both main system and on-farm system in the demonstration areas*.

Revised Components

16. Component activities remained unchanged. The cost of component 1 increased from US\$691.03 million at appraisal to US\$716.42 million at restructuring (an increase of 3%).

Other Changes

17. The project closing date was extended by 22 months to October 31, 2019 and the implementation schedule was updated accordingly.
18. Changes were made to the intermediate indicators. Specifically:
- The targets of the following indicators were modified: *Length of Xizi canal completed* (from 108.177 km to 108.00 km); *Length of sub-main or branch canals completed* (from 345.18 km to 305.24 km); and *Length of lateral and sub-lateral canals completed in demonstration areas* (from 479.57 km to 38.91 km).
 - The following indicators were dropped: *Height of the dam crest completed for Jinfeng Reservoir*; *Irrigation water use efficiency increased in the irrigation area*; *Annual net income of farmers increased with water provided by the project in project areas*; *Agricultural value increased per unit of water*.

⁸ Restructuring Paper report No.: RES27064.



19. The disbursement estimates were updated. Risk ratings were introduced following the (new) Systematic Operations Risk-rating Tool. The economic and financial analysis was also updated.

Rationale for Changes and Their Implication on the Original Theory of Change

20. The project was designed as a part of the overall irrigation scheme as per the established practice for large scale scheme development in China, and the project scope in terms of the physical structure was defined as “construction of main irrigation system” in both the PAD and Loan Agreement. The PAD explicitly stated that on-farm works (beyond this project scope) would be financed by county governments and farmers after the completion of the main system, following the cost-sharing arrangements established by the government of China (PAD footnote 1, paragraph 19).⁹ As such, the PDOs were changed for the reasons below:

- Part (a) was changed from “to increase the coverage of irrigation services in the project area in order to increase agricultural production” to “increase the command area¹⁰ for irrigation in the project areas”. The project only financed the upstream infrastructure (main and branch canals) which can provide water to the command area. The increase in coverage of irrigation service, which refers to the actual provision of water to the farm gate, would become possible after the construction of downstream infrastructure (laterals, sub-laterals and farm ditches), which was beyond the project scope and was expected to happen at a later stage. The reference to increased agricultural production was deleted as it would occur following the on-farm works investment, i.e., after project closing.
- Part (b) was changed from “to provide water supply in bulk to small rural communities and industries in the project area” to “increase bulk water supply capacity for small rural communities and industries in the project area”. The project financed the upstream infrastructure (main and branch canals). The actual provision of water would occur once the county governments finance the downstream infrastructure such as connection mains, supplementary water treatment plant and distribution networks, which was expected to be achieved after project closing.
- Part (c) was changed from “to introduce a community-based participatory approach in the management of water facilities and infrastructure and increase capacity of higher value agro-products in the project area to ensure sustainable development of agriculture” to “introduce community-based participatory approach in the management of water facilities and infrastructure in the demonstration areas”. This change was due to the consideration that (i) the project was financing the proposed activities (on-farm works) within the demonstration area only, while the same activities would be financed in the rest of the area by the local government/farmers after the main system was completed; (ii) the increase in production and the switch to higher-value crops was expected to take place much later; and (iii) ‘sustainable development of agriculture’ is a longer-term, higher level objective requiring the convergence of many factors beyond the project.

21. The targets for the engineering works were updated, as the PAD indicator targets were revised based on the preliminary design completed after the project was approved, while indicators beyond the project scope were dropped. The other indicators mentioned above were revised for clarity and alignment with project scope. The

⁹ PAD (footnote 1, paragraph 19) states, “The latter (on-farm works investment) should be financed by county government and beneficiaries in separate projects after main system is completed, per government water sector investment policy”.

¹⁰ The irrigation command area is defined as the designed irrigation area to which the main irrigation works can provide water for irrigation with irrigation reliability. The irrigation command area could become actual irrigated or service area once all on-farm works are completed within the designed irrigation area.



target dates were revised in line with the new project closing date.

22. The cost increase of US\$25.39 million in component 1 (or 3% of the original cost estimate) was due to updating of the unit cost in the preliminary design and was borne by the counterpart funds.
23. The closing date was extended to address the project implementation delay in the completion of the main systems construction and the demonstration of participatory on-farm works management. The disbursement estimates and implementation schedule were adjusted accordingly.
24. The economic analysis was updated to reflect the changes in the implementation schedule and the PDO, and confirmed the project was viable. The financial analysis was also updated to gauge the potential project impact on farmer incomes (see annex 4), and to recommend the minimum water tariffs to allow full recovery of O&M costs (see sections II.B and II.C for a discussion of O&M).
25. These changes were in line with the Theory of Change and the project description in the PAD and Loan Agreement.

II. OUTCOME

A. RELEVANCE OF PDOs

Assessment of Relevance of PDOs and Rating

Rating: High

26. **Alignment with World Bank strategy.** The project objective was fully aligned with the World Bank Group's CPS for 2013–2016¹¹, which was in effect at the time of project closing. Specifically, the project contributed to Strategic Theme 1: Supporting Greener Growth and Strategic Theme 2: Promoting More Inclusive Development as described below:
 - (a) CPS Outcome 1.4 - Promoting Sustainable Agriculture Practices: in particular, helping to deliver water to expand agricultural production and also to improve water productivity through support to agricultural extension technologies, modern irrigation technologies, WUAs and water markets in the demonstration areas. The project was listed in the CPS results matrix as a milestone for Outcome 1.4.
 - (b) CPS Outcome 2.3 - Enhancing Opportunities in Rural Areas and Small Towns: particularly, enhancing secondary town development by helping local governments design integrated rural-urban development plans, financing small town infrastructure, including water supply and sanitation. The project would entail investment in water supply facilities to provide water supply in bulk to small rural communities and industries in the project area.

¹¹ This CPS was in effect until the Country Partnership Framework (CPF) for the Period FY2020-2025 was discussed by the World Bank Board of executive Directors on December 5, 2019. The current CPF marks a new phase in the China-World Bank Group relationship, one in which engagement remains strong yet will be increasingly selective as lending declines, with a focus on China's remaining institutional gaps and the country's contribution to global public goods. The project is aligned with the CPF which continues to emphasize support for addressing natural resource (including water) scarcity, increasing farm productivity, promoting efficiency and productivity in water use and its quality, and overall water governance.



27. **Alignment with government and provincial strategies:** The project is highly relevant to the priorities for water resources development in China’s 13th FYP for 2016-2020. These emphasized the construction and rehabilitation of water engineering works, particularly in irrigated agriculture, and integrate increase in water use efficiency with increase in farmer income and agricultural production. Government policy also recognized the need for institutional reform, including increasing farmer participation and ownership in irrigation, and strengthening the organizations responsible for O&M. With its focus on delivering water to communities for domestic and industrial use in the project areas, the project is also contributing to China’s recently launched National Rural Revitalization Program and the 14th FYP (for the period 2021-2025). The second phase of the Wudu Scheme remains the top priority in water sector development for Sichuan Province in its new program for large scheme rehabilitation and development. On-farm works and water supply facilities investments were included as part of the economic stimulus package addressing the outbreak of COVID-19¹² (see section IV. D).

B. ACHIEVEMENT OF PDOs (EFFICACY)

Rating: Substantial

Assessment of Achievement of Each Objective/Outcome

28. As discussed earlier, the original PDO and indicators were not aligned with the project scope, which remained unchanged throughout the project duration. The revised PDO and indicators, introduced through the 2017 restructuring, reflect the scope of the project. In view of this, achievement of the PDO is being assessed in this section with reference to the revised PDO and indicators, under each of the three PDO outcomes listed below (see sections I.B and III.A), measured by the PDO indicators shown in table 1 below. The level of ambition, difficulty and scope of the project remained unchanged, as all project activities, interventions and geographic locations as indicated in the Loan Agreement and PAD remained unchanged before and after the restructuring. A split rating would therefore not be applicable per the Implementation Completion and Results Report (ICR) guidelines (paragraph 60 iii).

- (a) increased command area for irrigation in the project area;
- (b) increased bulk water supply capacity for small rural communities and industries in the project area;
- (c) community-based participatory approach in the management of water facilities and infrastructure in the demonstration areas introduced.

¹² Coronavirus disease 2019 (SARS-CoV-2 or COVID-19) is a new disease, caused by a novel (or new) coronavirus that that can spread from person to person and has not previously been seen in humans.



Table 1: Achievement of the PDO Outcome Indicators

Indicator Name	Baseline	Formally Revised Target	Actual Achieved at Completion
1. Increased command area for irrigation with the project (Unit: 10,000 mu)	0.00	92.96 ¹³	92.96
2. Increased annual industrial and domestic water supply capacity (Unit: 10,000 m ³ /year)	0.00	13,752.3	13,752.3
3. Number of farmers that would be benefitting from the increased command area for irrigation with the project (Unit: 10,000 persons)	0.00	115.15	120.00
4. Number of O&M plans prepared for both main system and on-farm system in the demonstration areas	0.00	22	22

Source: Borrower implementation completion report and Bank implementation support missions. See annex 1 for the entire project results framework.

29. **Outcome (a): increased command area for irrigation in the project area has been fully achieved** through the completion of the main irrigation systems (see the indicators above). As a result, a new large-scale irrigation scheme will soon be put into operation in south-west China and will contribute substantially to the implementation of the national policy on food security and self-sufficiency in China.
30. Completion of the increased command areas has sped up county government decisions on the construction of on-farm works, including lateral and farm ditches within the command areas in order for the main system to quickly deliver water to the farmland. All six counties have prepared and approved investment plans for the construction of on-farm works (in addition to the on-farm works already completed in the three demonstration areas). Construction was underway in three counties at the end of September 2020 on 11 lateral canals (of the total of 52, including the one from the demonstration site) in the scheme areas and three (of nine) water treatment plants. The remaining three counties are scheduled to start construction by end 2020. Based on the data collected through interviews with farmers in September 2020 from the three demonstration areas developed under component 2, it can be expected that the income of farmers in the project areas would increase after water is delivered to farmland (see annex 4). As such, once all the on-farm works are completed, these irrigation systems would consolidate the results achieved in poverty alleviation in the project areas, including by protecting farmers at risk of falling back in poverty.
31. Completion of the increased command areas and timely start of the construction of on-farm works has sped up the development of the 63 CDD-based WUAs in non-demonstration areas by the end of the project; these WUAs are building on the good practices in the project's demonstration areas (see below on outcome (c)). An additional 127 WUAs in the pipeline will cover the entire project area.
32. **Outcome (b): increased bulk water supply capacity for small rural communities and industries in the project area has been fully achieved.** The main water supply systems (used concurrently for main irrigation systems) were all

¹³ The target was incorrectly entered in the Restructuring Paper as 50.05 (x10,000 mu) as it referred to the estimated irrigation *service* area by the time of project completion. The correct target for the *command* area is as shown.



completed, as shown in table 1 above. The completion of increased annual industrial and domestic water supply capacity will have a positive impact on the long-term water scarcity in the project areas. Water will soon be delivered to the cities/towns and communities to meet the demands for domestic and industrial development, in line with the government development goals discussed earlier.

33. Most counties have prepared feasibility study reports and preliminary designs for the construction of water intakes and water supply pipelines to be connected to water plants and various factories. Thus, water is expected to be delivered to users over the next two to five years.¹⁴ In fact, on top of some CNY 400 million (US\$57 million equivalent) allocated in 2020, the local governments have formulated and put in place an investment program¹⁵ with a solid time frame and financial commitments in their 2021-2025 FYPs for on-farm works and water supply facilities in the whole scheme areas (see section D). Completion of the increased water supply capacity has sped up the construction of rural water supply networks to provide clean water to the rural communities along the water supply canals to ensure drinking water safety, and have contributed greatly to China's National Program on Drinking Water Safety in the project areas.
34. The main irrigation systems (concurrently used for domestic and industrial water supply) were completed with the works as specified in the PAD:
 - (a) Construction of branch canals from the right and left segments of the Wudu Reservoir to irrigate areas directly under the reservoir.
 - (b) Construction of a new main irrigation system consisting of:
 - The 108 km Xizi Main Canal to divert water from the Wudu Reservoir to irrigate areas under the Canal in the project area, including tunnels, aqueducts, siphons, gates and other structures.
 - A reservoir at Jinfeng with intake from the Xizi Canal with a total storage capacity of 98 million m³, consisting of tunnels, aqueducts, siphons, gates and other structures including an asphalt concrete core sock-fill dam, an irrigation intake and a tunnel to regulate the supply of water to the irrigation system.
 - Jinlong sub-main canal and 16 branch canals, consisting of numerous structures including tunnels, aqueducts, siphons, gates and other structures to divert water to irrigate areas covered under the Xizi Main Canal.
35. Of the works listed above, the Bank financed the first section (23 km) of the Xizi Main Canal, the Jinlong sub-main canal (24 km) and 10 branch canals (228 km), accounting for about 14% of the total investment under component 1. The rest of the main systems were fully financed by government. Side works such as a few slope-protections works for the canal banks and landscaping were completed in early 2020 (i.e., shortly after the project closed) with government financing.
36. Operation and maintenance plans for the main irrigation system constructed under the project have been approved. The O&M plans include delineation of responsibilities, technical standard requirements and financing source. Per

¹⁴ The rollout of the on-farms works is as follows: in late 2018, about a year before project closure, counties initiated preparation of the preliminary design of on-farm works for government approval. In early 2020, local government approved the local investment plan and started to allocate funds for construction of on-farm works. About CNY 400 million (about US\$57 million) has been allocated as of September 2020. In mid-2020, the response to the COVID-19 outbreak sped up the allocation of investment for scheme-wide on-farm works. In September 2020, local government updated the investment plan to cover the scheme-wide on-farm works and included it in the local 14th FYP (2021-2025).

¹⁵ Available in the project files and listed in annex 6.



current irrigation schedule and management policy, and in line with the current practice under the first phase of the Wudu Scheme, the main system O&M costs have been fully funded by the government via earmarked funding from the treasury. Although the Bank has advised on the water tariff and surcharge levels needed for full O&M cost recovery, the counterpart's current position is that imposing additional charges would result in unreasonable transaction costs and would affect farmers' willingness to pay.

37. **Outcome (c): introduce community-based participatory approach in the management of water facilities and infrastructure in the demonstration areas was fully achieved.** Support to this outcome included the completion and operation of on-farm works including a lateral canal and three sub-lateral canals in the demonstration sites with a service area of about 1,000 ha. WUAs and producer co-operatives were organized based on a community demand driven approach. The approach included the provision of an integrated package of agricultural inputs and supporting services in each demonstration area to smallholder agricultural producers and farmer groups to maximize the benefit of irrigated water delivered to the field and help increase farmers' production and income. The laterals and on-farm works were completed in the demonstration areas, water availability for irrigated agriculture production increased, and the demonstration sites were able to show the benefits that can be achieved in other areas, once these complementary works are also completed.
38. **Successful development of CDD-based WUAs.**¹⁶ The WUA plans were well developed and implemented in all three demonstration areas. The WUAs were registered with the local Civil Affairs Authority as autonomous entities with a mandate for O&M of on-farm works and water management.¹⁷ The WUAs carried out on-farm works and operated and maintained them on completion of construction. WUAs helped readjust cropping patterns and increase cropping intensities with irrigation water delivered during the critical stages of crop management. Based on farmer demand, various producer cooperatives and organizations became proactive in their involvement in WUA operations, including oilseed cooperatives, pig raising cooperatives, horticulture associations, and shrimp farming associations. O&M plans for the on-farm works were prepared and will be financed by the WUAs mainly through inputs in kind and a limited water tariff surcharge to be decided by the WUA members. Initial O&M costs are expected to be low, and will vary from year to year. In the case that high-cost repairs are needed, the WUAs can apply for assistance with the local government, as has been the practice in China. Based on interviews conducted by the Bank team with the farmers/WUAs in the field, this is a preferred practice because the local government would assume responsibilities for big repairs of on-farm works (mainly for laterals, rather than farm ditches). The local authorities provided technical support and supervision to ensure the sustainability of WUA operations based on the guidance contained in the WUA Operational Manual. The CDD approach adopted by WUAs has proven to be sustainable, as it empowered farmers by ownership of the facilities and generated financial incentives from increased agriculture production.
39. A beneficiary assessment conducted by the project Monitoring and Evaluation Team from the Policy and Development Research Center of the Ministry of Water Resources in connection with the social assessment in the demonstration sites found that farmers were satisfied with the completed main irrigation works. The construction of on-farm works has brought them tangible benefits from increased agricultural production. As mentioned above, the success of the demonstration areas has resulted in the development of 63 additional WUAs (as of project closure) in non-demonstration areas, with an additional 127 WUAs in the pipeline that will extend coverage to the entire project area, thus confirming the sustainability and replicability of the model demonstrated under the project.

¹⁶ See the Review and Evaluation of WUAs in the Pilot Sites prepared by the Project Management Office (available in the project files and listed in annex 6).

¹⁷ See the WUA Operational Manual (available in the project files and listed in annex 6).



40. **Benefits from irrigation water delivered to the demonstration villages.** The CDD demonstration villages had achieved income increases by June 2020. The latest data provided by the Project Management Office (PMO)¹⁸ confirmed that, in comparison with neighboring non-irrigated areas, the summer crop yields in the CDD demonstration villages had increased by 20% and cropping intensity by 30% as a result of additional vegetable production in Changliang village, one of three demonstration sites in Zitong County. Farm household incomes are estimated to have increased between 30-70% depending on the cropping pattern. In addition, development of livestock, aquaculture and orchards has been initiated with incomes expected to flow in two to three years. Given the short time for demonstration (only one annual crop season), the benefits to farmers are likely on the conservative side. Further increases in income are expected in the coming years from improved crop yields, changes in cropping patterns (shifting to higher value crops), increased cropping intensities, and diversifying into aquaculture/livestock production.

Justification of Overall Efficacy Rating:

41. Based on the above assessment of project outcomes, the overall efficacy of the project is rated Substantial. The project has laid a solid foundation toward achieving the development impact under the entire scheme by (i) delivering water in bulk for both agricultural and non-agricultural use, which is a prerequisite for the on-farm works and water supply facility investment and (ii) demonstrating results in terms of increased production and the replicability of the participatory on-farm water management for the scheme as whole.

C. EFFICIENCY

Rating: Substantial

Assessment of Efficiency and Rating

42. **Economic Analysis.** Following the approach adopted at appraisal, a cost benefit analysis was conducted at project closure, using the same assumptions as at appraisal for the economic prices of water for irrigation, industrial use and drinking, which are conservative. The major quantifiable benefits of the project (on an incremental basis) were derived from: (a) agricultural production from increased irrigation service areas; (b) value of water for industrial uses; and (c) value of water for domestic use. As the project only covered the main irrigation system, the analysis depends on the on-farm works investment plans and their implementation by the six project counties after project completion. Given the short time and limited scope of the demonstration sites (only one annual crop season after project closure, covering less than 2% of the total service area), benefits reaped by farmers so far are well below the full development potential.
43. The analysis was therefore conducted on the entire second phase of the Wudu Scheme, taking into account scheme costs (including investment planned for on-farm works after the project) in line with the updated investment plans prepared by the county governments¹⁹ and incorporated in the local FYPs (2021-2015) in early 2020, which are expected to be implemented as has been done previously, based on the track record of the local governments. Taking into account that (a) on-farm works investment costs will continue through 2025; (b) the O&M costs are expected to increase over time; (c) the benefits in the irrigation and non-irrigation sectors are already showing an increase; and (d) the benefits are estimated on the on-farm works to be completed by 2025, the project ERR at

¹⁸ The numbers were collected in the field from farmers by the PMO.

¹⁹ The detailed local government investment plans are available in the project files and are listed as supporting document in annex 6.



completion is estimated at 11%, indicating the project is economically viable and robust (which is consistent with the update during the project restructuring).²⁰ However, this is moderately lower than the ERR estimated at appraisal (13%) due to the scheme-wide on-farm works starting after project closure, instead of before project closure. A sensitivity test to gauge the impact of a delay in on-farm investments beyond the next FYP (2021-2025) indicates that the ERR would be 6%, which remains economically still viable. (Annex 4 provides more details on the assumptions and analysis.)

44. The project is expected to generate numerous non-quantifiable social and environmental benefits, which were not included in the analysis: (a) flood control/drainage function provided by the irrigation canal system (main canal and branch canals in particular), for lack of reliable empirical data of losses incurred in the past decades; (b) development of social capital and institutional capacity; and (c) the improved quality of soil and agricultural products due to the adoption of good agricultural production practices (for example, integrated pest management). The project ERR should therefore be considered a conservative estimate of the overall economic impact of project.
45. **Financial and Fiscal Impact Analysis.** The project was a key national public good investment. The main systems built under the project are operated by the Sichuan Wudu Water Diversion Management Bureau (a government agency reporting directly to the Mianyang municipal government). As discussed in the previous section, per current policies, the O&M costs of the main systems are fully sourced from the municipal government budget while the water charges are determined by the pricing and finance agencies of the local government and the CDD-based WUAs are responsible for O&M of the on-farm works. As such, a financial analysis for the main systems is not applicable. Current water charges at CNY 0.12/m³ for Phase I of the Wudu Scheme are below the level necessary to fully recover the O&M costs. The Bank has provided advice to the client that the water charges be set at least at a level to fully recover the O&M costs of the main systems (estimated at about CNY 0.55/m³). (See also paragraphs 36 and 38.)
46. **Implementation Efficiency.** All project activities were completed at costs below the appraisal and restructuring estimates (96% of appraisal estimates and 93% of estimates at restructuring), mostly due to bidding savings. The Bank loan was fully disbursed. Project management was mainstreamed at the provincial and county levels and Bank-financed project management costs (equipment, goods and consultancies) were below 1% of the Bank loan. The project required a 22 month extension of the closing date due to procurement issues and delayed government approval of the preliminary design (see section III.B); however, a delay of this magnitude in large scale irrigation schemes in China is not unusual.²¹ The late government approval did not constitute an efficiency loss from a budget perspective as the funds were used for other government priority projects through the annual budget balancing process.²² Implementation efficiency improved substantially after the restructuring, and all project activities were completed before the revised closing date. The project complied with Bank fiduciary and safeguard policies (see section IV.B).
47. Based on the discussion above, project efficiency is rated Substantial.

²⁰ In comparison with the opportunity cost of capital (social discount rate) of 5% as recommended in "The Technical Note on Discounting Costs and Benefits in Economic Analysis of World Bank Projects", issued on November 12, 2015.

https://worldbankgroup.sharepoint.com/sites/gsg/WaterPovertyEconomy/SitePages/Detail.aspx/Documents/mode=view?_Id=8&SiteURL=/sites/gsg/WaterPovertyEconomy/.

²¹ Wudu Phase I Scheme was delayed by 4 years against the original plan.

²² See Article 67, Budget Law of the People's Republic of China.



D. JUSTIFICATION OF OVERALL OUTCOME RATING

48. The overall outcome of the project is rated Satisfactory based on High Relevance, Substantial Efficacy and Substantial Efficiency.

E. OTHER OUTCOMES AND IMPACTS

49. **Gender.** Women's economic empowerment was improved under the project as demonstrated by their participation in on-farm works management (component 2). More female laborers (over 60% of the total) joined in irrigation operation and facility management. Women were empowered to participate in technical training and irrigation management, as the WUA guidelines require representation of women in the WUA executive committees. In fact, a higher-than-expected number of women joined domestic and overseas study tours organized by the PMO (80 against a target of 50; see annex 1, intermediate indicator 6). The scaling-up of on-farm works investment will create more economic opportunities for women in rural areas, especially as many men have migrated for jobs outside the village communities.
50. **Institutional Strengthening.** The institutional and project management capacity were strengthened through activities under component 3, coupled with Bank implementation support during missions. The PMOs have been institutionalized in the county water sector management structures to serve the next stage of on-farm works development. Institutional capacity developed through participatory management of on-farm works (component 2) has contributed to the scheme-wide replication of WUAs. Project staff and trainees from counties participated in workshops and study tours to improve their knowledge of financial management, procurement and contract management, Management Information System (MIS) operation, and safeguard policies.
51. **Mobilizing Private Sector Finance.** The project did not involve mobilization of private sector finance.
52. **Poverty Reduction and Shared Prosperity.** The project contributed to poverty reduction in the demonstration sites, as discussed in the efficacy section above (section II.B). Once the scheme is fully developed, it will contribute to poverty reduction in the three counties (out of the six project counties in the project area) that are located in poverty-tagged areas.

III. KEY FACTORS THAT AFFECTED IMPLEMENTATION AND OUTCOME

A. KEY FACTORS DURING PREPARATION

53. The project design was clear and straightforward, with a well-defined role of the Bank in the overall scheme. Project works were relatively complex, since they involved construction in mountainous areas with difficult topographic terrain. However, Sichuan Province had good experience in such construction. Qualified design institutes prepared the feasibility study and preliminary design following Chinese national technical standards. Design alternatives were considered with adjustments building on the experience from the first phase of the Wudu Scheme and the 2008 earthquake which hit some of the project areas. Environmental concerns and resettlement, as well as cost effectiveness, were also considered. The detailed designs were sequenced in a way that would allow enough consultations and interactions between the designers, PMO consultants and the WUAs.



Project implementing arrangements were well-suited to the centralized scheme-wide design with decentralized implementation at the county level. The beneficiary groups were appropriately selected for the demonstration of community-based participatory approach in the management of on-farm works. The results framework, however, was not reflective of the project design (see paragraph 55 below and section IV.A).

54. The overall risk was rated Moderate. Key risks considered lack of familiarity with Bank requirements and procedures, specifically those related to fiduciary aspects and safeguards, synchronization of the construction activities, and delay in the completion of the on-farm works which were not financed by the Bank. Risks were assessed appropriately at appraisal and mitigation measures were explicitly identified, especially for procurement. Other than the procurement issues during implementation (see section B below and section IV.B), no other unanticipated risks arose during implementation.
55. During appraisal, there was a misunderstanding between the Bank team and the Sichuan government: the Bank team appraised the on-farm works as part of the project, while government policies required on-farm works to be financed by local funds after the main system is completed and therefore could not be a part of the project. The PDO and the indicators were formulated based on this incorrect understanding that the main system would be connected to the on-farm works and water would be transferred to the farm level within the project implementation timeline. During loan negotiations this misunderstanding was cleared up and the project scope was revised accordingly. The PDO and indicators were, however, not revised in the PAD presented to the World Bank Board of Executive Directors for approval. These changes were eventually made only when the project was restructured in 2017, i.e., just before the original loan closing date.

B. KEY FACTORS DURING IMPLEMENTATION

Factors Subject to the Control of Government and/or Implementing Entities:

56. Project implementation benefited from various favorable factors:
- (a) Firm commitment and strong leadership of the national and provincial governments (see section II. A.);
 - (b) Effective project management arrangements, with project leading groups at provincial, municipal and county levels to provide policy guidance, make decisions and ensure coordination, while the project management offices at municipal and county levels were responsible for canal construction works and on-farm works demonstration;
 - (c) Technical support provided by an Expert Group and a Dam Safety Panel at the municipal level.
57. Project implementation was negatively impacted by the following factors:
- (a) Procurement issues, including delays and a conflict of interest case that arose during the early years of project implementation (see section IV.B);
 - (b) The long approval process for the project's preliminary design (a precondition for China's domestic water sector projects) took an entire year after the loan was declared effective, as the preliminary design had to be revised many times because of the complicated geological conditions at the construction sites.



Factors Subject to the Control of the Bank

58. The Bank provided strong implementation support, including during the Mid-Term Review (MTR) and the project restructuring (see section IV). Project restructuring to align the PDO and indicators with the scope of the project should have been carried out much earlier during implementation. Discussions during project implementation between the government and the World Bank on a possible additional financing for the construction of on-farm works (given the financial difficulties of the project counties) took time and in the end a decision was made to retain the scope of the project and modify the PDO and the indicators. This decision was in line with the central government policies which left project counties to finance themselves. Once this decision became clear, the restructuring process was initiated.

IV. BANK PERFORMANCE, COMPLIANCE ISSUES, AND RISK TO DEVELOPMENT OUTCOME

A. QUALITY OF MONITORING AND EVALUATION (M&E)

M&E Design

59. As discussed earlier, the project's Theory of Change was simple and was developed against established engineering solutions. However, the results framework was not aligned with the project scope and planned investments. The PDO indicators were long-term impact indicators, which could only be realized when on-farm works and water supply facilities investments were completed after the project. As indicated above, the indicators were only aligned with the project scope in the latter part of implementation. The PMO was to adopt a computer-based MIS, which was well-designed and had proven effective in a number of water sector projects in China.²³

M&E Implementation

60. An independent institute was contracted for project-wide data collection and processing, supported by the county PMOs and the MIS during project implementation. The project staff at both municipal and county levels were trained in the operation of the MIS. The data verification process was rigorous, backed by engineering quality assurance reports, and cross-checked with contract payments for reliable progress status and indicator values. M&E reports on the intermediate indicators were prepared regularly, with target values updated timely. However, tracking of the original PDO indicators was limited until 2017 (time of project restructuring), as the original PDO indicators could not have been reported on until only after the project closed.

M&E Utilization

61. Monitoring data that largely relied on the MIS was used to evaluate physical progress, calculate costs, assess efficiency, and measure progress towards the realization of the indicators. Project progress reports were based on the verified data generated by the MIS, which informed project management on the status of implementation. Project restructuring and the final evaluation of the project relied heavily on the monitoring data and implementation progress reports that were generated regularly by the M&E system.

²³ Including China Huai River Project and China Water Conservation Project II.



Justification of Overall Rating of Quality of M&E

62. The overall quality of M&E is rated Modest, given the disconnect between the original indicators and the project's scope and interventions, in spite of M&E implementation and utilization having been satisfactory to track physical implementation progress and overall project implementation.

B. ENVIRONMENTAL, SOCIAL, AND FIDUCIARY COMPLIANCE

Environmental and Social Safeguards

63. The project was classified as Category A-full assessment due to its location, type, sensitivity, and scale, as well as the nature and magnitude of the potential environmental impacts. It triggered the following Operational Policies (OP): OP 4.01 (Environmental Assessment), OP 4.04 (Natural Habitats), OP 4.09 (Pest Management), OP 4.12 (Involuntary Resettlement) and OP 4.37 (Safety of Dams).
64. Bank safeguard policies were mainstreamed in the whole project, including the larger portion (some 85%) that was to be financed entirely by counterpart funds. The main environmental issues considered were soil erosion caused by construction activities and potential pesticides issues (if not well managed) during the operational phase. Mitigation measures were incorporated in the design and construction phases, with possible adverse impacts minimized or entirely avoided. A two-stage public stakeholder consultation was conducted and received strong support for the project. On-farm works (some have already started, as mentioned) are to be constructed after the project using counterpart funds. Given the strong capacity and satisfactory performance track record, as well as the strong commitment of the client, these works are expected to be carried out in compliance with environmental requirements.
65. The Environmental Assessment (EA) documents, including EA summary, Environmental Impact Assessment, Environmental Management Plan (EMP) and Pest Management Plan as required by OP 4.09, were disclosed on December 2, 2010 at the Bank Beijing office website and at Bank headquarters (Infoshop). During project implementation, the mitigation measures and monitoring plan were carried out satisfactorily and the biannual reports on EMP implementation were submitted to the Bank on time.
66. **Dam Safety.** The policy was triggered because the project sites were located downstream of the dams that were either constructed or in the process of completion (Heping dam, Wudu dam, and Jinfeng dam). Failure of these upstream dams could cause extensive damage to or failure of some or all the investment under the project; furthermore, reservoirs formed by the Wudu and Jinfeng dams would provide water to the water users in the project area. The Dam Safety Panel, established at the beginning of project implementation, reviewed dam safety related issues and made recommendations throughout project implementation. The PMO and the related government departments acted on these recommendations and ensured compliance with the Bank's OP4.37 on dam safety. There were no issues during the project duration.
67. **Involuntary Resettlement.** Resettlement under the project included land acquisition and population relocation caused by the construction of Jinfeng reservoir, the Xizi main canal, and the branch and lateral canals in 14,408.04 mu (about 9.6 square km) of land acquisition and 3,449 relocated people in 992 households. In addition, about 16,500 people were affected by land acquisition to a limited extent in the canal areas as well. Resettlement Action Plans were prepared as required. Resettlement was implemented in consultation with the affected people and was continuously monitored by an external professional agency (River Development Corporation from General Planning



and Design Institute under the Ministry of Water Resources) employed by the PMO. Land acquisition and population relocation was completed satisfactorily by project closure, and the project affected people were compensated on time and in full. Resettlement was implemented and managed in compliance with the Bank safeguard policy requirements as well as with the relevant national laws and regulations.

68. **Compliance with Bank Safeguard Policies.** In summary, the project complied with all applicable safeguard policies and the overall safeguards rating was Satisfactory throughout project implementation.

Fiduciary Compliance

69. **Financial Management.** The financial management system, acceptable to the Bank, was maintained throughout project implementation to ensure that project funds were being used for the intended purposes. Fourteen unaudited interim financial reports were submitted to the Bank in line with the Loan Agreement; however, only half of the reports were submitted on time. The required annual audit reports were submitted on time since 2015 and the external auditors issued unqualified audit opinions. However, the auditors also highlighted some issues in the audit reports, including conflict of interest in procurement (see below). The final project audit report was submitted to the Bank in August 2020. Based on the Bank's supervision missions and the external audit reports, project financial management was overall in compliance with Bank requirements.
70. **Procurement.** In general, procurement of works, goods and consultant services was carried out satisfactorily in accordance with the legal covenants and the Bank procurement policy and procedural requirements. However, weak coordination between the municipal PMO and its county level branches in approving designs and contracting of works resulted in implementation delays. Procurement performance was rated by the Bank as Moderately Unsatisfactory in May 2017 due to the slow progress in procurement but it improved after that and became Satisfactory in the last year of implementation.
71. **Conflict of Interest.** Conflict of interest issues were raised in the audit reports of 2014 and 2015. These involved a contractor and a supervision company in two Bank-financed contracts. The PMO/Government prepared an action plan acceptable to the Bank and it was implemented in 2016. The 2016 audit report did not include any of the conflict of interest issues highlighted in the 2014 and 2015 audit reports. (See also paragraph 10 of the Restructuring Paper.)

C. BANK PERFORMANCE

Quality at Entry

72. The project was strategically relevant to national and sector development priorities, and was technically well designed. The technical designs were prepared by an experienced design institute with technical assistance from the Bank. Targeted beneficiaries included over a million poor farmers who would be able to switch from mainly dry farming to irrigated agriculture and boost their agriculture production, as well as another 1.7 million poor people in rural and small urban communities who would have access to bulk water supply for drinking and industrial purposes. Gender considerations were also incorporated in the project design (see paragraph 49).
73. A proven MIS was put in place to track implementation progress. The required safeguard documents were prepared in compliance with Bank safeguard policies, with extensive consultation. Institutional arrangements were



appropriate and were well-defined. (See also section III.)

74. The lack of clarity on the inclusion of on-farm works in the project (as discussed earlier in this report) should have been addressed at appraisal.

Quality of Supervision

75. The project was supported by a team of Bank staff and experienced consultants familiar with the project. Implementation issues, such as delayed procurement, were promptly identified and follow-up actions were proposed and addressed. With timely training and workshops organized by the Bank missions, Bank procurement policies and procedures were internalized by the client to achieve transparency and fairness in the bidding process. It was widely recognized that by carefully preparing the bidding documents, especially the technical specifications and bill of quantities, Bank procurement policies and procedures had ensured smooth implementation and higher construction quality. When the issue of conflict of interest was raised in the audit report of 2014 and 2015, the Bank team worked closely with the government to put in place appropriate remedial actions to address the conflicts of interest in a timely manner. Supervision missions also provided timely support on safeguard policies and on fiduciary aspects.
76. Bank support benefited from having the same Task Team Leader based in Beijing for most of the time through preparation and implementation, with the exception of the period from July 2015 to July 2017. Bank implementation support missions were regular, candid and timely in reporting progress and highlighting issues, and proposed practical follow-up actions in mission aide memoires, management letters, and Implementation Status and Results Reports. Issues related to procurement and disbursement, and the delay in the demonstration on-farm works construction were clearly identified and reflected in the performance ratings. In addition to supervising the quality of engineering works, Bank supervision also focused on the development of CDD-based on-farm works in the demonstration areas and on project management capacity. The Bank missions worked with the client to formulate the investment plan for on-farm works, O&M plans for the completed works, and scheme-wide WUA development.
77. As noted above, project restructuring to ensure the alignment between the PDOs and project scope should have been done earlier. Prior to the project restructuring, the World Bank team had explored the possibility of providing Additional Financing for the construction of on-farm works (given the finite county capital investment budgets), but this did not materialize. The Bank's efforts, however, resulted in the county governments initiating the preparation of preliminary designs for on-farm works and water supply facilitates in late 2018 which were later reflected in the local investment plans in early 2020 (see also paragraph 30).

Justification of Overall Rating of Bank Performance

78. The project was well designed and was satisfactorily implemented as designed. However, overall Bank performance is rated Moderately Satisfactory because of the misalignment of the original PDO and related indicators with the project scope, and the time taken to resolve this issue.

D. RISK TO DEVELOPMENT OUTCOME

79. The major risk to the materialization of the long-term outcomes of the project would be slow or insufficiently funded on-farm works investment. This risk has been adequately addressed by:



- (a) The overall positive policy environment for the on-farm works investment, including the second phase Wudu Scheme remaining the top priority for the national and provincial water sector development. On-farm works and water supply facilities investment for the second phase Wudu Scheme are also part of the economic stimulus package addressing the outbreak of COVID-19.²⁴
- (b) The on-going execution of the investment plans (see paragraph 33) for on-farm works by county and by lateral canal for the entire scheme, funded by local government bonds and development banks.
- (c) O&M plans for the main system which have been approved with funding from the municipal budget. As noted earlier, the O&M of the on-farm works will be secured through the consolidation and expansion of the WUAs (which already showed good results in terms of O&M in the demonstration areas). WUAs are already in the process of establishment in the entire project areas (See section II.B).

V. LESSONS AND RECOMMENDATIONS

80. **The Bank has an important role to play in middle income countries like China in terms of knowledge sharing and capacity building.** Although the Bank loan only covered about 15% of the entire second phase of the Wudu irrigation scheme development, Bank policies and procedures (particularly in environmental management and social development) were fully incorporated in the entire Phase II Wudu Scheme. In addition, the Bank's close support to the development of the CDD-based on-farm works in demonstration areas was key to its success and on-going scaling up.
81. **The Bank's longer-term involvement in the overall scheme development process would be desirable to generate tangible outcomes and impacts.** In hindsight, an approach similar to the Multiphase Programmatic Approach would have allowed the Bank to engage with the client in structuring a longer, larger, and more complex engagement as a set of smaller linked operations (or phases). Although the instrument was not available at the time of appraisal, a similar long-term engagement would have enabled the Bank to support the demonstration CDD approach for on-farm works management through the entire Phase II Wudu Scheme for the intended agriculture productivity enhancement (section II. B).
82. **PDOs should reflect the scope of the project, as negotiated with the Borrower.** It is essential to have a mutually agreed understanding on the sequencing of main systems and on-farm works, and define the PDO accordingly. The agricultural productivity related indicators should be selected realistically and conservatively, as improvements in agricultural production lag irrigation works development and take longer than the typical duration of an investment project.
83. **Demonstration of CDD type on-farm works management is critical for the successful outcome of large irrigation development schemes and should be treated as an integral part of scheme development.** Given the current irrigation scheme investment policy in China, on-farm works development must be demonstrated as financially profitable and attractive to the local government and farmers to ensure project sustainability. With the support of local governments, WUAs organized farmers to discuss and decide on the construction of their farm ditches with proper repairs and maintenance so as to increase their incomes by utilizing the water provided by the project, for example, cash crops and planting of fruit tree, fish breeding and poultry raising. (See section II.B & section IV.D.)

²⁴ The updated the investment plan for on-farm works and water supply facilities was made available to the Bank in the beginning of October 2020.



84. **Out-sourcing M&E to independent third-party institutions contributes to efficient M&E and compliance with environmental and social safeguard policies.** Third party external entities specialized in M&E and safeguard issues are in a better position to exercise fair judgment and allow the PMOs to focus on their core management and coordination functions. The PMO employed a professional team responsible for project M&E, and also external monitoring teams responsible for social aspects (including resettlement) and environmental safeguards, respectively, to carry out their respective tasks during project implementation (see section IV.A). As a result, safeguard aspects were in full compliance with Bank policies throughout implementation, despite the large scale and technical complexity of the project.



ANNEX 1. RESULTS FRAMEWORK AND KEY OUTPUTS

A. RESULTS INDICATORS

A.1 PDO Indicators

Objective/Outcome: PDO Indicators

Indicator Name	Unit of Measure	Baseline	Original Target	Formally Revised Target	Actual Achieved at Completion
1. Increased command area for irrigation with the project (10,000 mu)	Number	0.00	0.00	92.96	92.96
		31-Dec-2011	31-Dec-2011	28-Dec-2017	31-Oct-2019

Comments (achievements against targets):

Achievement of this indicator has ensured that water can be delivered through the completed main water distribution system to all planned irrigation areas of the irrigation scheme. It contributes to PDO (a).

Indicator Name	Unit of Measure	Baseline	Original Target	Formally Revised Target	Actual Achieved at Completion
2. Increased annual industrial and domestic water supply capacity (10,000 m3/year)	Number	0.00	0.00	13752.30	13752.30
		31-Dec-2011	31-Dec-2011	28-Dec-2017	31-Oct-2019

Comments (achievements against targets):

With this indicator fully achieved, there has been sufficient water available in the canal to be diverted by local industrial and domestic water users. The indicator contributes to PDO (b).



Indicator Name	Unit of Measure	Baseline	Original Target	Formally Revised Target	Actual Achieved at Completion
3. number of farmers that would be benefitting from the increased command area for irrigation with the project (10,000 persons)	Number	0.00	0.00	115.15	120.00
		31-Dec-2011	31-Dec-2011	28-Dec-2017	31-Oct-2019
Comments (achievements against targets):					
Completion of the target value of this indicator has ensured that more than one million farmers in the irrigation scheme would obtain access to water once the on-farm works are completed. Construction of on-farm works has started and cropping pattern adjustment has been planned for the water to be delivered to farmland. This indicator contributes to PDO (a).					
3.1 number of female farmers that would be benefitting from the increased command area for irrigation with the project (10,000 persons)	Number	0.00	0.00	57.58	57.58
		31-Dec-2011	31-Dec-2011	29-December-2017	31-Oct-2019

Indicator Name	Unit of Measure	Baseline	Original Target	Formally Revised Target	Actual Achieved at Completion
4. number of O&M plans prepared for both main system and on-farm system in the demonstration areas	Number	0.00	0.00	22.00	22.00
		31-Dec-2011	31-Dec-2011	28-Dec-2017	31-Oct-2019
Comments (achievements against targets):					
Completion and approval of the O&M plans ensure that the works completed under the project, including main systems with government financing and					



on-farm works with CDD-based participatory approach in the demonstration areas, are well maintained and repaired for sustainable operations to deliver water to the beneficiaries, which contributes to PDO (c).

A.2 Intermediate Results Indicators

Component: Construction of Main Irrigation Systems

Indicator Name	Unit of Measure	Baseline	Original Target	Formally Revised Target	Actual Achieved at Completion
1. Length of Xizi canal completed	Kilometers	0.00	0.00	108.00	108.00
		31-Dec-2011	31-Dec-2011	28-Dec-2017	31-Oct-2019

Comments (achievements against targets):

Xizi main canal has been fully completed under the project, which ensures that water is delivered, through sub-main or branch canal and on-farm works (once completed), to the field. The indicator contributes to PDO indicators 1, 2 and 3.

Indicator Name	Unit of Measure	Baseline	Original Target	Formally Revised Target	Actual Achieved at Completion
2. Length of sub-main or branch canals completed	Kilometers	0.00	0.00	305.24	305.24
		31-Dec-2011	31-Dec-2011	28-Dec-2017	31-Oct-2019

Comments (achievements against targets):

Sub-main or branch canals have been fully completed under the project, which ensures that water would be delivered, through on-farm works (once completed), to the field. The indicator contributes to PDO indicators 1, 2 and 3.

**Component:** Development of CDD-based WUAs and construction of on-farm Works in Demonstration Areas

Indicator Name	Unit of Measure	Baseline	Original Target	Formally Revised Target	Actual Achieved at Completion
3. Length of lateral and sub-lateral canals completed in demonstration areas	Kilometers	0.00	0.00	38.91	38.91
		31-Dec-2011	31-Dec-2011	28-Dec-2017	31-Oct-2019

Comments (achievements against targets):

On-farm works have been fully completed under the project, which ensures that water is delivered directly to the farmland in the demonstration areas. The indicator contributes to PDO indicator 3.

Indicator Name	Unit of Measure	Baseline	Original Target	Formally Revised Target	Actual Achieved at Completion
4. Increased number of female membership for WUAs and Producer Groups (PGs)	Number	0.00	0.00	80.00	80.00
		31-Dec-2011	31-Dec-2011	28-Dec-2017	31-Oct-2019

Comments (achievements against targets):

Completion of the target value for this indicator contributes to PDO indicator 3.



Component: Institutional Capacity Building and Project Management Support

Indicator Name	Unit of Measure	Baseline	Original Target	Formally Revised Target	Actual Achieved at Completion
5. Number of PMO staff familiarized with project concept, approach and operational procedures	Number	0.00	0.00	40.00	40.00
		31-Dec-2011	20-Jan-2012	28-Dec-2017	31-Oct-2019

Comments (achievements against targets):

Completion of the target value of this indicator contributes to capacity building on project management.

Indicator Name	Unit of Measure	Baseline	Original Target	Formally Revised Target	Actual Achieved at Completion
6. Number of female project staff participating in domestic and overseas study tours organized by the project	Number	0.00	0.00	50.00	80.00
		31-Dec-2011	31-Dec-2011	28-Dec-2017	31-Oct-2019

Comments (achievements against targets):

Completion of the target value of this indicator contributes to capacity building on project management and gender development and inclusion.



B. KEY OUTPUTS BY COMPONENT

Objective/Outcome 1 Increase the command area for irrigation in the project area	
Outcome Indicators	<ol style="list-style-type: none"> 1. Increased command area for irrigation with the project (10,000 mu) 2. Number of farmers that would be benefitting from the increased command area for irrigation with the project (10,000 persons)
Intermediate Results Indicators	<ol style="list-style-type: none"> 1. Length of Xizi canal completed 2. Length of sub-main or branch canals completed
Key Outputs by Component (linked to the achievement of the Objective/Outcome 1)	<p>1. Construction of Main Irrigation Systems, which includes completion of: (a) Xizi Main Canal with a total length of about 108 km including tunnels, aqueducts, siphons, gates and other structures; (b) a reservoir at Jinfeng with intake from the Xizi Canal with a total storage capacity of 98 million m³ consisting of tunnels, aqueducts, siphons, gates and other structures including an asphalt concrete core sock-fill dam with a height of 88m and a chest length of 454.87m, an irrigation intake and a tunnel to supply and regulate the supply of water to the irrigation system to be constructed; and (c) Jinlong sub-main canal and 16 branch canals consisting of numerous structures including tunnels, aqueducts, siphons, gates and other structures to divert water to irrigate areas.</p>
Objective/Outcome 2 Increase bulk water supply capacity for small rural communities and industries in the project area	
Outcome Indicators	<ol style="list-style-type: none"> 1. Increased annual industrial and domestic water supply capacity (10,000 m³/year)
Intermediate Results Indicators	<ol style="list-style-type: none"> 1. Length of Xizi canal completed 2. Length of sub-main or branch canals completed
Key Outputs by Component (linked to the achievement of the Objective/Outcome 2)	<ol style="list-style-type: none"> 1. Construction of Main Irrigation Systems
Objective/Outcome 3 Introduce community-based participatory approach in the management of water facilities and infrastructure in the demonstration areas	
Outcome Indicators	<ol style="list-style-type: none"> 1. Number of O&M plans prepared for both main system and on-farm system in the demonstration areas
Intermediate Results Indicators	<ol style="list-style-type: none"> 1. Length of lateral and sub-lateral canals completed in demonstration areas 2. Increased number of female membership for WUAs and Producer Groups (PGs) 3. Number of PMO staff familiarized with project concept,



	approach and operational procedures 4. Number of female project staff participating in domestic and overseas study tours organized by the project
Key Outputs by Component (linked to the achievement of the Objective/Outcome 2)	1. Development of CDD-based WUAs and construction of on-farm Works in Demonstration Areas 2. Institutional Capacity Building and Project Management Support



ANNEX 2. BANK LENDING AND IMPLEMENTATION SUPPORT/SUPERVISION

A. TASK TEAM MEMBERS

Project preparation		
Name	Title	Unit
Liping Jiang	TTL and Sr. Irrigation Specialist	EASCS
Zong-Cheng Lin	Sr. Social Development Specialist	EASCS
Yiren Feng	Sr. Environmental Specialist	EASCS
Ximing Zhang	Sr. Dam Safety Specialist	EASCS
Jinan Shi	Sr. Procurement Specialist	EASCS
Yuan Wang	Procurement Specialist	ESSCS
Yi Dong	Sr. Financial Management Specialist	EAPFM
Jun Zhao	Rural Development Specialist	EASCS
Zhuo Yu	Disbursement Officer	CTRLN
Xin Chen	Sr. Program Assistant	EACCF
Xuemei Guo	Program Assistant	EACCF
Dan Xie	Team Assistant	EACCF
Vel Fernandes	Program Assistant	EASIN
Junxue Chu	Sr. Finance Officer	CTRFC
Kishor Uprety	Sr. Counsel	LEGES
Syed I. Ahmed	Lead Counsel	LEGES
Xueming Liu	Sr. Economist	FAO/CP
Usaid L. Hanbali	Sr. Irrigation Engineer	Consultant
Li Ou	Sr. CDD/WUA Specialist	Consultant
Zhang Kaiping	Sr. Agricultural Specialist	Consultant
Li Zhi	Construction Programmer	Consultant
Abdulhamid Azad	Peer Reviewer	MNSWA
Paulus Van Hofwegen	Peer Reviewer	EASIS
IJsbrand Harko de Jong	Peer Reviewer	EASS1
Joop Stoutjesdijk	Peer Reviewer	SASDA
Project Supervision/ICR		
Liping Jiang	TTL and Sr. Irrigation Specialist	SEAW1
Gang Qin	TTL (July 2015 - July 2017)	SEAW1
Yuan Wang	Senior Procurement Specialist	EEAR1
Yi Dong	Senior Financial Specialist	EEAG1
Yongli Wang	Senior Environment Specialist	SEAE1
Kai Shang	Social Development Specialist	SEAS1
Zhong-cheng Lin	Senior Social Development Specialist	SEAS1
Huiying Guo	Program Assistant	EACCF
Anqi Li	Staff Assistant	WFACS
Ruxin Zhao	Staff Assistant	EACCF



B. STAFF TIME AND COST

Stage of Project Cycle	Staff Time and Cost	
	No. of staff weeks	US\$ (including travel and consultant costs)
Preparation		
FY10	5.350	33,998.46
FY11	31.525	172,938.03
FY12	6.450	38,527.95
Total	43.33	245,464.44
Supervision/ICR		
FY12	7.250	28,696.67
FY13	4.875	20,671.16
FY14	9.775	50,232.35
FY15	5.960	38,614.07
FY16	13.092	62,215.04
FY17	12.590	64,820.95
FY18	12.760	96,586.82
FY19	15.000	121,818.08
FY20	8.747	71,413.02
Total	90.05	555,068.16



ANNEX 3. PROJECT COST BY COMPONENT

Table 3.1: COST BY COMPONENT (US\$ MILLION)

Project Component	At Appraisal	Actual	Actual/ Appraisal
A. Construction of Main Systems	691.03	662.4	96%
B. CDD-based On-farm Demonstration	4.49	3.36	75%
C. Capacity Building and Management	1.44	1.46	101%
Total Project Cost*	696.96	667.22	96%
Interest during Construction**	3.56	4.70	132%
Front-end Fees	0.25	0.25	100%
Total Financing	700.77	672.17	96%

* Including physical and price contingencies

** Refers to the interest on the Bank loan the client needs to pay during construction, which varies with the LIBOR interest rate. The LIBOR interest rate at project appraisal was lower than that during construction.

Table 3.2: COST BY COMPONENT (US\$ MILLION) at Appraisal

Project Component	World Bank	Borrower	Total
A. Construction of Main Systems	97.41	593.62	691.03
B. CDD-based On-farm Demonstration	0.90	3.59	4.49
C. Capacity Building and Management	1.44	0	1.44
Total Project Cost	99.75	597.21	696.96
Interest during Construction	0.00	3.56	3.56
Front-end Fees	0.25	0.00	0.25
Total Financing	100	600.77	700.77

Table 3.3: COST BY COMPONENT (US\$MILLION) at Project Completion

Project Component	World Bank	Borrower	Total
A. Construction of Main Systems	97.49	564.91	662.40
B. CDD-based On-farm Demonstration	0.80	2.56	3.36
C. Capacity Building and Management	1.46	0.00	1.46
Total Project Cost	99.75	567.47	667.22
Interest during Construction	0.00	4.70	4.70
Front-end Fees	0.25	0.00	0.25
Total Financing	100	572.17	672.17



ANNEX 4. EFFICIENCY ANALYSIS

Introduction

1. The Wudu Water Diversion and Irrigation Scheme (Wudu Scheme), located in Mianyang Municipality, Sichuan Province, is a large-scale water diversion scheme consisting of the following two phases:
 - (a) the first phase was completed in 2002 and included the construction of the Wudu barrage on the Fujiang river, the general main canal, diversion gate, Fuzi main canal and its branch and lateral canals and providing water to irrigate about 84,667 hectares of land in the central part of Mianyang City and in parts of Suining city of Sichuan;
 - (b) the second phase included the construction of branch canals from the Wudu Reservoir, Xizi main canal, Jinfeng reservoir, Jinlong sub-main canal and 16 branch canals as set out in component 1 of the project and to be partially financed by the Bank loan in order to irrigate about 70,200 hectares of land in the project areas as well as to provide some water for urban, rural and industrial use in the project area.
2. Per government water sector investment policies, the funds from the central and provincial government are to be used to finance construction of the main irrigation systems only (dams, main canals and branch canals). The construction of on-farm irrigation systems (lateral canals, sub-lateral canals and farm ditches) should be financed by county governments and beneficiaries after the main systems are completed. This project is a central government financed project with Bank financing for the main systems of the second phase scheme development, excluding the construction of on-farm works and water supply facilities.
3. However, the efficiency analysis can only be done at the overall scheme level, factoring in the investments of on-farm works and water supply facilities, and projecting the anticipated scheme-wide benefits. At the time of this analysis, the second phase of the Wudu Scheme is yet to be completed in its entirety. As such, the analysis should be treated as “ex-ante” as on-farm works only started around the time of project completion. The analysis was therefore conducted for the second phase of the Wudu Scheme as a whole, covering all the scheme costs including the planned on-farm works in line with the updated investment plans prepared by the local governments.
4. A cost-benefit analysis for the project has been conducted to reassess the project’s economic viability at the ICR stage. The analysis has adopted the same approach as at project appraisal to ensure methodological consistency and comparability, while taking into account (i) that the project construction period was extended by 22 months; and (ii) the costs for the main systems are actual costs while the costs for on-farm works are based on latest estimates; (iii) the construction schedule of the on-farm works based on the latest local government investment plans by county.

Project Benefits

5. **Quantifiable benefits.** The major quantifiable benefits (on an incremental basis) of the project are derived from (a) value of irrigation water leading to increased agricultural production from improved irrigation areas (b) value of water for industrial uses and; (c) value of drinking water for human and animal consumption.



6. **Non-quantifiable benefits.** The project is expected to generate numerous non-quantifiable social and environmental benefits, which are not included in the analysis. These include (a) flooding control/drainage function provided by the irrigation canal system (main canal and branch canals in particular); (b) improved water management and development of social capital and institutional capacity; and (c) the improved quality of soil and agricultural products due to adoption of good agricultural production practices, such as integrated pest management.

Methodologies for Quantifying Project Benefits

7. The analysis has adopted the methodologies for the valuation of water use for various purposes as detailed below.
8. **Economic value of irrigation water: benefits from irrigation water delivered to the demonstration villages.** The CDD demonstration villages had achieved income increases by June 2020. The latest data provided by the client confirmed that the summer crop yield increased by 20%, cropping intensity by 30% with additional vegetable production in Changliang village, one of three demonstration sites in Zitong County. The farm household incomes are estimated to increase by 30-70% depending on the cropping patterns. In addition, development of livestock, aquaculture and orchard has been initiated with incomes expected to flow in two to three years.
9. Given the short time that the demonstration areas have been functioning (only one annual crop season since project closure), the benefits to farmers are well below the full development potential. Further income increases in the coming years are expected to be accrued from (i) improved crop yields; (ii) changed cropping patterns (shifting to higher value crop); (iii) increased cropping intensities; and (iv) diversifying into aquaculture/livestock production. As such, empirical data are as yet insufficient to determine the fair value of the irrigation water from the pilot sites. Instead, the analysis, following the approach adopted at appraisal, uses the incremental agricultural production value at full development as the proxy of the economic value of irrigation water, which is arrived at by comparing Phase I Wudu Scheme service areas²⁵ (as the “with project” situation) with the current Phase II scheme command areas (as the “without project” situation). The value of the incremental production per mu (one hectare =15 mu) estimated by the local agricultural extension workers and farmers is CNY 680.
10. **Water value addition for industrial use.** The total volume of water supplied for industrial use is based on the water balance estimation. The productivity of water used in industry, in terms of the economic value added by industrial production based on the water withdrawn, is defined as the economic value added (in CNY) per m³ of water withdrawn by industry. Therefore, industrial water productivity can be calculated as follows:

$$P_i = V_i/W_i,$$

Where V_i is the total annual industrial value added in the region, and W_i is the annual water withdrawn in the region.

11. The water productivity in industrial use is calculated at CNY 260 per m³, and therefore, the total annual industrial value added in the region using the incremental water withdrawn from the reservoirs is estimated as $V_i = 260W_i$.

²⁵ Phase I has been in operation since 2002, as noted above.



12. In line with the widely adopted ‘benefit sharing coefficient method in China’ (Codes and Standards for Appraisal of Water Sector Investment in China, No. SL72-94 issued by the Ministry of Water Resources, the net incremental value addition of water for industrial use was estimated at CNY 260 /m³), water consumption is assumed to contribute to 2.5% of the total industrial value added. Therefore, the net incremental value addition of water for industrial use is calculated using the following formula: $V_{nv} = 0.025 \times 260W_i$, which gives the economic price of water at CNY 6.5 /m³.
13. **Value of drinking water.** In line with the assumptions at the time of appraisal, the value of drinking water is conservatively estimated at the same level as for industrial use (CNY 6.5/m³).

Whole Scheme Costs

14. Whole scheme costs include (a) all the actual Bank project costs, (b) the on-farm works investment for the whole scheme per latest local government investment plans, by lateral canal²⁶ and (c) O&M costs for the scheme’s main systems and on-farm works.

Economic Rate of Return (ERR) Calculation at the Scheme Level

15. Assumptions: (i) the economic life of the scheme is assumed at 30 years; (ii) both cost and benefit flows are based on 2019 constant prices; costs are net of duties and taxes; (iii) the discount rate adopted by the analysis is 5% according to the latest guidelines²⁷ for economic analysis of Bank projects, which is comparable to the discount rate recommended by the China National Development and Reform Commission²⁸; and (iv) the construction schedule of the on-farm works is based on the latest local government investment plan by county.
16. The county governments have firmly committed and incorporated on-farm works investment into the local Five-Year Plans (2021-2015), and are institutionally and financially guaranteed for implementation per the local government track record. In fact, construction of 11 out of 52 lateral canals in the whole scheme areas and three out of nine water treatment plants was in progress as of end September 2020, the time of the last field visit by the team. The much faster than expected investment for on-farm works in 2020 was partly attributable to the stimulus package in response to the outbreak of COVID-19, where irrigation scheme development is a top priority area.
17. Quantifiable incremental benefits and costs for the whole scheme are projected over a 30-year period to estimate the ERR. In line with the latest local government investment plans for on-farm works and water supply facilities, the cumulative physical progress of the on-farm works and water supply facilities for the whole scheme is estimated in table 4.1, and the designed capacities for water provision are shown in table 4.2:

²⁶ Detailed local government investment plans are contained in the project files.

²⁷ See “The Technical Note on Discounting Costs and Benefits in Economic Analysis of World Bank Projects”, issued on November 12, 2015.

https://worldbankgroup.sharepoint.com/sites/gsg/WaterPovertyEconomy/SitePages/Detail.aspx/Documents/mode=view?_Id=8&SiteURL=/sites/gsg/WaterPovertyEconomy/

²⁸ The discount rate is 6% for investments with long-term unquantified social and environmental benefits. See “Economic Analysis of Construction Projects: Methods and Parameters”, China Planning Press, Beijing, 2006.



Table 4.1: Physical Progress of On-Farm Works and Water Supply Facilities

	2020	2021	2022	2023	2024	2025
Irrigation	10%	22%	40%	59%	83%	100%
Industrial & drinking water	21%	50%	80%	100%		

Table 4.2: Designed Capacities for Water Provision

	In Million m ³
Irrigation (service area of 929,600mu)	90-110
Water supply for industrial and domestic water	130

**depending on precipitation variations of cropping seasons.

18. Taking into account that (a) on-farm works investment costs will continue through 2025; (b) the O&M costs are expected to increase over time; (c) the benefits in the irrigation and non-irrigation sectors are already showing an increase; and (d) the benefits are estimated on the on-farm works to be completed by 2025, the ERR for the entire scheme is estimated at 11%. Judging against the Opportunity Cost of Capital of 5%, an ERR of 11% represents a much higher return, indicating the project is not only economically viable but is also robust. The ERR at ICR is moderately lower than the appraisal ERR (13%) due to the later start of the scheme-wide on-farm works, while the reduced project cost (4%, see "Implementation Efficiency" below) partially compensates for the negative impact of the delayed on-farm works investment.
19. A sensitivity test was conducted to gauge the impact of the delay of on-farm works construction. Even in the unlikely case of 50% completion of the on-farm works, the ERR is at 6%, indicating the robustness of the economic viability of the project and the entire second phase scheme.
20. The results represent a conservative estimate of the project economic impact due to the fact that the economic prices of water are conservative, the major investment costs have already been incurred, significant unquantifiable environmental and social benefits were not included in the analysis.

Financial and Fiscal Impact Analysis

21. The project was a key national public good investment. The main systems built under the project are operated by the Sichuan Wudu Water Diversion Management Bureau (a government agency reporting directly to the Mianyang municipal government). As discussed in the previous section, per current policies, the O&M costs of the main systems are fully sourced from the municipal government budget while the water charges are determined by the planning and finance agencies of the local government and the CDD-based WUAs are responsible for O&M of the on-farm works. As such, a financial analysis for the main systems is not applicable. Current water charges at CNY 0.12/m³ for Phase I of the Wudu Scheme are way below the level necessary to fully recover the O&M costs. The Bank has provided advice to the client that the water charges be set at least at a level to fully recover the O&M costs of the main systems (estimated at about CNY 0.55/m³).
22. **Implementation Efficiency.** All project activities were completed at costs below the appraisal and restructuring estimates (96% of appraisal estimates and 93% of estimates at restructuring), mostly due to bidding savings. The Bank loan was fully disbursed. Project management was mainstreamed at the provincial and county levels



and Bank-financed project management costs (equipment, goods and consultancies) were below 1% of the Bank loan. The project required a 22 month extension of the closing date due to procurement issues and delayed government approval of the preliminary design (see section III.B); however, a delay of this magnitude in large scale irrigation schemes in China is not unusual.²⁹ The late government approval did not constitute an efficiency loss from a budget perspective as the funds were used for other government priority projects through the annual budget balancing process.³⁰ Implementation efficiency improved substantially after the restructuring, and all project activities were completed before the revised closing date. The project complied with Bank fiduciary and safeguard policies (see section IV.B).

²⁹ Wudu Phase I Scheme was delayed by 4 years against the original plan.

³⁰ See Article 67, Budget Law of the People's Republic of China.



ANNEX 5. BORROWER, CO-FINANCIER AND OTHER PARTNER/STAKEHOLDER COMMENTS

Translation provided by the Translation Group of the World Bank Office, Beijing

We are pleased to receive the “Implementation Completion and Results Report” for Sichuan Wudu Irrigated Agriculture Development Project drafted by the World Bank on October 22, 2020. We carefully reviewed this report and agreed the review opinions and assessment raised in this report:

1. All key indicators of the project have been completed or exceeded the pre-set targets, and all the Project Development Objectives (PDO) have been achieved;
2. The benefits of the project have been initially emerging. The operation and maintenance plans of main systems built under the project have been in place. Upon economic and financial analysis, it's found that the economic, social and ecological benefits of this project are significant;
3. The project highly aligns with the policy and investment focus of the water sector development of the Chinese government;
4. An action plan has been prepared for the supporting on-farm works. Some lateral canals and sub-lateral canals have been completed or started to construct. The project will be sustainably developed.

In our opinions, the World Bank provides high-quality added-value knowledge services for the development of this large irrigation area in southwest China. In particular, the community-driven development model, the World Bank's excellent management model and advanced concept in environmental and social development have made great contributions to the successful implementation of the project, and provided experience and reference for other projects in the future. The project has played an important role in the reconstruction after the “May 12th Earthquake”, western development, improvement of drinking water safety in urban and rural areas, poverty alleviation and food security.

We would like to express our heartfelt thanks to the project team for your excellent work in the design and implementation phase of the project! Thank you for your timely and active communication with the Provincial Development and Reform Commission, Finance Department and Water Resources Department during implementation of the project! In particular, before the project negotiation, in line with actual situation of the major projects invested by the central government and provincial government and then the on-farm supporting projects organized by the local government, we reached a consensus that the on-farm works was removed from the project scope, which fully reflected the respect and understanding of the World Bank for China's policy and actual situation and ensures the project to be completed smoothly and successfully.

We look forward to working with the World Bank in the future!

Director of PMO
Sichuan Wudu Irrigated Agriculture Development Project
Gou Chengjian
October 26, 2020



ANNEX 6. SUPPORTING DOCUMENTS

- Project Appraisal Document (2012)
- Project Restructuring Paper
- Aide Memoires (from identification to completion)
- World Bank Group Country Partnership Strategy for China, 2006 - 2010
- World Bank Group Country Partnership Strategy for China, 2013 - 2016
- World Bank Group Country Partnership Framework for China, 2020 - 2025
- Government Implementation Completion Report and Annexes
- Local Government Investment Plans on the On-farm Works and Water Supply Facilities
- WUA Operational Manual (prepared by PMO)
- Review and Evaluation of the WUAs in the Pilot Areas (prepared by PMO)
- Annual M&E Reports
- Resettlement Action Plan and Beneficiary Assessment Reports
- Feasibility Study Report
- Preliminary Design Report
- MTR report prepared by the PMO
- Procurement process documentation
- Annual Auditing Reports
- Borrower's comments on the Bank ICR